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The Role of Emotional Expression in Performance and Health

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Thesis submitted to Bangor University in fulfilment of the requirements for the degree of Doctor of Philosophy

January, 2009

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This Thesis is Dedicated to My Grandparents:

Mr. J. W. & Mrs. E. Davis

&

Mr. H. & Mrs. B. Pickering

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SUMMARY

This thesis is written as a collection of research papers through which the role of emotional expression in performance and health was examined. Chapter 1 reviews specific research literature related to emotional expression in performance and health, and outlines the avenues of research investigated within the thesis. Chapter 2 contains three experimental studies that explored the influence of the emotions of happiness, hope and anger on acute cognitive and physical performance. The results of Experiment 1 revealed that anger enhanced physical performance, but cognitive performance was not enhanced by happiness or anger. Experiment 2 examined the role of effort in the emotion-performance relationship and found that hope and anger were related to increased investment of effort on the cognitive task; however only hope was associated with improvements in reaction times. Experiment 3 investigated the moderating influence of personality on the anger-physical performance relationship. In a replication of the physical task used in Experiment 1, extraverts' anger-derived performance gains were found to be greater than those of introverts'. Chapter 3 extended the findings of Chapter 2 by examining the role of anger-related individual differences and physiological reactivity as potential moderators of the anger-performance relationship. The results revealed that trait anger and the anger coping style of anger-out were associated with anger-derived performance enhancement. The anger coping style of anger-in was found to negatively influence the trait anger-performance relationship. Further, anger was associated with increased physiological arousal as increased salivary alpha-amylase was associated with anger; however, physiological reactivity was not related to anger-derived performance enhancement. Chapter 4 describes a six-month intervention-based study that examined a number of theoretical models that have been proposed to explain the mechanisms that underpin the beneficial effects of written emotional disclosure in fibromyalgia. The theoretical models of inhibition and exposure were found to have no association with specific health outcome variables. However, the theoretical model of cognitive adaptation was associated with improved health on a number of the outcome measures assessing the central features of fibromyalgia (i.e., physical impairment, pain, and stiffness). Chapter 5 discusses the findings arising from the research chapters, presents the central theoretical and applied implications, identifies the strengths and limitations of the research programme, and provides suggestions for future research.

CHAPTER 1

General Introduction

The aim of the current research programme was to examine the role of emotional expression in performance and health. This first chapter of the thesis provides a general introduction, which is organised into six main sections that are designed to establish the research area and to outline the structure of the thesis. These six sections are: theory of emotion; emotion-performance relationship in sport; emotion regulation; fibromyalgia; written emotional disclosure; and a summary of the thesis structure.

Theory of Emotion

Since James's (1884) now famous question (i.e., *What is an emotion?)* there is still only limited agreement amongst researchers as to what constitutes an emotion. Indeed, the identification and classification of emotion has been the subject of extensive academic debate. Specifically, conflicting theoretical approaches have debated whether the experience of emotion can be categorized into discrete "basic" emotions (Ekman, 1999) or whether emotions occur in relation to two underpinning dimensions reflecting activation and pleasantness (Russell, 1980).

Moreover, due to the complex nature of the experience of emotions, multiple theories have been forwarded in attempts to elucidate the origin of emotion (e.g., Cabanac, 2002; Frijda, 2005). For example, multiple frameworks posit that emotions occur independently of cognition (e.g., Zajonc, 1980). Conversely, a number of models of emotion have suggested that cognitive processes such as attributions (Weiner, 1985), goal orientations (Carver & Scheier, 1990) and appraisals (Lazarus, 1982) are central to the experience of emotion.

Appraisal based models of emotion have been forwarded in attempts to explain the influence of emotions on sport performance (Jones, 2003; Vallerand & Blanchard, 2000). Lazarus's (1991, 2000a) cognitive motivational relational (CMR) theory, similar to other appraisal theories (e.g., Roseman, 1991; Smith & Ellsworth, 1985), proposes that individuals engage in a process of appraisal focused on evaluating the risk and reward presented in the environment. These appraisals culminate in a core relational theme that summarizes the transaction between the individual and the environment (Lazarus, 1991, 2000a). Emotions arise from the core relational theme and are associated with an action tendency reflecting the evaluation of the situational stimulus in relation to the individual (Lazarus, 2000b). For example, the core relational theme of anxiety is, "facing uncertain, existential threat" (Lazarus, 2000b, p. 234), which links to the associated action tendency of avoidance or escape (Lazarus, 1991). Lazarus's CMR theory provides a useful theoretical framework for studying the influence of the full range of emotions in sport (e.g., Lazarus, 2000b; Uphill & Jones, 2007).

Uphill and Jones (2007) recently provided support for Lazarus's (1991, 2000a) CMR theory in sport. Using semi-structured interviews with 12 elite athletes, Uphill and Jones (2007) found evidence of the occurrence of the specific emotions: anger; happiness; sadness; shame; anxiety; guilt; pride; and relief. Although, the use of CMR theory to investigate emotions in sport has been somewhat validated (e.g., Lazarus, 2000b; Uphill & Jones, 2007), it seems surprising that it has received minimal performance research attention. Consequently, we investigated the emotion-performance relationship using Lazarus's (1991; 2000a) CMR theory as a framework.

Emotion-performance Relationship in Sport

Lazarus's CMR theory provides a useful framework for studying the influence of emotion on sport performance (Lazarus, 2000b; Uphill & Jones, 2007). For example, CMR theory suggests that anxiety's influence on performance will vary depending on the intensity of the anxiety experienced. Specifically, too little anxiety can be detrimental to performance if a lack of attention and/or effort is invested in preparation for and during performance (Woodman & Hardy, 2001).

Anxiety has been the focus of the large majority of research investigating the emotion-performance relationship within sport psychology (Woodman & Hardy, 2001). Further to this, numerous models (e.g., Hardy, 1996), hypotheses (e.g., Masters, 1992) and theories (e.g., Eysenck & Calvo, 1992; Wegner, 1994) have been developed in attempts to describe or explain the anxiety-performance relationship in sport. However, numerous emotions have been observed in sport (Cerin, Szabo, Hunt, & Williams, 2000; Gould, Medberry, Dieffenbach, Lauer, Hardy, & Jones, 2000; Hanin, 2000), which has prompted greater interest in the influence of a wider range of emotions on performance (e.g., Lazarus, 2000a). For example, joy, hope and anger are emotions that have been observed in sport (Gould et al., 2000; Lazarus, 2000a; Robazza & Bortoli, 2007), but have received limited research attention in the sport psychology literature.

Lazarus (2000b) posits that each specific emotion will differentially influence performance. For example, he proposes that the emotion of anger may be detrimental to performance if it draws resources away from the primary task at hand (Lazarus, 2000b). However, if the physical skill requires a "lashing out" motion (e.g., toward an opponent), performance may be facilitated due to its close association with anger's action tendency (Lazarus, 2000b). As such, Lazarus's (1991, 2000a) CMR theory offers a potentially

fruitful theoretical framework for investigating the influence of the full range of emotions on performance.

In review of the research that has examined the emotion-performance relationship within sport, numerous studies suggest that emotions can influence cognitive and physical subcomponents of performance (Botterill & Brown, 2001; Hanin, 2000; Jones, 2003; Jones & Uphill, 2004; Parfitt, Jones, & Hardy, 1990; Vallerand & Blanchard, 2000). Moreover, physical and cognitive aspects of performance appear to be differentially affected by different emotions (Jones & Uphill, 2004; Parfitt, Hardy, & Pates, 1995; Woodman & Hardy, 2001).

Physical Functioning in Sport Performance

Physical functioning is a key component of sport performance (Jones, 2003; Vallerand & Blanchard, 2000). A central theme within research examining the relationship between emotions and physical functioning has been the role of arousal (Hardy, 1990; Jones, 2003; Wrisberg, 1994). Arousal has been measured at physiological, psychological and behavioural levels (Perkins, Wilson, & Kerr, 2001; Schachter & Singer, 1962; Wrisberg, 1994). Findings arising from research examining the relationship between arousal and physical performance lead to the suggestion that arousal regulation is particularly influential on the execution of strength tasks (Wilkes & Summers, 1984). Specifically, high levels of arousal have been found to have a negative effect on coordination (Oxendine, 1970) and motor tasks requiring fine control (Parfitt et al., 1990). Conversely, high levels of arousal can facilitate performance on tasks that require explosive movements of maximal effort for short durations (Gould, Weinberg, & Jackson, 1980; Perkins et al., 2001; Whelan, Epkins, & Meyers, 1990). Attempts to explain the mechanism responsible for enhancing physical performance have suggested that increased

physiological arousal, associated with increased emotional arousal, may activate greater physical resources that are subsequently allocated to performance (Jones, 2003; Whelan et al., 1990).

Indices of physiological reactivity (e.g., heart rate), have been widely studied within research investigating the arousal-performance relationship (e.g., McGuigan, Ghiagiarelli, & Tod, 2005; Perkins et al., 2001). Research examining physiological reactivity associated with emotional arousal has centred on two main systems: the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS; Cacioppo, Tassinary & Berntston, 2000). In sport psychology research, the use of salivary cortisol as a measure of HPA axis activity associated with anxiety has increased in popularity (e.g., Kivlighan, Granger, & Booth, 2005; McGuigan et al., 2005). Historically, increased heart rate has been associated with increased SNS activity; however, re-examination of the measurement of heart rate has suggested that this may be an oversimplification of SNS reactivity to emotional arousal (Berntson, Cacioppo, & Quigley, 1993).

More recently, researchers have been searching for an indirect measure of SNS activity in saliva (Granger, Kivlighan, El-Sheikh, Gordis, & Stroud, 2007). Catecholamine concentration measured via the secretion of salivary alpha-amylase has been validated as a reliable indicator of SNS reactivity to emotional arousal (Granger et. al., 2007; Nater, Rohleder, Gaab et al., 2005; Van Stegeren, Wolf, & Kindt, 2008). Further, research investigating the response profiles of salivary cortisol and salivary alpha-amylase has found unique reactivity patterns, with salivary alpha-amylase reaching its peak response and recovering to baseline faster than salivary cortisol (Dickerson & Kemeny, 2004). The unique kinetic patterns of salivary alpha-amylase and salivary cortisol are consistent with the physiological differences of the SNS and the HPA axis (Granger et al., 2007).

Although the role of physiological arousal in the emotion-performance relationship has been widely acknowledged (e.g., Hardy, 1990; Jones & Uphill, 2004; Wrisberg, 1994), to date there has been limited evidence of physiological arousal mediating the emotion-performance relationship. Specifically, studies using heart rate and cortisol as indices of physiological reactivity have found no evidence that they mediate the relationship between emotion and performance (McGuigan, et al., 2005; Perkins et al., 2001). However, salivary alpha-amylase has not been used in research examining the role of physiological arousal in the emotion-performance relationship. Salivary alpha-amylase may offer a more appropriate measure of physiological arousal during strength-oriented tasks of a short duration, as the kinetic profile of salivary alpha amylase is more responsive than the profile of salivary cortisol (Dickerson & Kemeny, 2004).

Cognitive Functioning in Sport Performance

Increased emotional arousal can also influence cognitive functioning and changes in cognitions (Janelle, 2002; Jones, 2003; Parfitt et al., 1995). Under conditions of high emotional arousal, an individual's attentional focus is proposed to narrow, which may facilitate or debilitate performance depending on the nature of the task (Easterbrook, 1959). For example, the narrowing of attention may be beneficial for performance if it serves to block out distractions and enable the performer to focus exclusively on the most relevant cues for task execution (Woodman & Hardy, 2001). Conversely, if the field of attentional focus is too narrow, relevant cues for successful task execution may be missed and failure may be incurred (Murray & Janelle, 2003). Attentional focus can also be guided by the subjective importance of the situational stimuli rather than their position in the visual field (Hardy, Jones, & Gould, 1996). For example, individuals who are high in

anxiety may selectively attend to stimuli that are perceived to be threatening while neglecting other more relevant cues (Murray & Janelle, 2003).

Furthermore, Parfitt et al. (1990) posit that increased emotional arousal can reduce working memory and disrupt long-term recall. Moreover, when cognitive resources are allocated to emotional processing, reduced resources are available for cognitive functioning and task execution (Moran, 1996). Cognitive resources can also be diverted towards coping strategies and attempts to regulate emotions (Richards, 2004; Richards & Gross, 2000)

Emotion Regulation

Suppression and Expression

Among emotion researchers, there is increasing agreement that individuals exert considerable control over their emotions using a variety of strategies to influence which emotions are experienced and when they occur (Gross, 1998). Although there is ongoing debate over the definition of emotion regulation (e.g., Cole, Martin, & Dennis, 2004), there is some support for the proposal that emotion regulation refers to the strategic thoughts and behaviours that are initiated in attempts to influence the experience of emotion (Gross, 1999). In addition to the emotion regulation strategy of re-appraisal, emotional expression and suppression are identified as common approaches to emotion regulation (Gross 1999).

The emotion-performance relationship has been found to be influenced by emotional suppression and expression (e.g., Goldberg & Grandey, 2007; Woodman & Davis, 2008). Research investigating emotion regulation within sport has largely focused on individual's coping styles (e.g., Richards, 2004; Woodman & Davis, 2008). For example, Woodman and Davis (2008) investigated the role of anxiety coping styles on golf putting

performance, and demonstrated the debilitative influence of the coping style of repression on the incidence of ironic errors. Specifically, individuals who attempted to suppress their feelings of anxiety incurred greater errors in the direction that they were particularly attempting to avoid.

Other emotions (e.g., anger) in the emotion-performance relationship have also been found to be moderated by emotional expression and suppression. For example, emotion regulation strategies have been found to moderate anger's influence on cognitive performance and verbal aggression (Perbandt, 2007; Smits & De Boeck, 2007; Smulders & Meijer, 2008). Spielberger (1991) suggests that anger regulation can be conceptualized in terms of the direction of one's anger; specifically anger-in and anger-out. Anger-in refers to the predisposition to direct one's anger inward (i.e., "bottle it up") and has been associated with attempts to *suppress* anger's action tendency (Smits & De Boeck, 2007; Smits et al., 2004). Anger that is directed inward has been associated with debilitative moods including fatigue and depression (Lane & Terry, 2000). Anger-out refers to the predisposition to express one's anger outward (toward an external target) and corresponds with the *release* of anger's action tendency (Smits & Kuppens, 2005). Anger that is directed outward has been associated with increases in determination and effort (Lane & Terry, 2000).

Robazza and Bortoli (2007) found some support for Spielberger's (1991) model of anger regulation in their study of rugby players. Specifically, the players perceived the emotion regulation strategy of anger-out to be facilitative for performance. However, Robazza and Bortoli (2007) relied exclusively on players' perceptions of the facilitative/debilitative influence of anxiety and anger, and did not examine an objective measure of performance. To our knowledge, no research studies have objectively tested

the influence of anger regulation on performance. Consequently, we examined the influence of anger-suppression and expression on sport performance.

Individual Differences

The research of Woodman and Davis (2008) highlights the influential role that individual differences in emotion regulation may have in the emotion-performance relationship. Within the limited sport psychology research that has examined individual differences in emotion regulation, the personality variable of trait anger has been investigated (Robazza & Bortoli, 2007). Trait anger has been proposed to influence the regulation of anger as it reflects an individual's predisposition towards experiencing anger and subsequently increases the frequency and intensity of anger (Spielberger, Jacobs, Russell, & Crane, 1983). Robazzo and Bortoli (2007) found that rugby players' perception of anxiety symptoms (i.e., facilitative/debilitative) was associated with trait anger and anger expression. Moreover, trait anger has been linked with the activation of the action tendency of anger (Smits & De Boeck, 2007). Specifically, individuals who were high in trait anger were found to be more likely to verbally lash out in response to feelings of anger (Smits, De Boeck, & Vansteelandt, 2004). Therefore, high levels of trait anger would be expected to facilitate performance on tasks requiring the execution of a lashing out movement that aligns with anger's action tendency (Lazarus, 1991, 2000b).

Historically, research examining the influence of individual differences on sport performance has been developed with limited theoretical grounding (Gould & Tuffey, 1996). Hanin's Individual Zones of Optimal Functioning (IZOF; 1980, 2000) has assisted in establishing that individuals' performance will be affected by their emotional state in relation to their personal emotional arousal preferences. Although, this model has been

helpful in advancing the appreciation of the role of individual differences in the applied context, it has some limitations.

Considering the personality variables that are well established in the psychology research literature, extraversion appears to have implications for performance and health. Indeed, extraverts are outgoing, sociable individuals who are more willing to express themselves in front of others (Goldberg, 1992, 1993). Moreover, recent research has revealed a facilitative influence of extraversion and emotional expression on performance in the cognitive domain (Perbandt, 2007). However, there has been limited exploration of the influence of the 'Big-five' personality variables (e.g., extraversion) in sport. One of the aims of the thesis was to investigate the influence of individual differences on the emotion-performance relationship by examining the influence of trait anger and extraversion on a strength task.

Alexithymia

If emotion regulation and personality are important aspects of emotional expression, alexithymia is an individual difference variable that may be worthy of consideration when investigating the influence of emotional expression on performance and health. The construct of alexithymia, which was originally derived from clinical observations, outlines an inability to express one's emotions in words (Taylor, 1984). Alexithymic individuals are commonly described as having a lack of emotional awareness and a difficulty in acknowledging their own emotions (Taylor, 1984). In addition, alexithymia is characterized by a difficulty in identifying and describing feelings and an externally oriented cognitive style that is concrete and reality based (Paez, Velasco, & Gonzalez, 1999; Taylor, 1984; Taylor, Bagby, & Parker, 2003). Furthermore, alexithymia is a trait

deficit in emotional regulation and predisposes individuals to use cognitive strategies that result in restricted emotional processing (Mikolajczak & Luminet, 2006).

Research investigating the personality construct of alexithymia in sport performance is limited. A recent study by Woodman, Cazenave, and Le Scanff (2008) investigated alexithymia as a moderator of anxiety fluctuations in skydiving women. Woodman and colleagues posit that alexithymic women may derive an emotional benefit immediately following their engagement in high-risk sport. However, the emotional benefit of engaging in the high-risk activity is short lived and may lead alexithymic women to repeat the activity to renew the feelings of emotional benefit (Woodman et al., 2008).

Alexithymia has been widely researched within investigations of emotional expression and health (e.g., Baikie, 2008; Lumley, 2004). The deficient emotional processing associated with alexithymia impairs emotional regulation and has been identified as a risk factor in the development of clinical disorders including depression, heightened or prolonged psychophysiological arousal and medically unexplained psychosomatic symptoms (Lumley, 2004; Sayar, Gulec, & Topbas, 2004). Further study of the role of alexithymia appears warranted in order to enhance understanding of the influence of emotional regulation on performance and health.

Fibromyalgia

High levels of alexithymia have been found in individuals diagnosed with the chronic pain condition of fibromyalgia (FM; Sayar et al., 2004). FM has a reported prevalence of 2-3% in the general population (Endresen, 2007). The condition of FM is characterized by chronic musculoskeletal pain with common co-occurring symptoms of severe physical impairment, stiffness and fatigue (Wolfe, Smythe, Yunus, et al., 1990; Mease, 2005); it

has been described as a type of somatization, wherein restricted emotional processing of painful emotions are manifest in somatic symptoms (Brosschot & Aarsse, 2001).

FM has been diagnosed as a chronic pain condition for nearly twenty years (e.g., Wolfe et al., 1990); however, its aetiology and underlying pathology remain uncertain (Broderick, Junghaenel, & Schwartz, 2005; Smyth & Nazarian, 2006). Evidence of the role of emotional processing in FM has been forwarded in research demonstrating that the maintenance and exacerbation of FM symptoms are influenced by emotions (e.g., anger and sadness) and strategies aimed at their regulation (van Middendorp, Lumley, Jacobs, van Doornen, Bijlsma, & Geenen, 2008). Further, alexithymia has been found to be associated with FM patients' reported symptom severity and can influence the efficacy of attempts at treatment (van Middendrop et al., 2008; Sayar et al., 2004).

FM has proven to be a difficult condition to treat effectively with limited success in controlling the chronic pain and associated emotional difficulties (Smyth & Nazarian, 2006). Drug therapies (e.g., opiates and antidepressants) have proven to be the most widely prescribed course of treatment (O'Malley, Balden, Tomkins, Santoro, Kroenke, & Jackson, 2000). Pharmacological treatment programmes have produced health benefits in the management of some symptoms including pain and disability (Arnold, Lu, Crofford, Wohlreich, Detke, Iyengar et al., 2004; Arnold, Keck, & Welge, 2000). However, there are a number of limitations to pharmacological treatments; specifically drug therapies are associated with reports of negative side effects, challenges in determining the appropriate dosage, and the potential for interactions with other prescribed agents (O'Malley et al., 2000; Sammons, 2004). Greater success has been observed with cognitive-behavioural treatments, physical reconditioning and exercise interventions, which have been found to be moderately effective in managing some aspects of FM (e.g., physical impairment and

stiffness; Barkhuizen, 2002; Dobkin, Da Costa, Abraham, Drista, Berger, Fitzcharles & Lowensteyn, 2006; Rossy, Buckelew, Dorr et al., 1999).

However, individual differences have a significant influence on treatment outcomes (van Koulil, Effting, Kraaimaat, van Lankveld, et al., 2006). Individuals with FM have been found to make greater use of emotional avoidant strategies to process and regulate emotions than healthy controls (van Middendrop et al., 2008). Considering this deficit in emotional processing and strategy use could lead to the development of interventions that are tailored to patients' emotion regulation style. One particular emotional approach treatment programme that has been widely conducted with a variety of clinical populations including FM is written emotional disclosure (Broderick, et al., 2005; Smyth & Nazarian, 2006).

Written Emotional Disclosure

Written emotional disclosure was originally developed by Pennebaker and Beall (1986) and used with first year university students who were adapting to the new experience of living away from home. In the pioneering study, students were asked to write about a trauma or about superficial (non-emotional) topics for four days, 15 minutes per day. The findings from the study revealed that writing about the emotions and thoughts associated with intimate, personal issues promoted physical health, as measured by reductions in physician visits in the months following the study, fewer reports of self-medicating, and overall more positive long-term evaluations of the impact of the treatment (Pennebaker & Beall, 1986).

Twelve years later, the first meta-analysis of the expressive writing programme was conducted by Smyth (1998), which was based on 14 studies using healthy participants. The findings of this analysis revealed that the writing programme was associated with

positive outcomes with a weighted mean effect size of $d = .47$ ($r = .23$, $p < .001$); this effect size is comparable to other psychological interventions such as cognitive behavioural therapy (Smyth, 1998). More recently, Frattaroli (2006) performed a meta-analysis of written emotional disclosure studies that were conducted with healthy and clinical populations. One hundred and forty-six randomized studies of experimental disclosure were included in the random effects analyses, indicating that the treatment is effective, with a positive and significant average *r*-effect size of .08.

In consideration of the treatment effects of written emotional disclosure with populations consisting exclusively of clinical patients, Frisina, Borod and Lepore (2004) carried out a meta-analysis on 9 expressive writing studies. The results of this meta-analysis revealed that expressive writing significantly improved health outcomes ($d = .19$, $p < .05$). However, it is worth noting that the effect size was stronger for physical ($d = .21$, $p = .01$) than for psychological ($d = .07$, $p = .17$) health outcomes. Frisina and colleagues suggest that the small effect sizes were due to the heterogeneity of the samples.

Preliminary research of the structured expressive writing programme in FM produced promising results as short-term benefits in health outcome measures were found with effect sizes comparable to pharmaceutical and nonpharmaceutical clinical trials (Broderick et al., 2005). However, previous investigation of written emotional disclosure in FM has failed to consider the underpinning mechanisms that influence the efficacy of the expressive writing treatment programme. Moreover, multiple mechanisms have been proposed to underpin written emotional disclosure and influence the efficacy of the treatment programme (Frattaroli, 2006; Sloan & Marx, 2004).

Mechanisms Underpinning Written Emotional Disclosure

Although, numerous explanations have been forwarded in attempts to identify the mechanisms within expressive writing, three theoretical models have received the greatest amount of attention in the research literature (Frattaroli, 2006; Sloan & Marx, 2004). Specifically, the theoretical models of inhibition (Pennebaker & Beall, 1986; Pennebaker, 1989), exposure/emotional processing (Sloan, Marx, & Epstein, 2005), and cognitive adaptation have been proposed as possible explanations of the mechanisms that underpin the efficacy of written emotional disclosure; with no single theoretical model able to fully account for the effectiveness of written emotional disclosure (Pennebaker & Chung, 2007).

The first theoretical model that came to prominence in research attempting to account for the beneficial effects of written emotional disclosure described the concept of inhibition (Sloan & Marx, 2004). Initial expressive writing treatment programmes were guided by the Freudian concept of (dis)inhibition and its proposed influence on health (cf., Pennebaker & Beall, 1986; Pennebaker, 1989). Following the logic that inhibiting thoughts, emotions or behaviours is associated with unconscious physiological effort, the writing exercise provides an outlet to express the inhibited content and reduce the internal psychophysiological tension, thus resulting in improved health (Pennebaker & Chung, 2007). However, there is no evidence to support the proposal that decreases in inhibition mediate the relationship between expressive writing and health improvements (Sloan & Marx, 2004). Further, due to measurement difficulties inherent to the attempted examination of individuals' inhibition of thoughts and emotions, little research has focused on this proposed theoretical model (Pennebaker & Chung, 2007).

Repression is a coping strategy that is closely associated with the inhibition of emotions and is operationally defined as the discrepancy between reported emotional

experience and physiological indices of activation (Weinberger, 1990; Woodman & Davis, 2008). Recent developments of more sensitive measures of physiological reactivity to emotions (e.g., salivary alpha-amylase) offer new approaches to the investigation of individuals' attempts at inhibition and may provide a means of examining the role of inhibition in expressive writing with FM patients. However, research examining inhibition in written emotional disclosure has not examined the psychophysiological discrepancies that are central to inhibition and repression. Consequently, the experiment presented in Chapter 4 analysed FM patients' psychophysiological responses to the written emotional disclosure treatment to investigate the influence of the theoretical model of inhibition.

The second theoretical model proposed to underpin written emotional disclosure is the exposure hypothesis (Frattarolli, 2006). Sloan and Marx (2004) suggested that written emotional disclosure may serve as a less threatening context for participants to recall traumatic memories that had been previously avoided. Through repeated exposure to the traumatic stimuli via the expressive writing programme, participants experience a reduction in emotional arousal that results in the habituation of participants' stress responses and leads to beneficial health outcomes (Kloss & Lisman, 2002; Sloan, et al., 2005; Smyth, Hockemeyer, & Tulloch, 2008). Previous research investigating written emotional disclosure in FM has not examined patients' psychophysiological reactivity to the expressive writing treatment programme. Therefore, we examined participants' psychophysiological reactivity with the aim of investigating the role of the theoretical model of exposure in written emotional disclosure with FM patients.

Finally, the third theoretical model proposed to explain the mechanisms that underpin written emotional disclosure is cognitive adaptation (Sloan & Marx, 2004). Research suggests that translating a traumatic event into language allows an individual to organise, structure and make sense of disturbing events that may not have been previously

possible (Pennebaker, Mayne, & Francis, 1997). Research suggests that translating traumatic memories into language requires an individual to organise, structure and make sense of disturbing events, which may not have been previously possible (Pennebaker et al., 1997). It is proposed that this process of gaining insight and cognitively assimilating traumatic memories into existing schemas decreases demands on working memory and reduces uncertainty regarding the trauma (Graybeal, Sexton & Pennebaker, 2002; Klein & Boals, 2001; Pennebaker et al., 1997; Schwartz & Drotar, 2004).

Moreover, written emotional disclosure can lead participants into re-evaluating their role in the recalled traumatic situation, which may result in a greater internalization or externalization of the events that transpired (Brody & Park, 2004; Campbell & Pennebaker, 2003; Pennebaker, Mehl, & Niederhoffer, 2003). In support of this proposal, Campbell and Pennebaker (2003) found that participants who cognitively altered their individual and social perspectives over the course of the written emotional disclosure treatment were more likely to experience health benefits compared with participants who did not alter their perspective. Further, coming to terms with a traumatic event and the associated emotional memories appears to be linked to thoughts and feelings about oneself in relation to others (Campbell & Pennebaker, 2003; Swann, 1997). Brody and Park (2003) argue that written emotional disclosure provides an opportunity to increase self-awareness and integrate disconnected thoughts and feelings with aspects of identity. Repeated expressive writing can lead participants to make a gradual shift in their perspective, which can increase their self-awareness and acceptance of their emotions, thoughts, and behavioural experiences, thus resulting in increased health (Brody & Park, 2003). Despite this promising theoretical framework, previous investigations of written emotional disclosure in FM have not examined the potential relationships between an

individual's cognitive adaptation and health outcomes. Consequently, we investigated the role of cognitive adaptation in written emotional disclosure with FM patients.

Previous research examining the role of cognitive adaptation has typically analysed participants' written texts to assess changes in the use of pronouns and words reflecting insight. The use of computer programmes that conduct linguistic analyses has enabled researchers to track changes in participants' writing and link word usage with various health and behavioural outcomes (Pennebaker, et al., 1997). However, previous investigations of written emotional disclosure in FM have not examined the potential relationships between individual's writing styles and health outcomes. Therefore, we scrutinised participants' writing with the aim of exploring potential links between word use and health outcomes.

In summary, written emotional disclosure has been found to have beneficial effects on health in FM; however, previous research has not considered the role of the proposed theoretical models that have been forwarded in attempts to explain the mechanisms that underpin written emotional disclosure. Therefore, we conducted an in-depth study of written emotional disclosure in FM by examining the theoretical models that are proposed to explain the underpinning mechanisms of the treatment programme.

Summary and Thesis Structure

In summarising the role of emotional expression in performance and health, several areas of potential research have been identified. This thesis will examine a number of areas related to emotional expression including: the influence of the emotional expression of specific emotions (e.g., joy, hope and anger) on cognitive and physical performance; the role of individual differences in emotion regulation on performance; the role of a number

of theoretical models that have been proposed to explain the mechanisms that underpin written emotional disclosure.

In addition to this general introduction, the thesis consists of three research chapters and a general discussion. The three research chapters have been prepared as manuscripts for submission to academic journals. In light of this, there will be overlap and repetition of a number of topics so that the chapters are able to stand alone as individual research manuscripts.

The first research chapter (Chapter 2) is a three-study manuscript. Study 1 investigates the influence of the emotions joy and anger on physical and cognitive functioning. Study 2 further explores the emotions of anger and hope on a reaction time task. Study 3 examines the role of the personality variable of extraversion in the anger-performance relationship. It is important to note that the data presented in Study 1 and 2 have been presented previously in the partial completion of an MSc and an undergraduate degree, respectively. Chapter 2 is currently in press in the *Journal of Sport and Exercise Psychology*.

Chapter 3 extended the findings of Study 3 in Chapter 2, by further examining the role of individual differences as moderators of the anger-performance relationship. The role of individual differences in trait anger and the anger regulation styles (e.g., anger-in and anger-out) was examined on a strength task. Moreover, the role of physiological arousal was investigated with the use of salivary alpha-amylase as an indication of SNS activity.

The current research programme examined the role of emotional expression in both sport and health. Chapters 2 and 3 focused on sport performance, while Chapter 4 investigated the implications of emotional expression on health in a clinical population. Chapter 4 is a six-month longitudinal study of the mechanisms that underpin written

emotional disclosure in fibromyalgia (FM). A psychophysiological research design was used to examine the proposed mechanisms of inhibition, exposure and cognitive adaptation.

Finally, Chapter 5 discusses the main findings arising from the research chapters, presents the central theoretical and applied implications, identifies the strengths and limitations of the research programme, and presents a number of recommendations for future research.

CHAPTER 2

Emotions and Sport Performance: An exploration of Happiness, Hope and Anger[1]

Abstract

We conducted three experiments to examine the relationships between emotions and subcomponents of performance. Experiment 1 revealed that anger was associated with enhanced gross muscular peak force performance but that happiness did not influence grammatical reasoning performance. Following Lazarus (1991, 2000a), we examined hope rather than happiness in Experiment 2. As hypothesized, hope yielded faster soccer-related reaction times in soccer players. Experiment 3 was an examination of extraversion as a moderator of the anger-performance relationship. When angry, extraverts' peak force increased more than introverts'. Results are discussed and future research directions are offered in relation to Lazarus's framework.

[1] This chapter has been accepted for publication as Woodman, T., Davis, P.A., Hardy, L., Callow, N., Glasscock, I., & Yuill-Proctor, J. (in press). Emotions and Sport Performance: An exploration of Happiness, Hope and Anger. *Journal of Sport and Exercise Psychology.* The data presented in experiment 1 and 2 were collected by Jason Yuill-Proctor and Ian Glasscock, respectively; this data has been previously submitted in partial completion of an M.Sc. and an undergraduate degree, respectively.

Introduction

Although a range of emotions has been observed in sport, including anxiety, frustration, disappointment, happiness, hope, and anger (Crocker, Kowalski, Graham, & Kowalski, 2002; Gould, Medberry, Dieffenbach, Lauer, Hardy, & Jones, 2000; Hanin, 2000; Jones, Lane, Bray, Uphill, & Catlin, 2005; Jones & Uphill, 2004; Lazarus, 2000a; Robazza & Bortoli, 2007; Sève, Ria, Poizat, Saury, & Durand, 2007), it is anxiety that has received by far the most research attention. This is especially true for research that has examined the emotion-*performance* relationship, which is the focus of the present research.

Lazarus's (1991, 2000a) cognitive-motivational-relational (CMR) theory proposes that athletes' specific emotions are each guided by a core relational theme that describes the interaction between the individual and the environment. The core relational theme is a summary of the appraisals that individuals make in assessing the risk and reward involved in a particular situation. For example, the core relational theme of anger is, "a demeaning offence against me and mine" (Lazarus 2000a, p. 242). Each core relational theme has an associated action tendency that directly represents the manifestation of the person's appraisal of the stimulus in relation to the self (Lazarus, 2000b). The action tendency for anger is, "a powerful impulse to counterattack in order to gain revenge for an affront or repair a wounded self-esteem" (Lazarus, 2000a, p. 243).

Lazarus's (1991, 2000a) CMR theory proposes that the core relational theme and the associated action tendency will influence performance depending on the complex relationship between the athlete and the situation. For example, anger may negatively impact performance if it draws resources away from the primary task at hand. However, if the physical skill requires a "lashing out" motion toward an aggressor or opponent, performance may be facilitated due to its close association with anger's action tendency (Lazarus, 2000b). As such, Lazarus's CMR theory offers a potentially fruitful theoretical framework for investigating the likely complex emotion-

performance relationship. Thus, it seems surprising that it has received minimal performance research attention. One reason for this may be that many emotions are best thought of as *post*-performance emotions. For example, for positive emotions, a performer may feel: *happy* to have won; *relieved* at having achieved a performance goal; *proud* to have been in the final of a major competition. Similarly, although *anxiety* can be readily conceptualized as a *pre*-performance emotion, other negative emotions are more readily thought of as post-performance emotions. For example, a performer may feel: *angry* at having performed below potential; *ashamed* of a particularly poor performance in front of a crowd; *guilty* of letting the coach down with a poor performance.

Although these emotions can be experienced post-performance (Gould et al., 2000), some may also be experienced pre-performance and may affect subsequent performance. Also, there is evidence that positive affect is related to a number of criterion variables including health, marital well-being, relationship satisfaction, and coping (see Lyubomirsky, King, & Diener, 2005). Further, in the sport domain, Totterdell (2000) found that happiness was positively related to cricket batting average. However, although Uphill and Jones (2007) found some qualitative support for CMR theory, to the best of our knowledge there are no studies that have studied the emotion-performance link within Lazarus's (2000a) CMR framework. The aim of the present study was to build upon our understanding of the emotion-performance relationship within this framework.

Physical and cognitive subcomponents of performance appear to be differentially affected by emotional arousal (Parfitt, Hardy, & Pates, 1995; Parfitt, Jones, & Hardy, 1990). For example, physiological arousal has been positively associated with performance on aerobic tasks (Parfitt et al., 1995) and strength tasks (Perkins, Wilson, & Kerr, 2001). Also, heightened emotional intensity may sometimes be beneficial to performance especially if it can motivate individuals to invest greater resources to the task at hand (cf. Eysenck & Calvo, 1992; Fredrickson, 2001; Lazarus, 2000a).

Conversely, physiological arousal can be detrimental to performance on tasks that require fine motor control (Noteboom, Fleshner, & Enoka, 2001; Parfitt et al., 1990). Further, attempts to manage emotions have been found to divert cognitive resources from the primary task toward coping strategies (Janelle, 2002). Despite these promising research avenues, the majority of research examining emotional arousal has focused on anxiety and has disregarded other negative emotions (e.g., anger) as well as positive emotions (e.g., happiness, hope) that display similar or different patterns of physiological activation (Jones, Lavallee, & Thatcher, 2004; Lazarus, 2000b) that might differentially affect performance (Robazza & Bortoli, 2007).

Given the previous promising research with happiness (e.g., Lyubomirsky et al., 2005; Totterdell, 2000) we start with happiness as a positive emotion. Also, given the obvious theoretical benefits of anger on a purely physical task (i.e., the desire to lash out; Lazarus, 2000a), we explore anger as a negative emotion. To this end, in Experiment 1 we explore the effect of anger and happiness on the performance of physical and cognitive tasks. Specifically, as the action tendency for anger is associated with a lashing out movement (Lazarus, 2000a) that is similar to the task requirements of a maximal force task, we hypothesize that anger will benefit performance on such a task. Conversely, happiness has been shown to be positively related to effective problem solving (e.g., Erez & Isen, 2002; Estrada, Isen, & Young, 1994; Kavanagh, 1987) and signals that all is well and that resources can be committed to the task (Fredrickson, 2001; Lazarus, 2000b). Consequently, we hypothesize that happiness will facilitate performance on the cognitive task.

Experiment 1

Method

Participants. Fifteen physically active students (9 men, 6 women; M_{age} = 24.18 yrs; SD = 3.75) participated in the experiment. All provided written informed consent to participate in the experiment.

Measures

Imagery scripts. Imagery scripts were composed for the purpose of inducing happiness, anger, and an emotion-neutral affect. The emotion scripts (happiness and anger) were based on Lazarus's (1991, 2000a) core relational themes of happiness and anger, and contained vivid detail regarding stimuli, response, and meaning propositions to elicit physiological, cognitive, and somatic activation consistent with the appropriate emotional state (Cumming, Olphin & Law, 2007; Lang, 1979). The emotion-neutral script outlined the process of brushing one's teeth (see Kavanagh & Hausfeld, 1986). The delivery of the imagery scripts was standardized by recording the scripts onto a Compact Disc[1].

Happiness and Anger. To assess the degree to which the emotions were experienced, we presented participants with a Happiness and Anger inventory. Happiness statements were derived from Gould et al.'s (2000) study, which examined athletes' emotions during sport performance. The 10 happiness statements were chosen using a deductive approach. These were: *I am ecstatic*, *I am happy*, *I feel elated*, *I feel joyful*, *I feel blissful*, *I feel good*, *I feel pure happiness*, *I am on cloud nine*, *I am full of joy*, and *I feel like smiling*. The inventory also included the 10 state anger statements (*I am furious*, *I feel irritated*, *I feel angry*, *I feel like yelling at somebody*, *I feel like breaking things*, *I feel mad*, *I feel like banging on the table*, *I feel like hitting someone*, *I feel burned up*, *I feel like swearing*) from the State-Trait Anger Scale (STAS; Spielberger, Jacobs, Russell, & Crane, 1983). Each happiness and anger statement was rated on a four-point scale (1 = *not at all,* 4 = *very much so*). Spielberger et al. (1983) reported high internal consistency with a Cronbach alpha coefficient of .92. The Cronbach alphas for the present study were .86 for happiness and .90 for anger.

Visual Analog Scale. Although we were exploring Lazarus's (2000a) framework, in which emotions are conceptualized as discrete, we also used a two-dimensional Visual Analog Scale (VAS) to assess the degree to which participants experienced the emotions of happiness and anger before undertaking the experimental tasks. This was

simply to verify further that the emotion manipulations had been successful in inducing the appropriate emotions. Although such an approach is in line with Russell's (1980) circumplex model of affect, researchers, including Lazarus (2000a) and Russell (2003), have questioned the usefulness of such two-dimensional models. Indeed, based on this method alone, one would not be able to differentiate between anxiety and anger, for example (Russell, 2003). However, as an adjunct to the questionnaire data, we deemed this method appropriate for gleaning additional discriminatory information about the success of our emotion manipulations. We used a grid (two 200 mm axes each anchored by *Not at all* and *Very much*) that measured orthogonally the dimensions of arousal and hedonic tone (pleasantness).

Cognitive Task. We used a grammatical reasoning task that was originally developed by Baddeley (1968). This task requires participants to identify whether or not a sentence describes a letter pair correctly (e.g., *BA: A follows B; True or false?*). We presented participants with a list of 32 such pairs and asked them to complete as many as possible in a 90-second period. Further, we told participants that they would receive one point for every correct answer. Cognitive performance was assessed by accuracy (i.e., number of correct responses). As participants completed the same task on three occasions, the questions were randomized into three different orders (see Baddeley, 1968).

Physical Task. Participants performed a gross muscular peak force task on a Kin Com Muscle Testing adjustable dynamometer (model 125E+ Chattecx corporation) as a measure of physical performance. Peak force (Nm) was recorded by isometric extension of the right leg. After familiarization with the equipment and task demands, participants kicked as fast and as hard as possible for a period of five seconds. They performed the task twice with a period of ten seconds between the two trials. The mean of the two trials was used for analysis.

Procedure

We informed participants that the experiment was an examination of performance under different conditions of emotion and provided them with instructions on how to complete the cognitive and physical tasks. We administered the experimental conditions on different days at approximately the same time of day. Each participant completed the trials individually.

After providing demographic information and written informed consent, participants sat at a desk and the experimenter outlined the emotion that was to be induced during the testing session and asked participants to think of a situation in which they had experienced this emotion. The corresponding imagery script was then presented. When the imagery script had finished participants were asked to indicate how they were feeling on the VAS. The cognitive task was then completed. Immediately after completing the task we asked participants to complete the Happiness and Anger Inventory retrospectively in relation to how they had felt during the task.

Participants then moved to the dynamometer to perform the physical task under the same emotion condition. Upon confirmation that they were seated securely they performed one warm-up trial to familiarize themselves with the task. We then presented the relevant imagery script. As soon as the imagery script had finished participants indicated how they felt on the VAS and were reminded to perform the kick *as fast and as hard as you can*. Upon completion of the physical task, the Happiness and Anger inventory was completed retrospectively.

To finish, we offered participants the inducement of a more pleasant emotion (happiness) if they experienced residual unpleasant feelings (e.g., anger); no participants required this service. We finished by thanking and debriefing the participants. The same procedure outlined above was followed for each condition (i.e., happiness, anger, & emotion-neutral). The order of presentation of the emotion conditions was balanced and randomized across participants.

Results

Manipulation Checks

To assess the imagery scripts' efficacy in inducing the respective emotions (i.e., happiness, anger, and neutral) during the physical and cognitive tasks, single-factor repeated measures ANOVAs were conducted to examine the dimensions of arousal and pleasantness on the VAS, and the subscales of happiness and anger on the Happiness and Anger inventory. One participant failed to provide data in the emotion-neutral conditions and was removed from all analyses. When the assumption of sphericity was violated we applied a Greenhouse-Geisser adjustment to the degrees of freedom.

Happiness and Anger. There was a significant happiness difference across emotion conditions, both for the cognitive task, $F(1.17, 16.40) = 220.84$, $p < .001$, $\eta^2 = .94$, and for the physical task, $F(1.23, 17.25) = 313.06$, $p < .001$, $\eta^2 = .96$. Tukey's follow-up tests revealed that participants experienced significantly more happiness in the happiness condition compared to the anger and emotion-neutral conditions (see Table 1). Moreover, there was a significant anger difference across emotion conditions for both the cognitive task, $F(1.14, 16.01) = 54.88$, $p < .001$, $\eta^2 = .80$, and the physical task, $F(1.12, 15.72) = 61.44$, $p < .001$, $\eta^2 = .81$. Tukey's follow-up tests revealed that participants experienced significantly more anger in the anger condition compared to the happiness and emotion-neutral conditions (see Table 1).

Visual Analog Scale (VAS). The analyses revealed there was a significant arousal difference across emotion conditions, both for the cognitive task, $F(2, 26) = 13.52$, $p < .001$, $\eta^2 = .51$, and for the physical task, $F(2, 26) = 12.48$, $p < .001$, $\eta^2 = .49$. Tukey's follow-up tests revealed that participants experienced significantly greater arousal in the happiness and anger conditions compared to the emotion-neutral condition during both tasks (see Table 1); the anger and happiness conditions were not significantly different from each other during either of the tasks. Further, there was a significant hedonic tone (pleasantness) difference across emotions for the cognitive task, $F(2, 26) = 151.90$, $p < .001$, $\eta^2 = .92$, and for the physical task, $F(2, 26) = 73.53$, $p < .001$, $\eta^2 =$

Table 1

*VAS arousal, VAS pleasantness, Happiness, Anger, and Performance means (*SD*) for the three emotion conditions in Experiment 1*

	Cognitive Task			Physical Task		
	Happiness	Anger	Emotion-neutral	Happiness	Anger	Emotion-neutral
Happiness	***40.33 (6.37)	11.33 (2.23)	29.00 (6.13)	***41.73 (5.32)	11.27 (2.37)	30.27 (5.15)
Anger	13.20 (7.03)	***38.60 (5.82)	25.53 (7.01)	12.93 (7.33)	***40.07 (5.62)	27.13 (6.83)
Arousal intensity	*7.15 (2.12)	*6.96 (1.78)	3.79 (1.92)	*7.11 (1.86)	*6.80 (2.27)	3.64 (1.96)
Hedonic tone	***8.92 (0.93)	2.18 (1.62)	[a]5.39 (0.81)	***8.64 (1.05)	2.49 (1.93)	[a]5.42 (1.10)
Performance	18.29 (5.53)	19.29 (4.78)	18.93 (5.68)	561.36 (190.66)	*611.29 (203.85)	559.21 (191.75)

Note: Range of possible scores is: Arousal intensity, -10 to 10; Hedonic tone, -10 to 10; Happiness, 0 to 40; Anger, 0 to 40

* $p < .05$, * $p < .01$, *** $p < .001$, [a] significantly greater than anger ($p < .001$)

.85. Tukey's follow-up tests revealed that participants experienced more pleasantness in the happiness condition compared with the anger condition and less pleasantness in the anger condition compared to the emotion-neutral condition during both tasks (see Table 1).

The combined results of the VAS and the Happiness and Anger inventory reveal that the attempts to induce the respective emotions were successful. Further, the VAS findings suggest that the emotions of happiness and anger were characterized by high levels of arousal (Lazarus, 1991) and lend support to the proposal that happiness is a more pleasurable emotion than anger (Russell, 1980).

Performance

Cognitive Task. A single-factor repeated measures ANOVA revealed no significant difference across emotion conditions in the number of correct answers on the grammatical reasoning task, $F(1.43, 18.53) = .52$, ns, $\eta^2 = .04$ (see Table 1).

Physical Task. A single-factor repeated measures ANOVA revealed a significant difference across emotion conditions for peak force, $F(2, 26) = 4.52$, $p < .05$, $\eta^2 = .26$. Tukey's follow-up tests revealed that performance was significantly greater in the anger condition compared with the happiness and emotion-neutral conditions; there was no significant difference between the happiness and emotion-neutral conditions (see Table 1).

Discussion

The aim of Experiment 1 was to examine the influence of anger and happiness on cognitive and physical aspects of performance. The findings partially supported our hypotheses; participants' performance on the physical task was significantly greater in the anger condition compared with the happiness and emotion-neutral conditions. These results of the experiment are consistent with Lazarus's (2000b) suggestion that anger may facilitate physical performance if the required skill is similar to anger's associated action tendency (i.e., to lash out).

Although the anger results are encouraging, the results for happiness do not support our hypothesis and previous research (e.g., Lyubomirsky et al., 2005; Perkins et al., 2001; Totterdell, 2000). That is, happiness did not produce any significant differences in cognitive performance. A possible explanation of the lack of happiness findings resides in the core relational theme for happiness: "making reasonable progress toward the realization of a goal" (Lazarus, 2000a, p. 234). This suggests that happiness may in fact result in no change in the cognitive resources committed to the task. That is, the core relational theme of happiness suggests a satiated state: happiness signals that all is well and there is possibly no immediate need or desire to do anything to change this (see also Carver & Scheier, 1998; Mackie & Worth, 1989; Melton, 1995). Given these considerations, it is perhaps not surprising that anger results in significant performance gains (i.e., *I am angry; I want to lash out*) and that happiness does not (i.e., *I am happy; I do not feel the need to do anything*). We explore some alternative explanations of these results in the general discussion following Experiment 3.

The aim of Experiment 2 was to investigate potential performance gains with a more goal-oriented positive emotion. One obvious such emotion candidate is hope. Indeed, the core relational theme for hope is "fearing the worst but yearning for better, and believing the improvement is possible" (Lazarus, 2000a, p. 234; see also Lazarus, 1999), which is more likely to result in greater mental effort. Further, hope is a common pre-performance emotion among athletes: despite fear of failure, they hope for the best outcome. Given the core relational theme of hope, we hypothesized that participants who were hopeful would believe that improved performance was possible and would thus invest greater cognitive resources to the successful completion of the task and perform better (Eysenck, & Calvo, 1992; Lazarus, 2000a). Conversely, as some cognitive resources might be diverted away from the primary task toward coping strategies when participants were angry (Lazarus, 2000b), we hypothesized that anger would not result in better performance on such a task.

There were two other potential limitations in Experiment 1. First, although positive affect is thought to allow resources to be allocated to the task (cf. Fredrickson, 2001), we did not measure such resources. Second, the task (grammatical reasoning) was of limited relevance to participants, which may have resulted in few resources being allocated to the task. In Experiment 2 we aimed to redress these limitations by developing a more sport-specific task for sport participants and measuring resources via mental effort.

Experiment 2

Method

Participants. Eighteen semi-professional male British soccer players (M_{age} = 21.50 years; SD = 2.12) participated in the experiment.

Measures

Imagery scripts. Imagery scripts were used to elicit the emotional states of hope and anger for the appropriate conditions (e.g., Cumming et al., 2007; Lang, 1979). The imagery scripts were constructed in the same manner as in Experiment 1 but with some specific reference to football, considering Lazarus's (2000a) core relational themes for hope and anger. The emotion-neutral condition was the same as in Experiment 1 (i.e., instructing participants to imagine brushing their teeth; cf. Kavanagh & Hausfeld, 1986).

Hope and Anger. This inventory comprised nine hope statements (e.g., *I am hoping to do well on this task*) derived from Gould et al. (2000) and the same 10 state anger statements from the STAS (Spielberger et al., 1983) as were used in Experiment 1. Each of the hope and anger statements was rated on a five-point Likert-type scale from 1 (*not at all*) to 5 (*very much so*). The hope statements were: *I feel hopeful, I have hope, I am hoping to do well on this task, I feel hopeless about this task, I have not got much hope, I have faith in my ability, I do not want to perform badly on this task, I don't really mind how I perform on this task, I hope I will perform well on this task.*

The hope and anger subscales had high internal consistency with Cronbach alpha coefficients of .89 and .88 for hope and anger, respectively.

The Sport Affect Grid. A Sport Affect Grid (SAG) assessed two independent dimensions of affect: intensity and hedonic tone (pleasantness). The SAG has been used previously in sport research (e.g., Hardy, Hall, & Alexander, 2001) and is presented as a 9 x 9 grid: the vertical axis assesses the self-perceived intensity of an emotion, ranging from *Extremely Low Intensity* to *Extremely High Intensity,* and the horizontal axis assesses hedonic tone, ranging from *Unpleasant Feeling* to *Pleasant Feeling*. Participants are asked to mark an *X* on the part of the grid that best represents how he/she feels *right now*. Scores for the intensity and hedonic tone of the emotions were calculated separately by converting the location of the *X* on each axis to a value from one to nine.

Cognitive Task. As the letter transformation task used in Experiment 1 has limited applicability to sport situations, we presented the soccer players with a task that assessed their soccer-related reaction times. This computer task required participants to track the path of an opposing player as closely as possible with the cursor of the mouse while anticipating the appearance of a soccer ball on the screen. When the soccer ball appeared on the screen participants were to react as quickly as possible by clicking the mouse. The task lasted 45 seconds with a total of nine soccer balls appearing every four, five, or six seconds. The order of presentation of these time periods was randomized within participants. Participants' mean reaction time was retained for analysis.

Perceived Mental Effort Scale (PMES; Mullen & Hardy, 2000). Given the core relational theme of hope, we hypothesized that hope would be associated with an increase in mental effort. Consequently, we asked participants to assess how much mental effort they had invested in the task by completing the PMES: *Based on the most mental effort you have ever used to concentrate before, how would you rate your*

concentration effort during your performance on the task? The PMES is scored on a scale of 0 (*No effort*) through 5 (*Moderately Effortful*) to 10 (*Most effort ever*).

Procedure

Participants attended the testing sessions individually and we told them that we were studying emotions and soccer-related performance. After the participant had provided written informed consent and demographic information, the researcher explained the experimental task. Participants then sat at a desk in front of a computer monitor and listened to the first imagery script via headphones (i.e., hope, anger, or neutral). After the imagery script, participants completed the SAG and the computer soccer task. Immediately after the task, participants retrospectively completed the Hope and Anger Inventory and the PMES in relation to how they had felt immediately before the task. Once participants had completed the inventories and had rested for a few moments, we asked participants to stand with their eyes closed and to balance on alternate legs while counting backwards in threes from 100 to zero. This was performed between each of the conditions in order to minimize any carryover effects from one emotion condition to the next.

The order of the conditions (i.e., hope, anger, and neutral) was balanced across participants. After the third condition we thanked participants for their time, offered them the opportunity to ask any questions, and debriefed them before they left the laboratory.

Results

Manipulation Checks

Hope and Anger. Single-factor repeated measures ANOVAs were conducted across the three emotion conditions (i.e., hope, anger, neutral). There was a significant hope difference across conditions, $F(2, 34) = 4.60$, $p < .05$, $\eta^2 = .21$. Tukey's follow-up tests revealed that significantly more hope was expressed in the hope condition compared with the anger and emotion-neutral conditions; there was no significant difference in hope between the anger and emotion-neutral conditions. Further, there

was a significant anger difference across conditions, $F(1.40, 23.85) = 31.50$, $p < .001$, $\eta^2 = .65$. Tukey's follow-up tests revealed that significantly more anger was reported in the anger condition compared with the hope and emotion-neutral conditions; there was no significant difference in anger between the hope and emotion-neutral conditions (see Table 2).

The Sport Affect Grid. Single-factor repeated measures ANOVAs were conducted to examine the dimensions of hedonic tone (pleasantness) and intensity across emotions. There was a significant hedonic tone difference, $F(2, 34) = 11.37$, $p < .001$, $\eta^2 = .40$. Tukey's follow-up tests revealed that the anger condition yielded significantly lower pleasantness than the hope and neutral conditions. The difference between the hope and emotion-neutral conditions approached conventional significance with greater hedonic tone expressed in the hope condition, $p = .09$. Further, there was a significant intensity difference across emotions, $F(2, 34) = 40.71$, $p < .001$, $\eta^2 = .71$. Tukey's follow-up tests revealed that both the anger and hope conditions were significantly more intense than the emotion-neutral condition with no significant difference between the anger and hope conditions.

These analyses suggest the imagery scripts were successful in inducing the corresponding emotions. Further, they confirm that anger is an unpleasant emotion that is characterized by a high level of intensity (Lazarus, 2000a; Russell, 1980) and that hope is a pleasant and intense emotion (Lazarus, 2000a).

Mental Effort. A single-factor repeated measures ANOVA revealed that participants' mental effort differed across conditions, $F(2, 34) = 30.75$, $p < .001$, $\eta^2 = .64$. Tukey's follow-up tests showed that the mental effort invested in the hope and anger conditions was significantly greater than in the emotion-neutral condition; there was no significant difference between the mental effort invested in the hope and anger conditions (see Table 2).

Performance

Reaction time. A one-way repeated measures ANOVA revealed no significant difference between emotion conditions on reaction time, $F(2, 34) = 2.12$, $p = .14$, $\eta^2 = .11$. However, given that our hypothesis was that hope would yield faster reaction times than no emotion and that anger and emotion-neutral conditions would not differ, we proceeded with these two *a priori* comparisons. These revealed that the reaction times in the hope condition were significantly faster than in the emotion-neutral condition, $t(17) = 2.47$, $p < .05$, $\eta^2 = .26$, and that the anger and emotion-neutral conditions did not significantly differ, $t(17) = 1.69$, $p = .11$, $\eta^2 = .14$ (see Table 2).

Table 2

*Hope, Anger, Hedonic tone, Intensity, Mental effort, and mean Reaction Times (*SD*) for the three emotion conditions in Experiment 2*

	Emotion condition		
	Hope	Anger	Emotion-neutral
Hope	40.11* (3.83)	35.33 (7.97)	32.67 (7.77)
Anger	16.33 (6.58)	31.11* (11.72)	11.94 (2.55)
Hedonic Tone	6.94* (2.10)	4.06 (2.28)	5.94* (1.43)
Arousal	7.56* (1.24)	7.94* (1.58)	3.61 (2.00)
Mental Effort	8.06* (1.39)	7.78* (1.48)	4.78 (1.77)
Reaction Time	420.70* (104.73)	424.29 (75.34)	448.91 (88.83)

Note. Range of possible scores is: Anger, 0 to 50; Hope, 0 to 45; Hedonic tone, 1 to 9; Arousal, 1 to 9; Mental Effort, 0 to 10

* $p < .05$

Discussion

The purpose of Experiment 2 was to examine the influence of hope and anger on cognitive performance. The findings largely supported our hypothesis. That is, effort and performance were greater in the hope condition compared with the emotion-neutral condition. In the anger condition, although there was a significant increase in effort,

performance was not significantly improved compared to the emotion-neutral condition. This is possibly because the core relational theme of hope (i.e., yearning for better) can be directed to the task at hand. In this way, the hope-associated increase in mental effort was accompanied by an increase in performance, thereby rendering hope the more efficient emotion on this largely cognitive task. Indeed, the action tendency for anger (e.g., lashing out) can less obviously be directed to the cognitive task (cf. Lazarus, 2000a), which is possibly why the anger-associated increase in mental effort was not translated into a significant increase in performance. For anger to be an effective performance-enhancing emotion it appears that the task needs to be closely aligned with anger's action tendency (e.g., lashing out; Lazarus, 2000a). This was demonstrated in Experiment 1 where anger was associated with better performance on a maximal force gross muscular task. We discuss the similarity of the anger and hope reaction times further in the general discussion.

The aim of Experiment 3 was to further our understanding of how individual differences might moderate the emotion-performance relationship and specifically this anger-performance relationship. It has long been established (e.g., Hanin, 1980, 2000) that individuals' performance will be affected by their emotional state. For example, Hanin's individual zones of optimal functioning (IZOF) model states that individuals will perform better when they are within their preferred emotional range. In its simplest form, the model predicts that people are different and that their emotions will affect performance differently. Although this is helpful in an applied context, it bears limited theoretical weight. As Gould and Tuffey (1996) noted, the IZOF model is an individual difference model without any individual difference variables. In Experiment 3, we sought to explore a more theoretically derived individual difference approach to the emotion-performance relationship.

With specific reference to anger in the context of developing the results of Experiment 1, extraversion as an individual difference variable appears an obvious potential moderator candidate. Extraverts are sociable and active person-oriented

people who will more willingly express themselves in front of others (Goldberg, 1992, 1993), and recent research has revealed a facilitative extraversion and emotional expression effect on performance in the cognitive domain (Perbandt, 2007). Further, Cerin (2004) found that individuals higher in extraversion interpreted their anxiety as more facilitative than individuals lower in extraversion. However, there has been limited research examining the role of emotional expression and personality on physical performance. As Experiment 1 confirmed a facilitative performance effect for anger, it follows that extraverts' willingness to express their anger should translate into greater performance benefits. In other words, the performance-related benefits of expressing anger will be greater for extraverts. This is the hypothesis of Experiment 3.

Experiment 3

Method

Participants. Seventy-two physically active undergraduate students (45 men, 27 women; M_{age} = 22.23 yrs; SD = 3.68) participated in the experiment.

Measures

Imagery scripts. The imagery scripts from Experiment 1 were used to elicit the appropriate emotions for the anger and emotion-neutral conditions (i.e., brushing one's teeth).

State-Trait Anger Scale. Participants completed the state section of the STAS (Spielberger et al., 1983). In each condition participants were asked to complete the scale in relation to how they had felt after hearing the emotional induction script immediately before the task. Each of the anger statements was rated on a four-point scale (1 = *not at all,* 4 = *very much so*). The Cronbach alpha coefficient for the state anger subscale was .92.

Visual Analog Scale. The VAS from Experiment 1 was used to measure the degree to which participants felt the dimensions of arousal and hedonic tone (pleasantness) before performing the task.

Extraversion. Participants completed the International Personality Item Pool (IPIP; Goldberg, 1993). The IPIP assesses individuals' Big-Five personality markers: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Intellect/Imagination. The present experiment used the 50-item version consisting of 10 items for each of the Big-Five personality factors. Participants were asked to read each statement and then to rate how well it described them on a five-point scale from 1 (*very inaccurate*) to 5 (*very accurate*). We used only the data from the extraversion scale (e.g., *I am the life of the party*) for analysis. The Cronbach alpha coefficient for the extraversion subscale was .91.

Physical Performance. Participants performed individually the gross muscular peak force task used in Experiment 1.

Procedure

We told participants that the experiment was an examination of emotion and performance and provided instructions on how to complete the task. After providing demographic information and written informed consent, participants completed the IPIP. We then secured the participant to the dynamometer and he/she completed the strength task following the same procedure as in Experiment 1. The emotions were induced as in Experiments 1 and 2. Participants completed the task individually under anger and emotion-neutral conditions on different days at approximately the same time of day. The order of presentation of the emotion conditions was balanced across participants.

Results

Manipulation Check

State-Trait Anger Scale. A paired samples *t*-test on the STAS revealed that anger was significantly greater in the anger condition ($M = 27.57$, $SD = 6.95$) than in the emotion-neutral condition ($M = 11.54$, $SD = 3.74$), $t(71) = 19.11$, $p < .001$, $\eta^2 = .84$.

Visual Analog Scale. We conducted paired samples *t*-tests to examine the dimensions of arousal and pleasantness across the two emotion conditions (anger,

neutral). Arousal in the anger condition ($M = 144.57$, $SD = 29.45$) was significantly greater than in the emotion-neutral condition ($M = 77.94$, $SD = 43.57$), $t(71) = 11.10$, $p < .001$, $\eta^2 = .63$. Pleasantness in the anger condition ($M = 75.83$, $SD = 40.86$) was significantly lower than in the emotion-neutral condition ($M = 114.96$, $SD = 40.31$), $t(71) = 6.43$, $p < .001$, $\eta^2 = .37$.

Performance

A paired samples *t*-test revealed that the mean performance score in the anger condition (377.97, $SD = 135.86$) was significantly greater than in the emotion-neutral condition (301.94, $SD = 111.16$), $t(71) = 8.99$, $p < .001$, $\eta^2 = .53$. This replicates the findings of Experiment 1. In order to examine the extent to which extraversion allows individuals to glean additional anger-induced performance benefits, we created a performance improvement score (i.e., the ratio of anger and neutral performance scores). Extraversion was significantly related to this improvement score, $r = .21$, $p < .05$, thus suggesting that extraversion facilitates anger-induced performance increments.

To further investigate the potential moderating role of extraversion in the anger-performance relationship, we conducted a 2 (emotion: anger; neutral) x 2 (extraversion: high; low) mixed-model ANOVA with repeated measures on the first factor and with a median split on the extraversion data. This confirmed a significant main effect for emotion condition, $F(1, 70) = 82.73$, $p < .001$, $\eta^2 = .54$, such that participants performed better in the anger condition than in the emotion-neutral condition. Of more central interest, the ANOVA revealed a significant interaction between emotion and extraversion, $F(1, 70) = 6.90$, $p < .05$, $\eta^2 = .09$, which confirmed that the performance benefits when angry were significantly greater for extraverts than for introverts. One could argue that performing a median split on the extraversion data is insufficient for classifying individuals as extraverts or introverts. Consequently, we conducted the same analysis using quartile splits on the extraversion data. This yielded the same pattern of results. Specifically, a significant main effect for emotion

condition, $F(1, 36) = 50.69$, $p < .001$, $\eta^2 = .59$, and a significant extraversion x emotion condition interaction, $F(1, 36) = 4.71$, $p < .05$, $\eta^2 = .12$. This interaction is illustrated in Figure 1.

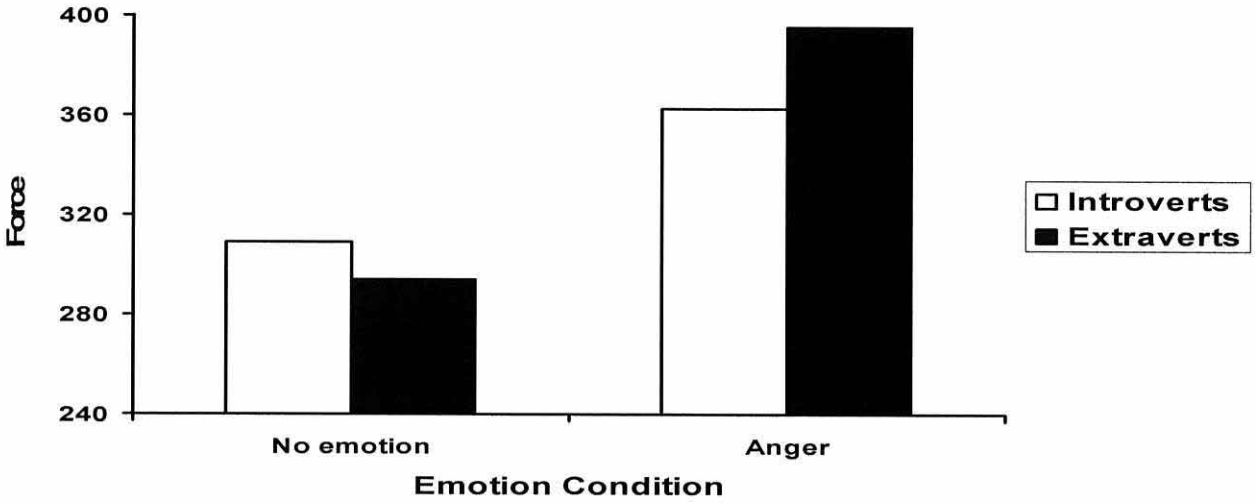

Figure 1. The significant interaction between emotion condition and extraversion on the maximal force task in Experiment 3.

Discussion

The anger findings replicated those of Experiment 1. That is, anger resulted in significantly greater performance on a gross muscular task. Further, in support of our hypothesis, extraverts' performance gains were greater than introverts'. These findings are also consistent with recent research examining the influence of personality and emotional expression on cognitive performance and behavior (e.g., Perbandt, 2007; Smits & De Boeck, 2007; Smulders & Meijer, 2008).

General Discussion

Although the role of emotion in sport performance has been widely recognized (Hanin, 2000; Lazarus, 2000a), only limited research has examined the performance effects of emotions beyond those of anxiety. The aim of the present research was to extend our understanding of the emotion-performance relationship by investigating the effect of specific emotions on physical and cognitive aspects of sport performance.

The findings largely support Lazarus's (2000a) theoretical framework. Specifically, if the emotion experienced is aligned with the task demands then it seems

to facilitate performance. The anger findings are also consistent with applied research on anger in combative and contact sports (e.g., Robazza & Bortoli, 2007; Terry & Slade, 1995). Although hope increased mental effort and reduced reaction time, happiness did not improve performance on a different cognitive task, possibly because it reflects a satiated state where no increase in effort is deemed necessary (also possibly because of task differences, which we address later). As such, in relation to performance, happiness may be most relevant as a post-performance emotion.

The present line of research is clearly in its infancy. Indeed, there is a wealth of research that anxiety researchers have promulgated: the multidimensional nature of anxiety (e.g., Martens, Vealey, & Bump, 1990); different theoretical frameworks including processing efficiency (Eysenck & Calvo, 1992), conscious processing (Masters, 1992), and catastrophe models (Hardy, 1990); the facilitative and debilitative nature of anxiety (Jones, Hanton, & Swain, 1994); the frequency of anxiety-related cognitive intrusions (Hanton, Thomas, & Maynard, 2004); as well as the complex interplay between stress, anxiety, and performance (e.g., Woodman & Hardy, 2001). However, despite promising research findings, there is a relative paucity of theoretically-driven research available on other emotions as they relate to sport performance. Furthermore, with specific reference to the present study, we have only investigated linear effects between emotion and performance. Non-linear relationships is an area that future researchers would do well to address, as there are likely emotion thresholds beyond which the emotion no longer facilitates performance and likely debilitates it, perhaps in a catastrophic manner similar to anxiety (see Hardy, 1990).

Also, as evidenced in Experiment 2, there are likely facets to positive emotions (e.g., hope) that are different to those of negative emotions (e.g., anger) that may allow the performer to persist longer at a task or to persist more efficiently, for example. Specifically, mental effort played a significant role in Experiment 2, in which participants reported the greatest investment of mental effort in the hope condition (albeit not significantly different from effort in the anger condition). Of course, any

associated performance differences across emotions are not likely to be simply categorized by negative and positive emotions, as these are likely intertwined (cf. Levine, 1996). For example, an athlete may hope to win a gold medal while simultaneously fearing that she might have a disaster (cf. Lazarus, 2000a).

Although only hope yielded significantly better performance in comparison to the emotion-neutral condition, the performance difference between the hope and anger emotion conditions was fairly minimal (see Table 2). Also, both hope and anger yielded an increase in effort invested on the task. Thus, it appears that hope and anger may not be that different in their effects on reaction time. This begs the question: would any arousal-inducing emotion have resulted in an increase in effort and, if so, would any associated effort always be beneficial to performance? This seems unlikely. For example, a conscious processing view (e.g., Masters, 1992) would suggest that effort will debilitate performance if such effort is self-directed whereas other control process views (e.g., Eysenck & Calvo, 1992) suggest that effort can serve a regulatory function and help performance. Although these theories have anxiety as their basis, other emotions may be worthy of investigation within similar frameworks.

Extraversion significantly moderated the degree to which participants experienced anger-derived performance benefits. This is promising, as there is a paucity of performance-related research that incorporates athletes' personality. In the present study, we operationalized anger as an intense and unpleasant emotion (Lazarus, 1991; Russell, 1980) and measured it using Spielberger et al.'s (1983) State Anger Inventory. However, there is increasing evidence that anger is a rather more complex emotion (see Russell & Fehr, 1994) including two distinct anger coping styles, most often referred to as anger-in and anger-out (Averill 1983; Smits & Kuppens, 2005; Spielberger, Reheiser, & Sydeman, 1995). The anger-in style refers to the person who experiences anger but keeps the expression of this anger in. The anger-out style refers to the person who experiences anger and expresses it outward. However, in the specific context of the present data, these anger styles may reflect the more fundamental

personality construct of extraversion. The degree to which anger expression style (i.e., anger-in and anger-out) may mediate or moderate the extraversion interaction revealed here seems a worthy avenue for future research on anger-performance and the role of individual differences in that relationship.

Limitations and Future Research

Although the cognitive task used in Experiment 2 had greater ecological validity than that used in Experiment 1, neither have strong ecological validity. Future research employing more ecologically valid tasks might allow us to better understand how emotion affects sport-specific performance. Such research might include testing pre-event naturally occurring emotions and their effects on subsequent subcomponents of performance. This approach would parallel the approach used by Hardy and associates in earlier anxiety research (see, for example, Parfitt et al., 1990).

On the basis of the null findings for happiness in Experiment 1, we suggested that happiness might be better investigated as a post-performance emotion. Indeed, although the happiness manipulation was successful in inducing intense and positive affect, participants' performance did not benefit from such states, which was contrary to our hypotheses and somewhat contrary to previous studies (e.g., Lyubomirsky et al., 2005; Perkins et al., 2001). We initially attempted to explain this finding as happiness reflecting a satisfactory *status quo*; that is, the happy person feels little need to actively change anything (cf. Mackie & Worth, 1989; Melton, 1995). On this basis, we abandoned happiness in favor of hope in Experiment 2. However, a closer look at Experiment 1 suggests that this abandonment may have been rather premature; another possible explanation for the null findings is that the task used was such that the motivation to engage in it was insufficient. This is quite possible for two reasons. First, the reasoning task was likely not of great interest to participants and certainly not of any direct relevance. Past research (e.g., Lyubomirsky et al., 2005) has found that positive affect does lead to success across a plethora of life domains (e.g., marriage, health), which hold considerably more personal meaning to people than a grammatical

reasoning task, for example. In response to this lack of task relevancy, in Experiment 2 we attempted to align the task demands (soccer-related task) with the sample (semi-professional soccer players) and the effect of hope on performance was evident. Future research would do well to investigate similar paradigms with happiness to ascertain the degree to which happiness might affect performance on tasks that hold more personal meaning for the individual. Second, the task may have been insufficiently challenging to motivate participants. For example, Erez and Isen (2002) found that happiness was associated with better performance but that happiness was motivational only when the task had reached a certain degree of difficulty. This suggests that happiness may only affect performance when it matters most: "when the going gets tough." That is, positive affect may provide both sufficient resources and sufficient motivation to pursue a demanding task (Frederickson, 2001). This seems particularly worthy of future research in the context of sport performance.

A final limitation in relation to the happiness experiment is sample size, which again suggests that happiness warrants further research attention. Of course, sample size does not explain the hypothesized findings that were obtained for the other emotions (i.e., hope and anger), which suggests that this was not a major shortcoming of these experiments. Further, the anger results were replicated across the experiments despite potential sample size concerns in Experiment 1.

The experiments reported here offer support for the notion that emotions other than anxiety are worthy of research attention when exploring attempting to understand the emotion-performance relationship. However, there is an important shortcoming here (and in all other research on emotions and performance) that is worth considering in future. That is, we did not control anxiety. In other words, we cannot be certain that the anger-performance relationship revealed here does not simply reflect an anxiety finding and that all negative, arousal-inducing, emotions would yield similar results. Future research would do well to investigate anxiety and anger in conjunction with

each other to ascertain the degree to which these emotions might yield differential, additive, or interactive effects on performance.

In summary, Lazarus's (2000a) theoretical framework appears to be a promising avenue for researchers interested in the effect of emotions on performance. Happiness did not affect performance, which may reflect a self-satisfied state although future research needs to explore more demanding and relevant task performance. Hope facilitates performance on reaction time tasks and anger helps performance of gross muscular tasks. Furthermore, extraverts benefit most from such anger-induced physical performance increases. The results of the present studies suggest that emotions other than anxiety deserve further attention.

CHAPTER 3

The Effect of Anger Expression on Physical Performance[2]

Abstract

We examined the role of anger-related individual differences as potential moderators of the anger-performance relationship. Following Lazarus's (1991, 2000a) cognitive motivational relational theory of emotion, we investigated the influence of trait anger, anger coping styles and physiological reactivity on the performance of a maximal strength task. As hypothesized, trait anger and anger-out were associated with anger-derived performance enhancement. Conversely, anger-in negatively influenced the trait anger-performance relationship. Further, anger was associated with increased physiological arousal as salivary alpha-amylase was greater in the anger condition; however, physiological arousal was not associated with performance enhancement. Results are discussed in consideration of Lazarus's (1991, 2000a) cognitive motivational relational theory and future research directions are offered.

[2] This chapter is currently in preparation as Davis, P.A., Woodman, T., & Callow, N. (in preparation). The effect of anger expression on physical performance.

Introduction

Lazarus's (1991, 2000a) cognitive motivational relational (CMR) theory of emotion offers a useful framework for studying the anger-performance relationship. CMR theory proposes that athletes engage in a process of appraisals aimed at evaluating the risk and reward in particular situations; these appraisals culminate in a core relational theme that summarizes the interaction between the athlete and the environment (Lazarus, 1991, 2000a). The core relational theme forms the basis of each emotion and is associated with an action tendency reflecting the assessment of the situational stimulus in relation to the athlete (Lazarus, 2000a). The core relational theme of anger is, "a demeaning offence against me and mine" (Lazarus, 2000a, p. 242), which links to the associated action tendency, "a powerful impulse to counterattack in order to gain revenge for an affront or repair a wounded self-esteem" (Lazarus, 2000a, p. 243). CMR theory suggests that anger's effect on performance will vary depending on the demands of the task. Specifically, if a task requires a "lashing out" motion, then anger may facilitate performance because anger's action tendency and the task demands are closely aligned. Conversely, if the action tendency and task demands do not align, anger will likely divert resources away from the task and performance will suffer (Lazarus, 2000b).

Moreover, CMR theory offers a theoretical underpinning for research exploring the influence of moderating variables (e.g., individual differences) on the relationship between specific emotions (e.g., anger) and performance. Personality has been found to moderate anger's influence on cognitive performance and verbal aggression (Perbandt, 2007; Smits & De Boeck, 2007; Smulders & Meijer, 2008). Recently, research has begun to investigate influence of individual differences in the anger-performance relationship (e.g., Robazza & Bortoli, 2007; Woodman, Davis, Hardy,

Callow, Glasscock, & Yuill-Proctor, in press). In their study of the impact of anger on rugby performance, Robazza and Bortoli (2007) noted that players experienced a moderate frequency of angry feelings and perceived their symptoms of anger to be facilitative for performance. In a series of studies, Woodman et al. (in press) found evidence to support Lazarus's (2000b) proposed facilitative influence of anger on tasks which require a movement that aligns with anger's action tendency. Moreover, extraversion moderated the anger-performance relationship, such that extraverts experienced greater anger-derived performance enhancement than introverts. The aim of the present study is to expand upon previous research of the anger-performance relationship by investigating the effects of specific anger-related individual differences on physical performance.

A number of individual difference variables specific to anger, and the regulation of anger, have been identified (Spielberger, Jacobs, Russell, & Crane, 1983). In particular, trait anger is an individual difference variable that is proposed to have a role in the experience of anger and may influence performance (Smits, De Boeck & Vansteelandt, 2004; Spielberger et al., 1983). Trait anger reflects an individual's tendency toward experiencing anger, and has been reported to influence the frequency and intensity of anger (Spielberger et al., 1983). Moreover, research has revealed that trait anger is associated with the activation of anger's action tendency, as the increased frequency of angry feelings has been found to promote the action tendency towards verbal acts of aggression (Smits et al., 2004). Consequently, as Lazarus (2000b) proposes that the performance of tasks requiring the execution of a lashing out movement that aligns with anger's action tendency can be enhanced by anger, we expected that higher trait anger would facilitate performance on the strength task in the present study.

Further investigation of individual's attempts to regulate anger has focused on the direction of one's anger; specifically anger-out and anger-in (Averill 1983; Smits & Kuppens, 2005; Spielberger, Reheiser, & Sydeman, 1995). Anger-out refers to the predisposition to convey one's anger outward (toward an external target) and corresponds with the *release* of anger's action tendency (Smits & Kuppens, 2005). Anger-in refers to the predisposition to direct one's anger inward (i.e., "bottle it up") and has been associated with attempts to *suppress* anger's action tendency (Smits & De Boeck, 2007; Smits et al., 2004). Consequently, as the task demands have been found to align with anger's action tendency in previous research, we hypothesized that anger-out would be associated with enhanced performance on the strength task in the present study (e.g., Woodman et al., in press). Conversely, as anger-in has been found to prevent the expression of anger's action tendency (Smits & De Boeck, 2007; Smits et al., 2004) we hypothesized that anger-in would have an inhibiting effect on the anger-derived performance enhancement associated with trait anger. That is, we expected the angry feelings that are associated with trait anger would be suppressed (directed inward) and performance would not be enhanced by anger.

Consistent across numerous theories of emotion (e.g., Russell, 1980; Lazarus, 2000a), anger is characterized by high levels of emotional intensity and arousal (Lazarus, 2000b). Arousal has been the focus of a great deal of research in the performance body of literature in sport psychology and has been measured at physiological, psychological and behavioural levels (Parfitt, Hardy, & Pates, 1995; Perkins, Wilson, & Kerr, 2001; Wrisberg, 1994). Research examining the relationship between arousal and performance suggests that physiological reactivity is particularly influential on the execution of tasks requiring explosive movements of maximal effort

for short durations (Gould, Weinberg, & Jackson, 1980; Perkins et al., 2001; Whelan, Epkins, & Meyers, 1990; Wilkes & Summers, 1984).

Physiological reactivity associated with increased arousal has been forwarded as the mechanism responsible for enhanced performance on strength tasks (Whelan et al., 1990). However, previous research examining heart rate and cortisol has found no evidence of these indices of physiological reactivity mediating the relationship between psychological arousal and performance (McGuigan, Ghiarelli, & Tod, 2005; Perkins et al., 2001).

More recently, catecholamine concentration measured via the secretion of salivary alpha-amylase has been validated as a reliable indicator of sympathetic nervous system activity associated with increased emotional arousal (Granger, Kivlighan, El-Sheikh, Gordis, & Stroud, 2007; Nater, Rohleder, Gaab et al., 2005; Van Stegeren, Wolf, & Kindt, 2008). Research comparing the response profiles of salivary alpha-amylase and salivary cortisol report distinct kinetic patterns (Granger et al., 2007). Specifically, the kinetic response profile of salivary alpha-amylase has been observed to reach its peak response and recover to baseline faster than the response profile of salivary cortisol (Dickerson & Kemeny, 2004). These kinetic patterns are in keeping with the physiological differences of the sympathetic nervous system (measured by salivary alpha-amylase) and the hypothalamic-pituitary-adrenal axis (measured by salivary cortisol; see Granger et al., 2007). Salivary alpha-amylase may offer a more appropriate measure of physiological arousal during strength-oriented tasks of a short duration, as the kinetic profile of salivary alpha amylase is more responsive than the profile of salivary cortisol (Dickerson & Kemeny, 2004). Based on the reactivity response profile of salivary alpha-amylase (Granger et al., 2007), we hypothesized that salivary alpha-amylase concentration would be associated with

anger. Further, we hypothesized that anger-derived performance enhancement on the short-duration strength task would be associated with increased salivary alpha-amylase concentration.

Method

Participants

Sixty-one university students (33 men, 28 women; M_{age} = 20.74 yrs, SD = 1.25) were recruited for the study. Prior to completing the experimental protocol, which received institutional ethics approval, participants provided signed informed consent.

Measures

Imagery scripts. To elicit physiological, cognitive and somatic activation consistent with the appropriate emotional state (i.e., anger and neutral), we used imagery scripts containing vivid detail regarding stimuli, response and meaning propositions (cf. Cumming, Olphin, & Law, 2007; Lang 1977, 1979) adapted from Kavanagh and Hausfeld's (1986) study of mood and performance. Specifically, the emotion script for anger was based on Lazarus's (1991, 2000a) core relational theme (i.e., "a demeaning offence against me and mine" Lazarus, 2000b, p. 234); the emotion-neutral script outlined the process of brushing one's teeth (cf. Kavanagh & Hausfeld, 1986). The delivery of the imagery scripts was standardized by recording the scripts onto an audio Compact Disc that was played back to the participants. The imagery scripts in the present study were used in the experiments reported in the previous chapter, and were presented using the same procedure (cf. Woodman et al., in press).

State-Trait Anger Scale. The State-Trait Anger Scale (STAS; Spielberger et al., 1983) comprises 10 trait items (e.g., *I am hotheaded*) and 10 state items (e.g., *I am furious*); responses are rated on a four-point scale from 1 (*not at all*) to 4 (*very much*

so). The STAS was used to measure individuals' predisposition to anger and to assess the effectiveness of the experimental manipulation. In the present study, the Cronbach alpha coefficient was .87 for the trait anger items and .94 for the state anger items.

Visual Analog Scale. Although our line of research followed Lazarus's (2000a) framework, which conceptualizes emotions as being discrete, we also used a two-dimensional Visual Analog Scale (VAS) to assess the degree to which participants experienced the emotion of anger (and neutral-emotion) before undertaking the experimental task. We asked participants to plot their current emotional state on a grid (two 200 mm axes each anchored by *Not at all* and *Very much so*) that measured the dimensions of arousal and hedonic tone (pleasantness) orthogonally. The aim of this assessment was to further verify that the emotion manipulations had been successful in inducing the appropriate emotions. As an adjunct to the data collected using the STAS, we deemed this method appropriate for collecting additional discriminatory information about the success of our emotion manipulations.

Salivary alpha-amylase. In both emotion conditions, participants provided two saliva samples via a passive drool collection for five minutes (Rohleder, Wolf, Maldonado & Kirschbaum, 2005). The samples were collected twice: before participants completed the task and immediately after they completed the task. Some participants had difficulty secreting a sufficient quantity (i.e., 10 μL; Granger et al., 2007) of saliva required for analysis; an additional 5 minutes were provided for those participants who required it. However, ten participants could not secrete sufficient amounts of saliva to be processed using the passive drool technique. The samples containing sufficient amounts of saliva for analysis were transferred to Eppendorf tubes and stored at -80°C for later analysis.

Salivary alpha-amylase concentrations were determined in duplicate by enzyme immunoassay using a Salimetrics Salivary Alpha-amylase Enzyme Kit (Salimetrics LLC, Pennsylvania, USA). Assay plates were read using an *Opsys* MR Microplate Reader (Dynex technologies, Oxford, UK). The intra-assay variance was 3.2%, which reflected an acceptable level of variation and indicates the salivary alpha-amylase analyses were reliable.

Anger expression. The Self Expression and Control Scale (SECS; Van Elderen, Maes, Komproe, & Van der Kamp, 1997) comprises four subscales that assess participants' anger coping styles: anger-in, which reflects the degree of anger being internalized (e.g., *I'm more angry than I show*); anger-out, which reflects the degree of anger being directed outward (e.g., *I say nasty things*); and two control-anger subscales that assess attempts to control internalized and externalized anger. We used only the anger-in and anger-out subscales in the present study. In the present study, the Cronbach alphas were .86 for anger-in and .86 for anger-out.

Performance. Participants completed a gross muscular peak force task on a Kin Com Muscle Testing adjustable dynamometer (model 125E+ Chattecx corporation) as a measure of performance. Participants executed the task by kicking as fast and as hard as possible for a period of five seconds; the task was performed twice with a ten-seconds recovery between the two trials. Peak force (Nm) was recorded on the isometric extension of the right leg; the mean of the two trials was used in subsequent analyses.

Procedure

We informed participants that the research was an examination of strength and performance under different conditions of emotion before presenting instructions on how to complete the task. After providing written informed consent and demographic

information, participants were seated in order to provide the baseline saliva sample for five minutes (or ten minutes if required). After providing the saliva sample, participants completed the trait section of the STAS, and the SECS. Participants were then secured in the apparatus to restrict their movement and to ensure that only the appropriate muscles were used in the execution of the task. Once participants had confirmed that they were securely seated, they performed one warm-up trial to familiarize themselves with the task. We then presented the corresponding imagery script (i.e., anger or emotion-neutral). As soon as the imagery script was finished, participants indicated how they felt on the VAS. Participants were instructed to perform the kick *as fast and as hard as you can;* at this time participants completed two kicks for a period of five seconds each, with a ten-second recovery in between trials. Upon completion of the task, the state section of the STAS was completed retrospectively in relation to how they had felt following the imagery script and immediately before the task. Participants then provided a second saliva sample for a period of five minutes (or ten minutes if required). To finish, we offered participants the inducement of a more pleasant emotion (e.g., joy) if they experienced residual unpleasant feelings of anger (no participants required this service). The same procedure outlined above was followed for each condition (i.e., anger and emotion-neutral). The order of presentation of the emotion conditions was counterbalanced and randomized across participants. The experimental conditions were administered on two different days at approximately the same time of day. All participants were tested individually.

Results

Manipulation Check

Induction of Emotions. To assess the efficacy of the imagery scripts to induce the appropriate emotions (i.e., anger and neutral), paired samples *t*-tests were conducted to examine the state anger subscale on the STAS, the dimensions of arousal and pleasure on the VAS, and post task salivary alpha-amylase concentration. Means and standard deviations are presented in Table 3.

Table 3

Arousal, pleasure, state anger, heart rate, alpha-amylase, performance mean scores (SD) *for the emotion neutral and the anger conditions*

	Emotion Neutral	Anger
Arousal	103.51 (42.72)	142.77*** (34.06)
Pleasure	117.20 (33.98)	60.36*** (38.28)
State Anger	11.19 (3.24)	27.70*** (7.99)
Heart Rate	89.05 (21.71)	99.53** (33.52)
Alpha-amylase	107.26 (61.75)	118.12 (58.98)
Performance	334.73 (148.91)	414.69*** (210.07)

Note: Range of possible scores is: VAS Arousal, 0 to 200; VAS Pleasure, 0 to 200; State Anger

1 (*not at all)* to 4 (*very much so*).

** $p < .01$; *** $p < .001$.

The analyses revealed that state anger was significantly greater in the anger condition than in the emotion-neutral condition, $t(60) = 15.98$, $p < .001$, $\eta^2 = .81$. Moreover, arousal on the VAS in the anger condition was significantly greater than in

the emotion-neutral condition, $t(60) = 5.93, p < .001, \eta^2 = .37$. Pleasure on the VAS in the anger condition was significantly lower than in the emotion-neutral condition, $t(60) = 8.20, p < .001, \eta^2 = .53$. These tests confirm that the attempt to induce high arousal and low hedonic tone was successful and consistent with anger (Lazarus, 1991; Russell, 1980).

Ten participants were unable to produce sufficient saliva required for testing; the data from the remaining 51 participants were retained for analysis. The difference in the post task alpha-amylase concentration between the two conditions approached conventional significance $t(50) = 1.45, p = .07, \eta^2 = .04$, with participants secreting higher concentrations of alpha-amylase in the anger condition compared with the emotion-neutral condition. These analyses revealed that there was a trend toward participants displaying increased physiological arousal in the anger condition compared with the emotion-neutral condition.

Performance

A paired samples *t*-test revealed that the mean performance score in the anger condition was significantly greater than in the emotion-neutral condition, $t(60) = 4.80, p < .001, \eta^2 = .27$.

In order to test the hypotheses regarding potential moderators, we created a performance improvement score (i.e., the ratio of anger performance and emotion-neutral performance scores) to be used in further analyses. To test the hypothesis that trait anger would be positively associated with enhanced performance we examined the association between trait anger scores and performance improvement scores. Trait anger was significantly related to this improvement score, $r = .29, p < .05$, which suggests that trait anger facilitated anger-induced performance improvement. Additionally, anger-out was significantly related to the improvement score, $r = .36, p <$

.01, supporting the second hypothesis that anger-out would be positively associated with improved performance.

To test the hypothesis that anger-in would attenuate the beneficial effect of trait anger on performance, we conducted a moderated hierarchical regression analysis. In consideration of the potential limitations associated with the use of ratio scores, histograms plotting the studentized residuals and the predicted values were used to assess homoscidasticity. There was no evidence of the assumptions of regression analyses being violated. Trait anger and anger-in accounted for a proportion of the variance in performance improvement scores that approached significance, $R^2 = .09$, $F(2, 58) = 2.83$, $p = .07$. Of more central interest in the context of this hypothesis, the product term (trait anger x anger-in) accounted for a further significant proportion of variance in performance improvement, $R^2_{cha} = .06$, $F(1,57) = 4.00$, $p < .05$, supporting our hypothesis that anger-in would suppress the anger-derived performance enhancement that was associated with trait anger.

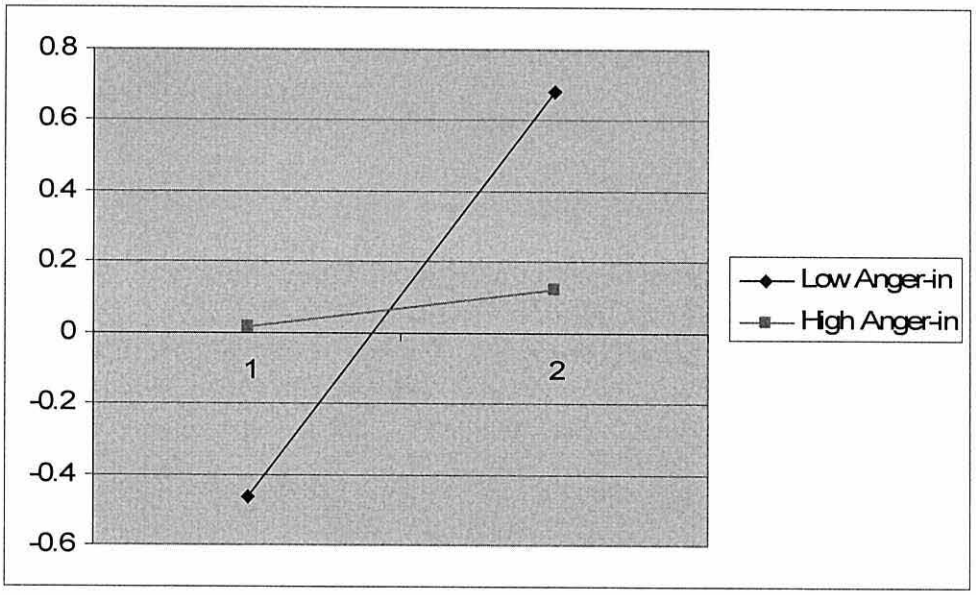

Figure 2. The significant interaction between anger-in and trait anger on the maximal force task.

In order to test the hypothesis that physiological arousal (i.e., salivary alpha-amylase) would be associated with enhanced performance, we created a physiological arousal reactivity score for post-task alpha-amylase concentration (i.e., the ratio of alpha amylase in the anger condition and alpha amylase in the emotion-neutral condition). Contrary to our hypothesis, there was no evidence of a significant association between alpha-amylase reactivity score and the performance improvement score ($r = .07$, $p = .61$).

Discussion

Consistent with previous research (e.g., Woodman et al., in press), anger had a facilitative influence on participants' strength performance. In line with our hypotheses, we found trait anger and anger-out were positively associated with anger-derived performance enhancement. Further, we found evidence to support the hypothesis that the trait anger-performance relationship is attenuated by anger-in. Although salivary alpha-amylase indicated that participants' physiological arousal increased in the anger condition, physiological reactivity was not associated with enhanced performance.

Individual differences in anger regulation were found to have a significant influence on the anger-performance relationship. As hypothesized, trait anger and anger-out were positively associated with anger-derived performance enhancement. This finding lends further support to Lazarus's (2000b) proposed influence of anger on performance; that is, the task demands and the action tendency of anger appeared to align as performance was facilitated by the induction of anger. Moreover, the significant influence of trait anger and anger-out on performance provides additional evidence of the role of anger's action tendency in performance (Smits et al., 2004).

We hypothesized that anger-in would be debilitative for strength performance as anger-in has been associated with the inhibition of anger's action tendency (Smits et al., 2004; Smits & De Boeck, 2007). Anger-in moderated the trait anger-performance relationship such that anger-in diminished the trait anger-derived performance enhancement. This finding highlights the complex, dynamic influence of individual differences on the emotion-performance relationship. Future research may be enhanced by considering the associations between individual differences (e.g., extraversion) that research has previously found to influence the emotion-performance relationship (Woodman et al., in press). Individual differences in the regulation of emotion may be predetermined by higher-order personality traits; for example, attempts to regulate anger via its expression may be guided by related personality variables such as extraversion. Alternatively, individual differences in anger regulation may be meaningfully distinct and reflect unique context specific personality traits.

The role of physiological arousal in the emotion-performance relationship has been the subject of a great deal of research (e.g., Hardy, 1996; Murphy, Woolfolk, & Budney, 1988; Perkins et al., 2001; Wrisberg, 1994). However, attempts to identify arousal's influence on performance have failed to demonstrate a clear link between particular indices of physiological reactivity (e.g., hear rate and cortisol) and enhanced performance (McGuigan et al., 2005; Perkins et al., 2001). In consideration of the nature of the task in the present study (i.e., explosive, short duration) and the reactivity of the response profile of salivary alpha-amylase, we hypothesized that the anger-derived performance enhancement on the strength task would be associated with sympathetic nervous system activity. We found no support for this hypothesis.

Research using salivary alpha-amylase to investigate the relationship between physiological arousal and performance would benefit from exploring the use of

alternative collection methods. The present study used a passive drool collection method, which requires participants to sit with their head bent down at the neck with a universal collection tube between their lips and their mouth ajar for five minutes (we provided an additional five minutes for participants who required it). However, this method of collection resulted in ten participants reporting that they had a dry mouth and could not produce enough saliva. Although ten participants experienced difficulties with the saliva collection, research has demonstrated that arousal induced increase in salivary alpha-amylase is independent of saliva flow rate (Rohleder, Wolf, Maldonado, & Kirschbaum, 2006); subsequently, the validity of the use of salivary alpha-amylase as a measure of physiological arousal was not compromised. Alternative methods of collection such as salivettes or microsponges are slightly more invasive than the passive drool method yet may be more reliable in collecting sufficient amounts of saliva for analyses.

Although salivary alpha-amylase was somewhat successful as a manipulation check of physiological arousal, further research examining its role in the anger-performance relationship is required. The combined use of salivary alpha-amylase and cortisol, would enhance research examining individual differences in arousal reactivity and performance as the measures are indices of different physiological systems (i.e., sympathetic nervous system and hypothalamic-pituitary-adrenal axis) that are both associated with psychological arousal and emotions. Research examining the potential interactive effects of cortisol and alpha-amylase in sport and performance research appear to be well justified and may provide greater insight into the role of physiological reactivity and arousal in performance. Moreover, the use of multidimensional methodologies combining self-report and physiological measures

may provide greater insight into the influence of emotions and individual differences on performance (cf. Woodman & Davis, 2008).

The emotion-performance relationship has been reviewed with frameworks that highlight the influence of individual differences (Robazza, Pellizzari, Bertollo, & Hanin, 2008). In consideration of previous research that has outlined the individualized effects of emotion on performance (e.g., Wilson, Smith, Chattington, Ford, & Marple-Hovart, 2006), we suggest that the facilitative influence of anger on performance may have a threshold. That is, anger may enhance performance to a certain degree at which point further increases of anger may lead to performance decrements of catastrophic proportions (e.g., Hardy, 1996). Further, the threshold in the anger-performance relationship may be moderated by individual differences in anger regulation. For example, trait anger may influence performance in a manner that is similar to trait anxiety (e.g., Wilson et al., 2006) such that individuals who are trait anxious may not be able to regulate increasing amounts of anger to the same degree as those that are low in trait anger. Future research may endeavour to identify the amount/intensity of anger that may be debilitative to performance. Increased understanding of the anger-performance relationship may assist in the development of appropriate individualized strategies aimed at successful anger regulation and maintaining performance.

The ecological validity of the task in the present study may be limited due to the nature of the controlled laboratory setting (e.g., the use of imagery scripts to induce the appropriate emotions). However, the procedure aimed to examine the influence of anger regulation on performance as immediately as possible before the event; this would have been more difficult in a setting with greater ecologically validity (e.g., sport competitions).

In summary, the current study provides support for the investigation of the moderating role of anger-specific individual differences in the emotion-performance relationship. The significant role of trait anger and anger regulation styles (anger-in and anger-out) suggest that the relationship between anger and performance is complex. These findings suggest that further theoretically driven research will help our understanding of the emotion-performance relationship.

CHAPTER 4

An Examination of the Underpinning Mechanisms of Written Emotional Disclosure in Fibromyalgia[3]

Abstract

Written emotional disclosure is an expressive writing treatment programme that has been found to produce health benefits for fibromyalgia patients (Broderick, Junghaenel, & Schwartz, 2005). The aim of the present study was to investigate three theoretical models that have been proposed to explain the mechanisms that underpin the expressive writing treatment programme. Specifically, using a psychophysiological research design, we examined the proposed theoretical models of inhibition, exposure, and cognitive adaptation. Twenty fibromyalgia patients completed three writing sessions, during which they were instructed to write for twenty minutes about a previous trauma they had experienced. Follow-up visits were conducted one-week, four-months and six-months after the final writing trial to assess outcome variables measuring the central features of fibromyalgia (e.g., physical impairment, stiffness and pain). Results revealed that inhibition and exposure were not associated with any health benefits. The theoretical model of cognitive adaptation was found to be associated with improvement on a number of the health outcome variables assessing the central features of fibromyalgia. Theoretical and applied implications are discussed along with recommendations for future research.

[3] This chapter is currently in preparation as Davis, P. A., Callow, N., & Woodman, T. (in preparation). An examination of the underpinning mechanisms of written emotional disclosure in fibromyalgia.. The authors would also like to acknowledge the assistance of Dr. Jeremy Jones and Zac Laraman for their insight on clinical considerations and Dr. Dave Markland for his assistance with linguistic analyses.

Introduction

Fibromyalgia (FM) is a medically unexplained condition with a reported prevalence of 2-3% in the general population (Endresen, 2007; Straud, 2006). The central features of FM are chronic musculoskeletal pain with common co-occurring symptoms of severe physical impairment, stiffness and fatigue (Mease, 2005; Wolfe, Smythe, Yunus et al., 1990). Although the aetiology and underlying pathophysiology of FM cannot be fully explained (Broderick, Junghaenel, & Schwartz, 2005; Smyth & Nazarian, 2006), investigations of FM using a psychology-based framework propose that the condition is a type of somatization, wherein restricted emotional processing of painful emotions are manifest in somatic symptoms (Brosschot & Aarsse, 2001). Indeed, van Middendorp, Lumley, Jacobs, van Doornen, Bijlsma, and Geenen (2008) have shown that the restriction of specific emotions (e.g., anger and fear) can increase the prevalence and exacerbation of FM symptoms (e.g., pain and fatigue).

Restricted emotional processing has been associated with alexithymia (Lumley, 2004), which is defined as a difficulty in identifying and describing feelings that result in deficient cognitive processing and regulation of emotions (Paez, Velasco, & Gonzalez, 1999; Taylor, 1984). Deficient cognitive and emotional processing impairs emotional regulation and has been identified as a risk factor in the development of clinical disorders including heightened or prolonged psychophysiological arousal and medically unexplained psychosomatic symptoms (e.g., FM; Lumley, 2004; Sayar, Gulec, & Topbas, 2004). Further, alexithymia has been found to be associated with FM patients' reported symptom severity and can influence the efficacy of attempts at treatment (Sayar et al., 2004; van Middendrop et al., 2008).

FM has proven to be a difficult condition to treat effectively with limited success in controlling the chronic pain and emotional difficulties associated with FM (Smyth &

Nazarian, 2006). Pharmacological treatments (e.g., opiates and antidepressants) have produced health benefits in the management of some symptoms including pain and disability (Arnold, Keck, & Welge, 2000; Arnold, Lu, Crofford, Wohlreich, Detke, Iyengar et al., 2004). However, reports of negative side effects, challenges in determining the appropriate dosage, and the potential for interactions with other agents (e.g., over the counter medications) are shortcomings associated with pharmaceutical treatments (O'Malley, Balden, Tomkins, Santoro, Kroenke, & Jackson, 2000; Sammons, 2004). Greater success has been observed with cognitive-behavioural treatments and exercise interventions, which have been found to be moderately effective in managing some aspects of FM (e.g., fatigue and stiffness; Barkhuizen, 2002; Dobkin, Da Costa, Abraham, Drista, Berger, Fitzcharles & Lowensteyn, 2006; Rossy, Buckelew, Dorr et al., 1999).

In particular, a cognitive treatment programme that has shown promising results with FM is written emotional disclosure (Broderick et al., 2005; Gillis, Lumley, Mosley-Williams, Leisen, & Roehrs, 2006; Smyth & Nazarian, 2006). Preliminary research of this writing programme in FM revealed encouraging findings as short-term benefits in health outcome measures (e.g., pain and fatigue) were found with effect sizes comparable to successful pharmaceutical treatments (without the side effects associated with pharmaceuticals; Broderick et al., 2005). However, previous investigations of written emotional disclosure with FM have failed to consider the underpinning mechanisms that influence the efficacy of the expressive writing treatment programme. Consequently, the general aim of the present study was to investigate three theoretical models that have been forwarded to explain the mechanisms that underpin written emotional disclosure and the resulting positive health outcomes. In line with previous research literature examining written emotional

disclosure in FM (e.g., Broderick et al., 2005), the present study had the overarching hypothesis that participants would experience health benefits as a result of completing the writing programme.

Within the research literature that has explored the mechanisms that underpin written emotional disclosure, three theoretical models are most prominent (Frattaroli, 2006; Pennebaker & Chung, 2007; Sloan & Marx, 2004). These theoretical models are: *inhibition* (Pennebaker, 1989; Pennebaker & Beall, 1986); *exposure/emotional processing* (Kloss & Lisman, 2002; Sloan, Marx, & Epstein, 2005); and *cognitive adaptation* (Pennebaker, Mayne, & Francis, 1997; Schwartz & Drotar, 2004; Sloan & Marx, 2004).

The first theory of *inhibition* was developed from initial expressive writing treatment programs, which were guided by the Freudian concept of (dis)inhibition (cf., Pennebaker, 1989; Pennebaker & Beall, 1986). Following the logic that inhibiting thoughts, emotions, or behaviours is associated with unconscious physiological effort, written emotional disclosure provides an outlet to express the inhibited content and reduce internal psychophysiological tension, thus resulting in improved health (Pennebaker & Chung, 2007). Yet, there is no evidence to support the proposal that decreases in *inhibition* mediate the relationship between expressive writing and health improvements (Sloan & Marx, 2004). Further, due to the measurement challenges presented in the attempted examination of individuals' inhibition of thoughts and emotions, little research has focused on this proposed theoretical model (Pennebaker & Chung, 2007).

However, related research on the psychological construct of repression (which is closely linked with *inhibition*) may provide a new approach for measuring individuals' attempts at *inhibition*. Specifically, the operational definition of repression highlights

the discrepancy between self-reported emotional experience and physiological indices of arousal, as a measure of the unconscious physiological effort of inhibiting emotions (Weinberger, 1990). Following this definition, repression (and potentially *inhibition*) can be observed by comparing self-reports of emotional experience with measures of physiological arousal (e.g., cardiovascular reactivity and/or activation of the central nervous system; cf. Woodman & Davis, 2008). Previous research examining *inhibition* in the structured expressive writing programme has not examined the psychophysiological discrepancies that are central to the theoretical model of *inhibition* and the closely related construct of repression. Consequently, the discrepancy between reported emotional experience and physiological arousal was examined with the aim of investigating the mechanism of *inhibition*. From this theoretical position, we hypothesized that a reduction in the discrepancy between self-report emotional experience and physiological indices of arousal (i.e., *inhibition*) over the course of the written emotional disclosure treatment programme would be associated with improved health.

The second theoretical model that has been proposed to underpin written emotional disclosure is the *exposure* hypothesis (Frattarolli, 2006; Sloan et al., 2005). Sloan and Marx (2004) suggested that written emotional disclosure may serve as a less threatening context for participants to engage with traumatic memories that had been previously avoided. Through repeated exposure to the traumatic memories via the expressive writing treatment, participants experience a reduction in emotional arousal that leads to the habituation of psychophysiological responses and beneficial health outcomes (Kloss & Lisman, 2002; Sloan et al., 2005; Smyth, Hockemeyer, & Tulloch, 2008). Previous research investigating written emotional disclosure in FM has not examined participants' psychophysiological responses to the expressive writing

treatment programme. Consequently, the present study examined participants' self-reported emotional experience and their physiological indices of arousal associated with the traumatic memories, with the hypothesis that participants' emotional and physiological arousal would decrease over the course of the written emotional disclosure treatment programme. Further, we expected that this decrease in psychophysiological arousal would correspond with improvement on the health outcome measures that assessed pain, physical impairment, fatigue and stiffness.

Finally, the third theoretical model proposed to explain the mechanisms that underpin written emotional disclosure is *cognitive adaptation* (Sloan & Marx, 2004). Research suggests that translating traumatic memories into language allows an individual to organise, structure and make sense of disturbing events that may not have been previously possible (Pennebaker et al., 1997). It is proposed that this process of gaining insight and cognitively assimilating traumatic memories into existing schemas decreases demands on working memory and reduces uncertainty regarding the trauma (Graybeal, Sexton, & Pennebaker, 2002; Klein & Boals, 2001; Pennebaker et al., 1997; Schwartz & Drotar, 2004).

Moreover, written emotional disclosure can lead participants to re-evaluate their role in the recalled traumatic situation and may result in a greater internalization or externalization of the events that transpired (Brody & Park, 2004; Campbell & Pennebaker, 2003; Pennebaker, Mehl, & Niederhoffer, 2003). In support of this proposal, Campbell and Pennebaker (2003) found that participants who cognitively altered their individual and social perspectives over the course of the written emotional disclosure treatment were more likely to experience health benefits compared with participants who did not alter their perspective. Further, coming to terms with a traumatic event and the associated emotional memories appears to be linked to

thoughts and feelings about oneself in relation to others (Campbell & Pennebaker, 2003; Swann, 1997). Brody and Park (2003) argue that written emotional disclosure provides an opportunity to increase self-awareness and integrate disconnected thoughts and feelings with aspects of identity. Repeated expressive writing can lead participants to make a gradual shift in their perspective, which can increase their self-awareness and acceptance of their emotions, thoughts, and behavioural experiences, thus resulting in increased health (Brody & Park, 2003).

Previous research examining the role of *cognitive adaptation* has typically analysed participants' written texts to assess changes in the use of pronouns and words reflecting insight (e.g., Pennebaker & Francis, 1996). Despite this promising theoretical framework, research within FM has yet to examine the potential relationships between patients' *cognitive adaptation* and health outcomes. Therefore, participants' writing texts were analysed to examine changes in the use of pronouns and words reflecting insight, with the aim of investigating the role of *cognitive adaptation* in written emotional disclosure and FM. We hypothesized that an increase in *cognitive adaptation* would be related to positive health outcomes. More specifically, we expected an increase in participants' use of words reflecting insight into the trauma (over the course of the written emotional disclosure treatment) would be associated with improved health. Additionally, we expected greater internalization of the trauma, as reflected by increased use of personal pronouns relative to the use of pronouns referring to others (over the course of the written emotional disclosure treatment), would be associated with positive health outcomes.

In summary, written emotional disclosure has been found to be associated with a number of psychophysiological health benefits in FM (Broderick et al., 2005). Given that previous research (e.g., Broderick et al., 2005) investigated the efficacy of the

expressive writing treatment on the central features of FM, we examined the influence of written emotional disclosure on the health outcome measures of physical impairment, fatigue, stiffness, and pain. We hypothesized written emotional disclosure would be associated with improvement on the health outcome measures. Further, previous research has not given full consideration to the underpinning mechanisms in the efficacy of the expressive writing treatment in FM. Consequently, the present study investigated three theoretical models that attempt to explain the mechanisms that underpin written emotional disclosure.

Method

Participants

After receiving ethical approval from the local National Health Service Trust Research Ethics Committee, we recruited FM patients through the rheumatology clinic at a local hospital and notices in newspapers. The experiment was advertised as a stress management writing programme. Exclusion criteria were: age younger than 18; major psychiatric disorder; current substance abuse; previous experience with systematic journaling; an inability to read English; cognitive or physical impairment that resulted in participants being unable to write for at least 20 minutes. Of 24 individuals who inquired, one was ineligible (due to not meeting the FM diagnosis criteria); thus, 23 individuals participated in the experiment. Specifically, 23 females and three males participated in the study (M_{age} = 54.09, SD = 13.06), predominantly they were white, married or living with a partner, middle-class, with some post-secondary education and reported the onset of their FM symptoms to have started over 10 years ago (M_{years} = 10.89, SD = 7.93).

Experimental Design

A fully repeated measures experimental design was used in the present study. Participants completed the written emotional disclosure treatment programme by undertaking three expressive writing sessions at one-week intervals. Participants were tested pre-treatment to attain baseline measures, which were to be used in comparison to the post-treatment follow-up tests (i.e., one-week, four-months and six-months).

Previous research investigating written emotional disclosure in FM (e.g., Broderick et al., 2005) found an effect size of 0.49 in pain outcome measures, thus we expected similar results with comparable effect sizes. As we used a repeated measures experimental design, we followed Stevens' (1996) method for calculating sample size. Specifically, we assumed an average correlation of 0.5 between the repeated measures variables; the Cohen (1992) effect size for one–way ANOVA's is divided by the square root of 1 minus 0.5 (i.e., the average correlation), with the product of an effect size of 0.49. Consequently, with four repeated measures (i.e., introductory visit, one week, one month and six month follow-up tests), an alpha of 0.05, an effect size of 0.49, and a power of 0.8, according to Stevens (1996) a sample size of 19 was required.

Written Emotional Disclosure Instructions

The instructions requested participants to write about the same traumatic event at each of the writing sessions. The instructions were designed to test the three theoretical models (i.e., *inhibition, exposure, cognitive adaptation*) and to minimize the variation in psychophysiological arousal that has been recorded when a different traumatic experience is the topic of each of the writing sessions (Sloan et al., 2005). The instructions were based on previous studies of written emotional disclosure with clinical populations (e.g., Smyth, Stone, Hurewitz, & Kaell, 1999)

The following written emotional disclosure instructions were presented to participants:

> We would like you to write for 20 minutes today, and the next two visits, about a traumatic life event that you have experienced. Please write about the same experience at each of the sessions in as much detail as you can. Really get into the exercise and freely express any and all emotions or thoughts that you have about the experience. All your writing will be completely confidential. As you write, do not worry about punctuation or grammar, just really let go and write as much as you can.

Measures

Regional Pain Scale. The Regional Pain Scale (RPS; Wolfe, 2003) is designed to assess the severity of FM symptoms including pain and fatigue. The RPS requests individuals to indicate the severity of their pain on a four-point scale (0 = *none*) to (4 = *severe*) across 38 joint and body areas. The body areas listed are relevant to FM pain, whereas pain in the joints is not associated with FM. Any non-zero response on an item assessing a body area associated with FM is scored as a value of one. An RPS score $\geq$ 8 together with fatigue score of $\geq$ 6 (indicated on a 10 cm visual analogue scale anchored by *Fatigue is no problem* and *Fatigue is a major problem*) constitute sufficient scores for the diagnosis of FM using the survey criteria (Wolfe, 2003; Wolfe & Michaud, 2004). In a recent study by Katz, Wolfe and Michaud (2006), comparing the American College of Rheumatology criteria (using tender point testing) and the survey criteria found the diagnostic methods to be moderately concordant (72-75%) whilst addressing a common pool of symptoms and physical findings. Katz et al. (2006) recommended the use of the survey criteria in treatment studies as it allows researchers to identify individuals who meet the criteria for fibromyalgia at the time of the study as opposed to relying on the American College of Rheumatology criteria, which may represent the individual's condition in the past (e.g., time of diagnosis). Furthermore, the survey method has the advantage over other assessments, as it does

not require physical examination or the possible inducement of pain through the testing of tender points.

Self-report emotion. The Self-Assessment Manikin (SAM; Bradley & Lang, 1994) was used to assess participants' subjective ratings of affect (i.e., valence and arousal) in response to each of the writing sessions. The SAM uses manikin figures on a 9-point scale for the valence dimension, the faces on the SAM figures range from a smiling, happy face (1 = *very pleasant*) to a frowning, unhappy face (9 = *very unpleasant*). On the dimension assessing arousal, the SAM figures range from a figure with a calm face with closed eyes and an inactive body (1 = *very calm*) to an excited figure with eyes wide open and an active body (9 = *very aroused*). Evidence that the SAM valence and arousal dimensions reliably covary with physiological reactions associated with emotional arousal has been demonstrated (Lang, Greenwald, Bradley, & Hamm, 1993).

Salivary alpha-amylase. Salivary alpha-amylase concentration has been identified as a reliable means of assessing activation of the central nervous system and physiological arousal (Granger, Kivlighan, El-Sheikh, Gordis, & Stroud, 2007; van Stegeren, Wolf, & Kindt, 2008;). Participants provided saliva samples via either a passive drool or the use of salivettes (an absorbent cotton-based product held in the mouth); salivettes were offered to participants who had difficulty with the passive drool collection. Participants used the same method of collection (i.e., passive drool or salivette) during each of the saliva collection. The use of both collection methods have been found to be effective without compromising the assay validity (Granger et al., 2007). All of the participants provided saliva samples for a period of five minutes before and after completing the writing sessions and at the introductory and follow-up visits (cf. Rohleder, Wolf, Maldonado, & Kirschbaum, 2006). Samples were stored and

analysed within the laboratory, using a quantitative enzyme kinetic method (cf. van Stegeren et al., 2008) with a commercially available immunoassay (Salimetrics LLC, Pennsylvania).

Toronto Alexithymia Scale. The Toronto Alexithymia (TAS-20; Taylor, Bagby, & Parker, 2003) is a 20-item self-report measure; participants were asked to indicate the extent to which they agreed with the statement (e.g., *I have feelings that I can't quite identify*) on a five-point scale (1 = *strongly disagree*) to (5 = *strongly agree*). The scale reports a total alexithymia score and three factors that outline: difficulty in identifying feelings; difficulty in describing feelings; and externally oriented thought. Cronbach alpha coefficient was .86 in the present study.

Fibromyalgia Impact Questionnaire. The Fibromyalgia Impact Questionnaire (FIQ; Burckhardt, Clark, & Bennett, 1991) is a health assessment questionnaire developed specifically for FM. The FIQ is an adaptation of the Health Assessment Questionnaire and the Arthritis Impact Measurement Scales. The 20 items that comprise the FIQ assess the key features of FM including physical impairment, fatigue and stiffness. Physical impairment is reflected in a composite score of 11 items (e.g., w*ere you able to prepare meals?*); each item was scored on a four-point scale (0 = a*lways*) to (3 = n*ever*). Fatigue was assessed by one item on a 10-point scale (1 = *no tiredness*) to (10 = *very tired).* Stiffness was assessed by one item on a 10-point scale (1 = *no stiffness*) to (10 = *very stiff*). One item in the FIQ assessed FM patients' pain; we did not include this item in our analyses as we used an alternative measure of pain that has been used in previous investigation of written emotional disclosure in FM. The final six items of the FIQ measure aspects of well-being that were not central to the investigation; consequently these items were not included in further analyses. One-week test-retest reliability for physical impairment is 0.95 and validity of the scale has

been found to be comparable with the scales from which it was adapted (Burckhardt et al., 1991). The FIQ Cronbach alpha coefficient of .86 within the present population indicates a high level of internal consistency.

Short Form McGill Pain Questionnaire. The Short Form McGill Pain (SF-MPQ; Melzack, 1987) is a self-report pain questionnaire that has been widely used in clinical populations including FM. The questionnaire consists of 15 descriptors (11 sensory and 4 affective) that are rated on a four-point intensity scale (0 = *none*) to (3 = *severe*) and a visual analogue scale (a 100mm scale anchored by *No pain* and *Worst possible pain*) assessing present pain intensity. The one-week test-retest reliability is 0.70 (Melzack, 1987) and the validity of the scale has been reported across several studies and pain conditions (Dudgeon, Raubertas, & Rosenthal, 1993). The Cronbach alpha coefficient of .87 within the present investigation indicates a high level of internal consistency.

Linguistic Inventory and Word Count. The Linguistic Inquiry and Word Count (LIWC; Pennebaker, Francis, & Booth, 2001) is a computer programme that analyses written texts and quantifies word use. More specifically, the LIWC programme is designed to search written text for words that correspond with an internal dictionary of more than 2,300 words and word stems. Each word is assigned to specific linguistic and psychological categories, and the percentage of total words in each category is reported. For example, the LIWC programme searches written texts and counts the number of words related to the cognitive process of insight (e.g., *because* and *therefore*) and enables researchers to examine changes over the course of multiple writing sessions. The LIWC programme can also be used to track changes in the use of pronouns. In particular, the LIWC programme can be used to examine the use of words

referring to the self (e.g., *I* and *me*) relative to the use of pronouns referring to other people (e.g., *you* and *they*).

Procedure

Individuals who responded to the recruitment notices were posted a patient information sheet that provided detailed information about the experiment. Upon confirmation that the participant understood what was involved in the study, they were scheduled for an introductory visit at the laboratory to determine if they met the inclusion criteria. During the introductory visit, participants provided informed consent, completed the RPS and provided background information to confirm they met the inclusion criteria. Upon confirmation that the patient met the inclusion criteria, participants completed the SAM and were provided with instructions outlining how the saliva sample was to be collected. Participants were then asked to provide a saliva sample for five minutes using a passive drool technique or with a salivette. Following the completion of the saliva sample, participants completed the psychological and physical inventories; specifically, the SF-MPQ, FIQ, and TAS-20.

Upon completion of the inventories, a second saliva sample was collected for a period of five minutes and the SAM was completed again to assess participants' emotional arousal following the writing session. Following the second saliva sample collection, participants were offered the opportunity to ask any questions. The experimenter and the participant then discussed a schedule to complete the writing sessions; times and dates for future visits were confirmed.

The three writing sessions were conducted once a week for three weeks on the same day of the week at the same time of day (within one hour) in an effort to control for any diurnal effects that can influence some of the psychophysiological measures (Granger et al., 2007). Participants attended the same laboratory where the pre-

treatment assessment was completed. Upon arrival at the laboratory, the participant completed the SAM and provided a saliva sample over a period of five minutes, following the same procedure as their introductory visit. Upon completion of collection of the saliva sample, the experimenter outlined the procedure for the writing task and asked the participant to type out their texts on a computer. Participants were offered the alternative to write with a pen and paper provided to them if they felt they were unable to type for the full 20 minutes (14 out of 20 participants preferred to use a pen and paper). Upon the participant confirming he/she was ready to undertake the writing task, the experimenter read aloud the writing instructions for that session. The participant was then left alone with a written copy of the instructions to complete the writing task. Following the 20 minutes allocated for the completion of the writing task, the experimenter informed the participant that the session time had expired and collected the writing text. The participant then completed the SAM and provided another saliva sample for 5 minutes. Upon collection of the saliva sample, participants were informed they had completed the first writing session; they were reminded of their next scheduled appointment and assessed to ensure that they were safe to depart the laboratory. The same procedure was carried out for all three of the writing sessions.

Following the third writing session, at one-week, four-months and six-months, participants attended the laboratory to complete the outcome measures of the experiment. Specifically, participants completed the FIQ and SF-MPQ for comparison with pre-treatment measures. Upon completion of the outcome measures at the six-month follow-up testing session, participants were provided with the opportunity to ask any final questions and were thanked for contributing their time and energy to the investigation. Three months following the completion of the study, participants were

mailed an information sheet outlining the findings of the research project. The institution carrying out the research paid for participants' travel expenses.

Analytic Strategy and Data Analysis

Demographic information and manipulation check. The experimenter collected participants' demographic information (e.g., age and gender) and case histories, via an interview conducted during the introductory visit. Information collected during the interview, attrition rates and participants' alexithymia scores are presented as descriptive data in the results section.

In order to confirm that participants followed the writing instructions, a manipulation check was carried out. Specifically, the experimenter reviewed participants' written texts with the aim of confirming that participants wrote about the same topic during each of the writing sessions. Moreover, the experimenter reviewed the written texts to determine whether the event that the participant had chosen to write about could be considered a traumatic life event; the topics that participants chose to write about are reported in the results section. Additionally, participants' psychophysiological responses to the written emotional disclosure programme were assessed in order to confirm that participants experienced an increase in emotional arousal as a result of completing the expressive writing sessions.

Hypothesis testing. The hypothesis that FM patients would benefit from undertaking the written emotional treatment programme was tested by comparing scores on the health outcome variables (i.e., pain, physical impairment, stiffness and fatigue) at baseline with scores on the follow up assessments (i.e., one-week, four- and six-months). Given the large number of potential measurements, Type 1 error was managed with the use of pre-planned comparisons that were developed from the study's aims and hypotheses.

The hypotheses relating to the theoretical models, were tested by examining changes scores on the health outcome variables (i.e., pain, physical impairment, stiffness and fatigue). The health change scores were calculated by creating ratio scores composed of the value at the time of the follow-up measure and the scores at the introductory visit (e.g., physical impairment at six-month follow-up divided by physical impairment at pre-treatment). These health change scores were used in subsequent analyses examining the three theoretical models that are proposed to explain the mechanisms that underpin written emotional disclosure in FM.

The first hypothesis proposed that a reduction in *inhibition* across the writing sessions would be associated with improved health. In order to examine the *inhibition* hypothesis, ratio scores were calculated to compare changes in self-report emotion relative to changes in physiological arousal across the writing sessions. For example, the first writing session ratio was calculated using the post-task measure of SAM affect/post-task salivary alpha-amylase and was divided by the ratio of the third writing session post-task measure of SAM affect/post-task salivary alpha-amylase to calculate participants' individual *inhibition* scores. *Inhibition* ratio scores were also calculated comparing the change in post-task SAM arousal scores relative to the change in post-task salivary alpha-amylase across writing sessions. The *inhibition* scores were correlated with the health change scores to examine the role of *inhibition* in the efficacy of written emotional disclosure in FM.

The second hypothesis proposed that participants' physiological and psychological arousal to the writing task would decrease over the course of the writing sessions and that this decrease in arousal would be associated with improvements on the health outcome measures. In line with previous research examining the *exposure* hypothesis (cf. Sloan et al., 2005) we pre-planned *t*-test comparisons of participants'

post writing physiological arousal (i.e., alpha-amylase), self-report arousal and affect of the first writing session with the scores after the third writing session. In order to examine the *exposure* hypothesis that improved health would be associated with reduced psychophysiological arousal, we calculated ratio scores of participants' post writing physiological arousal (i.e., alpha-amylase), self-report arousal and affect of the first writing session relative to the corresponding measures of psychophysiological arousal following the third writing session. These ratio scores, reflecting changes in psychophysiological arousal between the first and third writing session, were correlated with the health change scores to examine the *exposure* hypothesis in written emotional disclosure with FM.

Finally, the third hypothesis proposed that an increase in *cognitive adaptation* and internalization of the trauma would be related to positive health outcomes. More specifically, we expected an increase in the use of words reflecting insight about the trauma during the writing sessions would be associated with improved health. Participants' writing texts were analysed using the LIWC programme (Pennebaker et al., 2001), which quantified individuals' use of words reflecting insight into the event they are writing about. Additionally, the LIWC programme was used to analyse changes in the use of pronouns referring to the self, relative to changes in the use of pronouns referring to other people. In order to make this comparison, pronoun change scores were calculated by dividing the third writing session's use of personal pronouns relative to pronouns referring to others by the first writing session's use of personal pronouns relative to pronouns referring to others. The 'pronoun-use change scores' were correlated with the health change scores to examine the theoretical model of *cognitive adaptation* in written emotional disclosure with FM.

Results

Demographic Data

High levels of alexithymia have been found in FM (Sayer et al., 2004) and research suggests that alexithymia influences patients' reports of symptom severity and the efficacy of attempts at treatment (van Middendorp et al., 2008). In order to confirm that the present sample of participants accurately reflected the general population of FM described in the research literature, participants' levels of alexithymia were assessed. The mean of the alexithymia scores in the present sample ($M = 59.39$, $SD = 12.76$) nearly met the criteria to be considered high (≥ 61; Taylor et al., 2003) and were comparable to previous investigations of alexithymia in FM (e.g., Brosschot & Aarsse, 2001; Sayer et al., 2004). This finding lends further support to confirm that the participants in the present study were a representative sample of the FM population described in the research literature (Sayer et al., 2004).

Attrition

Two participants who completed the pre-assessment/introductory visit did not undertake the writing trials, and consequently did not complete the outcome measures at the follow-up visits. The reason for their lack of attendance could not be established. One participant who had completed two of the writing trials suffered an accident unrelated to FM and was no longer able complete the experiment; no outcome measures were obtained from this participant. Subsequent analyses were conducted on the remaining 20 participants.

Manipulation Checks

Writing topics. In order to confirm that participants followed the writing instructions and wrote about a previous traumatic event, the experimenter reviewed the content of the writing texts. The topics participants chose to write about included:

death of a loved one ($N = 8$); personal health ($N = 5$); physical or mental abuse ($N = 3$); car accident ($N = 2$); divorce ($N = 1$); and miscellaneous trauma ($N = 2$). This review of participants' writing confirmed that participants adhered to the writing instructions and wrote about a traumatic event they had experienced.

Self-report emotional arousal. To assess the degree to which participants' affect scores changed as a consequence of writing about their traumatic experiences over time, we conducted a 2 (time: pre & post) by 3 (writing session: first writing, second writing, third writing) mixed model ANOVAs with fully repeated measures on the first factor (see Table 1 for descriptive statistics). Analyses of the affect dimension of the SAM revealed a significant main effect for time, $F(1, 19) = 42.67$, $p < .001$, $\eta^2 = .69$, such that participants were feeling more negative affect at the end of writing sessions compared with how they felt before the writing sessions. Tukey's follow-up tests revealed that significantly more negative affect was expressed following the first writing session compared with the third writing session. Similarly, analyses of the arousal dimension revealed a significant main effect for time, $F(1,19) = 10.00$, $p = .005$, $\eta^2 = .35$, such that participants were feeling greater arousal at the end of each writing session compared with their reported arousal prior to commencing the writing task. Tukey's follow-up tests revealed that significantly greater arousal was reported following the first writing session compared with the third writing session. Taken together these results indicate that the written emotional disclosure treatment induced an increase in self-report emotional arousal.

Salivary alpha-amylase. In order to confirm that the expressive writing task induced an increase in physiological arousal in response to the recall of the traumatic memories, participants' samples of salivary alpha-amylase were analysed. A 2 (time: pre & post) by 3 (writing session: first writing, second writing, third writing) mixed

model ANOVA with fully repeated measures on the first factor was conducted to assess participants' salivary alpha-amylase concentration (see Table 1 for descriptive statistics). Analyses revealed a significant main effect for time, F (1,13) = 14.00, p = .002, η^2 = .32, such that participants responded with a greater concentration of salivary alpha-amylase at the end of each writing session compared with samples collected prior to commencing the writing task. These results indicate that the written emotional disclosure treatment induced an increase in physiological arousal associated with increased emotional arousal.

Hypothesis Testing

Health benefit. In order to examine the hypothesis that FM patients would benefit from undertaking the written emotional treatment programme the health outcome variables (i.e., pain, physical impairment, stiffness and fatigue) taken at baseline were compared with scores on the follow up assessments (i.e., one-week, four- and six-months). One way repeated measures ANOVAs were conducted for each of the health outcome variables. No significant changes were found on any of the health outcome variables (i.e., pain, physical impairment, stiffness of fatigue; see Table 1 for descriptive statistics). That is, we found no evidence to suggest that FM patients benefited from completing the written emotional disclosure treatment programme.

Inhibition. In order to examine the hypothesis that a reduction in *inhibition* would be associated with beneficial health outcomes, the *inhibition* ratio scores were correlated with the health change scores. No significant associations were found between the *inhibition* ratio scores and any of the health change outcome measures.

Exposure hypothesis. In order to examine the *exposure* hypothesis we first had to investigate participants' psychophysiological reactivity across the writing sessions. Two (time: pre & post) by 3 (writing session: first writing, second writing, third

writing) mixed model ANOVAs with fully repeated measures on the first factor were conducted for affect and arousal scores on the SAM and salivary alpha amylase. Analyses of the affect dimension revealed there was no significant main effect for writing session, F (2,38) = .06, p = .93, η^2 = .01, such that participants did not experience a change in affect across writing sessions. However, we were more interested in participants' change in post-writing affect from the first writing session to the third session, to investigate the difference between these writing sessions a paired samples t-test was conducted. The difference in post-writing affect from the first writing session to the third session approached conventional significance, $t(19) = 1.90$, $p = .09$, $\eta^2 = .09$.

We also investigated participants' change in arousal across the writing sessions; however, there was no significant main effect for writing session, F (2,38) = 2.87, p = .07, η^2 = .13, such that participants did not experience a significant change in arousal across writing sessions. Again, we were more interested in participants' change in post-writing arousal from the first writing session to the third session, to investigate the difference between these writing sessions a paired samples t-test was conducted. The difference between post-writing arousal in the first writing session was significantly lower from the post-writing arousal in the third session, $t(19) = 3.162$, $p < .05$, $\eta^2 = .14$.

We investigated participants' physiological response to the written emotional disclosure treatment by examining participants' salivary alpha-amylase concentrations across the writing sessions. However, there was no significant main effect for writing session, F (2, 26) = 1.74, p = .19, η^2 = .12, such that participants' salivary alpha-amylase concentration did not change significantly across writing sessions. To investigate the difference in post-writing alpha-amylase between the first and third writing sessions, a paired samples t-test was conducted. The difference in post-writing

alpha-amylase in the first writing session compared with the post-writing alpha-amylase in the third session was not significant, $t(17) = 1.58$, $p = .11$, $\eta^2 = .08$.

In order to examine the hypothesis that a reduction in psychophysiological arousal would be associated with beneficial health outcomes, the post-writing self-report affect and arousal ratio scores (i.e., first session post-writing affect and arousal scores/third session post-writing affect and arousal scores) were correlated with the health change outcome measures. No significant associations were found for either self-report affect or arousal and the health change scores on the outcome measures.

Further, we investigated post-writing alpha-amylase ratio scores (i.e., first session post-writing alpha-amylase/third session post-writing alpha-amylase) to see if they were associated with the health change outcome measures. No significant associations were found between the post-writing alpha-amylase ratio scores and the health change scores on the outcome measures. However, it should be noted that only participants' self-report arousal significantly decreased from the first writing session to the third. Self-report affect and physiological reactivity (i.e., alpha-amylase) did not shown signs of habituation or significant decreases across the writing sessions.

Table 4

Physical impairment, Fatigue, Stiffness, Pain sensory, Pain affective, and Pain intensity (SD) *at baseline and follow-up assessments*

	Assessment			
	Introductory	One-week	Four-month	Six-month
Physical impairment	5.38 (2.17)	5.23 (3.83)	5.17 (2.34)	4.76 (2.39)
Fatigue	8.69 (1.52)	7.95 (2.14)	8.25 (2.02)	8.10 (1.99)
Stiffness	7.96 (1.89)	7.70 (2.00)	8.05 (1.70)	7.85 (1.63)
Pain sensory	16.43 (7.93)	17.95 (8.82)	19.50 (7.29)	17.35 (8.36)
Pain affective	5.04 (3.08)	5.30 (2.96)	4.70 (2.03)	4.85 (2.58)
Pain intensity	70.74 (18.93)	70.10 (13.93)	68.12 (16.32)	69.47 (17.71)

Note. Range of possible scores is: Physical impairment, 0 to 33; Fatigue, 0 to 10; Stiffness, 0 to 10; Pain sensory, 0 to 33; Pain affective, 0 to 12, Pain intensity 0 to 100

Cognitive adaptation. We hypothesized an increase in *cognitive adaptation* would be associated with positive health outcomes; more specifically, we expected an increase in the use of words reflecting insight about the trauma during the writing sessions would be associated with improved health. Participants' writing texts were analysed using the LIWC programme (Pennebaker et al., 2001) to quantify individuals' use of words reflecting insight into the event they are writing about. Participants' increasing use of words reflecting insight were positively associated with improved health outcomes related to stiffness scores on the FIQ at the four month follow-up (r = .460, p = .02) and six-month follow-up (r = .471, p = .01). Additionally, increasing insight was associated with improvement in total pain (r = .379, p = .05) and sensory pain (r = .403, p = .04) on the SF-MGP respectively at the six-month follow-up assessment. Improvement in pain intensity scores at the four-month follow-up assessment were also associated with increasing use of words reflecting insight (r = .424, p = .03). These findings suggest that an increase in the use of words reflecting insight was associated with improvements on some of the health outcome measures.

We expected greater internalization of the trauma as reflected in an increased use of personal pronouns relative to the use of pronouns referring to other people would be associated with positive health outcomes. The LIWC programme was used to analyse changes in the use of pronouns referring to the self, relative to changes in the use of pronouns referring to other people. Pronoun-use change scores (i.e., first writing session's use of personal pronouns relative to pronouns referring to others/third writing session's use of personal pronouns relative to pronouns referring to others) were correlated with the health outcome change scores to examine whether an increase in internalization of the traumatic memories was associated with beneficial health outcomes. Participants' increasing use of personal pronouns relative to the use of

pronouns referring to others was positively associated with improvement in stiffness scores on the FIQ at the one-week follow-up ($r = .56, p = .01$), four-month follow-up ($r = .78, p < .001$) and six-month follow-up ($r = .79, p < .001$). As well as improvement in total pain at the one-week follow-up ($r = .57, p = .009$) and sensory pain at the one-week follow-up ($r = .71, p = .001$), four-month follow-up ($r = .49, p = .03$) and six-month follow-up ($r = .53, p = .02$) on the SF-MGP. These findings suggest that an increase in the internalization (and *cognitive adaptation*) of the traumatic memories recalled during the written emotional disclosure programme was associated with improvements on the health outcome measures.

Discussion

The aim of the present study was to conduct an in-depth analysis of written emotional disclosure in FM by examining three theoretical models that have been forwarded to explain the mechanisms that underpin the expressive writing treatment programme. Specifically, we investigated the theoretical models of *inhibition, exposure* and *cognitive adaptation*. In line with previous research literature examining written emotional disclosure in FM (e.g., Broderick et al., 2005), the present study had the overarching hypothesis that participants would experience health benefits as a result of completing the writing programme. Further, we hypothesized that a reduction in *inhibition* over the course of the written emotional disclosure programme would be associated with improvement on the health outcome measures. Additionally, we hypothesized that participants' emotional arousal to the writing task would decrease from the first writing session to the final session, and that this reduction in emotional arousal would be associated with improvement on the health outcome measures.

Finally, we hypothesized that an increase in *cognitive adaptation* and greater internalization of the trauma would be associated with improvement on the health outcome measures.

In the examination of the theoretical model of *inhibition,* our hypothesis was not supported, such that we found no association between a reduction in *inhibition* and improvement on the health outcome measures. This result is not entirely surprising, as previous research investigating the role of *inhibition* in the efficacy of written emotional disclosure has failed to provide evidence of its influence in the expressive writing treatment (Pennebaker & Chung, 2007). However, the lack of support for the theoretical model of *inhibition* may be attributed to the methodological challenge of measuring the *inhibition* of thoughts and feelings (Pennebaker & Chung, 2007). This study was exploratory in that we used the operational definition of the closely related concept of repression to measure FM patients' attempts at *inhibition* during the expressive writing programme. Specifically, we examined the discrepancy between participants' reported emotional arousal and physiological indices of arousal (i.e., salivary alpha-amylase) during the writing sessions with the aim of studying the theoretical model of *inhibition.* In the present study, we found no evidence to support the extension of the operational definition of repression to the investigation of *inhibition.* Future research investigating *inhibition* could explore alternative indices of physiological arousal (e.g., cardiovascular reactivity) that are associated with emotional arousal. Moreover, a consensus on the operational definition of *inhibition* would advance research investigating the effects of *inhibition* on health and elucidate its role in written emotional disclosure.

The theoretical model of *exposure* has received support in research investigating the mechanisms that underpin written emotional disclosure (e.g., Sloan et al., 2005).

However, in the present study, the theoretical model of *exposure* was not associated with beneficial health outcomes. Moreover, we observed that participants' negative affect and physiological arousal did not significantly decrease over the course of the written emotional disclosure treatment programme. Consistent with the *exposure* hypothesis, we observed a significant decrease in self-report arousal from the first to the third writing session. However, we may conclude that participants did not report a complete habituation to the expressive writing treatment as they displayed persistent negative affect and physiological arousal in response to the recall of the traumatic memories. It may be worth noting that the self-report and physiological measures of arousal displayed a trend of decreasing emotional arousal, yet the reduction from the first to the third/final writing session was not significant. In consideration of the severity of the psychophysiological symptomatology that is associated with FM, perhaps more writing sessions may be required to extinguish the negative emotional arousal associated with the traumatic memories. Future research may explore the dosage-response relationship of written emotional disclosure in FM, specifically the number (e.g., Cohen, Sander, Slavin, & Lumley, 2008) and length (e.g., Burton & King, 2008) of doses (i.e., expressive writing sessions) that comprise the expressive writing treatment programme.

In the examination of third theoretical model, we found evidence to support our hypothesis that an increase in *cognitive adaptation* would be associated with a reduction in FM symptoms. Specifically, participants' increasing use of words reflecting insight was positively associated with improvement on the outcome measures assessing stiffness and pain at the four- and six-month follow-up assessments. Additionally, participants' increasing internalization of the traumatic memories was positively associated with a decrease in reported stiffness severity at the

one-week, four-month and six-month follow-up assessments. Improvement on measures of total pain at the one-week follow-up and sensory pain at the one-week, four-month and six-month follow-up assessments were also related to increased internalization of the traumatic memories as reflected by an increasing use of pronouns referring to the self, relative to the use of pronouns referring to others.

In light of the findings arising from the present study, we suggest that the underpinning mechanism of *cognitive adaptation* may influence the efficacy of written emotional disclosure in FM. These results are particularly important as they highlight the role of *cognitive adaptation* in the processing of emotional memories. Moreover, *cognitive adaptation* appears to influence the internalization of emotional memories and emotional processing. Previous research examining emotional processing in FM patients has found that restricted emotional processing of negative emotions (e.g., anger and fear) can influence FM symptoms (van Middendorp et al., 2008). Specifically, a reduction of FM symptoms was observed in patients who engaged in emotional expression, while attempts to avoid or suppress negative emotions were associated with increased symptoms of pain in FM (van Middendorp et al., 2008). Written emotional disclosure provides an opportunity for emotional expression and may increase FM patients' self-awareness of thoughts and emotions (Sloan & Marx, 2004).

Alexithymia outlines a deficit in awareness of emotions and is prevalent within FM (Sayar et al., 2004). Moreover, alexithymia is proposed to moderate the effectiveness of written emotional disclosure (Baikie, 2008; O'Connor & Ashley, 2008). Lumley (2004) suggests that alexithymic individuals may not benefit from written emotional disclosure because of the nature of their emotional processing. Further, O'Connor and Ashley (2008) found that individuals low on alexithymia

benefited from written emotional disclosure, while individuals high on alexithymia did not. O'Connor and Ashley (2008) suggested that alexithymia influences how individuals respond to the written emotional disclosure treatment and may direct individuals' choice of words during the expressive writing task. Future research is required to explore how alexithymia may moderate the effects of written emotional disclosure in FM; this may lead to the development of specific strategies aimed at optimizing the outcomes of the writing treatment. For example, alexithymics may benefit from being encouraged to focus their writing on the negative emotional aspects of their traumatic memories in an effort to enhance emotional expression and increase self-awareness (O'Connor & Ashley, 2008).

Future use of written emotional disclosure with FM may be enhanced by the inclusion of specific writing instructions that assist patients' *cognitive adaptation* and emotional processing. Indeed, the instructions in Broderick and colleagues' (2005) investigation of written emotional disclosure in FM directed patients to focus on the factual retelling of the traumatic event along with emotional expression and cognitive reappraisal. Specifically, the instructions in the first two sessions encouraged patients to write about their feelings related to the trauma and to reflect on the event in a comprehensive, integrated way that considered its effect on their beliefs and life view. The instructions in their third/final session suggested that, "patients reflect on any new insights they might have gained from the previous writing sessions and to write about these insights, changes in how they think or felt about the event now, and things they could do differently in the future" (Broderick et al., 2004, p. 328). We posit that these instructions enhanced the efficacy of written emotional disclosure in FM by encouraging greater *cognitive adaptation* and internalization of the trauma over the course of the expressive writing treatment programme.

The instructional set developed by Broderick et al., (2005) was not used in the present study because the aim of the current line of research was to investigate the theoretical models of *cognitive adaptation, exposure* and *inhibition*. Specifically, the instructions requested participants to recall the same traumatic event at each of the writing sessions in order to minimize variations in emotional arousal that could arise if a different traumatic experience was written about at each of the sessions (Sloan et al., 2005). The use of salivary alpha-amylase as a manipulation check of emotional arousal during the expressive writing treatment was successful in the present study, as the pattern of physiological arousal was consistent with previous studies examining the activation of the central nervous system and emotional arousal (van Stegeren et al., 2008; Granger et al., 2007). That is, the concentration of salivary alpha-amylase was found to significantly increase as a result of undertaking the expressive writing task. However, to validate the use of salivary alpha-amylase as a manipulation check of emotional arousal in written emotional disclosure, further testing with a variety of clinical populations is required.

Contrary to previous research that found evidence of the beneficial use of written emotional disclosure in the reduction of FM symptoms (e.g., Broderick et al., 2005); this study found no evidence of the main effects of written emotional disclosure on any of the health outcome measures. However, this result is not entirely surprising as Gillis and colleagues (2006) suggest caution when reporting the benefits of written emotional disclosure in FM. In Gillis and colleagues' (2006) randomized trial of written emotional disclosure in FM, health benefits were found for the expressive writing treatment group in comparison to a control group. However, the significant difference between groups could be attributed to the disclosure group having poorer health than

controls at pre-treatment, and the control group displaying some worsening over the duration of the treatment (Gillis et al., 2006).

Moreover, a recent re-examination of the findings of Broderick and colleague's (2005) study revealed differential efficacy of written emotional disclosure for different subgroups of FM patients (Junghaenel, Schwartz, & Broderick, 2008). Specifically, a subgroup of patients with an "interpersonally distressed" coping style benefited from the expressive writing treatment; conversely, FM patients with "adaptive" and "dysfunctional" coping styles did not experience any health benefits as result of the written emotional disclosure programme (Junghaenel et al., 2008). Indeed, a substantial body of research has outlined the heterogeneity of psychophysiological stress responses in FM patients and identified a number of subgroups on the basis of psychological factors that may influence the efficacy of written emotional disclosure in FM (Giesecke, Williams, Harris, Cupps, Tian, Tian et al., 2003; Livneh, Lott, & Antonak, 2004; Malt, Olafsson, Lund & Ursin, 2002; Thieme & Turk, 2005; Turk, Okifuji, Sinclair, & Starz, 1996). Future research may further explore the moderating role of alternative FM subgroups in the efficacy of written emotional disclosure. For example, subgroups of FM patients categorised on the basis of individual differences in emotional processing (e.g., alexithymia) may be found to have varying responses to the expressive writing treatment programme.

FM patients' views on the mechanisms underlying written emotional disclosure may provide an area for future research examining the efficacy of the treatment programme. A recent qualitative study exploring rheumatoid arthritis patients' perspectives revealed that patients felt the expressive writing treatment programme enhanced their understanding of the traumatic event they were asked to recall, and provided an opportunity to resolve their memories of the event (Bryne-Davis,

Wetherell, Dieppe, Weinman, Byron, Donovan et al., 2006). Interestingly, of the nine participants interviewed in the study, only five felt that they benefited from the disclosure process (Bryne-Davis et al., 2006). Future research may explore FM patients' views about the efficacy of the expressive writing treatment.

Although this study was ambitious in its multi-dimensional, in-depth analysis of the theoretical models that have been proposed to underpin written emotional disclosure, it suffers from some limitations. For example, the small sample size may limit the generalizability of our findings. However, the sample size used in the present study was devised using Cohen's (1992) power calculation and considered the effect sizes reported in previous research of written emotional disclosure in FM (e.g., Broderick et al., 2005). Future research may include sample sizes that are large enough to permit the use of statistical analysis (e.g., moderated hierarchical regression) to investigate the role of moderating variables in the efficacy of written emotional disclosure in FM.

Additionally, the findings in the present study revealed an association between increased *cognitive adaptation* and improved health outcomes up to the 6-month follow-up assessment; however, we are limited in our ability to identify how long the beneficial effects of written emotional disclosure may last. Ideally, we would have included a greater number of time points in our follow-up assessments, which would have allowed us to be more accurate in identifying how long the beneficial health outcomes of written emotional disclosure may last. Indeed, previous research demonstrating the health benefits of written emotional disclosure in FM at four-month follow-up found patients returned to pre-treatment levels at the 10-month follow-up (Broderick et al., 2005). It is worth noting that this return to pre-treatment symptoms of FM is not exclusive to written emotional disclosure; other forms of treatment including

cognitive behavioural therapy and physical exercise have reported a similar lack of sustained benefits (Redondo, Justo, Moraleda, Velayos, Puche, Zubero et al., 2004).

Finally, the present study suffered from the methodological weakness that the individual administrating the treatment was the principal investigator. *Experimenter expectancies* are an inherent weakness that can influence outcomes of the research (Rosenthal, 1976). These expectancies can bias the results arising from the research as the administrator of the treatment may unknowingly behave in a manner that influences the findings in an expected direction. However, as previously outlined, steps were taken to minimize any potential contamination of effects. Specifically, standardized writing instructions were used in the present study, and a checklist outlining the experimental procedure was adhered to during the administration of the treatment programme. Moreover, the experimenter left the room while participants' completed the writing task independently.

Overall, the findings from previous research investigating written emotional disclosure with FM offer some hope to patients and practitioners, particularly as FM has proven resistant to treatment (Smyth & Nazarian, 2006). Moreover, written emotional disclosure offers an additional alternative to the prescription of pharmaceutical treatments and the negative side effects that have been associated with the use of drug therapies (O'Malley, 2000). However, the present study of written emotional disclosure in FM raises some important question regarding the use of this expressive writing treatment programme as we found no main effects of health benefits to provide support for its use. The theoretical model of cognitive adaptation was found to be associated with improvements on the health outcome measures, which suggests that emotional processing and internalization are important aspects of written emotional disclosure. Increased understanding of the theoretical models associated

with written emotional disclosure may lead to further refinement of the mechanisms that underpin the expressive writing treatment programme, resulting in the enhanced efficacy of the intervention and the long-term health benefits for FM patients.

CHAPTER 5

General Discussion

Introduction

This chapter provides a summary and discussion of the findings that arise from the studies within the thesis. To facilitate the organization of the chapter, seven main sections are presented. The first section provides a summary of the thesis and reports the main findings. The second section outlines the central theoretical implications related to the research presented in the thesis. The third section offers a number of applied implications and recommendations to practitioners aiming to enhance health and performance. Section four discusses the strengths and limitations of the research programme. Section five proposes a number of suggestions for future research. In section six, the thesis author provides some personal reflections on the research programme. Finally, a summary and concluding remarks are presented in section seven.

Summary and Main Findings

The aim of this thesis was to examine the role of emotional expression in performance and health. The first chapter provided an introduction to some of the research investigating emotional expression in sport and health. Chapter 2 presented three experimental studies that examined the influence of the emotions happiness, hope and anger on physical and cognitive functioning. Chapter 3 extended the findings of Chapter 2 by examining the moderating effect of individual differences in anger regulation on the anger-performance relationship. Chapter 4 was a six-month intervention-based study that examined a number of theoretical models that have been

proposed to explain the mechanisms that underpin written emotional disclosure in fibromyalgia (FM) and the concomitant treatment effects.

The first series of experiments (Chapter 2) explored the relationships between emotions and subcomponents of performance. Specifically, Experiment 1 revealed that anger was associated with enhanced gross muscular peak force performance but that happiness and anger did not influence grammatical reasoning performance. Following Lazarus's (1991, 2000a) cognitive motivational relational (CMR) theory of emotion, we examined hope rather than happiness in Experiment 2 as hope has been associated with increased effort. We examined the influence of hope and anger on cognitive performance by examining reaction times on a soccer-related task in competitive soccer players. The findings largely supported our hypothesis; that is, effort and performance were greater in the hope condition compared with the emotion-neutral condition. In the anger condition, although there was a significant increase in effort, performance was not significantly improved compared to the emotion-neutral condition. The aim of Experiment 3 was to further our understanding of how individual differences (e.g., extraversion) might moderate the emotion-performance relationship and specifically this anger-performance relationship. The anger findings replicated those of Experiment 1; that is, anger resulted in significantly greater performance on a gross muscular task. Further, in support of our hypothesis, extraverts' performance gains were greater than introverts'.

Chapter 3 further investigated the anger-performance relationship by examining the role of anger-related individual differences as potential moderators of the anger-performance relationship. Specifically, we investigated the influence of trait anger, anger coping styles (i.e., anger-in and anger-out) and physiological reactivity (i.e., salivary alpha-amylase) on the performance of a maximal strength task. As

hypothesized, trait anger and anger-out were associated with anger-derived performance enhancement. Conversely, anger-in negatively influenced the trait anger-performance relationship. Further, anger was associated with increased physiological arousal as salivary alpha-amylase was greater in the anger condition; however, physiological reactivity was not associated with performance enhancement.

The final study of the thesis (Chapter 4) examined written emotional disclosure in FM. We investigated the efficacy of the expressive writing treatment program with a particular focus on three theoretical models that have been proposed to explain the underpinning mechanisms of written emotional disclosure. The theoretical models of inhibition and exposure were found to have no association with the health outcome measures. However, the theoretical model of cognitive adaptation was associated with improved health on a number of the outcome measures assessing the central features of FM (i.e., physical impairment, pain, and stiffness).

Theoretical Implications

The purpose of this section is to outline the main theoretical implications arising from the thesis. A number of areas will be discussed in this section: the effects of happiness, hope and anger on cognitive and physical aspects of performance; the role of individual differences as moderators in the anger-performance relationship; the role of physiological arousal in the emotion-performance relationship; and the influence of three theoretical models that are proposed to explain the mechanisms that underpin written emotional disclosure.

Effects of Happiness, Hope, and Anger on Performance

The findings from Chapter 2 provide evidence to suggest that specific emotions (i.e., happiness, hope and anger) have differential effects on cognitive and physical aspects of performance. Furthermore, the findings largely support Lazarus's (2000a) theoretical framework. Specifically, if the emotion experienced is aligned with the task demands then it seems to facilitate performance. In particular, in Experiment 1 anger was found to facilitate gross muscular peak force performance; however, happiness did not produce any significant differences in performance. One possible theoretical explanation for the lack of happiness findings relates to the core relational theme for happiness, which suggests a satisfaction in current performance that would not influence the resources committed to the task.

Following Lazarus's (2000b) proposed influence of specific emotions' core relational themes and associated action tendencies; we investigated the more goal-oriented positive emotion of hope. We found effort and cognitive performance were greater in the hope condition compared with the emotion-neutral condition. We also examined the influence of anger and found there was a significant increase in effort; however, performance did not significantly improve compared to the emotion-neutral condition. Considering the theoretical implications of this result, the core relational theme of hope (i.e., yearning for better) may have increased the mental effort invested in the task and resulted in performance enhancement. Conversely, the action tendency for anger (e.g., lashing out) was less appropriate for the cognitive task (cf. Lazarus, 2000a), which may account for the anger-associated increase in mental effort not being translated into a significant increase in performance. This result suggests anger is likely an effective performance-enhancing emotion only to the extent that the task aligns with anger's action tendency. The results of Chapter 2 lend further support to Lazarus's

(1991, 2000a) CMR theory of emotion and his proposed influence of anger on performance.

It may be worth noting that Lazarus's (1991, 2000a) CMR theory is one of the many theories that attempt to explain the experience of emotion. Further, other emotion theorists (e.g., Ekman, 1999; Russell, 2003) may argue that the findings from the present research lend equal support to their theoretical proposals of emotions and performance. For example, Russell (2003) may posit that other emotions characterized by high intensity and negative hedonic (e.g., anxiety) would have a similar influence on strength performance as was observed with anger. Although the current study was based on Lazarus's (1991, 2000a) CMR theory, we are not able to able to discount alternative theoretical explanations of the results. Theory-driven research testing competing theories of emotion simultaneously may help to identify the strengths of particular theories in their explanation of the emotion-performance relationship.

Individual Differences as Moderators in the Anger-performance Relationship

We sought to undertake a theoretically driven examination of the influence of individual differences on the emotion-performance relationship. It has been established that individuals' performance will be affected by their emotional state (Hanin, 2000; Jones, 2003). However, previous models such as the IZOF (Hanin, 1980, 2000) bear limited theoretical weight. The findings from Experiment 3 in Chapter 2 suggest that the 'Big five' personality variables (Goldberg, 1992) offer an appropriate avenue for examining the potential moderating effect of individual differences in the emotion-performance relationship. Moreover, the 'Big five' model of personality variables (Goldberg, 1992) offers a theoretically grounded approach to the investigation of emotions in sport that goes beyond the descriptive explanation offered by the IZOF

model (Hanin, 1980, 2000). Future research examining the role of emotional expression in sport will be better served by experimental designs that are theoretically driven.

We also found support for the theoretical conceptualization of anger that outlines two distinct styles of anger regulation, most often referred to as anger-in (i.e., suppression) and anger-out (i.e., expression; Averill 1983; Smits & Kuppens, 2005; Spielberger, Reheiser, & Sydeman, 1995). The anger-specific personality variable of trait anger was also found to influence the emotion-performance relationship in the sport context. Research examining the influence of anger on verbal aggression (e.g., Smits, De Boeck, & Vansteelandt, 2004) suggests that the suppression and expression of anger can also be influenced by the context. In consideration of the findings that arose from Chapter 3, we suggest that future research examining the anger-performance relationship would be enhanced by the use of theoretically established conceptualizations of anger (e.g., Spielberger et al., 1995). Theory driven research, which empirically tests the implications of anger on performance and health, will advance the development of strategies aimed at effective emotion regulation.

Physiological Arousal in the Emotion-performance Relationship

The role of physiological arousal in the emotion-performance relationship has been the subject of a great deal of research (e.g., Hardy, 1996; Murphy, Woolfolk & Budney, 1988; Perkins et al., 2001; Wrisberg, 1994). Multiple methodologies, using a variety of measures have attempted to elucidate the role of physiological reactivity in the relationship between emotional arousal and performance (McGuigan et al., 2005; Perkins et al., 2001). However, limited evidence has been forwarded to demonstrate a clear link between a particular measure of physiological reactivity (e.g., heart rate or

cortisol) and enhanced performance (McGuigan et al., 2005; Perkins et al., 2001). Salivary alpha-amylase may now join the list of physiological indices that have failed to provide evidence of a link between physiological reactivity and emotion-derived performance enhancement. Indeed, this analysis did not support the hypothesis that anger-derived performance enhancement on the strength task would be associated with sympathetic nervous system activity, indicated by increased concentration of salivary alpha-amylase. Although the physiological measure of salivary alpha-amylase was somewhat successful as a manipulation check of physiological arousal, further research examining its role in the anger-performance relationship is required.

Psychophysiological research investigating emotional arousal has validated the analysis of catecholamine concentration measured via the secretion of salivary alpha-amylase as a reliable indicator of sympathetic nervous system activity (Granger, Kivlighan, El-Sheikh, Gordis, & Stroud, 2007; Nater, Rohleder, Gaab et al., 2005; Van Stegeren, Wolf, & Kindt, 2008). Moreover, research comparing the response profiles of salivary alpha-amylase and salivary cortisol report distinct kinetic patterns (Granger et al., 2007). Specifically, the kinetic response profile of salivary alpha-amylase has been observed to reach its peak response and recover to baseline faster than the response profile of salivary cortisol (Dickerson & Kemeny, 2004). These kinetic patterns are in keeping with the physiological differences of the sympathetic nervous system (measured by salivary alpha-amylase) and the hypothalamic-pituitary-adrenal axis (measured by salivary cortisol; Granger et al., 2007). Salivary alpha amylase was somewhat useful as a manipulation check for the induction of anger; however, we cannot suggest that salivary alpha-amylase is more appropriate as a measure of physiological arousal with explosive tasks of short duration than alternative measures of physiological arousal (e.g., heart rate and cortisol).

That said, the use of salivary alpha-amylase as a manipulation check of emotional arousal during the expressive writing treatment was successful in the study presented in Chapter 4. Specifically, the concentration of salivary alpha-amylase was found to significantly increase as a result of undertaking the expressive writing task and was consistent with previous studies examining the activation of the central nervous system and emotional arousal (Granger et al., 2007; van Stegeren et al., 2008).

It may be worth noting that the mixed-method measurement used in the current research programme to assess emotional arousal (i.e., self-report and salivary alpha-amylase) is inherently less likely to yield significant relationships than the use of two measures that share greater similarity in their method of assessment. That is, self-report and salivary alpha-amylase are not as closely related as alternative measures of arousal (e.g., heart rate and blood pressure; Granger et al., 2007). Further, in consideration of the complex and dynamic nature of emotional arousal, the use of more sophisticated statistical analyses (e.g., multilevel modelling) might assist future research to elucidate the mechanisms that underlie the emotion-performance relationship.

Theoretical Models in Written Emotional Disclosure

The aim of the study in Chapter 4 was to conduct an in-depth analysis of written emotional disclosure in FM by examining three theoretical models that have been forwarded to explain the mechanisms that underpin the expressive writing treatment programme. Specifically, we investigated the theoretical models of *inhibition, exposure* and *cognitive adaptation.*

Although previous research has reported that written emotional disclosure is effective in reducing FM symptoms (e.g., Broderick et al., 2005), this study found no such evidence. However, these results are not entirely surprising, as a previous

randomized controlled trial of written emotional disclosure in FM did not find a significant improvement in the treatment group (Gillis et al., 2006). Further, Gillis and colleagues (2006) observed significant differences between a treatment and control group that could be attributed to the disclosure group having poorer health than controls at pre-treatment, and the control group displaying some worsening over the duration of the treatment.

A substantial body of research has outlined the variability of FM symptoms between patients (Harris, Williams, Mclean et al., 2005). Further, research has highlighted the heterogeneity of psychophysiological stress responses in FM and identified a number of patient subgroups on the basis of psychological factors (Giesecke, Williams, Harris, Cupps, Tian, Tian et al., 2003; Livneh, Lott, & Antonak, 2004; Malt, Olafsson, Lund & Ursin, 2002; Thieme & Turk, 2005; Turk, Okifuji, Sinclair, & Starz, 1996). It is very likely that these subgroups of FM patients would experience differential effects in response to the written emotional disclosure treatment program. In support of this proposal, a recent re-examination of the findings of Broderick and colleagues' (2005) data revealed differential efficacy of written emotional disclosure for different subgroups of FM patients (Junghaenel, Schwartz, & Broderick, 2008). Specifically, a subgroup of patients with an "interpersonally distressed" coping style benefited from the expressive writing treatment; conversely, FM patients with "adaptive" and "dysfunctional" coping styles did not experience any health benefits as result of the written emotional disclosure program (Junghaenel et al., 2008).

Increased understanding of the role of moderating variables in the efficacy of written emotional disclosure in FM is required. For example, individual differences in emotional processing (e.g., alexithymia) may be found to have varying responses to the

expressive writing treatment program. Alexithymia has been proposed to moderate the effectiveness of written emotional disclosure (Baikie, 2008) and influence physiological reactivity (e.g., blood pressure) to the expressive writing treatment program (O'Connor & Ashley, 2008). Moreover, research examining emotional processing in FM patients has found that restricted emotional processing of negative emotions (e.g., anger and fear) can influence FM symptoms (van Middendorp et al., 2008). Specifically, a reduction of FM symptoms has been observed in patients who engage in emotional expression, while attempts to avoid or suppress negative emotions have been associated with increased symptoms of pain in FM (van Middendorp et al., 2008). Written emotional disclosure may provide FM patients who are high in alexithymia with an opportunity to express their negative emotions and reduce the likelihood of restricted emotional processing. Specifically, during the expressive writing treatment, participants are instructed to write about their thoughts and emotions in a focused manner that is uncharacteristic of the degree of emotional processing usually found in alexithymics.

Restricted emotional processing is associated with limited awareness of cognitions related to emotions (Taylor, 1984). We suggest that a reduction in restricted emotional processing would likely be associated with increased cognitive adaptation. Therefore, research highlighting the influential role of emotional processing in written emotional disclosure (e.g., O'Connor & Ashley, 2008) may lend support to our finding of the theoretical model of cognitive adaptation being associated with improvement on the health outcome measures.

Conversely, in our examination of the theoretical model of *inhibition,* we found no association between a reduction in inhibition and improvement on the health outcome measures. Previous research investigating the role of inhibition in the efficacy

of written emotional disclosure has similarly failed to provide evidence of its influence in the expressive writing treatment (Pennebaker & Chung, 2007). The investigation of the theoretical model of inhibition is challenged by the difficulty of measuring the inhibition of thoughts and feelings. Consequently, we undertook the examination of the theoretical model of inhibition with an exploratory approach using the operational definition of the closely related concept of repression in an effort to measure FM patients' attempts at inhibition during the expressive writing program. We found no evidence to support the extension of the operational definition of repression to the investigation of inhibition. That is, we found no indication that a reduction in the discrepancy between self-reported emotional arousal and physiological arousal being associated with health benefits resulting from the written emotional disclosure treatment. Further research investigating the theoretical concept of inhibition faces many challenges in attempting to measure the inhibition and internalization of emotions and thoughts. Alternative indices of physiological arousal (e.g., cardiovascular reactivity) associated with emotional arousal may help to elucidate the unconscious physiological effort and psychophysiological tension associated with inhibition.

The theoretical model of *exposure* has received support in research investigating the mechanisms that underpin the benefits of written emotional disclosure (e.g., Sloan et al., 2005). However, in the present study, the theoretical model of exposure was not associated with beneficial health outcomes. Moreover, we observed that participants' negative affect and physiological arousal did not significantly decrease over the course of the written emotional disclosure treatment program. Previous research examining the theoretical model of exposure examined the effects of written emotional disclosure with individuals suffering from Post Traumatic Stress Disorder (e.g., Sloan at al.,

2005); the psychophysiological distress associated with FM may reflect a deeper level of somatic internalization that requires a greater number of writing sessions to realize the potential benefits of the expressive writing treatment. Further to this, individuals are required to present somatic symptoms (e.g., pain and fatigue) for at least six months prior to being diagnosed with FM; this degree of severity and duration of somatization might require a more intensive course of written emotional disclosure treatment in order to realize health benefits.

Written emotional disclosure offers an additional alternative to the prescription of pharmaceutical treatments and the negative side effects that have been associated with the use of drug therapies (O'Malley, 2000). However, the present study of written emotional disclosure in FM raises some important question regarding the appropriateness of the expressive writing treatment program with this particular population. We found no main effects of health benefits to provide support for its use. That said, a number of studies have outlined a variety of moderating variables (e.g., alexithymia) that can influence the efficacy of the program (Fratarolli, 2006). Increased understanding of the theoretical models associated with written emotional disclosure-related health benefits may lead to further refinement of the expressive writing treatment program. The theoretical model of cognitive adaptation was associated with improvements on the health outcome measures, which suggests that emotional processing and internalization are important aspects of written emotional disclosure. Optimizing the influence of the underpinning mechanisms of written emotional disclosure will enhance the efficacy of the intervention and the long-term health benefits for FM patients.

Applied Implications

In review of the thesis as a whole, and in consideration of related research literature, several implications are proposed for applied practitioners aiming to enhance health and performance. First, we found that specific emotions (i.e., happiness, hope and anger) had differential affects on performance depending on the nature of the task. This is particularly important for practitioners who are attempting to assist athletes in creating the appropriate emotional state for a particular context or performance.

Specifically, anger was found to facilitate the execution of strength-oriented tasks of short duration that require a lashing out movement, similar to anger's associated action tendency (Lazarus, 2000b). The anger findings in Chapters 2 and 3 are consistent with applied research on anger in combative and contact sports (e.g., Robazza & Bortoli, 2007; Terry & Slade, 1995). Practitioners may want to be aware of the intensity and frequency of performers' anger in order to optimize the potential facilitative influence of anger on performance. Although the current line of research is unable to identify if the facilitative influence of anger has a threshold, research investigating the influence of anxiety on performance suggests that emotions that are high in intensity and low in hedonic tone can lead to fatigue and withdrawal of effort (Wilson, Smith, Chattington, Ford, & Marple-Hovart, 2006). Moreover, the threshold for anger may be substantially lower depending on the nature of the task. Specifically, performance of fine motor tasks may benefit from small amounts of anger, but may suffer if anger increases to a level that is inappropriate for the execution of delicate motor control. Further, some sports (e.g., power lifting) may be more 'forgiving' of surplus amounts of anger compared with activities (e.g., golf) that are optimally performed with lower levels of arousal.

The emotion of hope appears to be beneficial for performance by increasing the investment of effort devoted to a task, which may result in performance enhancement. However, the lack of significant results in the examination of happiness in Chapter 2 leaves us to suggest that happiness may only affect performance when faced with challenge. That is, the positive affect associated with happiness may bolster motivation to pursue a demanding task (Frederickson, 2001). We would also posit that the emotion of happiness is more likely to be associated with well-being and health (Pennebaker, 1995), which may translate into enhanced performance. Further, greater life satisfaction is often related to lower stress levels (e.g., organizational stress) and greater amounts of social support (e.g., family) (Botterill & Patrick, 2003). In particular, to optimize recovery from training and competition, athletes require a degree of comfort and an absence of stress (e.g., physical, mental and emotional; Kellmann, 2002). Athletes who experience a greater frequency of positive emotions (and fewer negative emotions) are more likely to experience optimal recovery and less likely to suffer from burnout (Botterill & Wilson, 2002).

The overall results of Chapter 2 outline the importance of creating and maintaining an emotional state that is appropriate for the nature of the task and the demands placed on the performer. Specifically, if the emotion performers are experiencing aligns with the task demands, then the emotion seems to facilitate performance.

The results of Experiment 3 in Chapter 2 and the experiment presented in Chapter 3 suggest that the emotion-performance relationship is influenced by individual differences. Specifically, personality and anger regulation variables were found to influence the emotion-performance relationship. Further, individual difference variables that are associated with the outward expression of emotion (i.e., anger-out)

and social interaction (i.e., extraversion) were associated with anger-derived performance enhancement. Practitioners may be better able to assist athletes if they are aware of athletes' personality and preferred anger regulation style. Moreover, practitioners may assist athletes' performance by providing attentional cues that help to direct anger-out at an appropriate target. Individualized performance plans that take into consideration the personality and emotional regulation style of the athlete will enhance performance and increase satisfaction with the approach to training.

We investigated the role of emotional expression in health by examining the influence of written emotional disclosure in FM. Practitioners may question the lack of health benefits to provide support for its use. A number of potential explanations for the non-significant results have been forwarded in Chapter 4 and in other sections of this Chapter. The results of Chapter 4 outlined that the theoretical model of cognitive adaptation was associated with improvements on the health outcome measures, which suggests that emotional processing and internalization are important aspects of written emotional disclosure.

Practitioners using written emotional disclosure with FM (or any population) may enhance the treatment effects by including specific writing instructions that assist patients' cognitive adaptation and emotional processing. Indeed, the instructions in Broderick and colleagues' (2005) investigation of written emotional disclosure in FM directed patients to focus on the factual retelling of the traumatic event along with emotional expression and cognitive reappraisal. Additionally, practitioners could adapt the writing instructions used in the expressive writing treatment to request clients to write about any life event. That is, practitioners may instruct clients to write about life goals (e.g., King, 2001), injury rehabilitation or future positive performance outcomes. It may be suggested that writing about future events may serve as a form of self-talk

that includes aspects of imagery that are initiated when the individual attempts to create a vision of the desired outcome (Lang, 1979).

Further, the severity of the psychophysiological symptomatology that is associated with FM may require more writing sessions to extinguish the negative emotional arousal associated with the traumatic memories. Practitioners may find that increasing the number and length of the expressive writing sessions that comprise the expressive writing treatment program may result in enhanced treatment effects.

Finally, a number of moderating variables (e.g., alexithymia) have been observed to influence the efficacy of the expressive writing treatment program (O'Connor & Ashley, 2008). Increased understanding of how these moderating variables may influence written emotional disclosure in FM may lead to the development of specific strategies aimed at optimizing the outcomes of the writing treatment. For example, alexithymics may benefit from being encouraged to focus their writing on the emotional aspects of their traumatic memories in an effort to enhance emotional expression and increase self-awareness (O'Connor & Ashley, 2008). Further, alexithymics may benefit from specific guidance from a practitioner as they complete the writing programme. That is, the writing treatment may serve as a 'starting point' from which therapeutic counselling sessions can continue to explore the emotional aspects of the internalized trauma. Moreover, using written emotional disclosure in combination other treatments of FM (e.g., physical therapy) may enhance the overall efficacy of the therapies.

Strengths of the Research Programme

The current research programme has several strengths that may be highlighted. The research design incorporated the use of a variety of methodologies (e.g., performance-

oriented experimental studies, clinical treatment-based studies) in an effort to investigate the broad theme of emotional expression in performance and health. Further, the use of a variety of methodologies included qualitative and quantitative research designs, requiring a range of approaches to data collection and analysis. Moreover, the diversity of the methodologies necessitated the use of different analyses (e.g., ANOVA, correlations, regression analyses) to be performed on the data sets.

A strength of the research presented in the thesis was the use of a multi-experiment study. The repeated effects observed in the multiple experiments gives greater confidence in the findings and diminishes the likelihood that the results were spurious. Certainly, the progression of the studies following Lazarus's (1991, 2000a) CMR theory of emotion contributes to the understanding of the emotion-performance relationship in sport, and these results should encourage further exploration of potential moderators of this relationship.

An additional strength of the research programme was that the treatment-based research was developed in consultation with clinicians who work directly with FM patients. The research protocol was also reviewed by the National Health Service Research Ethics Committee prior to the research being carried out. This review process enhanced the quality of the research programme and endeavoured to optimize the potential benefits for the clinical population of FM. An additional strength was the longitudinal (i.e., six-month) nature of the clinical treatment-based research programme. The within-subjects research design allowed for the assessment of the long-term effects of the written emotional disclosure programme in FM, and to obtain more accurate measures of the efficacy of the treatment.

Finally, the psychophysiological research methodology used in the present research programme provided greater insight into the experience of emotion. The use

of self-report in conjunction with physiological indices of emotional arousal allowed the exploration of theoretical concepts such as inhibition and exposure. Moreover, the accuracy of manipulation checks used in the experiments was enhanced by the use of a variety of measures assessing the multiple dynamic aspects of emotion.

Limitations of the Research Programme

Although attempts to minimize the limitations of the thesis were made, a number of potential weaknesses are apparent and require discussion. First, the small sample size in Experiment 1 may be of concern to some researchers and may limit the ability to generalize our findings to wider populations. However, the replication of the anger results across the multiple experiments provides further support for the hypothesized findings that were obtained. Further, on the subject of sample size, a greater number of participants in the investigation of written emotional disclosure in FM would have allowed the use of statistical analyses (e.g., regression analyses) enabling the comparison of the theoretical models proposed to explain the mechanisms that underpin the expressive writing treatment. The sample size used in the FM study was calculated using Cohen's (1992) power calculation and considered the effect sizes reported in previous research of written emotional disclosure in FM (e.g., Broderick et al., 2005).

An additional potential weakness concerns the lack of control groups, as previous research of written emotional disclosure has included a usual treatment control group. Although this is a potential limitation in experimental terms, previous research with FM patients has observed a worsening in the control group that may have contributed to the apparent significant effects that were reported (Broderick et al., 2005; Gillis et al., 2007). Moreover, the disease progression associated with FM may confound the

results of randomized control trials, as patients are observed to go through cycles of increased symptom severity (Wolfe, 2003). Further, there is debate over the ethics of using a control group that is denied the opportunity to receive potentially beneficial treatment (Shadish, Cook, & Campbell, 2002). We did not feel that the research design would be sufficiently enhanced by the addition of a control group to warrant the inclusion of a group that did not receive treatment.

The fibromyalgia patients participating in the study reported in this thesis were self-selecting. That is, they contacted the principal investigator to offer their time and participate in the study. It must be noted that a segment of fibromyalgia patients would have been unable to participate in the study of written emotional disclosure due to the severity of their disability. Although this is a drawback of all research that requires participants to attend a laboratory for testing, written emotional disclosure may be adapted for use at home. Future research may explore the efficacy of written emotional disclosure with fibromyalgia patients who complete the treatment from the relative comfort of their own home.

Another limitation relates to the use of salivary alpha-amylase as a manipulation check of anger induction. Previous research using salivary alpha-amylase as a measure of emotional arousal has investigated psychophysiological stress responses resulting from social anxiety (Nater et al., 2005). The extension of salivary alpha-amylase as a measure of emotional arousal associated with anger was somewhat successful. Salivary alpha-amylase was found to be a reliable measure of physiological arousal when used with written emotional disclosure and FM. However, further research is required to validate the use of salivary alpha-amylase as a measure of physiological reactivity related to emotional arousal with clinical populations and athletes.

As noted in Chapter 4, the present research program suffered from the methodological weakness that the individual administrating the treatment and carrying out the testing was the principal investigator which may make experimenter expectancies a potential issue (Rosenthal, 1976). However, as previously outlined, steps were taken to minimize any potential contamination of effects.

Summary of Future Research Directions

The findings from the present thesis offer a number of potential areas for future research. The results arising from Chapter 2 raises the question of the influence of other specific emotions (e.g., pride, sadness) on cognitive and physical aspects of performance. Future research may use Lazarus's (1991, 2000a) CMR theory as a framework for extending the understanding of the emotion-performance relationship to encompass multiple emotions, extending beyond anxiety and anger.

Lazarus (2000b) proposes that specific emotions will facilitate performance if the associated action tendency of the emotion aligns with the task demands. Future research may explore a variety of tasks that may differentially align with the action tendencies associated with a range of specific emotions. Moreover, in an effort to further applied sport psychology research, greater consideration may be invested into constructing environments for testing that offer greater ecological validity. For example, testing the performance of athletes completing sport specific tasks will provide more relevant information for practitioners that are seeking to enhance performance outcomes.

In consideration of the results from Chapter 2, it appears that effort may influence the emotion-performance relationship. Research examining the role of effort in the emotion-performance relationship may benefit from the consideration of the well-

established concept of motivation. Future research investigations of the emotion-performance relationship may consider theories such as social determination theory (Deci & Ryan, 2000) when interpreting the results of research examining the influence of motivation and specific emotions on performance.

The role of motivation in the emotion-performance relationship may also explore individual differences in behavioural approach and inhibition (e.g., Gray, 1980). Moreover, sensitivity to reward and punishment (Corr, 2004) may influence individuals' attempts at emotion regulation and subsequently impact upon performance outcomes. Future research may explore the potential interactions between individual differences in anger regulation (e.g., anger-in and anger-out) and reinforcement sensitivity in relation to sport performance. This avenue of research may be particular relevant to further investigations of emotion regulation in 'high risk' sports (e.g., Woodman, Cazenave, & LeScanff, 2008).

The exploration of research questions surrounding the influence of trait anger on sport performance has not been expired. The long-term implications of high trait anger and frequent expression of anger in sport may be an area to investigate further (Isberg, 2000). The related traits of anger, hostility, and aggression have long been identified as risk factors for coronary heart disease (Smith, Glazer, Ruiz, & Gallo, 2004) and may have an impact upon athletes' health and wellbeing. This may be particularly relevant for athletes that are expected to express high levels of anger and aggression in their role as 'enforcer' on professional ice hockey teams. For example, research has explored potential links between using violence in the sport setting and transferring that aggression outside of the athletic arena (Pappas, Mckenry, & Catlett, 2004). Theory-driven research exploring trait anger may advance understanding of violence and may help to minimize its occurrence within sport.

The current programme of research only focused on the acute implications of happiness, hope and anger on cognitive and physical functioning. Emotions are complex and dynamic (Cabanac, 2002); consequently, research that is designed with the inclusion of a greater number of data points reflecting the influence of emotions over a longer period of time may provide greater insight into the influence of varying degrees of emotion and provide greater ecological validity.

It may also be worth considering the interplay between specific emotions (e.g., hope and fear). For example, in both health and performance environments, the potentially negative effects of fear/anxiety may be moderated by hope such that hope protects/diminishes the negative anxiety-performance/health relationship. Moreover, emotions are frequently experienced simultaneously, as reflected by the common phrase that describes an individual as having 'mixed emotions'. Conflicting theories of emotion (e.g., Ekman, 1999; Russell, 2003) may propose differing approaches to testing the impact of co-occurring emotions and would require innovative methodologies to differentiate the degree to which each emotion is experienced. However, this line of study appears to be warranted within sport and health as emotions seldom occur independently of each other.

The social context that anger is experienced within may also influence the quality (e.g., intensity) of the emotion and performance outcomes. Future research may explore the 'target' or stimulus of the induced anger. That is, anger can be directed at oneself or projected at an external target. This differentiation may also relate to the experience of other emotions simultaneously (e.g., guilt). The target of an individual's anger may be manipulated in future research of the anger-performance relationship to determine if differential effects arise as a result of variations in the focus of the projected anger.

In regards to research examining emotional expression in health, future research may examine FM patients' views on the mechanisms underlying written emotional disclosure. A qualitative study exploring patients' perspectives could reveal whether patients were consciously aware of the mechanisms involved in the expressive writing treatment. Research investigating FM patients' views about the efficacy of the expressive writing treatment may lead to improved application of the written emotional disclosure program in the future.

Moreover, fibromyalgia is characterized by high levels of physical impairment and fatigue. It must be acknowledged that some patients would not be able to write continuously for 20 minutes as the instructions of the written emotional disclosure protocol requested. Reducing the duration of the writing sessions may make the treatment more manageable/accessible for those patients suffering greater disability. Future research may seek to determine the amount of time that is required to be devoted to the writing task in order to experience the beneficial health outcomes; this may lead to the customization of the writing protocol to maximize the treatment effects

Finally, written emotional disclosure appears to be somewhat useful as an independent modality in the treatment of the central features of fibromyalgia. Future research may seek to explore the efficacy of the expressive writing treatment program in combination with alternative therapies. Further, the writing therapy may be adapted to complement exercise treatment programs and seek to enhance the underlying mechanisms of exercise by focusing the topic of the writing sessions accordingly.

Personal concluding remarks

The research programme has provided the candidate with a rich and wide-ranging experience. In particular, the candidate has experienced growth within two main areas

of development whilst completing the research programme, the first is research skills, and the second is self-awareness. The psychophysiological research that has been the focus of the thesis has used qualitative and quantitative methodology to explore the role of emotional expression in performance and health. Increased understanding of physiological arousal and developing the ability to measure physiological reactivity (e.g., salivary alpha-amylase) has enhanced the candidates' appreciation of the experience of emotion. Moreover, by developing the skills required to conduct linguistic analyses using computer software (e.g., LIWC) the candidate has the opportunity to explore numerous lines of enquiry. Developing proficiency with multiple methodologies will no doubt serve the candidate well in future research within emotion and beyond.

Further, the research programme has been very influential in the candidates' professional and personal development. During the course of the research programme the candidate was provided with a great deal of autonomy and support that enhanced his motivation and education. Moreover, the focus of the research was particularly meaningful to the candidate. For example, prior to undertaking the research project investigating written emotional disclosure in FM (Chapter 4), the candidate completed the expressive writing treatment and reported a number benefits as a result. Specifically, completing the expressive writing program enhanced the empathy of the candidate in relation to the participants. Moreover, the written emotional disclosure program prompted the candidate to engage in further autoethnography. This practice of writing has increased the candidate's meta-cognition and emotional awareness.

Finally, the research programme, in conjunction with other activities undertaken by the candidate aimed at personal and professional development (e.g., training in

mindfulness-based stress reduction), has enhanced the candidate's appreciation of the implications of cognitions and emotions upon his own health and the health of others.

Conclusion

In summary, this thesis has examined the role of emotional expression in performance and health. The thesis has contributed to, and extended research examining the emotion-performance relationship and has provided more in-depth analysis of the use of written emotional disclosure in FM. The findings arising from this thesis have revealed a number of future research questions that may stimulate further academic exploration from interested researchers.

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APPENDIX A

Imagery Scripts in Chapters 2 and 3

No Emotion Condition

Sit back and make yourself comfortable, close your eyes, focus all of your attention on my voice. Let yourself sink into the chair and become completely absorbed in the things I am telling you. In a moment, I want you to use your imagination. I want you to think about brushing your teeth, like I asked you to think about earlier.... To picture it so vividly so that it might feel like you are brushing your teeth right now.... To feel the same inside.

Think about the situation now. Imagine it as vividly as you can. Make the picture come alive. See all the details. Picture the surroundings as clearly as possible. See yourself, see your toothbrush. Hear the sounds, experiencing the event exactly as it happens to you.... Thinking the same thoughts....feeling the same feelings....letting yourself react as if you are actually there.

As you imagine that you are brushing your teeth you realize you are feeling incredibly calm. Your mind is clear of any emotions....You are feeling unemotional about anything. As you continue to focus all of your attention on the experience, feel even more unperturbed about surround events....You are feeling completely unemotional....When you are ready and whilst you continue to imagine that you are brushing your teeth, open your eyes and point on the visual analogue scale the degree to which you feel unemotional.

Anger Condition

Sit back and make yourself comfortable, close your eyes, focus all of your attention on my voice. Let yourself sink into the chair and become completely absorbed in the things I am telling you. In a moment, I want you to use your imagination. I want you to think about the angry situation I asked you to think about earlier....To picture it so vividly that you actually feel angry right now.... To feel the same inside.

Think about the situation now, imagine it as vividly as you can. Make the picture come alive, see all the details, picture the surroundings as clearly as possible. See the people, the objects. Hear the sounds, experiencing the event exactly as it was happening to you. Thinking the same thoughts, feeling the same feelings, let yourself react as if you are actually there now. As you imagine the situation, you realize that this wasn't your fault. That someone else has done this to you on purpose. That you are feeling angry....That you want to lash out.... Your muscles tense and blood rushes to your face as you focus all your attention on the experience....Deepen this feeling even more feeling full of rage, feeling incredibly angry... When you are ready, whilst continuing to imagine the situation and holding on to the angry feeling, open your eyes and point on the visual analogue scale the degree to which you are feeling angry.

Happiness Condition

Sit back and make yourself comfortable, close your eyes, focus all of your attention on my voice. Let yourself sink into the chair and become completely absorbed in the things I am telling you. In a moment, I want you to use your imagination. I want you to think about the angry situation I asked you to think about earlier....To picture it so vividly that you actually feel angry right now.... To feel the same inside.
As you imagine the situation, you realise that it is a reward for something you have done. You're feeling happy, light hearted....feeling great. You're smiling as you get really happy as you continue to focus all your attention on the experience. Deepen the feeling even more...warm, smiling, light-hearted...feeling incredibly happy... When you are ready, whilst continuing to imagine the situation and holding on to the angry feeling, open your eyes and point on the visual analogue scale the degree to which you are feeling angry.

Hope Condition

Sit back and make yourself comfortable, close your eyes, focus all of your attention on my voice. Let yourself sink into the chair and become completely absorbed in the things I am telling you. In a moment, I want you to use your imagination. I want you to think about the angry situation I asked you to think about earlier....To picture it so vividly that you actually feel angry right now.... To feel the same inside.
Think about a past event in football when you felt hope... For example, when you hoped you had scored a crucial goal after you connected with the football, or the belief that you could save a goal by heading the ball away... Take a few seconds to recall an experience you have had where you felt hopeful... Now imagine, this experience again, thinking the same thoughts and feeling the same hopeful feeling. Feel the hope that success is possible and this is what you are striving for....Deepen this feeling even more, feeling incredibly hopeful... When you are ready, whilst continuing to imagine the situation and holding on to the angry feeling, open your eyes and point on the visual analogue scale the degree to which you are feeling angry.