

Lincoln University Digital Thesis

Copyright Statement

The digital copy of this thesis is protected by the Copyright Act 1994 (New Zealand).

This thesis may be consulted by you, provided you comply with the provisions of the Act and the following conditions of use:

- you will use the copy only for the purposes of research or private study
- you will recognise the author's right to be identified as the author of the thesis and due acknowledgement will be made to the author where appropriate
- you will obtain the author's permission before publishing any material from the thesis.

Humour Physiology and Motor-skill Performance under Stress

A thesis
submitted in partial fulfilment
of the requirements for the Degree of
Master of Applied Science

at
Lincoln University
by
Steele A. Taylor

Lincoln University
2012

Abstract of a thesis submitted in partial fulfilment of the requirements for the Degree of Masters of Applied Science

**Humour Physiology and
Motor-skill Performance under Stress**

by
Steele A. Taylor

Humour is an important social and emotional activity and research indicates that it has a multitude of positive effects. This has led to considerable research interest in its potential function in relation to the experience of stress. As such, it has been included as a moderator variable within a number of stress-performance relationship studies. Results of these studies vary, and findings appear to be contingent upon both the nature of the humorous manipulation and the performance measure used. A salutary neuroendocrinological arousal profile, associated with mirthful humour, has also been identified. According to toughness theory, positively valenced forms of arousal can contribute to positive cognitive appraisals in putatively stressful situations. In turn, improved appraisals can reduce experienced stress and may, therefore, contribute to improvements in performance. This study was conducted to test the hypothesis that such a pattern of arousal, following a humour induction video, would both increase feelings of energy and reduce tension, and thereby improve performance on a complex motor-skill task – a simulated rock climb. In order to measure changes in energy, tension, and performance between a humour and a non-humour group, three 2 x 2 repeated measures MANOVAs were conducted. Further, in order to measure performance with relation to energy and tension changes, a regression analysis was conducted. Results indicated that the humour induction film was insufficient to improve performance on the climbing task. Based on a review of the literature, and the present findings, it was concluded that humour that is unrelated to stressful activity – as was the case with the humour induction video - is insufficient to enhance motor-skill performance in a stressful setting. Future research examining the stress moderating role of humour should focus on an individual's ability to create humour with situationally relevant content, rather than use it as a passive manipulation, as is most commonly done in research in performance settings.

Keywords: Humour, anxiety, arousal, stress-performance, toughness, attentional focus

Table of Contents

ABSTRACT	ii
LIST OF FIGURES	v
1 INTRODUCTION	1
2 LITERATURE REVIEW	5
2.1 STRESS, AROUSAL AND PERFORMANCE	5
2.1.1 <i>Stress</i>	5
2.1.2 <i>Arousal</i>	9
2.1.3 <i>Performance Theory</i>	11
2.2 TOUGHNESS THEORY – ADAPTATION & PERFORMANCE	14
2.2.1 <i>The Neuroendocrine System and the Stress Response</i>	14
2.3 HUMOUR	23
2.3.1 <i>The Psychological Function of Humour</i>	23
2.3.2 <i>Humour – Experienced Stress and Physiologic Responses</i>	24
2.3.3 <i>Humour and Task Performance</i>	26
3 HYPOTHESES – HUMOUR AND THE TOUGHNESS MODEL	31
4 METHOD	33
4.1 ETHICAL APPROVAL	33
4.2 PARTICIPANTS	33
4.3 INSTRUMENTS	33
4.3.1 <i>Rock climb</i>	33
4.3.2 <i>Questionnaires</i>	36
4.3.3 <i>Film</i>	38
4.4 PROCEDURE	39
5 RESULTS	41

5.1 PARTICIPANT ATTRITION	41
5.2 MANIPULATION CHECK.....	41
5.3 TENSION-ANXIETY AND VIGOUR-ACTIVITY	41
5.4 CLIMBING PERFORMANCE	44
5.5 EFFECTS OF MOOD STATE ON CLIMBING PERFORMANCE	45
6 DISCUSSION	46
6.1 EFFECTS OF THE HUMOUR AND CONTROL FILMS	46
6.2 CHANGES IN MOOD STATE AND PERFORMANCE.....	46
6.3 THEORETICAL IMPLICATIONS	48
6.3.1 Toughness Theory – Appraisals and Arousal.....	48
6.3.2 Humour or Mirth – Psychology or Physiology?.....	49
6.4 METHODOLOGICAL ISSUES.....	50
6.4.1 Measures.....	51
6.4.2 Intensity of the Stimulus.....	51
6.4.3 Humour as a distraction.....	52
6.4.4 Sources of Stress.....	53
6.4.5 Confounding Variables	53
6.4.6 Personality Traits.....	54
6.4.7 Environmental Factors	54
7 CONCLUSION	56
ACKNOWLEDGEMENTS	58
REFERENCES.....	59
APPENDIX A CONSENT FORM GIVEN TO PARTICIPANTS.....	66
APPENDIX B INFORMATION SHEET GIVEN TO PARTICIPANTS	67
APPENDIX C RESEARCH QUESTIONNAIRE	68
APPENDIX D PROFILE OF MOOD STATE BRIEF FORM	69

List of Figures

Figure 2.1 The Inverted-U	12
Figure 2.2. The Cusp Catastrophe Model.....	13
Figure 4.1 Climbing Wall Layout.....	35
Figure 5.1 Tension-Anxiety by Sex by Condition.....	44
Figure 5.2 Vigour-Activity by Sex by Condition.....	45
Figure 5.3. Climbing Performance by Sex by Condition.....	46

1 Introduction

I first went rock climbing at an indoor gym when I was fifteen years old. In a commercially run climbing gym with fixed safety ropes and big padded mattresses I found the heights quite physically and emotionally threatening. After learning some basic skills, I went on my first outdoor climb. Climbing outside on real rock in the mountains was much more terrifying. The rope barely seemed substantial enough to hold me while in the safety of the gym. By contrast, perched above a deafening river on a steep glacially carved granite wall I doubted that the rope would hold me at all if I fell off. I remember climbing left and right in order to find the best holds to move upwards. As I did so, I could feel the fine line grating back and forth against the coarse granite above me. My girlfriend had already gone up and fixed the rope through an anchor at the top of the wall to ensure my safety as a beginner. Yet, I didn't feel safe. I started to dream about horrific outcomes for the thin rope, with me dangling below it. I made it about 20 meters up our chosen route and feeling heavy, and uncomfortable, looked down to see my friends who seemed to be an eternity away. They were laughing and although I could not hear anything I assumed it was about me, which, naturally, served to increase my anxiety. My feelings became so unsettled that my leg started to shake violently up and down as I tried to put weight on my foot in order to stand up on the next tiny edge. Later on, I learned that this scenario is actually so common in rock climbing it is often referred to as 'sewing machine leg' or, more endearingly, 'Elvis leg'. As my leg bounced uncontrollably it added to the feeling that my feet might pop off their small holds at any moment. This would surely send me careening into unknown obstacles below with equally unknown consequences, in my mind certain hospitalisation. The climbing movements which I had practiced indoors were reduced to shaky and imprecise lurches between hand and foot holds. Before reaching the top I gave into my fear and shouted down that I wanted to be lowered off the climb. I nervously clung to the rope as I was brought back to safety. I remember feeling decidedly uncomfortable with the apparent danger, my friends' laughter, and at having given up before reaching the top. I was still alive at least, though my ego had been sorely diminished.

Why did I shake so badly when what I actually wanted was to climb with grace and poise? What causes degradation to performance, particularly when success so crucial in the face of peer judgements or physical danger?

Considerable attention has focused on such questions (Hancock & Szalma, 2008; Matthews, 2000; D. Smith & Bar-Eli, 2007; Staal, 2004). Stress, performance, and coping have been extensively investigated as each is relevant to the military, emergency service providers, sports professionals, and recreationalists. With such a wide-ranging interest in the connections between these concepts an array of theoretical constructs has emerged in order to explain the nuances of performance changes under conditions of stress and anxiety. Of course, many questions are still unanswered, such as the role specific emotions in performance settings. A criticism of psychological research which primarily comes from the positive psychology movement, as well as sports science, is the over-emphasis of negative emotions (Hanin, 2000; Snyder & Lopez, 2002).

Positive emotions such as mirth, from humour appreciation, have continued to grow in popularity as a research topic. Although humour has been studied for benefits on cognitive tests, it has not been studied in motor-skill or sports performance settings. Humour can be derisive, and have negative implications for performance. For example, in the introductory story laughter had been negatively interpreted, increased anxiety, and interrupted performance. Instead, this thesis focuses on what happens when humour is interpreted positively. Understanding the positive attributes of humour is valuable in order to appreciate the role of positive emotions for performance. As Suedfeld (1987, p. 872) points out, “humour is probably one of the most easily available methods for reducing stress and aversive arousal” in extreme and unusual environments.

Two earlier empirical investigations provided the basis for this study. Each investigation involved different aspects of stress and performance and were brought together to provide the foundation of this thesis experiment. The first of these investigated the effects of humour on performance outcomes (Dienstbier, 1995). The performance measure was an academic-style task – a proof-reading test that involved identifying in-text errors under time constraints. A hypothesis derived from toughness theory

(Dienstbier, 1989) proposed that the physiological response from humour should improve situational appraisal and reduce anxiety, thereby improving coping efforts and performance outcomes (Dienstbier, 1995). The term toughness is a reference to psychological adaptation that develops in response to a variety of different stressors with an emphasis on physical stimuli. The study did not find significant changes in performance as a result of humour. Findings indicated improvements regarding appraisals, mood, and energy levels. In addition, shortcomings of the experiment were discussed and were considered in the present experiment.

The other body of work of primary importance for the present experiment involved a series of assessments of performance under anxiety during the execution of a simulated rock climb (Pijpers, Oudejans, & Bakker, 2005; Pijpers, Oudejans, Holsheimer, & Bakker, 2003). According to the conscious processing hypothesis, performance will deteriorate on motor-skill tasks under conditions of anxiety (Masters, 1992). This happens because the performer will attempt to elicit greater conscious control of movements that had, otherwise, become automated. As the result of anxiety, the degree of freedom given to task execution is substantially reduced (Masters, 1992). The consequence of this shift in focus is a rigid and halted series of movements that appear similar to early stages of motor-skill acquisition. With decreased anxiety, a task that is relatively well learned will be more fluid in nature and represent a greater degree of freedom from conscious control than when in a situation of high anxiety (Pijpers et al., 2005; Pijpers et al., 2003). In a repeated measures test participants climbed in both a low and a high anxiety condition. Performance decreased significantly between conditions in accordance with the explanation from the conscious processing hypothesis.

The aim of this project is to examine a prediction derived from toughness theory regarding the anxiety-reducing effects of humour. The hypothesised consequence is that performance should be improved on a motor-skill task. Humour has been found to elicit a salutary neuroendocrine response (Berk, Felten, Tan, Bittman, & Westengard, 2001; Berk, Tan, & Berk, 2008; Berk et al., 1989) producing a positive form of physiological arousal (Tomaka, Blascovich, Kibler, & Ernst, 1997). According to the relationships outlined in the toughness model, strong humorous emotions should positively influence cognitive reappraisals. This may in turn, improve performance on a simulated

rock climb following a humorous manipulation. This change may be explained through reduced anxiety and, hence, reductions in the degree of conscious processing of the task. The outlined relationships may have relevance for physically demanding tasks and cognitive ones (Dienstbier, 1995). Hence, simulated rock climbing provides an alternative level of assessment to the traditional cognitive tests normally conducted in humour studies.

In order to outline the theoretical rationale for the hypotheses a brief review of stress and performance theory is provided. This includes assumptions held within the toughness theory. Toughness theory is covered in detail with a focus on the relationships between cognitive appraisals and arousal. Then, a discussion of humour in terms of its psychological and physiological characteristics follows. Finally, a review of the specific literature regarding humour and task-performance is given and the hypotheses are presented.

2 Literature Review

2.1 Stress, Arousal and Performance

A long history of research has suggested that stress impacts performance (Broadhurst, 1957; Hancock & Szalma, 2008; Hanin, 1989; Hardy & Fazey, 1987; Hull, 1943; Masters, 1992; Spence, 1951; Yerkes & Dodson, 1908), this seems intuitive, but its effects are not always consistent. Stress – and emotions such as fear – can be detrimental to performance. Yet, some people claim to thrive when pressure is high. Consider rock climbing for example. It has been suggested that anxiety from exposure to height significantly reduced performance for novice-climbers (Pijpers et al., 2003). However, Hardy & Hutchinson (2007) found that increasing cognitive and somatic anxiety caused experienced rock climbers to exert higher levels of effort which resulted in commensurately higher performance. In order to understand such contradictions it is important to, first, understand the nature of stress itself.

2.1.1 Stress

Early explanations of stress largely came in two primary forms. These were stimulus based and response based approaches (Lazarus, 1999; Staal, 2004). On one hand, it was understood that some stimulus, agent, or circumstance – such as exposure to extreme temperature or time pressure – was responsible for stress. These stimulus based approaches are often criticised for leaving out emotion and the subjective experience of stress, as such they are criticised for treating people as overly mechanistic (Staal, 2004). Alternatively, stress has been defined as the pattern of responses a person displays in terms of physiology, affect, or behaviour. A prominent example comes from Selye's (1936) work on the General Adaptation Syndrome (GAS). Selye (1936), prior to using the term stress, first described the effects of damaging nonspecific noxious agents as a reference to challenging external circumstances. Later, Selye (1950) would refer to such agents as stress, borrowing the term from physics – as the interplay between force and the resistance offered to it – and adapting it for biological purposes, where he described it as the relationship between damage and defence. He referred to stress in a non-specific way, saying that it is ultimately the cause as well as the result of anything that endangers life unless met with sufficient resistance (Selye, 1950).

A proposed limitations of response based approaches is that they may not provide a complete understanding of stress because they may not necessarily equate to psychological stress (Staal, 2004). Further, Lazarus (1999) argued that response based approaches are tautological. This is because the stressful stimulus is defined by the fact that a stress response occurs. In turn, the stress response is understood to have arisen because of the stressful circumstance that triggered it. The question remains unanswered, what is it about the stressful stimulus that triggers the response (Lazarus, 1999)? To answer this question, and account for the variability in individuals' responses to stress, transactional models have been proposed.

Transactional models outline stress as a dynamic construct. This is achieved by placing emphasis on the person's psychological evaluation of stressful situations (Staal, 2004; Stokes & Kite, 2001).

According to Aldwin (2011), transactional models are still the dominant model of stress held currently in as much as they account for variability of individual appraisals in response to environmental contingencies. Research has both extended and amended components of transactional explanations of stress but the fundamental aspects of the model still serve as the foundation for much research (Folkman & Nathan, 2011).

2.1.1.1 The Transactional Model of Stress

One important and widely cited definition is provided by Lazarus and Folkman (1984). These authors explained that psychological stress "is a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, 1984, p. 21). In this model, psychological stress is not a direct consequence of an environmental entity but instead the cognitive evaluation of it. The model also considers an individual's awareness of their own ability to cope with the stressor. According to Lazarus and Folkman's (1984) definition, experienced stress is a consequence of a 'cold', cognitive process following which arousal and emotion arise. The stressor may be objective but will result in different levels of stress because of the subjective nature of cognitive appraisals (Lazarus & Folkman, 1984).

2.1.1.1.1 Appraisal

Cognitive appraisals play a central role in the transactional model of stress because they define how stress is experienced and dealt with. The appraisal process consists of three components: primary appraisals, secondary appraisal and reappraisals (Lazarus & Folkman, 1984). During initial interactions with the environment a primary appraisal is made with reference to personal well-being. Primary appraisals are either 'irrelevant', 'positive', or 'stressful'. Essentially, a situation or object may be perceived as benign, beneficial, or harmful in some way for the individual (Lazarus & Folkman, 1984).

Stress appraisals are further sub-divided into the orthogonal variables of 'challenge' and 'threat'(Lazarus & Folkman, 1984). Threat involves projections of harm/loss if efforts at coping prove to be ineffective (Lazarus & Folkman, 1984). Emotionally, threat appraisals involve "the anticipation or fear of physical or psychological harm" (Driskell & Salas, 1996, p. 23). By comparison, appraisals of challenge, which contain aspects of threat, are frequently accompanied by positive emotions and perceptions of possible situational mastery.

Situations that are primarily appraised threatening or challenging involve further evaluation. In these cases an individual makes a secondary appraisal which is an evaluation of what might and can be done to deal with the perceived stressor (Lazarus, 1993; Lazarus & Folkman, 1984). Secondary appraisal involves consideration of the coping options a person has in order to deal with the circumstances and reduce their experience of distress.

Following primary appraisal of situational relevance, and the secondary appraisal of coping options, reappraisals are made. Reappraisals do not differ from primary appraisals other than that they are based on new information and follow earlier cognitive evaluations within the same situation (Lazarus & Folkman, 1984).

2.1.1.1.2 Coping

Appraisals are said to determine how a person will cope with the stressor. Two dominant types are outlined, those that are internally focused and those that are aimed at altering the environment.

Emotion-focused coping, used to alter emotional distress, is often the dominant response in cases where a person perceives that nothing can be done to alter the current situation (Lazarus, 1993). This may, for example, involve creating jokes in order to provide an emotional distance thereby reducing experienced stress (Kuiper, Martin, & Olinger, 1993; Lazarus & Folkman, 1984) or expressing emotion and seeking social support (Olf, Langeland, & Gersons, 2005). Conversely, problem-focused coping, which involves instrumental efforts to alter the stressful circumstance directly, is more likely to be used when the situation appears amenable to change (Lazarus, 1993). Problem-focused coping is similar to problem solving. It includes defining the problem, generating possible solutions, and weighting the alternatives (Lazarus & Folkman, 1984). Problem-focused coping involves efforts to attack stressors actively in order to experience some control, as contrasted with attempts at regulating the emotional discomfort that arises (Lazarus & Folkman, 1984; Olf et al., 2005). Problem-focused coping “implies an objective analytic process that is focused primarily on the environment” (Lazarus & Folkman, 1984, p. 153).

The appraisal process, including appraisals of coping options, determines the quality and content of the emotional reaction and the degree of stress that is experienced (Lazarus & Folkman, 1984). The emotional quality that accompanies the appraisal process can be seen as adaptational. Arguably, this is because emotions serve to orientate an individual to the nature of the situation. A strong emotion acts like a primer from which “every fibre of our being is likely to be engaged – our attention and thoughts, our needs and desires, and even our bodies” (Lazarus, 1993, pp. 6-7). Researchers continue to debate the formation and roles of emotion. However, there is strong support for a functionalist, adaptational, perspective of emotions (Cummins, 2005; Izard, 2011; Lench, Flores, & Bench, 2011; Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). Proponents of this view argue that there are discrete categories of emotion and that each serves an adaptational purpose. As such, emotions are responsible for the coherence and interaction of multiple systems – including behaviour, judgement, experience, and physiology – in order to meet the demands of the environment that elicited them (Lench et al., 2011).

2.1.2 Arousal

Arousal is a critical concept for human performance because it refers to the brain and the body's extent of responsiveness and readiness for taking action in stressful situations. Arousal is associated with both positive and negative psychological and physiological states (Jamieson, Mendes, Blackstock, & Schmader, 2010). Mayes' (2000) definition of arousal fits nicely with the transactional view of stress because consideration is given to the individual's unique response to stress, and the ongoing regulation of arousal states by the individual.

In terms of trait, arousal regulation indicates an individual's average degree of excitability or reactivity, that is, the rate of change in CNS [Central Nervous System] activation, in novel or stressful situations. In terms of state, it indicates moment-to-moment changes in states of excitation within and across individuals

(Mayes, 2000, p. 268)

Essentially, arousal refers to the energetic state of the organism in terms of CNS activity that corresponds to a behavioural continuum ranging from sleep to alertness (Razmjou, 1996; Stokes & Kite, 2001). Although arousal contributes to the experience of emotion, it is thought to be void of emotional valence until a cognitive appraisal or attribution is given to the arousing circumstance (Reisenzein, 1983; Schachter & Singer, 1962).

As a consequence of appraisals, increasing arousal innervates specific end-organ activity suited to the specific situation (Olf et al., 2005; Quigley, Barrett, & Weinstein, 2002). For example, fear stemming from projections of serious physical injury or psychological harm is associated with very high arousal levels (Öhman, 2008; Pijpers et al., 2005) that stimulate the body to mobilise resources for effortful coping. Consequently, a trade-off is made within the body's systems between long term investments, such as growth and repair, for more immediate physical action (Fink, 2009), such as running or pulling oneself to safety.

The difficulty for the performer is that behavioural outcomes can differ depending on the affective valence of the arousing situation. When arousal is associated with positive excitement, "individuals become motorically more active, respond more quickly, and may even show more accurate performance and judgement. Conversely, under highly aversive stressful situations, individuals may

actually freeze or become immobile, respond slowly, perseveratively and with decreased accuracy” (Mayes, 2000, p. 270). For this reason, it is important to consider appraisals and emotional valence in performance settings.

Although, the transactional understanding of stress helps to appreciate the differences with which stress is experienced and responded to, its large number of components makes testing the theory in its entirety cumbersome (Mark & Smith, 2008). It has been suggested that operationalising the large number of variables within transactional models often results in methods where individual components are treated statically and as having uni-dimensional effects (Cox, Griffiths, & Rial, 2010). Transactional models are also not very practical in terms of developing specific predictions regarding performance outcomes associated with the experience of acute putative stressors. This is because transactional models are more commonly applied to stressors that are diffuse in nature, such as overall quality of life, or subjective appraisals of health related to illness (for example see Groarke, Curtis, & Kerin, 2011; Rüsçh et al., 2009). Rather, in performance settings, it is said generally, that appraisals will alter subjective distress and objective performance (Staal, 2004). Unsurprisingly, it has been suggested that positive evaluation will tend to yield better performances, and negative evaluations will lead to negative outcomes (Staal, 2004). Like appraisals, predictions regarding performance outcomes in relation to coping style are also non-specific. In a performance context, problem-focused coping is likely to lead to more beneficial response efficiency (Matthews, 2000).

In the present context, the transactional view is useful to understand the varied experience of, and responses to, stress. It also provides the basis for the relationships outlined within the toughness model, which will be discussed below. However, due to the limitations of the transactional approaches in predicting specific outcomes, as well as their complexity, the model does not provide the best theoretical foundation for the hypothesis herein. The next section, therefore, reviews literature that is specific to task performance and presents a model that helps extend transactional explanations in order to allow a precise prediction to be made.

2.1.3 Performance Theory

The earliest performance theories were arousal theories. The Yerkes-Dodson law (Broadhurst, 1957; Yerkes & Dodson, 1908), or inverted-U theory, is likely the most pervasive in the stress-performance literature. The explained relationship, shown in Figure 2.1, is that a person's performance will be at its peak when arousal is at a moderate level and that when arousal is either too low or too high performance will be poor. Criticisms of this explanation are that the symmetrical shape is inaccurate on two accounts. First, research appears to show that once performance passes the top of the curve it does not decline steadily but rather rapidly (Hardy & Parfitt, 1991). Second, once performance has deteriorated, small reductions of arousal do not necessarily improve performance according to the curve (Hardy & Parfitt, 1991)

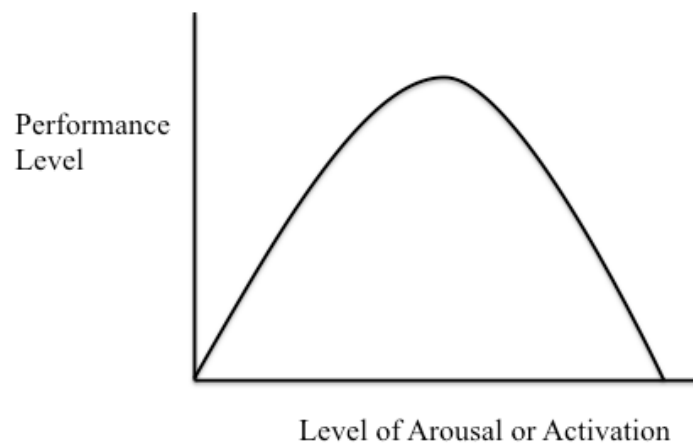


Figure 2.1 shows the inverted-U as adapted from Hebb, 1955.

Also, among the early arousal theories was drive theory (Hull, 1943; Spence, 1951). The relationship between performance and drive – which has frequently been equated with arousal by a number of researchers (Staal, 2004) – is considered to be positive and linear. However, drive theory does not explain performance consistently either. Consider the paradox of ‘choking’ under pressure. In a situation where drive is exceptionally high, such as during an important sports competition, performance may often deteriorate.

Arousal theories have often been criticised for being descriptive only because they neglect to provide an understanding of the mechanism responsible for the proposed outcomes (Landers, 1980). For

example, they do not discriminate between types of energy mobilisation, additionally, the role of emotion or affective valence is inconsequential. “As a result, arousal theories are not able to explain why under some conditions efficient performance is possible even with high levels of activation, whereas debilitating states that degrade performance may also occur at medium or low levels of activation” (Gaillard, 2008, p. 71).

The cusp catastrophe model, shown in Figure 2.2, involves an extension of the inverted-U theory (Hardy & Parfitt, 1991) . It considers the relationship between arousal and performance to take a similar form to the inverted-U. However, the additional consideration of cognitive anxiety changes the predicted outcomes. The cusp catastrophe model explains that performance is based on the interaction between cognitive anxiety and physiological arousal (Hardy & Parfitt, 1991). As these two predictor variables increase so will performance up to a point. After a critical threshold is exceeded, performance may crash dramatically. The crash involves performance falling off the cusp of the upper performance platform – the right hand side of the overlap in Figure 2.2. Small reductions of cognitive anxiety or physiological arousal back to the point of the crash are not predicted to be sufficient for a return to higher levels of performance. Rather, the total sum of these two variables must be reduced substantially – to the left hand cusp – in order to regain representation on the upper part of the performance surface.

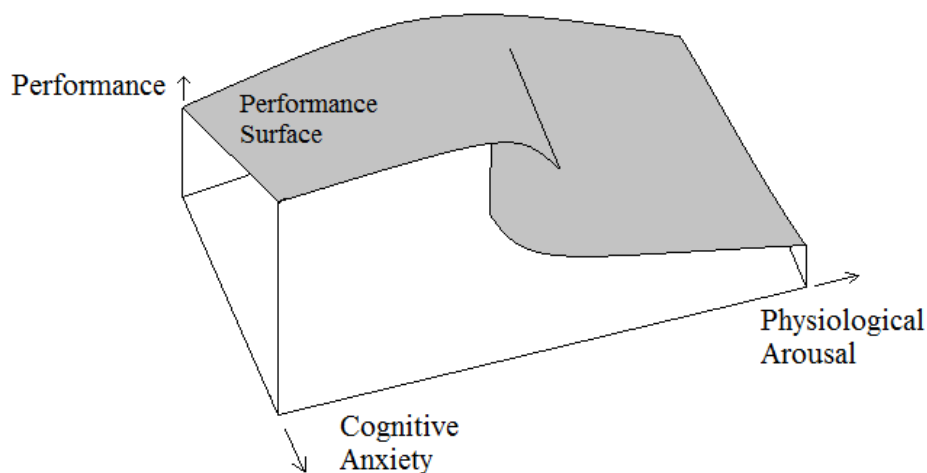


Figure 2.2 shows the cusp catastrophe model as adapted from Hardy & Parfitt, 1991.

The cusp catastrophe model receives similar criticism to the transactional model. Its relative complexity makes testing all of its assumptions extremely difficult (Gill, 1994). A study of the complete model would involve assessing both the increasing and decreasing trends of the two predictor variables in order to observe the large crash and substantial increase in performance that are shown at the lip of the upper and lower performance platforms, respectively. Additionally, the cusp catastrophe model refers to physiological arousal in a general sense and does not address the subtleties that are associated with appraisals, which may have differential impacts upon performance.

2.1.3.1 Conscious Processing Hypothesis

Literature specific to motor-skill performance frequently refers to attentional focus theories, including the conscious processing hypothesis and processing efficiency theory (A. Moran, 2004; Weinberg & Gould, 2010). The conscious processing hypothesis is introduced here both for its relevance to motor-skill performance and to make a definitive prediction regarding performance outcomes as the result of changes in anxiety.

The conscious processing hypothesis explains that an acquired motor-skill will eventually become automated. Once this happens, the individual no longer requires the same degree of conscious effort to execute the automated skill. However, when the individual becomes stressed, due to anxiety or worry, they will attempt to regulate the movements consciously because of an inordinate amount of concern for situational control (A. Moran, 2004). This increased attention to skill execution and the step-by-step control disrupts normal task processing (Pijpers et al., 2003). The increased conscious control of movement limits the degree of freedom given to the movement. This results in movements becoming stilted. Weinberg and Gould (2010, p. 367) have suggested that, individuals “no longer perform on ‘automatic pilot’; rather, their conscious attention reverts back to the task when they are put in a pressure situation”. Good support exists for the effects of anxiety on movement behaviour as explained by the conscious processing hypothesis (Baumeister, 1984; Hardy, 1999; Hardy & Hutchinson, 2007; Mullen & Hardy, 2000; Pijpers et al., 2005; Pijpers et al., 2003; Woodman & Hardy, 2003).

2.2 Toughness Theory – Adaptation & Performance

The toughness theory can be thought of as incorporating physiological and psychological components of stress in order to appreciate their interactions. The theory suggests that physical stimuli can cause positive psychological adaptations that better equip humans to cope with situations that demand conscious effort (Dienstbier, 1989). Dienstbier & Zillig (2002) have outlined the process of ‘toughening’ as a cycle of continual growth. Within this cycle there is reciprocity between the body and mind. This implies that, not only does psychological health influence physical well-being but that manipulations, which impact the body, have an influence on the mind through observable neuroendocrine mediation (Dienstbier & Zillig, 2002).

Briefly, the cycle according to Dienstbier & Zillig (2002) is as follows. First, the presence of some amount of ‘toughness’, such as having a healthy capacity for arousal and consequently feelings of energy, leads to successful experiences rather than failures. Second, a large repertoire of successes promotes positive primary appraisals in situations that may be appraised as challenging or threatening. Third, positive appraisals, coupled with attributes of toughness, leads to positive forms of arousal and associated feelings of energy with minimal tension. This may be due to the suppression or delay in arousal that is commonly associated with negatively valenced appraisals – especially those associated with threat. Altered arousal capacity and improved feeling states serve to strengthen optimistic secondary appraisals and support the likelihood of using instrumental coping efforts. Instrumental coping, such as problem focused coping, is more reliable for success than is emotion focused coping. Effective coping means that a person will likely engage, rather than avoid, future challenges. The process comes full circle because over time regularly engaging challenging situations contributes to toughening.

2.2.1 The Neuroendocrine System and the Stress Response

The nervous and endocrine systems are the two principal regulatory systems that control the involuntary functions of the body. This includes circulation (e.g. heart rate), energy and arousal levels, reproductive function, and the immune system (Christensen, Martin, & Smyth, 2004). In response to stress, the neuroendocrine system increases arousal. This response is predicated on the interaction of

multiple systems (for review see Chrousos & Gold, 1992). Two of these are fundamental to appreciate the connections drawn between cognition and physiology as described below. These two systems of relevance collectively result in whole system physiological arousal (Sothmann, 2006). They are the locus ceruleus-sympathetic-adrenomedullary (LCSA) system and the hypothalamic-pituitary-adrenocortical (HPA) axis.

In response to challenge appraisals, from both physical and psychological events, the LCSA-system releases adrenaline and noradrenaline from the adrenal medulla, and noradrenaline is also released from sympathetic nervous system overflow (Acevedo & Ekkekakis, 2006; Olff et al., 2005; Susman, 2006). The presence of these two catecholamines in the blood represents a principal mechanism for eliciting a stress response. Catecholamines prompt increases in heart rate and contractility, blood glucose in vital organs and muscles, and bronchodilation (ventilation) (Bray, 1999). They are primary constituents for energy mobilisation for the central nervous system as well as the muscles (Dienstbier, 1989). Catecholamines function as a primer for the organism to take effective action in demanding and stressful encounters.

In cases of severe or prolonged stress, where a situation is likely to be appraised as threatening, the HPA-axis is activated (Olff et al., 2005). HPA-axis activation happens over minutes, as opposed to only seconds with the LCSA-system (Bray, 1999). Catecholamines have a half-life of less than three minutes in the blood stream whereas corticosteroids, from HPA activation, have a half-life of approximately sixty to ninety minutes (Dienstbier, 1989). The primary corticosteroid released from the HPA-axis is cortisol (Lundberg & Frankenhaeuser, 1980). Cortisol is frequently used to measure stress or anxiety, although it does serve a number of functions within a healthy non-stressed body (Berk et al., 2001). Cortisol prolongs the stress response and potentiates the full effects of the catecholamines. The effects of cortisol are catabolic (Al'Absi et al., 1997; Bray, 1999). This means that in order to sustain energy production cortisol prompts protein catabolism. Additionally, cortisol is responsible for immunosuppression and glucose mobilisation (Bray, 1999; Kemeny, 2003). As a result of the HPA-axis response the body shunts long term processes such as digestion, immune function, and growth in favour of immediate physical action.

The endocrine HPA-axis and the LCSA systems collectively prepare to the body to deal with dangerous and demanding encounters. This happens in terms of both physical activities, such as fighting or fleeing, and psychological activities, such as problem solving (Susman, 2006).

2.2.1.1 Neuroendocrine Adaptation

The way in which improved neuroendocrine capacity from physical stress contributes to psychological processes can be understood in terms of the General Adaptation Syndrome (GAS) (Selye, 1936). Selye first observed the response among rats as they adapted to stressful situations. He described the nature of their adaptation in three stages (Selye, 1936). In the first stage, described as general alarm, a multitude of responses occur. Changes include, but are not limited to, loss of muscular tone, changes in the lymphatic system, and metabolism. The general alarm stage continues until there is a withdrawal of the stressor. In the second stage, which is referred to as adaptation or resistance, the body adapts to these demands through processes such as modified gene activity, increased hormone production, and the accumulation of metabolic and structural proteins (Rippetoe, Kilgore, & Bradford, 2009; Selye, 1936). Not only is there resistance during the second stage but the capacity of these processes will exceed that of the pre-stress levels if there is sufficient opportunity for recovery. In sports science, such increased capacity is referred to as supercompensation (Rippetoe et al., 2009). Finally, exhaustion will occur if the duration, frequency, or intensity of the stressor is too great.

After the initial publication of GAS, Selye (1950) reviewed a panoply of biological changes observed among humans responding to a variety of stressors. As before, he also noticed the occurrence of a general biological response and adaptation. Researchers have since criticised GAS, pointing towards discrete changes in response to specific stressors thereby implying a specificity of adaptation; however, there is also a *nonspecific response syndrome*, alongside more specific ones, that yields systemic adaptation of the entire organism (Sothmann, 2006).

An appreciation of neuroendocrine adaptation from physical stressors, as explained by the toughness model, is based upon investigations with both animals and humans (Dienstbier, 1989). So called

'toughening manipulations' result in "resistance to central catecholamine depletion, peripheral catecholamine responsivity, increased beta-receptor sensitivity, and cortisol suppression" (Dienstbier, 1989, p. 92). For example, pharmacological intervention and electric shock have yielded neuroendocrine adaptation in animal experimentation (Dienstbier, 1989). Upon repeated exposure to similar stressors, animals exhibit a blunted neuroendocrine response to preserve their capacity for arousal when needed (Sothmann, 2006). Furthermore, with regular exposure to stress, the system improves its capacity for production of catecholamines and the receptor organs become more responsive to their presence (Dienstbier & Zillig, 2002). When the same animal is exposed to a novel stressor it benefits from a newly established LCSA response capacity and displays a response that exceeds that of the initial, non-habituated, levels. This process is called *sensitisation* (Sothmann, 2006) and is analogous to supercompensation. Such adaptations are important components of an effectively organised physiological stress response.

Examples which have resulted in adaptation among humans are seasonal exposure to cold and engaging in regular cardiovascular exercise (Dienstbier, 1989). Nabkasom et al. (2006) have found that group jogging exercises are effective in altering the hormonal response to stress. These authors found that regular exercise reduced the presence of both adrenaline and cortisol at base levels. Further, exercise was associated with improvements in well-being and reduced reports of depression (Nabkasorn et al., 2006). Likewise, Salmon (2001) showed that exercise training was responsible for measured improvements to psychological health, such as reducing symptoms of depression and anxiety.

In addition to the adaptation seen from physically stressful stimuli, regular engagement in cognitively demanding tasks as well as acts of humour and jocularity have been proposed to promote similar changes (Dienstbier, 1989). This is due to the nature of neuroendocrine demand, hence, potential for adaptation, that is associated with these activities (Al'Absi et al., 1997). Some support for this idea can be seen indirectly with humour research. During a 3-week period it was found that regular 20-minute sessions of humour were as effective as 20-minute sessions of exercise for promoting positive well-being and reducing psychological distress (Szabo, 2003). It was shown within the same study that

humour exerted a greater anxiety-lowering effect than exercise over a three week testing protocol (Szabo, 2003).

Further support for the relationship between physical stimuli and psychological states, as mediated by the neuroendocrine system can be appreciated when the experience of such stimuli are taken to their logical extension in terms of GAS. The same sorts of physical stress, when excessive, can result in exhaustion, such as overtraining in athletes (Rippetoe et al., 2009). Acute overtraining can produce stress levels that result in imbalances of the neuroendocrine system, immune system, as well as cause mood disturbance, fatigue, and disruptions to concentration (R. W. Fry et al., 1994).

Assuming exhaustion is avoided and toughening occurs, the individuals will enjoy an increased capacity of the LCSA-system, meaning that the activation of the HPA-axis may be delayed, or even suppressed entirely during the stress response (Dienstbier & Zillig, 2002). Another benefit is the increased time to depletion of the LCSA-system, which translates to more reliable feelings of energy for dealing with extended stressful episodes (Dienstbier, 1989). This pattern of LCSA-arousal and suppression of HPA-arousal is emphasised for its association with increased feelings of energy and reductions of tension during stressful encounters (Dienstbier, 1995). Such adaptations contribute to an increased sense that coping efforts will be effective in demanding situations.

2.2.1.2 Cognitive Appraisal and Neuroendocrine Interactions

Arguably, cognitive appraisals play a significant role in determining the emotional valence and the intensity of the stressful experience (Lazarus & Folkman, 1984). Evidence has shown that challenge and threat appraisals are strong determinants of the activation of the LCSA-system and HPA-axis, respectively (Gaab, Rohleder, Nater, & Ehlert, 2005; Olf et al., 2005). The different systems work conjointly, but their respective levels of activation are contingent upon antecedent factors; “emotion and cognitive processes have long been recognised to be critical modulators of a neuroendocrine and autonomic activation pattern” (Sothmann, 2006, p. 152) .

Olf et al. (2005, p. 460) have suggested that a challenge appraisal is accompanied by positive emotional valence and perceptions of situational control; further, they are associated with a salutary

neuroendocrine response. When a challenge appraisal is made the LCSA-system is activated and the presence of catecholamines increases. At the same time, cortisol levels are held at base rates or even reduced (Buchanan, al'Absi, & Lovallo, 1999; Dienstbier, 1992). Conversely, according to Buchanan et al. (1999), negative affect is associated with higher cortisol levels. HPA arousal, from threat appraisal, is associated with feelings of tension and has been an indicator of unsuccessful coping (Dienstbier, 1995; Markus, Panhuysen, Tuiten, & Koppeschaar, 2000). This type of response, from threat appraisal, is normally associated with anxiety, low energy, and depressed mood states (Mayes, 2000).

The purported differences in energy levels and emotional states, accompanying cognitive appraisals, also correspond with specific physiological activity profiles (Tomaka & Blascovich, 1994; Tomaka, Blascovich, Kelsey, & Leitten, 1993; Tomaka et al., 1997). These profiles appear to align with the neuroendocrine responses outlined above. Cardiac reactivity has been found to be positively related to challenge appraisals and negatively related to threat appraisals; conversely, the relationship with vascular reactivity is negatively related to challenge and positively related to threat (Tomaka & Blascovich, 1994; Tomaka et al., 1993; Tomaka et al., 1997). Consequently, in a situation perceived as challenging, where demands are evaluated as being within one's coping ability, there is an increase in cardiac output and decrease in systemic vascular resistance (Tomaka et al., 1997). In other words, blood is more efficiently delivered to vital areas, such as the major muscles. By contrast, when a situation is perceived as threatening there is only moderate cardiac reactivity coupled with either decline or no decrease in systemic vascular resistance (Tomaka et al., 1997).

Essentially, challenge appraisal are associated with an organised physiological response that includes diversion of blood to vital areas (e.g., major muscles) and increased energy mobilisation (e.g., blood sugar level increase) for use in the muscles and the brain. This positive state of arousal and increase in energy is likely to affirm appraisals that success will be likely (Christensen et al., 2004; Dienstbier & Zillig, 2002). This may also be reinforced through somatosensory feedback (M. A. Gray, Harrison, Wiens, & Critchley, 2007).

Physiological arousal can become a component of the appraisal process, if sufficiently intense (Hardy, 1999). State anxiety is generally understood to have two components, somatic anxiety and cognitive anxiety (Hardy & Hutchinson, 2007). Somatic anxiety, or somatosensory feedback, is the cognitive appraisal of physiological activation within the body (Hardy & Hutchinson, 2007). In essence, this is the claim derived from toughness. That feelings from arousal will reinforce optimistic secondary appraisals and potentially influence reappraisals (Dienstbier & Zillig, 2002). Indeed, evidence suggests that somatosensory feedback may influence situational reappraisals (M. A. Gray et al., 2007). For example, a person giving a speech to a large audience may appraise the situation as somewhat stressful and react with increased heart-rate and sweaty palms. An awareness of their own 'stressed' reaction can increase their level of anxiety. Of course, the result is not always negative because the way somatosensory feedback is interpreted can have major consequences for task performance. In a study of graduate students it was found that a group making reappraisals outperformed their peers on a mathematics test when they were informed that arousal improves performance, by comparison their peers were not given any information regarding arousal (Jamieson et al., 2010).

Dienstbier & Zillig (2002) explain that as a consequence of improved appraisals and improved confidence a person will establish a repertoire of positive experiences. This repertoire contributes to their sense of coping effectiveness. This idea is echoed in the broaden and build theory of positive emotions (Fredrickson, 2003, 2004). Fredrickson (2003) argues that the cultivation of positive emotional experiences is important because these contribute to optimal functioning in a long term sense, as opposed to solely during the momentary positive emotional experience itself. Positive emotions "*broaden* people's momentary thought-action repertoires and *build* their enduring personal resources" (Fredrickson, 2003, pp. 165-166). This repertoire of success, according to the toughness model, would lead to more optimistic appraisals by contributing to a person's sense of efficacy. In stressful situations, for a so-called 'toughened' individual, this would involve placing greater emphasis on appraisals of challenge than threat. This brings us full circle because perceiving stressors as challenging instead of threatening contributes to more positive emotional experiences than negative

ones (Driskell & Salas, 1996; Lazarus & Folkman, 1984) and therefore more likely engagement with future demanding situations (Dienstbier & Zillig, 2002).

In sum, the benefits of neuroendocrine adaptation are understood to occur both immediately as a result of momentary appraisals (Olf et al., 2005) and in the long term from positive encounters with demanding situations (Dienstbier, 1989; Dienstbier & Zillig, 2002). Within this relationship there is the recognition that stress appraisals – emphasising either challenge or threat – modulate neuroendocrine responses (Sothmann, 2006). In turn, neuroendocrine adaptation can occur and may contribute to improved feelings of efficacy regarding coping ability. Through time, the result of regular encounters with stressful and challenging circumstances will contribute to an individual's repertoire of successful experiences – which also promotes positive appraisals in situations where stress might be perceived (Christensen et al., 2004; Dienstbier & Zillig, 2002; Fredrickson, 2003).

2.2.1.3 Weaknesses within Toughness

Toughness theory suggests that the relationship between arousal and appraisals is reciprocal.

Evidence, however, has shown that an existing state of arousal may be insufficient to alter situational appraisals (Tomaka et al., 1997). Rather, the relationship might exist in the opposite direction only.

Tomaka et al. (1997) used physical stressors, such as the cold pressor task and an ergometer, in order to evoke states of physiological activity that would correspond with different appraisals. In a separate test they manipulated instructional sets regarding appraisals and measured the subsequent physiological responses. They found that cognitive appraisals (i.e., of challenge or threat) could be manipulated using different instructional sets. Individuals, then, displayed corresponding physiological activity patterns. By contrast, manipulating physiological variables, such as cardiovascular reactivity and vascular activity, did not influence a subsequent cognitive appraisal made by individuals. In light of their results, Tomaka et al. (1997, p. 71) stated that their studies “go a considerable way toward ruling out likely physiological response patterns as important causal antecedents of threat and challenge responses.”

In another challenge to toughness theory, a study tested the hypothesis that individuals who made appraisals of challenge would respond with higher levels of catecholamines than individuals who made appraisals of threat (Ennis, Kelly, Wingo, & Lambert, 2001). This follows from the claim that ‘tough’ individuals have an increased LCSA response capacity, described earlier as sensitisation. Prior to an exam, each participant was asked what test score would be ‘just good enough’. They were then asked to report the grade they expected they would obtain. Individuals who reported an ‘expected grade’ equal to or above what they said was just good enough were recorded as making challenge appraisals. Participants who expected to do worse than what they had reported as ‘just good enough’ were recorded as making threat appraisals. It was found that individuals who made threat appraisals had much larger increases in catecholamine levels from LCSA responding (Ennis et al., 2001). The authors argue that their findings contradict the notion that individuals who make appraisals of challenge will respond with an increased LCSA arousal profile when compared to those who make appraisals of threat.

Arguably, the measure Ennis et al. (2001) used is not definitive of the challenge–versus–threat appraisal. It could be that individuals who reported an expected grade that was better than their ‘just good enough grade’ did not find the test challenging or threatening. As mentioned earlier, when an individual/organism is exposed to a familiar stressor they normally display a blunted neuroendocrine response (Dienstbier, 1989). Arguably, the individuals who expected to do ‘just good enough’ or ‘better than expected’, may not have even perceived the exam as a stressor because they were both familiar with the scenario and expected success. Rather, they may have perceived the event as relatively benign. By contrast, the ‘threat’ group may have shown an increased arousal response, from both LCSA and HPA activation, because they did, in fact, find the test to be stressful since they anticipated failing to meet their own standards. The claim made by Ennis et al. (2001) is somewhat questionable but may cast doubts on predictions derived from the toughness concept.

So far, the discussion has emphasised the relationships within the toughness model – including the way neuroendocrine processes relate to cognitive appraisals. These relationships provide the foundation for the link with humour. That is to say, appraisals bring about a physiological response

which in turn provides somatosensory feedback – a self-perception of physiological arousal associated with nervousness and tension (Deckers, 2005). Somatosensory feedback in turn influences the nature of emotion and motivation. Such changes modify future perceptions and cognitions, namely reappraisals (Dienstbier & Zillig, 2002). It is within this system of feedback that humour is proposed to play a role in antagonising negative perceptions and ineffective coping behaviours associated with appraisals of threat. This is because mirthful emotion from humour and laughter prompt a salutary neuroendocrine response that may influence the appraisal process, and the concomitant feelings of energy, thereby contributing to improved performance outcomes (Dienstbier, 1995).

2.3 Humour

2.3.1 The Psychological Function of Humour

Several psychological theories regarding humour claim that its primary function is to provide a ‘cognitive shift’ and hence mitigate the effects of stress (Kuiper et al., 1993). From this perspective, using humour allows for the gravity of a stressful situation to be fully appreciated while contributing to the reappraisal of the situation as less personally relevant (Geisler & Weber, 2010). For example, by using humour, such as sarcasm, situations may be perceived as less threatening as the result of diminishing ego-involvement (Van Zuuren, Schoutrop, Lange, Louis, & Slegers, 1999). It has been found for emergency workers that “humour allows individuals confronted with awful situations to create an emotional distance that both protects their emotional state and permits concentration on the important tasks at hand” (Rowe & Regehr, 2010, p. 459). Workers can re-evaluate a situation after joking about it as seemingly less serious and, therefore, less threatening to their personal well-being.

Martin and Lefcourt (1983) proposed that for humour to be an effective moderator of experienced stress the individual must be able to create humour in everyday stressful situations. With this consideration in mind, Newman & Stone (1996) had individuals create, and act out, their own dialogue for a silent stressful film. They found that participants who created a humorous monologue had lower negative affect, lower tension, and reduced psychophysiological reactivity when compared to individuals who generated a non-humorous monologue. The effectiveness of humour in these situations depends on its cognitive features and specific instrumental use. Yet in a separate domain, a

prominent anecdotal account of humour has arisen that has led to investigations of its biological features and has paralleled research on the health benefits of other positive emotions.

In the 1960s, Norman Cousins – a journalist and researcher on the biopsychology of emotion – suffered from a severe form of rheumatoid arthritis. In order to deal with his painful condition during recovery, he watched reels of Marx Brothers films. Cousins claimed that just ten minutes of good belly-laughter could provide up to two hours of respite from discomfort. He recorded and published his experience, reporting that humour and laughter were vital for his recuperation (Cousins, 1976). Since then, the role of humour in health settings has gained popularity as a research topic. One consequence has been the investigation of the specific biological markers of humour.

2.3.2 Humour – Experienced Stress and Physiologic Responses

Humour appears to be effective for improving emotional valence and reducing reports of tension in relation to different types of stressors. Yovetich, Dale & Hudak (1990) found that participants in a humour condition, who listened to a humour tape, reported lower levels of anxiety overall in anticipation of an impending electric shock when compared to a control group. Moreover, the humour participants reported less increase in stress as the shock approached. Cann, Calhoun & Nance (2000) found that humour induction video was effective for improving mood states before and after an unpleasant stimulus – a videotape compilation of graphic death scenes. In their study, humour was effective for improving reports of anxiety but only when shown prior to the unpleasant stimulus. Additionally, their study showed that humour was effective for improving depression and anger regardless of whether it was shown before or after the unpleasant stimulus.

Underlying the positive emotional valence from humour appreciation is a neuroendocrine profile that is markedly similar to the one observed among individuals making challenge appraisals during a demanding encounter. Research shows that mirthful laughter is significant for attenuating the classical stress response at a neuroendocrine level (Berk et al., 2001; Berk et al., 2008; Berk et al., 1989; Buchanan et al., 1999; Godkewitsch, 1976). Although the effectiveness of humour as a coping strategy may stem from its specific relevance to the stressor, such that it may shape situational

reappraisals, it has been hypothesised that the mirth from humour is sufficient in its biological effects to subdue stress.

Accordingly, humour has been referred to as a form of eustress, which “is a positive phenomenon that ameliorates the biological effects of distress. However, not all effects of mirthful laughter are counter to the classical stress responses” (Berk et al., 2001, p. 63). This is because humorous experiences have been linked specifically with LCSA-arousal and the associated peripheral catecholamine increases (Godkewitsch, 1976; Sakuragi, 2005). For example, Levi (1965) found that a pleasant emotional response to a comedy film increased LCSA arousal as measured by adrenalin secretion.

Also, mirthful laughter has been found to reduce levels of hormones associated with the HPA-axis, including a faster return to base levels for a humour group than a control group in response to a stressor (Berk et al., 1989). Buchanan et al. (1999) measured changes in affect and cortisol levels between individuals that either watched a positive affect induction film, gave a public speech or rested for a day. They found that cortisol secretion was strongly altered in the different situations. Cortisol levels were significantly decreased following the positive affect induction film compared to both the stress group and the rest/control group.

Further support for the positive arousal quality associated with humour comes from research showing that the mere anticipation of experiencing mirthful laughter will significantly decrease cortisol and other stress hormones associated with HPA-axis activation (Berk et al., 2008). Lai et al. (2010) have also found that humour reduced HPA-axis activation. They used the Coping Humour Scale (CHS) – a scale designed to assess the degree to which humour was used by participants to cope with everyday stressors. They found that individuals who scored high on the CHS exhibited lower levels of cortisol when compared to those who use humour less often.

Physiological activity has also been found to support the nature of the neuroendocrine profile associated with humour. Shurcliff (1968) reported that humour generally decreases physiological arousal. Humour is associated with the reduction of blood pressure, reduced heart rate variability (Lefcourt et al., 1995; Sakuragi, Sugiyama, & Takeuchi, 2002), and improvements in cardiovascular

activity (Miller & Fry, 2009). In addition to observed cardiovascular changes, the relaxing effects of mirthful laughter appear to help diminish physical bodily tension (W. Fry, 1979). It has been stated that “laughter produces similar, if not identical, responses to those associated with progressive muscular relaxation” (Seaward, 1992, p. 68). The same underlying mechanism is also considered to explain increased pain tolerance from humour during cold pressor tasks, which involve a subject voluntarily placing a limb in water that is painfully cold for as long as tolerable (Weisenberg, Tepper, & Schwarzwald, 1995).

Finally, improved arousal quality was the rationale for the finding of one study that used humour for systematic desensitisation practices – a form of classical conditioning therapy that involves relaxation and graded exposure to aversive stimuli in order to improve coping with specific fears (Ventis, Higbee, & Murdock, 2001). Humour administration was found to be as effective as more traditional methods in reducing fear and associated fear behaviour as part of such treatment. Ventis et al. (2001) proposed two competing rationales for their findings. First, humour may be significant for reducing physiological arousal associated with anger and apprehension. Alternatively, it is possible that the experience of positive emotions promotes feelings of self-efficacy, which contribute to overcoming the aversion of specific stimuli.

A reasonably strong case can be made for improved emotional valence, endocrine, and physiological arousal from humour. This has not, yet, been analysed in terms of its effects for motor-skill performance.

2.3.3 Humour and Task Performance

Within investigations examining links between humour and task performance, stress has normally been induced via stereotype threat (e.g. informing subjects of performance differences between sexes), time pressure, or ego involvement (e.g. informing subjects that the test is a measure of their ability to learn and use information). Most commonly, the effects of humour on stress have been evaluated with regards to cognitive performance, normally using educational examination-type scenarios.

Smith, Ascough, Ettinger, & Nelson (1971) gave a humorous and non-humorous test to undergraduate students differing in anxiety levels as measured by the state trait anxiety inventory (STAI). Of the students who received the non-humorous version, highly anxious individuals performed the worst when compared with low and moderately anxious students. Additionally, highly anxious students who received the non-humorous test performed significantly worse than the highly anxious students who received the humorous version. The authors concluded that scores were improved by the reduction of anxiety from exposure to humour.

Terry & Woods (1975) included humorous testing material in the academic tests prescribed to students in their third and fifth year of schooling. Mathematics scores were 'restricted' for year 3 students, by contrast there was no significant change for year 5 students (Terry & Woods, 1975). Humour had no effect on year 3 verbal performance and mixed results for year 5 performance. From the findings of their study it was theorised that "the effects of humour on test performance are mediated by the momentary arousal levels of the students" (Terry & Woods, 1975, p. 185). McMorris, Urbach & Connor (1985) also examined the role of humour in testing with children and found that it did not have an effect on performance of children's grammar test scores but under the condition of exposure to humour the children judged the problems as easier and found them more appealing.

Townsend and Mahoney (1981) challenged the theory that humour might be beneficial for test performance by reducing affective arousal. It is important to note that their study was directed at students already high in trait anxiety. The findings from their study suggest that humour does not reduce tension for students high in trait anxiety such that their performance might improve (Townsend & Mahoney, 1981). Critical of their own study, the pair suggested that the nature of the incorporated humorous material – humour was an adjunct to test items – was such that it may have appeared as an extraneous distraction and hence been a cause of decreased performance. In spite of such interpretations, their study challenges the notion that humour incorporated into a test will improve performance from reduced arousal.

McMorris, Boothroyd & Pietrangelo (1997) conducted a review of ten different experiments, including the ones described immediately above, involving the use of humour in academic tests. None of the studies examined in their review had found main effects for humour on performance. They noted, however, that humour interacted with other variables to influence performance. In four of the studies humour and gender interactions occurred, as did humour and perception interactions. Additionally, humour and trait anxiety interacted which had performance consequences. Only the results of one of the studies supported the prediction that humour would be beneficial for individuals who were highly stressed. The other studies that were reviewed had somewhat mixed results, showing benefits for those who were already less stressed. In all cases, the effects were contingent on the variables already mentioned.

Dienstbier (1995) found that humour administered prior to a test did not subsequently influence performance. Based on the implications from his theory, there is reason to believe that the effects of humorous arousal may have died out prior to, or during, the testing phase of the study. This depletion of arousal may have been due to the time taken for filling out the questionnaires between the humorous stimulus and the performance measure. This may have been because catecholamines have a half-life of only two to four minutes in the blood, any significant effects from the humour stimulus may have diminished during the time taken to fill out questionnaire items (Dienstbier, 1995). Although performance was not affected, the study did find humour to have significant effects on ratings of energy, tension, task choices, and attributions. Reported levels of energy increased significantly and tension was lower in the humour condition than in the control condition. The subjects in the humour group were also more inclined to choose testing scenarios that were challenging as opposed to ones that were easy or boring. Subjects exposed to humour also felt less tension prior to task performance and appraised their task in a more positive manner than the non-humour group.

In contrast to the studies described above, Adair & Siegel (1984) separated humour from the testing scenario altogether. They tested the notion that humour may act as a confounding variable when directly incorporated into the testing scenario. They hypothesised that the timing of the humour

stimulus would be salient in order to improve performance on a stressful task. For their study, participants were required to take both a pre-test and post-test. Modified versions of the quiz electrocardiogram were used. The quiz used is an experimental stress test that appears similar to intelligence quotient testing. In the break during the two examination sessions, test subjects were given a humorous tape to listen to and the control group received a non-humorous set of magazines to read. It was found that humour during the break improved subsequent performance on the stressful task. The critical distinction between this and other studies was the fact that humour was not confounded with task participation. The authors argued that altering tests by inserting humorous material, as done in other studies, may have perhaps been seen as inappropriate by subjects, in turn mitigating potentially significant benefits. The authors suggested that humour may reduce tension or serve to reinforce attentiveness (Adair & Siegel, 1984).

Humour has also been tested with regard to stereotype threat. O'Brian & Crandall (2003) conducted a study on whether individuals high in arousal would score better on an easy test and worse on a difficult test. They administered an easy and a hard mathematics test to both men and women. The experimental group was informed that the test had gender differences; this information was given to provoke stereotype threat and consequently increase arousal. The control group did not receive this information. O'Brian & Crandall (2003) found that women higher in levels of arousal, as induced by stereotype threat, scored better on the easy test and worse on the difficult test compared to the control group. Men's scores did not differ significantly by comparison. Following this study on stereotype threat, Ford, Ferguson, Brooks & Hagadone (2004) found that humour, when used as a coping strategy by participants, was a good cognitive resource for mitigating the influence of anxiety associated with stereotype threat for women and helped to improve their performance on a mathematics test.

Ford, Ford, Boxer & Armstrong (2012) conducted a study with undergraduate students on the effects of humour as a moderator of anxiety for mathematics test performance. Students who read a series of cartoons prior to the task outperformed individuals who read non-humorous poetry. The authors argue that humour may have improved performance in two ways. First, humour may have produced an

affective state that inhibited anxiety. Second, humour may have served to break apart the logical and rational constraints that can limit thinking and therefore improved creativity – a speculation that has been supported elsewhere (see Cade, 1982; Holmes, 2007). In essence the argument is that because of humour's ability to promote creative thinking it can be beneficial for problem solving and improving the nature of information processing during cognitive tasks.

3 Hypotheses – Humour and the Toughness Model

Although there is support that a humorous disposition has merit for coping with general forms of anxiety, such as daily hassles and on-going stressors, its influence on performance in relation to acute putative stress is unclear. Another issue in humour research is that humour appreciation is highly nuanced and it may be used and interpreted quite differently by individuals based on their knowledge, culture, and upbringing (Palmer, 1994). In order to examine the difference between the psychological and physiological aspects of humour, the neuroendocrine profile of mirthful emotion can be analysed separately from the cognitive response to humour appreciation. A specific boundary is provided for analysis by considering the situational characteristics of mirth derived from humour. As such, findings may speak towards a functional account of humorous emotions and therefore towards a functional and adaptational account of emotions more generally (Cummins, 2005; Lazarus, 1991; Lench et al., 2011). Such an explanation also lends itself to assessments regarding task performance.

As discussed in the previous section, stress from fear is associated with threat appraisals and is distinct from challenge (Lazarus & Folkman, 1984). Challenges, although containing some aspects of threat, are associated with more positive emotions and expectations of potential situational mastery (Dienstbier & Zillig, 2002). People who make appraisals of challenge tend to function better because they essentially feel more confident and less emotionally overwhelmed than those who feel threat (Lazarus & Folkman, 1984). These appraisal types are not mutually exclusive (Lazarus & Folkman, 1984) but are associated with different neuroendocrine profiles (Gaab et al., 2005; Olff et al., 2005). A strong LC/NA-system response, normally accompanying challenge appraisal, can delay or even suppress the response of the HPA-axis. This can have positive consequences for the performer because LC/NA-system arousal “corresponds with physical and mental task demands; in the absence of [HPA] arousal, spikes of [LC/NA] arousal (but not high base rates) are energizing” (Frankenhaeuser, 1979 as cited in Dienstbier, 1995, p. 256).

Dienstbier (1995) proposed that stressed individuals should experience this pattern of arousal after exposure to humorous material. Research has shown that mirthful emotions from humour appreciation

are specifically associated with a neuroendocrine response that is similar to the one elicited during appraisals of challenge. Humour has been shown to both activate the LC/SA-system and suppress the HPA-axis response (Berk et al., 2001; Berk et al., 2008; Berk et al., 1989). Furthermore, research by Lefcourt et al. (1995) and Sakuragi et al. (2002) suggests that the physiological response associated with humour is reflective of such a neuroendocrine arousal profile. Mirthful emotions from humour are proposed to improve appraisals through positive somatosensory feedback.

In order to explain changes in task performance, the conscious processing hypothesis is offered. Accordingly, individuals who are highly anxious may do poorly on a motor-skill task as they attempt to consciously control each movement (A. Moran, 2004). This excessive conscious control interrupts the degree of freedom normally given to an otherwise automated skill.

Based on the relationships outlined above, humour is hypothesised to reduce situational anxiety and improve appraisal thereby relaxing the conscious control of movement. Additionally, humour may have direct physical consequences. The arousal profile from humour is physiologically favourable to motor-skill execution because it results in an increased heart rate coupled with decreased peripheral resistance allowing for greater blood flow to major muscles; in other words, a more organised physiological response (Tomaka et al., 1997).

Based on these findings, two hypotheses for this project are suggested:

Participants who experience humour prior to a stressful situation will report more positive levels of affect than the non-humour group.

Participants who experience humour prior to a stressful situation will exhibit improved performance on a motor skill task (under conditions of stress resultant from fear).

4 Method

4.1 Ethical Approval

This research project received ethical approval from both the Lincoln University Human Ethics Committee and the University of Canterbury Human Ethics Committee in order to recruit participants from their respective student bodies.

4.2 Participants

Participant recruitment was done on a face-to-face basis immediately in front of the James Height library at the University of Canterbury, and in front of the Ivy Hall library at Lincoln University. A random set of numbers was used in order to select which students to invite to the project. Individuals passing through the entrance of one of the libraries were approached regarding the project and asked if they would participate. Potential participants were given the opportunity to read an information sheet (Appendix B) and given a verbal explanation of the nature of the project. Of the individuals who were informed of the project's details, 28% from Lincoln University and 40% from University of Canterbury participated. If individuals agreed to participate then meeting times were arranged and directions provided to the testing facility. Participants were 44 undergraduate and postgraduate students between 19 and 44 years of age ($M = 26.33 \pm 5.67$). Participants provided their own written consent (Appendix A). Individuals with no prior climbing experience were selected to ensure they were unfamiliar with climbing at height. Individuals with previous experience were ineligible to participate. Free climbing was offered as an incentive. This included admittance to the climbing facility and the necessary equipment and training to remain and climb recreationally. Thirteen participants took advantage of this incentive.

4.3 Instruments

4.3.1 Rock climb

The layout of the testing procedure used in the present study follows extensively from the design used by Pijpers and colleagues (2005; 2003). They conducted multiple experiments on the conscious processing hypothesis in order to examine the effects of anxiety induced from exposure to height

during indoor rock climbing. The manifestation of anxiety at a psychological, physiological, and behavioural level was assessed by having novice rock climbers traverse an artificial rock wall. Participants were instructed to complete the climbs as quickly as possible in both conditions. In a repeated measures test, it was found that when climbing at height, individuals reported increased levels of subjective stress and displayed decreased movement efficiency when compared to a low condition (Pijpers et al., 2003). Further, when climbing in the high condition, participants showed increased heart rates, increased muscle fatigue, and higher blood lactate concentrations (Pijpers et al., 2003). Also, movement behaviour deteriorated in a number of ways. When climbing in the high condition, participants climbed more slowly, made more exploratory movements, held individual holds for longer (Pijpers et al., 2005) and had significantly greater entropy of movement – a less fluid displacement of the body's centre of gravity (Pijpers et al., 2003).

For the present experiment, two identical climbs were set at different heights, as depicted in Figure 4.1, and provided different stress conditions. Climbing low to the ground served as a baseline measure of participant's relative ability and to familiarise them with the task. Exposure to the task at height was used to provide a stressful scenario that may have been appraised as either more challenging or more threatening. This setup is argued to provide an ecologically valid environment for studying the hypothesised relationships (Pijpers et al., 2005; Pijpers et al., 2003). The climbs were placed in a commercially run rock climbing gymnasium with permission from the manager.

Although participants had no prior climbing experience, the climbing routes were learned easily. It has been found that early stages of learning can be very short, "covering only the time required to understand instructions, to complete a few preliminary trials, and to establish the proper cognitive set for the task" (Fitts, 1964, p. 262). Also, observations in performance change could be made because skill may deteriorate regardless of skill level or ability (Baumeister, 1984). Although the participants' skills may not be fully automated it is still an appropriate level of assessment for the hypotheses in light of these reasons.

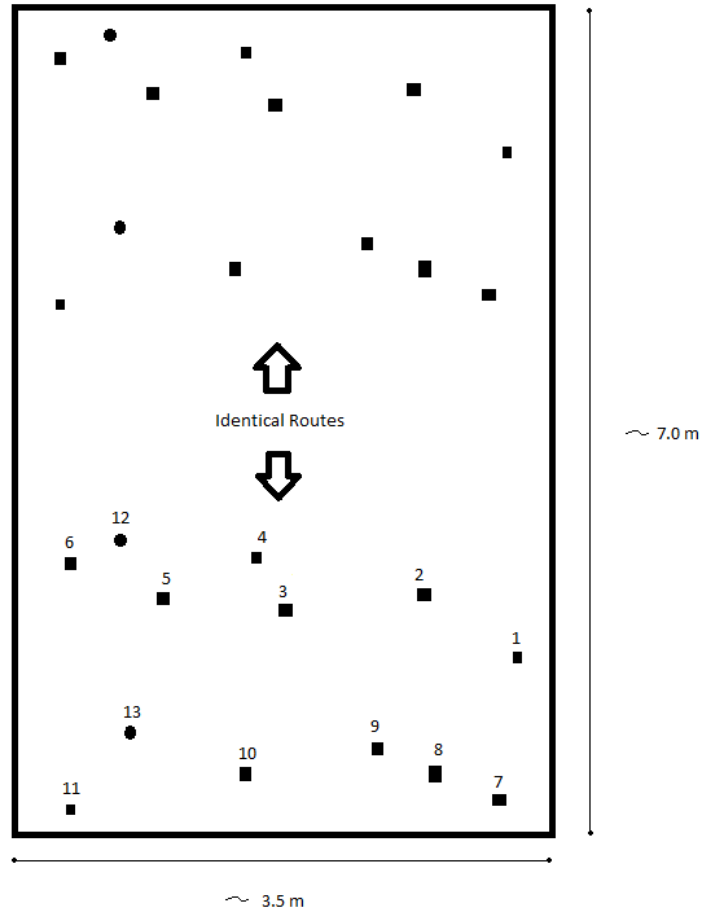


Figure 4.1 Climbing Wall Layout

Holds (1 to 6 and 12) were approximately 0.15 m for the low climb and 5.0 m for the high climb. The holds varied in shape, size, and orientation. The task was made as accessible as possible to novice climbers. In order to begin the high traverse in the same physical condition as the low traverse – without having to climb up the wall in order to reach the starting point – participants stepped directly off a mezzanine that terminated at the beginning of the high climbing wall. Having participants climb directly off the mezzanine floor had the additional benefit of suddenly exposing them to the height because there is no awareness of height until close to the edge of the floor. This degree of suddenness is an important factor when eliciting fear (J. A. Gray, 1987).

Participants wore Aspiring Enterprises climbing harnesses and a pair of well-fitted rock climbing shoes. Rock climber's shoes have a special sole for maximum contact and friction against variable rock and synthetic surfaces. Participants were secured during the climb using a top-rope system. For

top-roping, a dynamic safety rope is tied directly to the harness worn by the climber and then threaded through a smooth iron sleeve at the top of the wall and back to the ground where it is secured by a belayer. The belayer is the individual managing the rope in order to provide security for the rock climber so as to allow movement and prevent a potential ground fall (Graydon, Hanson, & Mountaineers, 1997). In order to increase consistency between the conditions, the top-rope system was used in both the low condition and high condition.

The requirements for the task involved traversing from the starting holds (1, 2, 7 & 8) across to the far side of the wall, then back to the starting holds, and finally repeating without a stepping off the wall. A total of four complete traverses were made across the wall. Participants were instructed to complete these as quickly as possible without compromising completion of the task for the sake of speed. The low traverse was used to familiarise individuals with the climb and as a norming procedure in order to record performance without fear or anxiety. Potentially, the low traverse may have been a source of stress among some individuals. However, participants were given the opportunity to become familiar with the low traverse by practising prior to their measured performance. As such, there should be a degree of familiarisation and desensitisation regarding what is already a low stress situation. The high traverse involved immediately stepping out onto the climbing holds from a height of five meters. Both the high and the low climbs were recorded using a Flip Mino Camera-Recorder. The experimenter watched each video at a later time and recorded the duration of each climbing condition in number of seconds for analysis.

4.3.2 Questionnaires

Fear was operationalised as psychological distress and was measured using the Profile of Mood State Questionnaire-Brief (POMS-B) form (McNair, Lorr, & Droppelman, 1981) (see Appendix D). The POMS-B questionnaire is a self-report measure and is used to assess affective mood state fluctuation. POMS has been a commonly used measure of psychological distress (Curran, Andrykowski, & Studts, 1995). It measures six dimensions of mood states, including tension-anxiety, vigour-activity, depression-dejection, fatigue-inertia, anger-hostility, and confusion-bewilderment. The tension-anxiety and vigour-activity subscales were of particular interest because they most closely reflect the

hypothesised effects of humour. According to the hypothesised changes, the tension-anxiety subscale is used to account for tension changes and the vigour-activity subscale is used as a proximate measure of energy change.

Quick assessments were needed due to the nature of the proposed neuroendocrine response from humour. The POMS-B questionnaire was selected as it contains 30 of the 65 items in the original POMS questionnaire. The POMS is psychometrically strong with good validity and reliability (McNair et al., 1981). The POMS-Brief form is highly correlated with the total mood disturbance score from the original version and exhibits good internal consistency (Curran et al., 1995). A number of studies have shown links between mood state and neuroendocrine activity using the POMS questionnaire (for example see Jin, 1989; Kahn, Asnis, Wetzler, & Praag, 1988; Malarkey, Kiecolt-Glaser, Pearl, & Glaser, 1994; O'Connor, Morgan, Raglin, Barksdale, & Kalin, 1989). Hence, the POMS-B was used as an indirect indication of the mood states associated with such processes.

Self-administered questionnaires (see Appendix C) controlled for demographic differences and also included two visual analogue scales (VAS) for participants to make appraisals of the degree of perceived challenge and stress in the high climbing condition. These were based on criteria from Lazarus and Folkman's (1984) work on stress appraisals. The two VASs were headed with the statement, "I think the climbing traverse will be". The respective scales contained two antithetical responses which completed the statement; these were "not challenging" versus "extremely challenging" and "not at all stressful" versus "extremely stressful". Participants were asked to place a mark on the scale nearest the most appropriate response. Scores were recorded in millimetres. Finally, there was one measure each for behaviour, and smiling.

Data were coded directly onto the questionnaires at the time of the climbs. They were later entered into the computer programme *Statistical Package for the Social Sciences* (IBM SPSS Statistics 19.0) for analysis.

4.3.3 Film

To induce mirthful emotions in the experimental group, a humorous video was shown as a mood manipulation. A control group watched a neutral video of similar duration to the humorous video. Perceived funniness of the videos was recorded with a Likert-type scale ranging from “not funny at all” to “extremely funny” (see Appendix C). Laughter and smiling were also recorded in order to measure the effectiveness of the manipulation. These items were recorded on a three point scale (see Appendix C). Good support exists for linking laughter and smiling to emotional mirth as these are its most common behavioural expressions (Gavanski, 1986; Martin, 2007; Roetkelein, 2002). Furthermore, it has been shown that laughter and smiling are more closely associated with the emotional aspects of humour appreciation than ratings of ‘funniness’, which are more closely associated with cognitive appreciation (Gavanski, 1986). Dolan (2002, p. 1191) has argued that emotions “are embodied and manifested in uniquely recognizable, and stereotyped, behavioural patterns of facial expression, comporment, and autonomic arousal”. Therefore, including measurements of behaviour change provided a more comprehensive indication of the effectiveness of the video in eliciting an emotional reaction than a funniness rating alone.

All participants in a condition watched the same video. The humorous video was one minute and forty-four seconds long, the content of which was a seated baby laughing intensely at its father ripping apart credit card bills. The video shown to the neutral condition was slightly longer, at two minutes and thirty-one seconds. The video was a montage of black and white images taken by the photographer Ansel Adams, with accompanying music by Sigur Rós. The track has no lyrics and can be described as ethereal, ambient music.

The video shown to the humour group was chosen to overcome some of the issues with humour appreciation. Humour is highly subjective; it has many culture specific aspects and for it to be successfully elicited there must be a very tight fit between the culture of the humour producer and the recipient (Palmer, 1994; Vaid, 1999). Even within the same culture, individual preferences mean there are large differences regarding the degree to which some material will be found funny or humorous.

Laughter and smiling can be induced because of their contagion effects (Freedman & Perlick, 1979; Gervais & Wilson, 2005) which is significant for eliciting a strong emotional reaction (Gavanski, 1986). This means that mirth could be derived while avoiding joke comprehension that is contingent upon prior knowledge and culture. As mentioned in the literature review section, the key feature of this study is the emotional response to humour as opposed to its cognitive facilitation. These facts were substantial in supporting the use of laughter, as opposed to jocularity, in order to influence emotional state. Hence, a laughing baby was thought to be an effective manipulation that would transcend many restrictions of contextual or cultural knowledge and thus humour comprehension. This was a concern in the present experiment because participants were from 14 national backgrounds.

4.4 Procedure

To begin the procedure, the experimenter explained the safety precautions and rules of the climbing centre. Participants were then informed of the task requirements for the experiment. After which, they signed an agreement form specific to the climbing centre as well as consent forms for the experiment. Prior to any data collection, participants were directed to the low climb and given the opportunity to rehearse the climb wearing climbing shoes. This was done in order to familiarise participants with the experiment and ensure that they were capable of completing the task before committing to the experiment. They were given an opportunity to rest on couches in the centre of the gym for approximately ten minutes to ensure complete physical recovery. During the ten-minute rest period participants were fitted with a climbing harness and then filled out the first POMS-B form.

Next, each individual was tied to the rope in front of the low condition. All participants were reminded of the goal; to climb as quickly as possible without compromising the completion of the four traverses; that is to say, they were told to climb more slowly if they thought they might fall off the wall. Once the camera was recording, they were informed that they could begin climbing whenever they were ready. Participants started on the right hand side and climbed to the leftmost hold, then back to the starting holds, and finally repeated the process once more without interruption. After the low condition was complete, participants were given another ten-minute break.

During the break, participants were taken up stairs into a separate room where they watched either the humorous or control video according to their respective group assignment. Behavioural notes were taken with discretion. Afterwards, participants rated the funniness of the video and were then taken over to view the high condition. After examining the climb from the edge of the mezzanine, which was 5 meters above the main floor of the climbing centre, they filled out a second POMS-B form. Participants were then asked to rate how stressful and challenging they felt the climb would be by marking the two visual analogue scales.

The experimenter tied them into the belay system and reminded each of the importance of climbing as quickly as possible without falling. Once tied into the top-rope system, and with the video camera recording their movements, participants could climb when they were ready. Participants stepped directly off the mezzanine in order to reach the starting holds. After they completed the high traverse they were either lowered to the ground or stepped back onto the mezzanine. This indicated the end of the experiment.

Climbing performance was recorded by video and then loaded onto a computer. The traverse times were measured using a stop watch while each climb was reviewed. The time began as soon as participants moved any limb from one of the four starting holds – either of the handholds (1, 2) or footholds (8, 7) – and returned to these holds after traversing four times in succession.

5 Results

5.1 Participant Attrition

Before describing the results, the attrition of participants in the control group should be noted. All individuals participated in the low height climb and viewed their respective videos. Subsequently, four subjects (2 males, 2 females) in the control group declined to participate in the high traverse. Only one participant declined to finish the experiment prior to completing the second POMS-B questionnaire. All individuals in the humour group completed the experiment. The results presented below reflect these participation rates. The difference in participation rates may, in itself, be considered a suggestive result, coming, as it did, after the humour manipulation.

5.2 Manipulation Check

To assess the effectiveness of the manipulation, a 2 (Sex: male, female) X 2 (Film: humour, control) multivariate analysis of variance (MANOVA) was performed on three dependent variables: rating of funniness, laughter, and smiling. No main effect was observed for Sex (Wilk's $\Lambda = 0.828$; $F(1, 38) = 2.62$, $p < n.s$), and no interaction effect was observed for Sex X Film (Wilk's $\Lambda = 0.893$; $F(1, 38) = 1.52$, $p < n.s$). There was a significant main effect for the film condition (Wilk's $\Lambda = 0.184$; $F(1, 38) = 56.22$, $p < .001$, $\eta^2 = .82$). Regarding the film condition, pairwise comparisons showed significant differences in all three dependent variables. Participants in the humour group rated the film as funnier ($M = 2.64$, $SD = 0.12$) than the control group ($M = 1.14$, $SD = 0.12$), ($F(1, 43) = 81.03$, $p < .001$). Also the humour group smiled more ($M = 1.55$, $SD = 0.09$) than the control group ($M = 0.10$, $SD = 0.09$), ($F(1, 43) = 124.99$, $p < .001$). Finally, the humour group laughed more ($M = 1.13$, $SD = 0.11$) than the control group ($M = 0.06$, $SD = 0.11$), ($F(1, 43) = 44.77$, $p < .001$).

5.3 Tension-Anxiety and Vigour-Activity

A 2 (Sex: male, female) X 2 (Film: humour, control) repeated measures MANOVA, with the Tension-Anxiety subscale of the POMS-B (Time 1/ Time 2) as the repeated dependent variable tested whether viewing the humorous video would reduce reports of tension compared to individuals who watched

the neutral/control film. This is shown in Figure 5.1. The Tension-Anxiety subscale increased significantly from Time 1 to Time 2, (Wilk's $\Lambda = 0.741$; $F(1, 39) = 13.66$, $p < .001$, $\eta^2 = .26$). Overall, participants scored lower on Tension-Anxiety at Time 1, prior to the low climb ($M = 3.35$, $SD = 2.57$), than at Time 2, prior to the high climb ($M = 5.09$, $SD = 4.21$). There was also a significant interaction between Tension-Anxiety and Sex (Wilk's $\Lambda = 0.899$; $F(1, 39) = 4.39$, $p < .05$, $\eta^2 = .10$). Pairwise comparison showed a significant increase in Tension-Anxiety for males (Wilk's $\Lambda = 0.713$; $F(1, 39) = 15.73$, $p < .001$, $\eta^2 = .29$) from Time 1 ($M = 3.10$, $SD = 1.68$) to Time 2 ($M = 6.20$, $SD = 3.25$) and no significant change for females (Wilk's $\Lambda = 0.966$; $F(1, 39) = 1.37$, $p < n.s$).

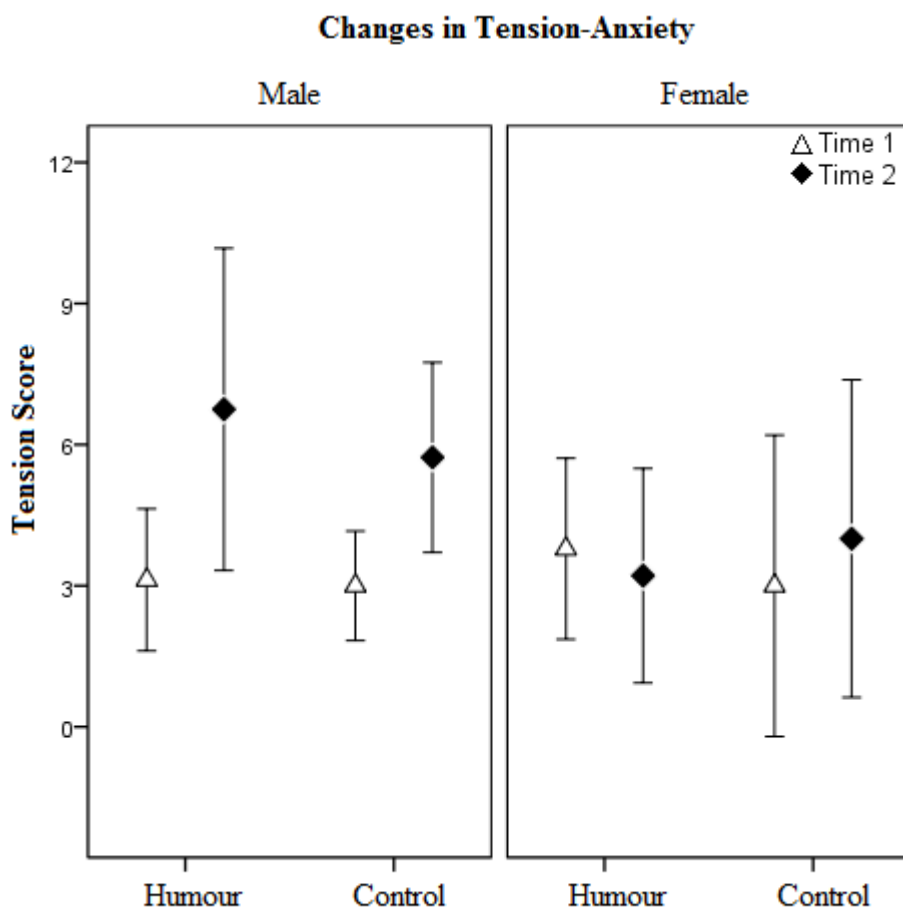


Figure 5.1 showing Tension-Anxiety scores with 95% confidence intervals by Sex by Condition.

Increases in Tension-Anxiety occurred prior to the high climb irrespective of the film viewed by participants (Wilk's $\Lambda = 0.979$; $F(1, 39) = 0.85$, $p < n.s$). However, there may be emergent trends worth mentioning. Pairwise comparison showed a significant increase in Tension-Anxiety for control participants (Wilk's $\Lambda = 0.784$; $F(1, 39) = 10.71$, $p < .01$, $\eta^2 = .22$) from Time 1 ($M = 3.14$, $SD =$

2.31) to Time 2 ($M = 5.71, SE = 4.16$) and no significant change for the humour group (Wilk's $\Lambda = 0.911; F(1, 39) = 3.83, p < .n.s$). Finally, no interaction was observed for Tension-Anxiety X Film Condition X Sex (Wilk's $\Lambda = 0.930; F(1, 39) = 2.95, p < .n.s$).

A second 2 (Sex: male, female) X 2 (Film: humour, control) repeated measures MANOVA, with the Vigour-Activity subscale of the POMS-B (Time 1/ Time 2) as the repeated dependent variable, tested whether viewing the humorous video would improve vigour compared to individuals who watched the neutral/control film. This is shown in Figure 5.2. Overall, a significant main effect for changes in Vigour-Activity was observed (Wilk's $\Lambda = 0.893; F(1, 39) = 4.68, p < .05, \eta^2 = .11$). Participants scored higher on Vigour-Activity at Time 1 ($M = 9.50, SD = 3.78$) than at Time 2 ($M = 8.80, SD = 4.42$). Decreases in Vigour-Activity occurred regardless of the film viewed by participants (Wilk's $\Lambda = 0.938; F(1, 39) = 2.56, p < .n.s$).

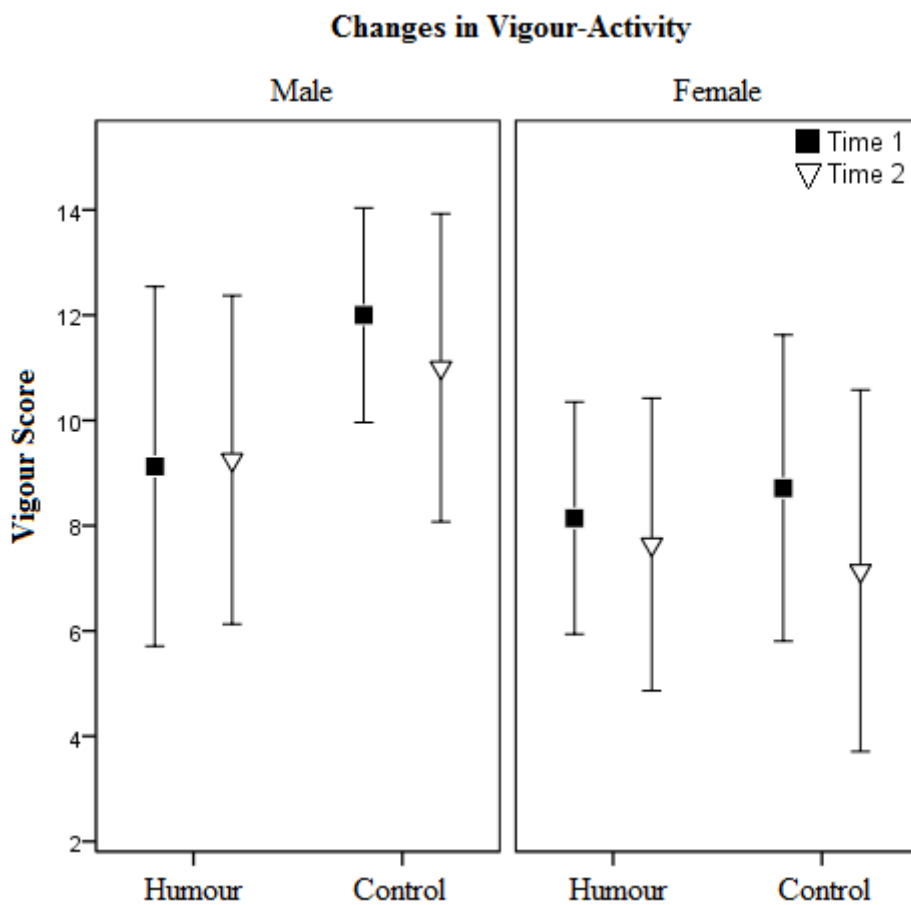


Figure 5.2 showing Vigour-Activity scores with 95% confidence intervals by Sex by Condition.

As with the changes in tension, there are trends worth mentioning. Pairwise comparison showed a significant decrease on the Vigour-Activity subscale for control participants (Wilk's $\Lambda = 0.846$; $F(1, 39) = 7.12$, $p < .01$, $\eta^2 = .15$) from Time 1 ($M = 10.72$, $SD = 3.41$) to Time 2 ($M = 9.50$, $SD = 4.45$) and no significant change for the humour group (Wilk's $\Lambda = 0.996$; $F(1, 39) = 0.16$, $p < n.s$). No interaction effect occurred between Vigour-Activity and Sex (Wilk's $\Lambda = 0.991$; $F(1, 39) = 0.36$, $p < .n.s$) or Vigour-Activity X Film Condition X Sex (Wilk's $\Lambda = 0.997$; $F(1, 39) = 0.12$, $p < .n.s$).

5.4 Climbing Performance

A 2 (Sex: male, female) X 2 (Film: humour, control) repeated measures MANOVA, with the times at different heights (Low/High) as the repeated dependent variable, tested the hypothesis that viewing the humour film would yield improved climbing performance at 5m height compared to those who watched the neutral/control film.

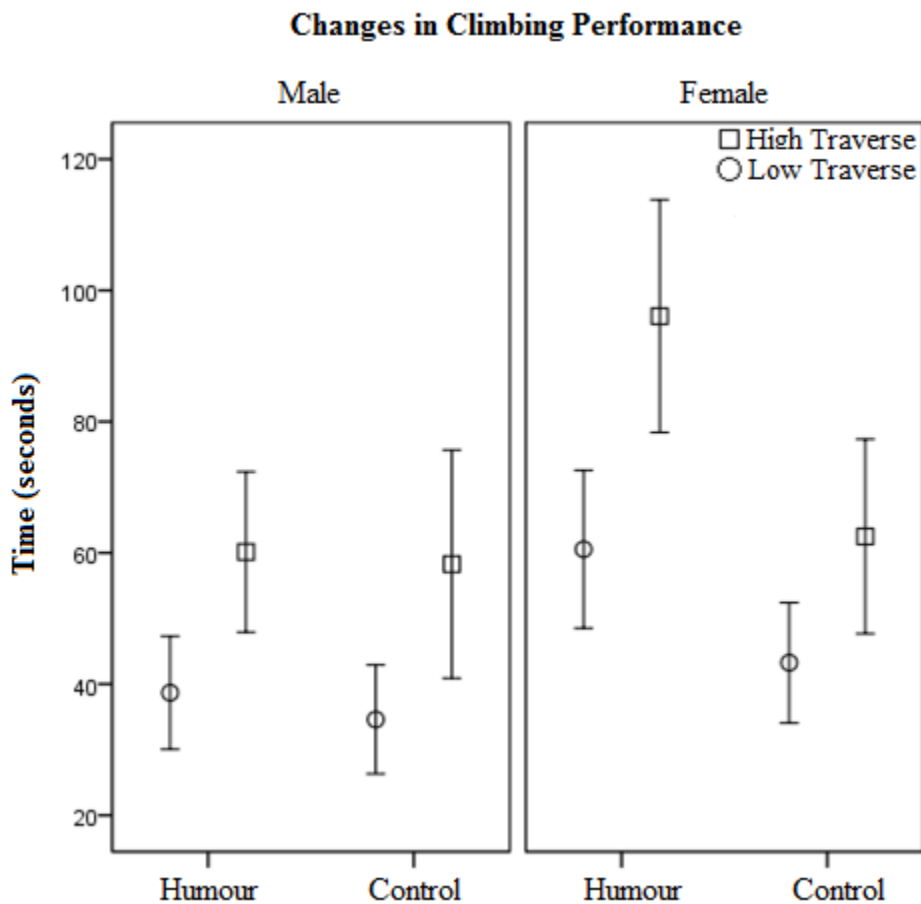


Figure 5.3 showing changes in performance with 95 % confidence intervals by Sex by Condition.

Results indicated a significant main effect on Climbing Performance from exposure to height (Wilk's $\Lambda = 0.320$; $F(1, 36) = 76.47$, $p < .001$, $\eta^2 = .68$). As expected, individuals climbed slower in the High condition ($M = 72.62$, $SD = 29.50$) than in the Low condition ($M = 46.01$, $SD = 18.53$). There was a significant climbing performance difference between the sexes ($F(1, 36) = 8.33$, $p < .01$, $\eta^2 = .18$). Overall, males climbed faster ($M = 47.93$, $SD = 26.72$) than females ($M = 65.59$, $SD = 27.98$). Also a significant climbing performance difference between the film conditions was observed $F(1, 36) = 5.40$, $p < .05$, $\eta^2 = .13$. Climbing Performance was slower for the humour group ($M = 63.86$, $SD = 27.42$) than the control group ($M = 49.66$, $SD = 27.80$).

Decrements in climbing performance occurred irrespective of the film viewed by participants (Wilk's $\Lambda = 0.960$; $F(1, 36) = 1.51$, $p < n.s.$). No interaction effect was observed for Climbing Performance X Film Condition X Sex (Wilk's $\Lambda = 0.932$; $F(1, 36) = 2.62$, $p < n.s.$).

5.5 Effects of Mood State on Climbing Performance

In order to assess whether mood state had a direct bearing on overall performance, the changes in Tension-Anxiety and Vigour-Activity subscales (the difference between Time 1 and Time 2) were regressed against climbing performance (the difference in time taken to complete the Low and High climbing traverses). No effects were observed regarding the subscales on overall climbing performance ($F(1, 39) = 0.88$, $p < n.s.$).

6 Discussion

6.1 Effects of the Humour and Control Films

Can humour reduce stress sufficiently to improve motor-skill performance on a stressful task? All of the members of the humour group found the film clip humorous, with no participants reporting that the film was 'not funny at all'. A 50% majority of participants found the film to be very funny; and another 41% found the film to be somewhat funny; the remaining 9% of participants found the film to be extremely funny – a good indication that an effective humour manipulation was selected for the experiment. Surprisingly, some members of the control group (14%) also reported that their film clip was somewhat funny. This may be explained by the short appearance of an Ansel Adams portrait at the end of the film in which he was shown with a wry smile. The portrait is somewhat unexpected as the film is, otherwise, comprised entirely of landscape photographs. However, this effect was negligible in the difference observed between the groups. The remaining control group participants indicated that they did not find the clip to be funny at all. The behavioural measures, laughter and smiling, reflected these reports of funniness. None of the humour participants failed to smile, and most of them laughed somewhat. A small number (18%) did not laugh at all during the film. By comparison 91% of the control group did not smile and none of them laughed.

6.2 Changes in Mood State and Performance

It is clear that the height of the climb was significantly effective for increasing reports of mood disturbance and reducing climbing performance. Mood state was altered slightly according to the film condition. However, the humour manipulation had no bearing on task performance.

Regarding mood state, trends emerged that suggest watching the humour film may have been beneficial compared to the control film. Individuals in the control group reported an increase in tension whereas individuals in the humour group did not. The observed change in tension aligns with the explanation from arousal. The HPA-response would have been suppressed in the humour condition but not in the control condition resulting in less tension among the humour group. Also, the fact that men responded with increased tension compared to women provides support for the

explanation from arousal. A substantial review of the literature shows that men normally respond with increased HPA activation over women when exposed to acute laboratory stressors (Kudielka & Kirschbaum, 2005). This would explain the increased reports of tension, as it is associated with HPA activation (Olf et al., 2005).

Individuals in the control group also showed a drop in feelings of energy. By comparison, the participants in the humour group did not experience a change in energy. A neat defense of the changes observed for energy is somewhat more difficult to make than for tension. Potentially, the high stress condition could be responsible for diminishing feelings of energy and humour may have functioned to counterbalance this decline.

The arousal profile from humour has been suggested to be similar to that of a toughened individual responding to a challenging circumstance (Dienstbier, 1995). Such an “individual will be labelled by self and others as emotionally stable” (Dienstbier, 1989, p. 93; Ennis et al., 2001). If this is true, then humour may have acted to stabilise or buffer the negative feelings elicited from confrontation with the high stress condition. Yet, changes in mood state did not appear to affect performance. The observed changes in performance fit with the results of earlier work using the same task challenge (Pijpers et al., 2005; Pijpers et al., 2003). On average, participant climbing time took 57% longer on the high stress climb than on the low stress climb. The observed changes in mood state and performance bring up some issues. According to the study hypothesis, increased tension should be accompanied by decreased motor-skill performance. The relative difference in performance change between the groups was negligible. Why, then, did the control group – having shown an increase in tension – not experience a commensurately large decrease in climbing performance when compared to the humour group? The remainder of the discussion section offers theoretical and methodological considerations that may help explain these findings.

6.3 Theoretical Implications

6.3.1 Toughness Theory – Appraisals and Arousal

One particular question arising with regards to toughness theory is whether or not arousal will influence appraisals. Although mood state was altered somewhat by watching the humour film changes may not have had any bearing on the appraisal of the high climb. Toughness theory suggests that the relationship between physiological arousal and appraisals is reciprocal. Early on, Schachter & Singer (1962) maintained that the differences in physiology associated with the emotions are too subtle to have psychological significance. Research since then has distinguished between the physiological response associated with divergent appraisals (Olf et al., 2005) and their concomitant emotional development, such as mirth (Berk et al., 2001; Berk et al., 2008). Yet, these features may not be adequate for influencing subsequent psychological processes in anticipation of a stressor. Cognitive theories of emotion suggest that arousal and emotion are derivatives of the appraisal process and not antecedents for it (Lazarus & Folkman, 1984). Hence, the reason that the humour manipulation did not influence performance could be because arousal and emotions are merely consequential and not determinants of cognition.

As discussed earlier, the work from Tomaka and his colleagues (1997), which analysed the arousal-appraisal relationship, suggested that an existing state of arousal is insufficient to alter situational appraisals. Rather, the relationship may exist in the opposite direction only. The authors found that cognitive appraisals (i.e., of challenge or threat) could be manipulated using different instructional sets. Individuals then displayed corresponding physiological activity patterns. By contrast, manipulating physiological variables, such as cardiovascular reactivity and vascular activity, did not influence a subsequent cognitive appraisal made by individuals. In light of their results, Tomaka et al. (1997, p. 71) state that their studies “go a considerable way toward ruling out likely physiological response patterns as important causal antecedents of threat and challenge responses.”

A similar conclusion is difficult to draw in the present study because appraisals were not assessed accurately. However, it is possible to infer the nature of appraisals because increased distress as assessed by the POMS, is associated with reports of threat appraisal (Wooten et al., 2007). If existing

arousal states do not influence appraisals then performance may not have improved on the high climb because humour, as an arousing manipulation, is not operating as a causal antecedent for appraisals about the high climb. In other words, appraisals of the climb and emotional responses to the film events would have been independent. Therefore, stress while climbing would be the same across the groups. Potentially, an intervention that was directly connected to the event may have been more effective in altering appraisals.

Some feedback from participants appears to support this explanation. One respondent commented specifically on their experience by stating, “I watched the video when I was not yet nervous about climbing. When we moved to the second wall, my ‘happy feeling’ resulting from watching the video was gone immediately when I saw the degree of the second wall”. The stressful event was completely void of the preceding humorous emotional state. This argument is supported by further participant feedback, as many felt it would have been more beneficial to watch the humorous film in order to calm them down after having closely inspected the high traverse from the mezzanine, rather than prior to the event. Moreover, it may have been effective to incorporate humour directly with the stressful scenario such as while standing and evaluating the climb, rather than presenting it during a break.

6.3.2 Humour or Mirth – Psychology or Physiology?

A likely explanation is that humour, which is devoid of cognitive content, may not be beneficial for performance outcomes. As discussed in the methods section, in order to overcome cultural and language issues it was proposed that the contagion effects of laughter would be sufficient to elicit the physiological response that would improve performance. Dienstbier’s (1995) claim was that the physiological features of humour reflect the response of a tough individual. Within the stress and coping literature, humour is primarily viewed as a cognitive coping mechanism. The ability of humour to modify stress is primarily contingent upon its content specificity and its role in altering appraisals (Martin & Lefcourt, 1983; Newman & Stone, 1996). Humour helps to modify the appraisal of the situation or the stressor itself (C. Moran, 1990; C. Moran & Massam, 1997; C. Moran & Massam, 1999). Joking about stressors directly can help to reframe events and reduce their magnitude, both by reducing their apparent severity and personal relevance (C. Moran & Massam, 1997). The

findings suggest that humour which is not directed at the source of stress is insufficient to alter motor-skill performance.

Humour in the present study would not have the protective psychological effect it has when created by the individual with regard to the situation. Arousal may only be a consequence of humour and not have a bearing on cognitive appraisals, regardless of how strong its physiological effects are.

Arguably, humour, which is not situationally relevant, is not going to have an observable effect on an individual who is dealing with a stressful circumstance. It is the cognitive processes underlying humour that are responsible for minimising perceptions of threat and reducing stress and not solely the accompanying emotional experience.

Future researchers examining the stress moderating effects of humour for motor-skill performance could instruct participants to create a humorous dialogue or joke that pertained to the stressful task. For example, Newman & Stone (1996) had individuals create dialogue for a silent and stressful film. They found that individuals who created a humorous monologue had lower negative affect, lower tension, and reduced psychophysiological reactivity compared to individuals who generated a non-humorous monologue. Changes such as these, when also directed at the source of the stressor, may have much stronger implications for altering task performance. Assessments could be made regarding the degree to which individuals are able to create jokes and laugh at themselves and their own anxiety in a given situation. Such uses of humour could have multiple consequences, such as diminishing the apparent importance of the situation; or further, diminishing an individual's sense of self importance. If individuals are capable of reducing their own expectations about their performance or the situation with joking, they may be able to escape issues associated with self-limiting behaviours that accompany choking under pressure. Either, by freeing up attentional resources or allowing for the redirection of attention to task execution (DeCaro, Thomas, Albert, & Beilock, 2011).

6.4 Methodological Issues

Although humour did appear to make minor changes in tension and energy in the present study, these changes may not have been substantial enough to have had any perceptible influence on the

experience of anxiety during the actual climb. This would mean that anxiety concerning the high climbing condition was not allayed at all. This leads to questions regarding the way in which anxiety was measured during the present experiment.

6.4.1 Measures

It is possible that the administration of the POMS-B did not provide an accurate depiction of participants' experience during the actual climb. In other studies involving the same climbing task, researchers assessed reports of anxiety both immediately prior to, and following, the climb. The average of these two values was used to record experienced anxiety (Pijpers et al., 2005; Pijpers et al., 2003). One participant in the present study commented that the amount of 'anxiety' or stress that they had experienced in anticipation of the event was much worse than it needed to be. They explained that while climbing the high traverse, their experience was not nearly as stressful as had been anticipated. Potentially, reports of stress may not accurately reflect stress while climbing, which would account for the inconsistency between performance and the reported changes in mood states.

The results regarding changes in mood state should be interpreted with caution because the trends are not statistically robust. Furthermore, although changes in mood state are in alignment with the hypothesis itself – participants who experienced humour were expected to report more positive levels of affect over those who did not – they did not occur in the expected direction. According to the explanation in the literature review it was anticipated that the humour group would report an increase in vigour and a decrease in tension. Instead, the humour group reported no significant changes on either of these dimensions. By comparison, the control group showed increased tension and decreased vigour. Hence, although humour was argued to act as an emotional buffer, such an explanation may be a 'just-so' account of the observed events. Finally, arousal is inferred from the observations in mood state. Because arousal was not measured directly it is difficult to know whether or not humour did in fact produce the desired arousal profile.

6.4.2 Intensity of the Stimulus

The arousing stimulus may not have been of adequate intensity to elicit a response that was effective for performance change. Although all participants rated the video as funny, only a few individuals

appeared to respond with a very strong reaction of full body laughter and facial expressions. It has been suggested that physiological arousal may become a component for appraisal or judgement in the form of somatosensory feedback but only if sufficiently intense (Hardy, 1999). It is possible that the humour manipulation would have to be of greater intensity to yield a response that is significant for performance change. For example, Buchanan et al. (1999) conducted an experiment examining changes in cortisol levels in response to positive and negative affect. They showed a thirty-minute induction video, which involved three different segments. By comparison the present experiment showed a two-minute video. Thus, the proposed effects of humour may not have been observed because the stimulus was not of sufficient intensity.

One shortcoming, as with the study conducted by Dienstbier (1995), was the time delay that occurred between the humour manipulation and the performance of the task. Even if participants experienced increased energy from LC/SA responding, the effects may have diminished during the time taken to fill out the POMS-B and get ready with the belay/rope system. The brief version of the POMS questionnaire was used as an attempt to overcome this issue, but participants took 5 minutes or longer on average to complete the form. Time for completion was significantly worsened because many participants did not speak English as their first language. Arguably, the length of time between the manipulation and the task could have been sufficient for the effects of the manipulation to have disappeared since the half-life of catecholamines is only two minutes in humans (Dienstbier & Zillig, 2002).

6.4.3 Humour as a distraction

Other researchers have proposed that humour, which does not have situationally relevant content, could simply be distracting from the task at hand (Townsend & Mahoney, 1981). It is also possible to misinterpret humour. Beyond simply serving as a positive cognitive resource for coping, humour can have negative consequences, especially when it is derisive in nature. This happened, specifically, in the present experiment with one participant, who said that the laughter in the humour film was like the “Devil’s laugh”. For this participant, and potentially others, the humorous film was actually a source of tension regarding the upcoming climbing task. Although the experimenter recorded behavioural

observations for all participants, the laughter and smiling may have been misinterpreted and could have represented nervous tension or embarrassment at the situation, rather than genuine mirthful emotions. This issue is difficult to account for; with the exception that the observed trends in mood state suggest that the humour film was, generally, positively interpreted.

6.4.4 Sources of Stress

As discussed in the literature review, investigations of humour have always been conducted using cognitively demanding tasks. In such studies, stress is induced with time constraints and ego-involvement. Potentially, the source of stress in the present experiment is greater than in other investigations because it involved the perception of real physical harm. In terms of evolutionary psychology, this may be because the fear of height represents a fundamental threat. Evolutionary psychology assumes an environment of adaptedness in order to explain psychological phenomena. Repeated environmental demands would have allowed for the development, and selection, of specific adaptationally advantageous artefacts; an emotion, such as fear, helps to orchestrate the stress response and suppress or override other processes (Cummins, 2005). Commonly mentioned stimuli within evolutionary psychology that would have comprised the environment of adaptedness, includes heights, among other things, as a primary example (Cummins, 2005; Öhman, 2008). The fundamental nature of the stressor could account for the fact that humour did not mitigate fear because it may have been more severe than in other contexts (e.g. written examination).

6.4.5 Confounding Variables

Potentially, increased reports of tension in the present experiment could be equated with increased levels of effort. In a study involving experienced rock climbers it was found that increased reports of anxiety were associated with commensurately higher levels of effort and performance (Hardy & Hutchinson, 2007). The high levels of stress reported by male participants in the present experiment could be related to concerns about their own performance and not necessarily exposure to height. This increase in concern could have been associated with greater effort, and hence better performance. Males did, indeed, climb faster than females. In future, researchers using a similar assessment might evaluate the extent to which the intended stressor and not some confounding variable, such as performance or competition pressure, was the source of tension.

6.4.6 Personality Traits

Although participants had little or no experience climbing, the reactions to the high traverse were extremely varied. Some individuals appeared completely at ease climbing at height, regardless of the film condition that they were in. In contrast, some individuals appeared exceptionally nervous during the entire experiment in anticipation of having to climb at height. For example, one participant, although both willing and able to complete the high traverse, was extremely upset and in tears due to a strong fear of heights as the result of a traumatising childhood experience. In an experiment involving a relatively strong source of stress personality traits need to be accounted for. For example, the State Trait Anxiety Inventory (STAI) could be used in future tests to account for predispositions to respond with an increased level of anxiety. This is highly salient in the present context because it has been pointed out that personality traits can have an impact on differences in physiological responding (Deckers, 2005). Sense of humour, similar to anxiety, is a personality trait that can strongly influence the nature of the response. Individuals with a good sense of humour will show a stronger response than individuals with a poor sense of humour (Deckers, 2005).

6.4.7 Environmental Factors

Additional concerns, regarding the results, are environmental/situational factors. It has been suggested that it “may not be possible to identify physiological profiles that are specific to each emotion, since the situation, cognition, and task demands all contribute to physiological reactivity” (Deckers, 2005, p. 365). The facility used for this experiment was commercial, and experiments were conducted at the convenience of the participants. As a result the circumstances were variable. Participants watched the humorous film in isolation, which made delivery relatively consistent. By comparison, the climbing segment of the experiment changed dramatically. Changes in the setting ranged from the presence of large noisy school groups, to an entirely empty facility, and the presence or absence of different types of music. These factors could have altered levels of stress or task concentration during climbing and therefore account for the lack of consistency between the hypothesis and observed performance change.

The power analysis conducted at the outset of this project suggested a minimum number of participants that was more than twice what was obtained. Results may be incidental due to the small

number of participants. However, the expected effect size was anticipated to be very small. In light of the fact that individuals in the humour group did not report increases in tension or distress, it is with some confidence that the interpretation provided in the discussion is accurate.

7 Conclusion

Humour is used in stressful environments to reframe events in ways that are less personally relevant and therefore less damaging (C. Moran, 1990; C. Moran & Massam, 1997). This reduces the relevance of stressors for personal well-being and provides a protective psychological function. Research has also shown that humour is effective in improving task performance, when used as a specific coping strategy in order to deal with threat (Ford et al., 2004; Perlini, Nenonen, & Lind, 1999). Studies examining the efficacy of humour on specific task performance, under conditions of stress, appear to provide contradictory findings, and the role of humour for improving performance through reductions in tension and anxiety may be overstated.

In order to appreciate the nuances of humour, its physiological aspects were assessed separately from its psychological ones in the present experiment. Studies have shown that the experience of humour has additional positive consequences, which include salutary endocrine and physiological responses, that can alleviate anxiety and tension (Berk et al., 2001; Berk et al., 2008; Berk et al., 1989; Levi, 1965; Newman & Stone, 1996). Further, these changes can improve feelings of energy (Dienstbier, 1995; Godkewitsch, 1976). The findings of the present study suggest that an existing state of positive emotional arousal is insufficient to alter a successive encounter with an acute stressor. This has now been shown to be the case for motor-skill performance herein and for cognitive performance elsewhere (Dienstbier, 1995). Probably, the mirthful experience pertained only immediately to the appreciation of the humour stimulus.

Humour appears to be very important for positive physical and psychological health. Efforts to measure the stress moderating effect of humour on the immediate outcome of performance under pressure from putative stressors may be extraneous. The present findings, coupled with a review of the literature, suggest that a more substantial avenue for humour and task performance investigations would be to consider it as a personality trait or individual characteristic; in other words, analysing humour as an instrumental cognitive tool, rather than a passive manipulation, as was done in the present study. This could be done by instructing participants to create jokes about stressors as well as

assessing the relevance of humour as an individual coping strategy, such as with the coping humour scale and the situational humour response questionnaire.

Acknowledgements

My father has been one of the most important people in my life. It is difficult to express how thankful I am to him for his on-going support and guidance throughout my education and through to the conclusion of this project. Also, I am very grateful to my grandmother Jan, who has always been supportive, kind, and loving. My families in Australia and the U.S. have been a tremendous source of inspiration and energy, without them I would not have come this far. I especially want to say thank you to the Czernys and the Madsens.

I would like to thank my supervisors Gary Steel and Kevin Moore. They both gave excellent support through my, sometimes, very sluggish rate of progress. Thank you for all of the meetings and for answering my questions *ad nauseam*. Also, thank you for the ‘pep talks’ and helping to keep me motivated. You helped capture my interest in social psychology and philosophy.

I’m exceptionally grateful to my friends Simon Fryer and Annabel Clouston who both proof-read my thesis in its entirety and cheered me onto the end.

Finally, I would like to acknowledge the many special people who have made being at Lincoln so memorable. Thanks for sharing this time with me – Laxmi Gurung, Lhakpa Lhama, , Kate Hicks, Nick Reuther, Joe Harrison, Benita Chambers, Johannes Welsch, Maiki Anderson, Abbie Bull, Sam Sullivan, Mark Eltom, Will Schultz, Graham Swanepoel, Tom Maxwell, Russell Moss, Carlos Ramirez, Alejandro ‘Jimmy’ Mora-Muñoz, Elisabeth Christensen, Juan Fernando Dueñas-Serrano, Zoe McCormack, Lisa Couet, Jake Shaw, Jonathan Fox, Peter Jacksons, Alana Harrison, Lara Peters, Roland Foster, Jane Mather, Bin Tian, Nick Kirk, Maria Jose Iturbide Flores, Fernando García-Barrios, Merrilyn Grey, Gareth Wheeler, Shailindra, Julia Lindemann, Kelly Martin, Amanda Hurley, Jill Spevacek, Romain Legrande, Ajay Iyengar, Andrew ‘Stag’ Wilkinson, Tim ‘Bur’, Amanda Cook, Brendon Rule, Kimberly Ransfield, Sho and Anna Kasuya, Chathura Prasan, Andy Zimmerman, Matthias Schmidtner, Maëlle Talichet, Aditya Lukas, Anna Blum, Felix Cambiaso, Maria Kollar, Martin Bienek, Fred William, Ben Gira, and Matthew Watkins.

References

- Acevedo, E. O., & Ekkekakis, P. (2006). *Psychobiology of physical activity*. Champaign, IL: Human Kinetics Publishers.
- Adair, F. A., & Siegel, L. (1984). *Improving performance through the use of humor*. Paper presented at the meeting of the Southeastern Psychological Association (30th, New Orleans, LA, March 28-31, 1984).
- Al'Absi, M., Bongard, S., Buchanan, T., Pincomb, G. A., Licinio, J., & Lovallo, W. R. (1997). Cardiovascular and neuroendocrine adjustment to public speaking and mental arithmetic stressors. *Psychophysiology*, *34*(3), 266-275.
- Aldwin, C. (2011). Stress and coping across the lifespan. In S. Folkman (Ed.), *The Oxford handbook of stress, health, and coping* (pp. 15-34). New York, NY: Oxford University Press.
- Baumeister, R. F. (1984). Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of Personality and Social Psychology*, *46*(3), 610.
- Berk, L. S., Felten, D. L., Tan, S. A., Bittman, B. B., & Westengard, J. (2001). Modulation of neuroimmune parameters during the eustress of humor-associated mirthful laughter. *Alternative therapies in health and medicine*, *7*(2), 62-76.
- Berk, L. S., Tan, S. A., & Berk, D. (2008). Cortisol and Catecholamine stress hormone decrease is associated with the behavior of perceptual anticipation of mirthful laughter. *The FASEB Journal*, *22*(1_MeetingAbstracts), 946.911.
- Berk, L. S., Tan, S. A., Fry, W. F., Napier, B. J., Lee, J. W., Hubbard, R. W., . . . Eby, W. C. (1989). Neuroendocrine and stress hormone changes during mirthful laughter. *The American journal of the medical sciences*, *298*(6), 390.
- Bray, J. J. (1999). *Lecture notes on human physiology*: Wiley-Blackwell.
- Broadhurst, P. L. (1957). Emotionality and the Yerkes-Dodson law. *Journal of Experimental Psychology*, *54*(5), 345.
- Buchanan, T. W., al'Absi, M., & Lovallo, W. R. (1999). Cortisol fluctuates with increases and decreases in negative affect. *Psychoneuroendocrinology*, *24*(2), 227-241.
- Cade, B. W. (1982). Humour and creativity. *Journal of Family Therapy*, *4*(1), 35-42. doi:10.1046/j..1982.00575.x
- Cann, A., Calhoun, L. G., & Nance, J. T. (2000). Exposure to humor before and after an unpleasant stimulus: Humor as a preventative or a cure. *Humor*, *13*(2), 177-192.
- Christensen, A. J., Martin, R., & Smyth, J. M. (2004). *Encyclopedia of health psychology*. New York, NY: Kluwer Academic.
- Chrousos, G. P., & Gold, P. W. (1992). The concepts of stress and stress system disorders. *JAMA: the journal of the American Medical Association*, *267*(9), 1244.
- Cousins, N. (1976). Anatomy of an illness (as perceived by the patient). *New England Journal of Medicine*, *295*(26), 1458-1463.
- Cox, T., Griffiths, A., & Rial, E. (2010). Work Related Stress. *Occupational Health Psychology*.
- Cummins, D. (2005). Dominance, status, and social hierarchies. In D. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 676-697). Hoboken, NJ: John Wiley & Sons, Inc.
- Curran, S. L., Andrykowski, M. A., & Studts, J. L. (1995). Short Form of the Profile of Mood States (POMS-SF): Psychometric information. *Psychological Assessment*, *7*(1), 80.
- DeCaro, M. S., Thomas, R. D., Albert, N. B., & Beilock, S. L. (2011). Choking under pressure: Multiple routes to skill failure. *Journal of Experimental Psychology: General*, *140*(3), 390.

- Deckers, L. (2005). *Motivation: Biological, psychological, and environmental*. Boston, MA: Allyn & Bacon.
- Dienstbier, R. A. (1989). Arousal and physiological toughness: Implications for mental and physical health. *Psychological review*, *96*(1), 84-100.
- Dienstbier, R. A. (1992). Mutual impacts of toughening on crises and losses. *Life crises and experiences of loss in adulthood*, 367-384.
- Dienstbier, R. A. (1995). The impact of humor on energy, tension, task choices, and attributions: Exploring hypotheses from toughness theory. *Motivation and Emotion*, *19*(4), 255-268.
- Dienstbier, R. A., & Zillig, L. P. (2002). Toughness. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of Positive Psychology*. Oxford, NY: Oxford University Press.
- Dolan, R. J. (2002). Emotion, cognition, and behavior. *Science*, *298*(5596), 1191.
- Driskell, J. E., & Salas, E. (1996). *Stress and human performance*: Lawrence Erlbaum.
- Ennis, M., Kelly, K. S., Wingo, M. K., & Lambert, P. L. (2001). Cognitive appraisal mediates adrenomedullary activation to a psychological stressor. *Stress and health*, *17*(1), 3-8.
- Fink, G. (2009). *Stress science: neuroendocrinology*: Academic Press.
- Fitts, P. M. (1964). Perceptual-motor skill learning. In A. W. Melton (Ed.), *Categories of human learning*. New York, NY: Academic Press.
- Folkman, S., & Nathan, P. E. (2011). *The Oxford handbook of stress, health, and coping*. New York, NY: Oxford University Press.
- Ford, T. E., Ferguson, M. A., Brooks, J. L., & Hagadone, K. M. (2004). Coping sense of humor reduces effects of stereotype threat on women's math performance. *Personality and Social Psychology Bulletin*, *30*(5), 643.
- Ford, T. E., Ford, B. L., Boxer, C. F., & Armstrong, J. (2012). Effect of humor on state anxiety and math performance. *Humour*, *25*(1), 59-74.
- Fredrickson, B. L. (2003). Positive emotions and upward spirals in organizations. *Positive organizational scholarship*, 163-175.
- Fredrickson, B. L. (2004). The broaden-and-build theory of positive emotions. *Philosophical Transactions-Royal Society of London Series B Biological Sciences*, 1367-1378.
- Freedman, J. L., & Perlick, D. (1979). Crowding, contagion, and laughter. *Journal of Experimental Social Psychology*, *15*(3), 295-303.
- Fry, R. W., Grove, J. R., Morton, A. R., Zeroni, P. M., Gaudieri, S., & Keast, D. (1994). Psychological and immunological correlates of acute overtraining. *British Journal of Sports Medicine*, *28*(4), 241-246.
- Fry, W. (1979). Using Humor to Save Lives. *Address to the American Orthopsychiatry Association*.
- Gaab, J., Rohleder, N., Nater, U. M., & Ehlert, U. (2005). Psychological determinants of the cortisol stress response: the role of anticipatory cognitive appraisal. *Psychoneuroendocrinology*, *30*(6), 599-610. doi:10.1016/j.psyneuen.2005.02.001
- Gaillard, A. W. K. (2008). Concentration, stress and performance. In P. A. Hancock & J. L. Szalma (Eds.), *Performance under stress* (pp. 59-75): Ashgate Publishing Limited.
- Gavanski, I. (1986). Differential sensitivity of humor ratings and mirth responses to cognitive and affective components of the humor response. *Journal of Personality and Social Psychology*, *51*(1), 209.
- Geisler, F., & Weber, H. (2010). Harm that does not hurt: Humour in coping with self-threat. *Motivation and Emotion*, *34*(4), 446-456. doi:10.1007/s11031-010-9185-6
- Gervais, M., & Wilson, D. S. (2005). The evolution and functions of laughter and humor: A synthetic approach. *The Quarterly Review of Biology*, *80*(4), 395-430.
- Gill, D. L. (1994). A sport and exercise psychology perspective on stress. *Quest*, *46*, 20-27.

- Godkewitsch, M. (1976). Physiological and verbal indices of arousal in rated humor. *Humor and laughter: Theory, research, and applications*, 118-138.
- Gray, J. A. (1987). *The psychology of fear and stress* (Vol. 5): Cambridge Univ Pr.
- Gray, M. A., Harrison, N. A., Wiens, S., & Critchley, H. D. (2007). Modulation of emotional appraisal by false physiological feedback during fMRI. *PLoS One*, 2(6), e546.
- Graydon, D., Hanson, K., & Mountaineers. (1997). *Mountaineering: the freedom of the hills*: Mountaineers.
- Groarke, A. M., Curtis, R., & Kerin, M. (2011). Global stress predicts both positive and negative emotional adjustment at diagnosis and post-surgery in women with breast cancer. *Psycho-Oncology*.
- Hancock, P. A., & Szalma, J. L. (2008). *Performance under stress*. Burlington, VT: Ashgate Publishing Limited.
- Hanin, Y. L. (1989). Interpersonal and intragroup anxiety in sports. In D. Hackfort & C. D. Spielberger (Eds.), *Anxiety in sports: An international perspective* (pp. 19-28). New York, NY: Hemisphere.
- Hanin, Y. L. (2000). *Emotions in sport*. Auckland, NZ: Human Kinetics.
- Hardy, L. (1999). Stress, anxiety and performance. *Journal of Science and Medicine in Sport*, 2(3), 227-233.
- Hardy, L., & Fazey, J. (1987). The inverted-U hypothesis: a catastrophe for sport psychology. *Unpublished Conference Paper*, 1-26.
- Hardy, L., & Hutchinson, A. (2007). Effects of performance anxiety on effort and performance in rock climbing: A test of processing efficiency theory. *Anxiety, Stress and Coping*, 20(2), 147-161.
- Hardy, L., & Parfitt, G. (1991). A catastrophe model of anxiety and performance. *British journal of psychology*, 82(2), 163-178.
- Holmes, J. (2007). Making humour work: Creativity on the job. *Applied Linguistics*, 28(4), 518-537.
- Hull, C. L. (1943). *Principles of behavior: An introduction to behavior theory*. New York, London: Appleton-Century Company, Incorporated.
- Izard, C. E. (2011). Forms and functions of emotions: Matters of emotion–cognition interactions. *Emotion Review*, 3(4), 371-378.
- Jamieson, J. P., Mendes, W. B., Blackstock, E., & Schmader, T. (2010). Turning the knots in your stomach into bows: Reappraising arousal improves performance on the GRE. *Journal of Experimental Social Psychology*, 46(1), 208-212.
- Jin, P. (1989). Changes in heart rate, noradrenaline, cortisol and mood during Tai Chi. *Journal of psychosomatic research*, 33(2), 197-206. doi:10.1016/0022-3999(89)90047-0
- Kahn, R. S., Asnis, G. M., Wetzler, S., & Praag, H. M. (1988). Neuroendocrine evidence for serotonin receptor hypersensitivity in panic disorder. *Psychopharmacology*, 96(3), 360-364.
- Kemeny, M. E. (2003). The psychobiology of stress. *Current Directions in Psychological Science*, 12(4), 124.
- Kudielka, B. M., & Kirschbaum, C. (2005). Sex differences in HPA axis responses to stress: a review. *Biological Psychology*, 69(1), 113-132.
- Kuiper, N. A., Martin, R. A., & Olinger, L. J. (1993). Coping humour, stress, and cognitive appraisals. *Canadian Journal of Behavioural Science*, 25, 81-81.
- Lai, J. C. L., Chong, A. M. L., Siu, O. T., Evans, P., Chan, C. L. W., & Ho, R. T. H. (2010). Humor attenuates the cortisol awakening response in healthy older men. *Biological Psychology*, 84(2), 375-380.

- Landers, D. M. (1980). The arousal-performance relationship revisited. *Research Quarterly for Exercise and Sport*, 51(1), 77-90.
- Lazarus, R. S. (1991). *Emotion and Adaptation*. Carry, NC: Oxford.
- Lazarus, R. S. (1993). Coping theory and research: Past, present, and future. *Psychosomatic Medicine*, 55, 234-234.
- Lazarus, R. S. (1999). *Stress and emotion: A new synthesis*. New York, NY: Springer Publishing Company.
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York, NY: Springer Publishing Company.
- Lefcourt, H., Davidson, K., Shepherd, R., Phillips, M., Prkachin, K., & Mills, D. (1995). Perspective-Taking Humor: Accounting for Stress Moderation. *Journal of Social and Clinical Psychology*, 14(4), 373-391. doi:10.1521/jscp.1995.14.4.373
- Lench, H. C., Flores, S. A., & Bench, S. W. (2011). Discrete emotions predict changes in cognition, judgment, experience, behavior, and physiology: A meta-analysis of experimental emotion elicitation. *Psychological Bulletin*, 137(5), 834.
- Levi, L. (1965). The urinary output of adrenalin and noradrenalin during pleasant and unpleasant emotional states: A preliminary report. *Psychosomatic Medicine*, 27(1), 80.
- Lundberg, U., & Frankenhaeuser, M. (1980). Pituitary-adrenal and sympathetic-adrenal correlates of distress and effort. *Journal of Psychosomatic Research*, 24(3-4), 125-130.
- Malarkey, W. B., Kiecolt-Glaser, J. K., Pearl, D., & Glaser, R. (1994). Hostile behavior during marital conflict alters pituitary and adrenal hormones. *Psychosomatic Medicine*, 56(1), 41.
- Mark, G. M., & Smith, A. P. (2008). Stress models: A review and suggested new direction. *Occupational health psychology: European perspectives on research, education, and practice*, 3, 11-144.
- Markus, R., Panhuysen, G., Tuiten, A., & Koppeschaar, H. (2000). Effects of food on cortisol and mood in vulnerable subjects under controllable and uncontrollable stress. *Physiology & Behavior*, 70(3-4), 333-342. doi:10.1016/s0031-9384(00)00265-1
- Martin, R. A. (2007). *The psychology of humor: An integrative approach*: Academic Press.
- Martin, R. A., & Lefcourt, H. M. (1983). Sense of humor as a moderator of the relation between stressors and moods. *Journal of Personality and Social Psychology*, 45(6), 1313-1324.
- Masters, R. S. W. (1992). Knowledge, knerves and know-how: The role of explicit versus implicit knowledge in the breakdown of a complex motor skill under pressure. *British journal of psychology*, 83(3), 343-358.
- Matthews, G. (2000). *Human performance: Cognition, stress, and individual differences*. New York, NY: Routledge
- Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion*, 5(2), 175.
- Mayes, L. C. (2000). A developmental perspective on the regulation of arousal states. *Seminars in Perinatology*, 24(4), 267-279.
- McMorris, R. F., Boothroyd, R. A., & Pietrangelo, D. J. (1997). Humor in educational testing: A review and discussion. *Applied Measurement in Education*, 10(3), 269-297.
- McMorris, R. F., Urbach, S. L., & Connor, M. C. (1985). Effects of incorporating humor in test items. *Journal of Educational Measurement*, 22(2), 147-155. doi:10.1111/j.1745-3984.1985.tb01054.x

- McNair, D. M., Lorr, M., & Droppelman, L. F., & E. a. T. Service. (1981). *Manual for the profile of mood states* [San Diego].
- Miller, M., & Fry, W. F. (2009). The effect of mirthful laughter on the human cardiovascular system. *Med Hypotheses*, 73(5), 636-639.
- Moran, A. (2004). *Sport and exercise psychology: A critical introduction*. New York, NY: Routledge.
- Moran, C. (1990). Does the use of humor as a coping strategy affect stresses associated with emergency work? *International Journal of Mass Emergencies and Disasters*, 8(3), 361-377.
- Moran, C., & Massam, M. (1997). An evaluation of humour in emergency work. *The Australasian Journal of Disaster and Trauma Studies*, 3, 26-38.
- Moran, C., & Massam, M. (1999). Differential influences of coping humor and humor bias on mood. *Behavioral Medicine*, 25(1), 36-42.
- Mullen, R., & Hardy, L. (2000). State anxiety and motor performance: Testing the conscious processing hypothesis. *Journal of Sports Sciences*, 18(10), 785-799.
- Nabkasorn, C., Miyai, N., Sootmongkol, A., Junprasert, S., Yamamoto, H., Arita, M., & Miyashita, K. (2006). Effects of physical exercise on depression, neuroendocrine stress hormones and physiological fitness in adolescent females with depressive symptoms. *The European Journal of Public Health*, 16(2), 179-184.
- Newman, M., & Stone, A. (1996). Does humor moderate the effects of experimentally-induced stress? *Annals of Behavioral Medicine*, 18(2), 101-109.
doi:10.1007/bf02909582
- O'Brien, L. T., & Crandall, C. S. (2003). Stereotype threat and arousal: Effects on women's math performance. *Personality and Social Psychology Bulletin*, 29(6), 782.
- O'Connor, P. J., Morgan, W. P., Raglin, J. S., Barksdale, C. M., & Kalin, N. H. (1989). Mood state and salivary cortisol levels following overtraining in female swimmers. *Psychoneuroendocrinology*, 14(4), 303-310. doi:10.1016/0306-4530(89)90032-2
- Öhman, A. (2008). Fear and anxiety: Overlaps and dissociations. *Handbook of Emotions*, 3rd Edition. Guilford Press: NY, 709-729.
- Olf, M., Langeland, W., & Gersons, B. P. R. (2005). Effects of appraisal and coping on the neuroendocrine response to extreme stress. *Neuroscience & Biobehavioral Reviews*, 29(3), 457-467.
- Palmer, J. (1994). *Taking humour seriously*. London: Routledge.
- Perlini, A. H., Nenonen, R. G., & Lind, D. L. (1999). Effects of humor on test anxiety and performance. *Psychological reports*, 84(3c), 1203-1213.
- Pijpers, J. R., Oudejans, R. R. D., & Bakker, F. C. (2005). Anxiety-induced changes in movement behaviour during the execution of a complex whole-body task. *The Quarterly Journal of Experimental Psychology Section A*, 58(3), 421-445.
- Pijpers, J. R., Oudejans, R. R. D., Holsheimer, F., & Bakker, F. C. (2003). Anxiety-performance relationships in climbing: a process-oriented approach. *Psychology of Sport and Exercise*, 4(3), 283-304. doi:10.1016/s1469-0292(02)00010-9
- Quigley, K. S., Barrett, L. F., & Weinstein, S. (2002). Cardiovascular patterns associated with threat and challenge appraisals: A within-subjects analysis. *Psychophysiology*, 39(03), 292-302.
- Razmjou, S. (1996). Mental workload in heat: toward a framework for analyses of stress states. *Aviation, space, and environmental medicine*.
- Reisenzein, R. (1983). The Schachter theory of emotion: Two decades later. *Psychological Bulletin*, 94(2), 239.
- Rippetoe, M., Kilgore, L., & Bradford, S. (2009). *Practical Programming for Strength Training*. Witicha Falls, TX: Aasgaard Company.

- Roeckelein, J. E. (2002). *The psychology of humor: A reference guide and annotated bibliography*: Greenwood Press/Greenwood Publishing Group.
- Rowe, A., & Regehr, C. (2010). Whatever gets you through today: An examination of cynical humour among emergency service professionals. *Journal of loss and trauma*, *15*, 448-464.
- Rüsch, N., Corrigan, P. W., Powell, K., Rajah, A., Olschewski, M., Wilkniss, S., & Batia, K. (2009). A stress-coping model of mental illness stigma: II. Emotional stress responses, coping behavior and outcome. *Schizophrenia research*, *110*(1-3), 65-71.
- Sakuragi, S. (2005). Laughing and Weeping. In A. V. Clark (Ed.), *Psychology of moods*. NY, New York: Nova Science Pub Inc.
- Sakuragi, S., Sugiyama, Y., & Takeuchi, K. (2002). Effects of laughing and weeping on mood and heart rate variability. *Journal of physiological anthropology and applied human science*, *21*(3), 159-165.
- Salmon, P. (2001). Effects of physical exercise on anxiety, depression, and sensitivity to stress: A unifying theory. *Clinical Psychology Review*, *21*(1), 33-61.
- Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological review*, *69*(5), 379.
- Seaward, B. L. (1992). Humor's Healing Potential. *Health Progress*, 67.
- Selye, H. (1936). A syndrome produced by diverse nocuous agents. *Nature; Nature*, *138*(32).
- Selye, H. (1950). Stress and the general adaptation syndrome. *British Medical Journal*, *1*(4667), 1383-1392.
- Shurcliff, A. (1968). Judged humour, arousal, and the relief theory. *Journal of Personality and Social Psychology*, *8*(4, Part 1), 360-363. doi:10.1037/h0025493
- Smith, D., & Bar-Eli, M. (2007). *Essential readings in sport and exercise psychology*: Human Kinetics Publishers.
- Smith, R. E., Ascough, J. C., Ettinger, R. F., & Nelson, D. A. (1971). Humor, anxiety, and task performance. *Journal of Personality and Social Psychology*, *19*(2), 243-246. doi:10.1037/h0031305
- Snyder, C. R., & Lopez, S. J. (2002). *Handbook of positive psychology*: Oxford University Press, USA.
- Sothmann, M. (2006). The cross-stressor adaptation hypothesis and exercise training. In E. O. Acevedo & P. Ekkekakis (Eds.), *Psychobiology of physical activity*. Auckland: Human Kinetics.
- Spence, K. W. (1951). Theoretical interpretations of learning. In S. S. Stevens (Ed.), *Handbook of experimental psychology*. New York: Wiley.
- Staal, M. A. (2004). Stress, cognition, and human performance: A literature review and conceptual framework. *NASA Technical Memorandum*, *212824*.
- Stokes, A. F., & Kite, K. (2001). On grasping a nettle and becoming emotional. *Stress, workload, and fatigue*. Mahwah, NJ: L. Erlbaum.
- Suedfeld, P. (1987). Extreme and unusual environments. *Handbook of environmental psychology*, *1*, 863-887.
- Susman, E. J. (2006). Psychobiology of persistent antisocial behavior: Stress, early vulnerabilities and the attenuation hypothesis. *Neuroscience & Biobehavioral Reviews*, *30*(3), 376-389.
- Szabo, A. (2003). The acute effects of humor and exercise on mood and anxiety. *Journal of Leisure Research*, *35*(2).
- Terry, R. L., & Woods, M. E. (1975). Effects of humor on the test performance of elementary school children. *Psychology in the schools*, *12*, 182-185.

- Tomaka, J., & Blascovich, J. (1994). Effects of justice beliefs on cognitive appraisal of and subjective physiological, and behavioral responses to potential stress. *Journal of Personality and Social Psychology*, 67(4), 732.
- Tomaka, J., Blascovich, J., Kelsey, R. M., & Leitten, C. L. (1993). Subjective, physiological, and behavioral effects of threat and challenge appraisal. *Journal of Personality and Social Psychology*, 65(2), 248.
- Tomaka, J., Blascovich, J., Kibler, J., & Ernst, J. M. (1997). Cognitive and physiological antecedents of threat and challenge appraisal. *Journal of Personality and Social Psychology*, 73(1), 63.
- Townsend, M. A. R., & Mahoney, P. (1981). Humor and anxiety: Effects on class test performance. *Psychology in the schools*, 18(2), 228-234.
- Vaid, J. (1999). The evolution of humor: Do those who laugh last. *Evolution of the psyche*, 123-138.
- Van Zuuren, F. J., Schoutrop, M. J. A., Lange, A., Louis, C. M., & Slegers, J. E. M. (1999). Effective and ineffective ways of writing about traumatic experiences: a qualitative study. *Psychotherapy Research*, 9(3), 363-380.
- Ventis, W. L., Higbee, G., & Murdock, S. A. (2001). Using humor in systematic desensitization to reduce fear. *The Journal of General Psychology*, 128(2), 241-253.
- Weinberg, R. S., & Gould, D. (2010). *Foundations of sport and exercise psychology* (Fifth ed.). Champaign, IL: Human kinetics publishers.
- Weisenberg, M., Tepper, I., & Schwarzwald, J. (1995). Humor as a cognitive technique for increasing pain tolerance. *Pain*, 63(2), 207-212.
- Woodman, T., & Hardy, L. (2003). The relative impact of cognitive anxiety and self-confidence upon sport performance: A meta-analysis. *Journal of Sports Sciences*, 21(6), 443-457.
- Wooten, A. C., Burney, S., Foroudi, F., Frydenberg, M., Coleman, G., & Ng, K. T. (2007). Psychological adjustment of survivors of localised prostate cancer: investigating the role of dyadic adjustment, cognitive appraisal and coping style. *Psycho-Oncology*, 16(11), 994-1002. doi:10.1002/pon.1159
- Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of comparative neurology and psychology*, 18(5), 459-482.
- Yovetich, N. A., Dale, J. A., & Hudak, M. A. (1990). Benefits of humor in reduction of threat-induced anxiety. *Psychological Reports*, 66(1), 51.

Appendix A Consent Form Given to Participants

Consent Form

Name of Project: Does humour appreciation impact task performance.

I have read and understood the description of the above-named project. On this basis I agree to participate as a subject in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved. I understand also that I may at any time, prior to the 1st of November, 2011, withdraw from the project, including withdrawal of any information I have provided. The opportunity to withdraw will not be possible after the specified date as this is the intended submission date of the thesis.

Name: _____

Signed: _____ Date: _____

Appendix B Information Sheet Given to Participants

Lincoln University
Faculty of Environment Society and Design

Research Information Sheet

You are invited to participate in a project entitled “Does humour appreciation impact task performance” the aim of this project is to identify the influence of anxiety on performance in a wall-climbing task. The project is being undertaken as part of the requirements for a Master’s Degree in Applied Science at Lincoln University. This research has been reviewed and approved by the Lincoln University Human Ethics Committee. A twenty four hour period is required by the University prior to participation in order that you may read the research information sheet in detail and reflect on whether or not you would like to take part in the study. Should you decide not to participate please contact and inform the experimenter.

Your participation in this project is voluntary and will involve the following activities:

- reading and signing a consent form
- filling out a demographics questionnaire (e.g., age, sex)
- participating in a training traverse (horizontal climb) at a low level – approximately 0.5 metre high -- on a climbing wall. Climbs will involve the use of a safety harness and rope.
- assignment to a control or humour video group, these will be viewed during rest periods
- making two more traverses at two different heights (1 metre and 5 metres) (climbs will be video recorded to assess performance differences)
- completing two short mood measures.

In total, this should take about thirty minutes. The climbing part of the study will take place at the Roxx Climbing Gym. While it is very unlikely that any harm may arise from your participation, you should be aware that you will be put in a situation designed specifically to produce moderate anxiety. If you feel that this will cause undue stress, (or you have a relevant medical condition), you are requested not to participate. Note that you have the right to withdraw from the study at any time without explanation, including choosing not to participate in the climbing portion.

The results of the project may be published, but you are assured of the complete anonymity of the data gathered in this investigation: the identity of participants will not be made public. To ensure anonymity, the results will only be presented as group-level figures and numbers, so that no person can be identified; you will be given a unique identifying number, which will be known only to you which you can use to have your information withdrawn from the project; consent forms will be stored securely and separately from the questionnaire so that at no time individual identities can be linked to their respective responses; and all information will be stored either under lock and key or in secure, encrypted electronic files.

If you have any questions, I would be happy to answer them at any time. Contact me at:

Steele Taylor

Faculty of Environment Society and Design,

Lincoln University

(03) 325 3820

steele.taylor@lincolnuni.ac.nz

If you have any concerns in connection with the answers you have provided or the manner in which the project was carried out, please contact the project’s supervisor:

Dr. Gary Steel

Faculty of Environment Society and Design,

Lincoln University

(03) 325 3820

gary.steel@lincoln.ac.nz

Thank you for your time today. Your help is very much appreciated

Appendix C Research Questionnaire

Basic Information

Date _____

Demographic information

(1) How old are you? _____ [years]

(2) Male Female [please circle appropriate response]

Items 3-5 are optional

(3) Ethnicity _____

(4) What is your highest level of education achieved?

(5) Marital Status _____

Directions:

To be completed at the end of recording

(6) Please rate how funny you found the video by circling one of the following

Not funny at all	Somewhat funny	Very funny	Extremely funny
1	2	3	4

(7) Place a mark the lines nearest the appropriate response.

I think the climbing traverse will be...

Not Challenging	Extremely Challenging
-----	-----
Not at all Stressful	Extremely Stressful
-----	-----

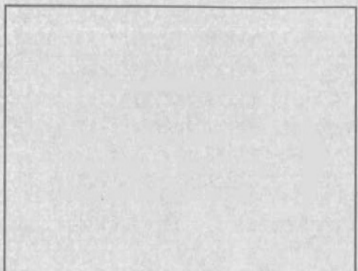
Directions:

To be completed by the experimenter

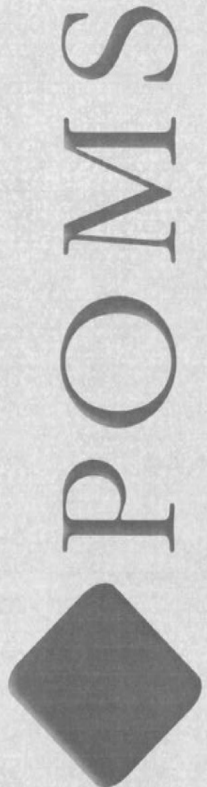
(8) Climbing Time (seconds) L _____ H _____ (9) S: 0 1 2 (10) L: 0 1 2

Appendix D Profile of Mood State Brief Form

Client ID: _____ Age: _____ Gender: Male Female
 Birth Date: / / Today's Date: / /
Month Day Month Year
(Circle)



To the Respondent:
 each word carefully. Then circle the number that best describes
 how you have been feeling during the PAST WEEK, INCLUDING TODAY.
 how you feel RI HT NOW.
 other: _____
 If box is marked, please follow the instructions for the first box.



	Not at all	A little	Moderately	Quite a bit	Extremely
1. Tense	0	1	2	3	4
2. Angry	0	1	2	3	4
3. Worn out	0	1	2	3	4
4. Lively	0	1	2	3	4
5. Confused	0	1	2	3	4
6. Shaky	0	1	2	3	4
7. Sad	0	1	2	3	4
8. Active	0	1	2	3	4
9. Grouchy	0	1	2	3	4
10. Energetic	0	1	2	3	4
11. Unworthy	0	1	2	3	4
12. Uneasy	0	1	2	3	4
13. Fatigued	0	1	2	3	4
14. Annoyed	0	1	2	3	4
15. Discouraged	0	1	2	3	4
16. Nervous	0	1	2	3	4
17. Lonely	0	1	2	3	4
18. Muddled	0	1	2	3	4
19. Exhausted	0	1	2	3	4
20. Anxious	0	1	2	3	4
21. Gloomy	0	1	2	3	4
22. Sluggish	0	1	2	3	4
23. Weary	0	1	2	3	4
24. Bewildered	0	1	2	3	4
25. Furious	0	1	2	3	4
26. Efficient	0	1	2	3	4
27. Full of pep	0	1	2	3	4
28. Bad-tempered	0	1	2	3	4
29. Forgetful	0	1	2	3	4
30. Vigorous	0	1	2	3	4

have every