THE UNIVERSITY OF HULL

The construct of mental toughness:

A psychometric and experimental analysis

Being a Thesis submitted for the Degree of

Doctor of Philosophy in the University of Hull

By

Keith Earle (BSc)

May 2007

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Mental toughness is a familiar and commonplace term in both the sporting arena and the workplace. However, attempts to investigate the nature of mental toughness have been inconclusive and, following more than twenty years of research, the construct remained ill-defined. As a consequence of this lack of an accepted definition, a series of different strands of research were then undertaken, but each produced differing conceptualisations of the phenomenon.

The work presented in this thesis represents an attempt to address these issues using both psychometric and experimental approaches. Preliminary work investigated the psychometric basis for the construct of mental toughness and enabled the development of a multidimensional measurement tool. This work was followed by a series of four experiments: The first two experiments focused on the moderating effects of mental toughness on the impact of physical and cognitive stressors, and the final two experiments considered the changes in mental toughness in individuals facing new life challenges and a mental toughness training programme. Both experimental and psychometric analyses supported the proposition of a meaningful construct with real world applications. The evidence in support of a psychometrically sound construct was particularly strong and the beneficial effects of superior mental toughness were highlighted in both the physical and cognitive studies undertaken. Most importantly, in terms of applied sport and occupational psychology, self ratings of mental toughness and objective performance were enhanced following exposure to appropriate psychological skills training.

ACKNOWLEDGEMENTS

My first thanks goes to my supervisor Dr Peter Clough, who has been a supervisor, a mentor and a true friend. Without his ideas this thesis would never have got off the ground.

Much of the work presented in the thesis required a huge investment of time and effort on the part of the participants. So, thanks must also go to the participants who took part in this research, as it would not have been possible without them.

Most importantly I would like to thank my wife Fiona, who has provided immense emotional, physical and intellectual support and guidance during the very long process of this thesis.

Finally I would like to dedicate this thesis to my ever supportive mother and the most precious thing in my life, my daughter Madeleine Rose Earle.

Chapter 1:

Introduction: Stress, mental toughness and related concepts

1.1 Summary

This chapter aims to outline the importance of the concept of mental toughness and the central issues surrounding the related areas of research. Previous methodological issues are examined and limitations of current operationalisations of mental toughness are considered. The end of the chapter sets out the aims of the current programme of research and outlines a plan for the thesis.

1.2 Introduction

Since the pioneering work of Loehr in the mid-1980s, the term Mental Toughness has become synonymous with sporting greatness. Following Loehr's regular interactions with elite American athletes, he identified a highly relevant construct which has become a frequently used layman's term for individual tolerance to stress and performance maximisation. While the work of Loehr was important for bringing the term Mental Toughness into modern-day parlance, the work was limited in its development of the construct and it could be argued that the anecdotally-based work generally lacked the rigours of a scientific approach.

Over the next 15 years, interest in Mental Toughness was limited to that of sporting practitioners and journalists, and the term became increasingly mentioned on television and radio broadcasts. However, since the publication of a book chapter

entitled "Mental Toughness: The concept and its measurement" (Clough, Earle & Sewell, 2002) academic interest has flourished. In the past five years a number of research groups in Britain, and more recently Australia, have started to contribute a growing body of literature and begun to address the fundamental issues surrounding the construct of mental toughness.

However, before going on to detail the current status of the mental toughness literature, some background into the broader theoretical underpinnings of the stress literature is required, as these are closely related constructs. One could argue that a central component of mental toughness is how effectively one deals with potentially stressful situations. Furthermore, the development of scientific rigour in the field of mental toughness requires researchers to draw upon pre-existing and scientifically sound psychological frameworks.

1.3 Stress

1.3.1 Key Developments in the Stress Literature

Within modern psychology the concept of stress remains a major focus of interest, with significant research efforts across a range of disciplines including work psychology, sport psychology, clinical psychology and health psychology. However, the concept has its beginnings in the 18th century, within the field of physiology, when the French physiologist Claude Bernard proposed that life was dependent on an organism maintaining an internal environment in a constant state during changes in the external environment. Bernard's recognition of the physiological need for balance between the internal state and the range of external variables formed the foundation of stress research. However, there was little conceptual advancement over the following century until the seminal work of Harvard physician Walter Cannon, who continued to expand on the physiological perspective, with his research on the roles of adrenaline

and the autonomic nervous system in regulating and maintaining physiological balance. This research by Cannon (1929) led to the introduction of the key stress-related term "homeostasis" which described the balance of physiological systems.

Following on from this initial theorising, Selye (1936, 1950) proposed what he labelled the "general adaptation syndrome" (GAS), which has its foundation in the activation of the adrenal cortex in response to stress. Where Selye furthered the stress literature was in his proposition that changes in homeostasis were not just a response to alterations in the environment, but that an animal's physiological systems could be trained to maintain adaptive defences against potential exposure to stress. He suggested that "conditioning factors", such as previous exposure and controllability of a stressor, could alter the GAS. Furthermore Selye proposed that stressors, including physical exercise, could possibly lead to cross-stressor adaptations that would develop resistance to psychosomatic and neurotic diseases.

The work of Selye represented a significant advancement in the field of stress, because of his recognition of the impact of previous exposure to stressors, and the proposition of conditioning factors. These themes are central to the current thesis and will be returned to later in the chapter.

Since the 1950's, research interest in stress has continued to grow. However, like so many psychological concepts, there have been major difficulties defining what stress actually *is*. While it has long been recognised that stressful situations have both psychological and physiological implications, developing a broadly accepted definition of stress has been difficult (Lazarus & Launier, 1978). However, while there has been much debate about the exact definition of stress, there has been some broad agreement about the physiological and psychological correlates. Typical physiological changes include increased blood pressure, sweating, increased heart rate and dry

mouth, and psychological behaviours may range from aggression to social withdrawal (Tenenbaum, 1984). These symptoms and behaviours can either occur independently or together with stress emotions, which are the subjective responses, both physiological and behavioural, that the individual experiences. These may include responses such as happiness, fear and anxiety among many others (Holahan & Moos, 1990). Therefore, it is generally accepted that the condition of stress is associated with physiological changes, a range of psychological behaviours and changes at the subjective/emotional level.

In addition to the ongoing and considerable research which has attempted to investigate fully the 'stress state' from physiological and psychological perspectives, three further, and closely related, strands of research have developed. Essentially, researchers have taken a range of contrasting perspectives and considered stress as either a *response* to certain conditions which can broadly be considered to be 'stress inducing', or alternatively, as a causal factor in a range of performance-related variables. Therefore, the strands of research have included (1) the situational factors which generate stress and (2) the consequences of the stress state for performance. The third strand of research is focused upon the existence and nature of any individual differences which may moderate the stress response – and it is this issue which relates most closely to the work reported in the current thesis, as mental toughness should be considered to be a key individual difference which can significantly moderate the stress process.

In light of this, the following sections will provide an overview of the situational factors which are currently considered to generate stress and the theories which attempt to explain the relationship between stress and performance. These sections are not intended to be comprehensive, but aim to provide a flavour of the stress research in

these fields. The chapter will then go on to provide a discussion of the individual differences which are believed to moderate the stress process, focussing particularly on those concepts which are closely related to mental toughness.

1.3.1.1 Situational moderators of the stress process

As with all areas of research, the situational moderators of stress have been considered from a number of different perspectives, first with regard to the context, e.g. occupational settings or sporting settings, and secondly, with a focus on the physiological changes associated with certain situational (or task-related) variables or the subjective experience.

From a physiological perspective, research carried out by Frankenhaeuser (1971) was particularly significant in exploring the physiological responses to a range of task-related variables. She found that responses in the adrenal glands were at their greatest when individuals were required to carry out tasks which are multifaceted, require quick decisions and when the individual has little control over the event in question. This highlighted three of the most widely considered stress-inducing factors in the occupational setting – i.e. aspects of workload, time pressure and control. With regard to workload, Wickens (1986) has provided a framework for considering those tasks which are more likely to be stressful when combined. He based his model on the principle that we have a series of 'pools' of resources upon which we can draw to carry out information processing tasks. Essentially, the model proposes that we will be less able to cope effectively with multiple tasks which draw on the same resources, e.g. two tasks which require auditory processing will clearly be more demanding (and therefore potentially stressful) than tasks which combine aspects of verbal and auditory processing. Time pressure is a further factor that has been broadly accepted as an occupational stressor (Hackman & Oldman, 1976). This is clearly intuitive, as it

is not difficult to imagine the increased subjective pressure associated with having too many things to do in not enough time. It is testament to the importance of this variable in both theoretical and practical occupational settings that time pressure has been incorporated into key methods of assessing subjective workload, such as the NASA TLX (Hart & Staveland, 1988) and the Subjective Workload Assessment Technique (SWAT: Reid & Nygren, 1988). With regard to the factor of control, this construct is a fundamental aspect of the occupational stress literature. The influential job design model of Hackman and Oldham (1976) and the demands-control model of Karasek (1979) both highlight the importance of control as a moderator of the work-stress relationship. However, the construct of control is a fuzzy one used in many different ways within psychology theory, for example as an personal need or drive, within motivational theory (e.g. Bandura, 1977) or as an individual difference in the need to exert control (Burger & Cooper, 1979). In the context of the Karasek, and Hackman and Oldman models, control refers primarily to employees having a high degree of decision latitude or autonomy over the way work tasks are managed. However, while the issue of control will be returned to throughout this thesis, as this construct is an important component of mental toughness, the meaning of control here will refer more closely to control as an individual difference. This will be discussed in more detail later.

In addition to the situational moderators of stress in an occupational context, some research has been carried out in the specific situational context of the sporting environment. For example, Martens (1987) proposed two general areas of situational stress (1) the importance placed on an event or contest and (2) the uncertainty of the outcome of the event. *Event importance* relates to how much the individual rates each prospective stress-inducing occasion. The more importance an individual places on a particular event, the greater the likelihood is that stress will occur. In respect of *outcome uncertainty* it can be broadly postulated that the greater the uncertainty there is about the result of an event, the greater the stress there is likely to be. While these

issues clearly have parallels in an occupational setting, this work, like much of the sport psychology literature, did not make use of existing theory and research frameworks from broader fields of psychology. Nonetheless, this type of context specific work clearly has practical implications and may provide some guidance for coaches in the goal of improving performance.

1.3.1.2 Stress and performance

While the body of research on situational moderators considers stress from the response perspective (i.e. stress as an outcome of environmental conditions) the following consideration of the impact of stress on performance takes the perspective of stress as a causal factor. Within this body of research, the concepts of stress, arousal, and anxiety are closely linked and it is not unusual to find these terms used interchangeably. Nonetheless, the impact of these closely-related constructs on performance is important from both practical and theoretical perspectives and in both sporting and occupational contexts. It is therefore not surprising that this has been a major area of research which has led to the development of numerous theories, which have been used, with varying degrees of success, to explain differential performance and suggest potential interventions to aid the functioning of certain tasks. The following section aims to highlight a number of important theoretical explanations regarding the impact of stress on performance.

(1) Drive Theory

Early researchers in the field of performance psychology postulated that there was a direct and linear relationship between arousal and performance. This view was embodied in the work of Hull (1943, 1951). Hull proposed Drive Theory, a multifaceted stimulus-response theory of motivation and learning, which predicted that as drive (arousal) increased this brought about the elicitation of the 'dominant response':

University
Library
Hull

In simple terms, as an individual's arousal level increases, so does the performance of that individual. This somewhat simplistic explanation of the relationship between arousal and performance clearly does not fully explain the complex nature of the relationship (Martens, Vealey & Burton 1990). However, Drive Theory did highlight the important role of physiological arousal in performance and the theory obviously has implications for training and learning environments.

(2) Inverted-U Theory

Further influential work in this field was the undertaken by Yerkes and Dodson (1908) who developed the basic premise of Drive Theory and further examined the relationship between arousal and task difficulty and their effect on performance. Initial findings were formulated into the Yerkes-Dodson law, which, in its simplest terms, proposes that as the complexity of a skill increase(s), the amount of arousal required for peak performance decreases. Irrespective of the type of skill involved, it is argued that performance always conforms to the inverted-U principle. There is a plethora of research documenting the inverted-U relationship between athletic performance and arousal: e.g. Sonstroem and Bernardo (1982) who found that basketball performance related to levels of arousal, with best performance enacted under moderate levels of arousal and poorest performance occurring at high and low levels. Other studies, such as Gould, Petlichkoff, Simons and Vevera (1987) and Burton (1988), highlighted that optimal performance in shooting and swimming were associated with somatic anxiety in a way consistent with the inverted-U hypothesis. The inverted-U principle has also been found in non-sporting tasks such as reaction time (Lansing, Schwartz & Lindsley, 1956), auditory tracking (Stennet, 1957) and hand steadiness (Martens & Landers, 1970), and clearly has implications across the full range of occupational contexts.

Building on the work of Yerkes and Dodson, Easterbrook (1959) attempted to explain this stress-performance relationship and theorised that, as arousal increases, attention narrows and it is a consequence of attentional narrowing that results in cues being missed. It is argued that, at first, the cues missed are irrelevant ones but as arousal increases, relevant cues are likely to be missed. Therefore, when arousal is low the presence of irrelevant cues is a distracting element and causes a decrement in performance. At the optimal level of arousal only the irrelevant cues are removed and performance is subsequently high. When arousal is too high, attentional focus is narrow, and this results in both relevant and irrelevant cues being discarded. It is not difficult to see how this could lead to decrements in performance, as proposed by the inverted-U theory, and this clearly provides some explanation to the process which may underlie the stress-performance relationship.

Further theories of the stress-performance relationship which build on the inverted-U hypothesis include Signal Detection Theory and Information Processing theory (Cox, 1990). In the terms of Signal Detection Theory, the basic premise is that errors in decision-making will occur when an individual is either insensitive (stringent response criterion) or supersensitive (lenient response criterion) to a physical stimulus: i.e. at high levels of arousal, an individual demonstrates a lenient response criterion and is very susceptible to environmental cues (errors of commission). At low levels of arousal, an individual exhibits a stringent response criterion and is insensitive to environmental stimuli (errors of omission). At moderate levels of arousal, an individual displays an optimal response criterion. These patterns of response are consistent with the inverted-U theory.

(3) Catastrophe Theory

Since the development of the inverted U theory there have been many criticisms regarding its simplistic explanation of the relationship between strain related variables (stress, arousal and anxiety) and performance. The basic tenets of the theory propose that relatively small increases in arousal have a proportionate effect on performance, either negatively or positively, and that optimal performance is obtained when arousal is moderate. However, the Catastrophe Theory, proposed by Fazey and Hardy (1988) challenges both of these assumptions. They propose that when the athlete is faced with debilitating stress, they encounter more dramatic decrements in performance (hence catastrophic in nature). They further posit that small reductions in arousal do not bring the athlete back to their previous level of performance when under a similar amount of stress. This model clearly proposes a more complex relationship between stress and performance than earlier models account for, and a number of studies in the 1990s have provided support for this theory (Hardy & Parfitt, 1991; and Hardy, Parfitt & Pates, 1994). More recent findings have been equivocal, for example the work of Cohen, Pargman and Tenenbaum (2003), which investigated the effects of exercise on anxiety and failed to show support for the theory. However, studies by Krane, Joyce and Rafeld (1994) and Durr (1996) did offer partial support. Further work by Hardy, Woodman and Carrington (2004) attempted to refine the Catastrophe model by stating that other personality factors, such as self-confidence, did have a major moderating effect on the relationship between stress (and its related concepts) and performance. This is an important theme, both in the stress literature and within this thesis, and the following theories of stress and performance place individual differences at the heart of their models.

(4) Individualized Zones of Optimal Functioning (IZOF)

Yuri Hanin (1980, 1986 and 1997) proposed that an individual athlete has their own zone of optimal state anxiety within which they perform at their peak. This theory differs in two ways to the inverted-U theory in that the optimal level of state anxiety differs from individual to individual and does not always occur on the midpoint of the continuum, and secondly, the optimal level of state anxiety is considered to be a bandwidth rather than a single point. With regard to the individual differences issues, this has real relevance in the field of applied sport psychology. If this optimum level of anxiety (stress level) can be determined it is then possible to manipulate, through psychological interventions, the athlete's level of anxiety which has been shown to correlate with optimal performance. However, methodological difficulties in measuring pre-performance anxiety have brought into question the findings of a number of studies. Nonetheless, there is some support for Hanin's model from a number of studies which have shown that predictions of performance based on the IZOF theory have been more accurate than other models (e.g. Prapavessis & Grove, 1991 and Turner & Raglin, 1996).

(5) Flow Theory

This theory proposed by Csikszentmihalyi (1990) is closely related to the IZOF model, in that it attempts to identify the optimal performance state for an individual (known as the 'Flow' state). This state is one in which the performance of the task undertaken is done in an effortless and almost mystical manner. This theory supports anecdotal evidence from athletes and has been subject to research scrutiny for the past 15 years. In particular, Jackson has produced a body of research examining the concept of flow in relation to sport and exercise (1992, 1995 & 1996). She defines flow as "…. a state of optimal experiencing involving total absorption in a task, and creating a state of consciousness where optimal levels of functioning often occur" (p138, 1995).

A further definition proposed by Csikszentmihalyi himself includes a loss of self-awareness (becoming one with the activity) and a loss of time awareness. While these models clearly have value in the way they describe an important subjective state, they fall short of providing an explanation of the broader stress process.

1.3.1.3 Individual moderators of the stress process

The latter models above provide some recognition of the importance of individual differences in the stress process, rather than attempting to outline a 'stimulus response' model which suggests the individual is a passive respondent to the situation, and responds in a uniform manner to given stressors. More recent models of stress have placed the individual at the centre of the process, providing an active interaction with the situation (see Lazarus, 1993). In light of the importance such researchers place on the individual, a major goal within this field has been the identification of potential individual differences which can moderate the stress process.

Many factors have been considered including high trait anxiety and low self-esteem (Scanlon, 1986). Trait anxiety is a personality factor that predisposes an individual to view certain situations as more or less anxiety provoking (Spielberger, 1983). Individuals with high trait anxiety will perceive events as being more threatening than individuals with lower trait anxiety. Similarly, self-esteem is another personality factor which has a bearing on the amount of stress an individual perceives (Rosenberg, 1989).

Mental toughness is potentially an important individual difference in the stressor-strain relationship, however, as highlighted above research in this area is somewhat limited. In light of this, the following section aims to provide a brief overview of current conceptualisations of mental toughness, before outlining the series of individual

differences which relate to the construct. It is intended that this review will examine the broad range of related constructs and provide a comprehensive foundation on which to develop further the mental toughness construct.

1.4 Existing constructs relating to mental toughness

1.4.1. What is mental toughness?

The term 'Mental toughness' is commonly used in all manner of sporting contexts, whether it is when Michael Atherton bats for 10 hours saving a test match, or when the German football team win another trophy with an apparently 'untalented' side. Vincent Lombardi, former Green Bay Packers coach stated, "Mental toughness is many things and rather difficult to explain. Its qualities are sacrifice and self-denial. In addition, most importantly, it is combined with a perfectly disciplined will that refuses to give in. It's a state of mind – you could call it character in action". (Curtis, 1998 p20).

From an applied perspective, whether one is dealing with coaches of professional sides or of an under 10's football team, the one thing that they all want is mental toughness instilled into each of their players. Unfortunately this 'toughening up' of players has usually involved employing psychological skills training, which is hoped to be fixing this problem. However, as the concept of mental toughness remains a little 'ill-defined' it is clearly difficult to attempt to address the lack of it.

There are obviously common elements to the range of conceptualisations employed, and, in essence, what this commonly means is an individual's ability to resist the stressors that would normally cause decrements in performance. Within the context of applied experience, mental toughness has been described as follows;

"It's the ability to handle situations. It's somebody who doesn't choke, doesn't go into shock, and who can stand up for what he believes. It's what someone has who handle pressures, distractions, and people trying to break their concentration. It involves focussing, discipline, self-confidence, patience, persistence, accepting responsibility without whining or excuses, visualizing, tolerating pain, and a positive approach."

Brennan (1998), p2.

Therefore, mental toughness would appear to incorporate aspects of both commonly recognised sport psychology interventions, such as focussing and visualization, and a number of personality characteristics which include persistence, resilience, confidence and discipline. The importance of both these elements needs to be considered to formulate a definitive explanation of what mental toughness is. The concept as it currently stands could be argued to contain both the theoretical underpinnings of personality constructs as well as the practical implications involved with sport psychology interventions. This mixture of application and theory is the key to the comprehensive development of the construct.

From a theoretical perspective, the conceptual development of mental toughness will benefit from considering related constructs. Existing relevant constructs include Hardiness (Kobasa, 1979), Physiological Toughness (Dienstbier, 1989) and Resilience (Dyer & McGuinness, 1996). The majority of the aforementioned terms have their roots firmly in the area of health psychology. However, the underlying principles of these terms have significant relevance in the fields of sport and occupational psychology.

1.4.2 Resilience

In layman's terms, resilience can be described as the process by which people are able to bounce back from adversity. This ability to bounce back (reboundability) is an essential tool for humans in everyday life, and this is intensified in the sporting arena and high-powered business. As mentioned previously, the majority of research in this area examined resilience in the context of general health, and indeed it has been defined as the way in which a person acts to modify their responses to situations incorporating elements of psychosocial risk (Rutter, 1985). Resilience is described as a dynamic process in which a number of elements, known as protective factors, are either available or unavailable for a particular person to utilise. These factors consist of specific competencies, or abilities, that an individual can access. These factors obviously have relevance to mental toughness as the resulting effects of the act of resilience lead to psychological toughening of the individual. This 'stickability' represents the amount of effort and perseverance that an individual is prepared to expend in completing a particular task or reaching a specific goal. It can be said that a resilient person is not afraid of dealing with the adversities that are commonplace both in everyday and sporting life. Extreme cases that highlight resilience can be taken from any sport, for example, a footballer who undergoes career threatening surgery, and may be out of the game for over a year, must show this quality in order to regain fitness and form despite the pain and the psychological effects (e.g. depression) of non-competition.

Recent research in the field of occupational psychology has been undertaken examining the concept of resilience, its impact on performance at work and the

development of resilience within individuals (Jackson & Watkin, 2004). Their research suggested that the following items were key in the way individuals deal with difficult situations:

1. the accuracy of analysing events
2. the number of alternative scenarios envisaged
3. flexibility
4. internal drive to face new challenges

Jackson and Watkin posit that our internal thinking processes can both moderate the impact of these adversities and provide a valuable resource in moving forward from them, focusing on the things we can control rather than those we cannot. They further proposed that the key to resilience is the ability to recognise one's own thoughts and structures of belief and harness the power of flexibility of thinking to manage the emotional and behavioural consequences more effectively. Most interestingly they state that this ability can be measured, taught and improved and they further proposed a resilience development programme that is outlined below: (taken from Jackson & Watkin, 2004)

Seven Factors of Resilience

1. Emotion regulation – the ability to manage our internal world in order to stay effective under pressure. Resilient people use a well developed set of skills that help them to control their emotions, attention and behaviour.
2. Impulse control – the ability to manage the behavioural expression of thoughts emotional impulses, including the ability to delay gratification explored in Daniel Goleman's work in Emotional Intelligence. Impulse control is correlated with Emotion Regulation.
3. Causal Analysis – the ability to identify accurately the causes of adversity. Resilient people are able to get outside their habitual thinking styles to identify more possible causes and thus more potential solutions.
4. Self-efficacy – the sense that we are effective in the world – the belief that we can solve problems and succeed. Resilient people believe in themselves and

as a result, build others' confidence in them – placing them in line for more success and more opportunity.

5. Realistic optimism – the ability to stay positive about the future yet be realistic in our planning for it. It is linked to self-esteem but a more causal relationship exists with self-efficacy and involves accuracy and realism – not Pollyanna-style optimism.

6. Empathy – the ability to read others' behavioural cues to understand their psychological and emotional states and thus build better relationships. Resilient people are able to read others non-verbal cues to help build deeper relationships with others, and tend to be more in tune with their own emotional states.

7. Reaching Out – the ability to enhance the positive aspects of life and take on new challenge and opportunity. Reaching out behaviours are hampered by embarrassment, perfectionism and self-handicapping.

Clearly this work has strong links to mental toughness and the elements of resilience outlined above will be closely considered when attempting to develop further the construct of mental toughness from this broader base of existing research.

1.4.3 Hardiness

Another concept, similar to resilience, is that of hardiness (Kobasa, 1979). This construct also has its roots in the health psychology area, and more particularly in the stress-illness relationship. There has been a plethora of research investigating the concept of hardiness or 'hardy personality' (Funk, 1992). Kobasa proposed that hardiness consists of three interrelated concepts, namely, *control*, *challenge* and *commitment*. This concept of hardiness is considered to have a buffering effect between stressful life events and illness. Earlier work by Lazarus (1966) suggested that this buffering effect is influenced by the type of coping strategies which are used by the individual, which are in turn dependent on the personality dispositions of that

individual. Kobasa considers that hardiness is an important factor in the way individuals perceive situations and the way in which they decide to undertake an appropriate set of actions. This can best be done by transforming the event so it can be perceived as less threatening, helping to avoid "illness-provoking" biological states such as adaptational exhaustion (Selye, 1956) or depressed immunological surveillance (Schwarz, 1975; Kobasa, Maddi & Kahn, 1982). It was suggested that the qualities possessed by 'hardy' individuals activated the transformation process so that the event, no matter how stress inducing, became congruous with the individual's self-view. If this view is correct, this leads us to a number of implications one of which is the identification of the less 'hardy' individuals and providing these individuals with appropriate psychological interventions or coping strategies.

As mentioned earlier, Kobasa proposed three components of Hardiness (control, challenge and commitment). These components are briefly summarised as follows; Control is "expressed as a tendency to feel and act as if one is influential (rather than helpful) in the face of the varied contingencies of life" (Averill, 1973; Seligman, 1975; Kobasa, Maddi & Kahn 1982). As discussed above, this is a complex concept, which operates on a number of levels. Within this context it is argued that control gives the cognitive ability to incorporate stressful events into "an ongoing life plan" (Kobasa, 1979), using knowledge, skill and choice, thus influencing how situations are appraised. Control is further said to allow an individual to choose the most appropriate course of action when facing a potentially stressful situation. This in turns is likely to transform the situation into something more congruous for that individual. Commitment is the "tendency to involve oneself in (rather than experience alienation from) whatever one is doing or encounters" (Maddi, Hoover & Kobasa, 1982). Commitment is relevant to cognitive appraisal as it helps identify and give meaning to new situations in the individual's environment. At the action level it makes the person

take the initiative in the environment rather than passively accept it. Moss (1973) proposed that failure to feel involved in an environment that provides accurate and congruent information can leave an individual vulnerable to disease. The final component of Hardiness is Challenge, which expressed as the belief that change rather than stability is normal in life and that the anticipation of change provides incentives to grow rather than threats to security (Kobasa *et al*, 1982). Seeing potentially stressful occurrences as challenging has the effect of mitigating the stressfulness of the situation. In relation to the coping strategies used, the challenge disposition empowers the individual to develop and grow instead of protecting what the individual has already.

Further research into hardiness has found that the concept appears to be more effective at buffering stressors than either social support or physical exercise (Kobasa, Maddi, Puccetti & Zola, 1986). Studies have also found that hardy individuals are more likely to cope with stressors by transforming them mentally into something less threatening (e.g. Maddi, 1991; Rhodewalt & Agostsdottir, 1984). Furthermore, physiological responses have also been related to the hardy personality. For example, Contrada *et al* (1991) found associations with heart rate and blood pressure patterns in the resting state and in response to stressful situations. However, while little research has been carried out in the area of hardiness and performance effectiveness, Westman (1990) found that trainees entering the Israeli military officer training school had more chance of performance success if they scored highly on the hardiness scale.

One of the few studies to investigate the relationship between hardiness and sporting performance is that carried out by Maddi and Hess (1992). They examined basketball performance using eight specific performance indicators, ranging from points scored, free-throw percentage, rebounds to the number of steals in a game.

All eight-performance indicators were examined over a season of high school basketball. The sport of basketball was chosen because of its similarities to previously

examined areas of hardiness research, namely those concerning occupational environments. Similar aspects were considered to include "the relevance of competitiveness, combined individual and team effort, and turning disruptions or problems to advantage and solving them" (Maddi and Hess, 1992, p.362). The results showed significant correlations between seven out of the eight performance indicators and the total hardiness score.

Despite the wide ranging support for this construct, hardiness has had its critics over the past 30 years. One of the key criticisms has stemmed from the use of different hardiness scales when undertaking follow-up research in the area (Younkin & Betz, 1994). As stated by Younkin and Betz, at least five different versions of the hardiness scale have been seen in published research and it is this lack of consistency in use of the Kobasa measures that has gained most criticism. However, in addition to this problem surrounding the varied measurement tools, there is also an issue with the conceptualisation of hardiness. According to Younkin and Betz, Kobasa's construct is intended to reflect a unitary trait (hardiness). However, it is defined in terms of three further traits (commitment, challenge and control). In terms of psychometrics it is thought to be more desirable if a unidimensional approach is used rather than multidimensional approach when examining trait measurement (Nunnally, 1978). When a trait is multidimensional, a multiple scale instrument is required. Younkin and Betz further state, "factor analyses do not indicate any general factor or second-order dimension that would warrant inferences that hardiness is being measured." (p.162). They add that the measures of control, challenge and commitment also relate very differently to criterion variables such as health outcomes. Nonetheless, while review papers by Hull, Van Treuren and Virnelli (1987) and Carson (1988) did agree with these criticisms they added that, while the measurement of hardiness is not particularly psychometrically sound, the concept itself is one full of promise and of interest. This work once again provides an excellent basis on which to develop further the mental toughness construct.

1.4.4. Physiological toughness

The researcher most associated with the concept of physiological toughening is Dienstbier. He has produced some interesting and influential work on the process by which an individual can actually *develop* their physiological toughness. This issue will be address in greater detail in Chapters 5 & 6, but this work also has relevance here as the concept of physiological toughness may provide further insight into the concept of mental toughness.

Dienstbier (1989 and 1991) primarily investigated the relationship between arousal and physiological toughness, by examining individuals' confrontations with stress which evoke both central and peripheral physiological arousal. The physiological reactions to stress have been frequently explored, and the work of researchers such as Frankenhauser and colleagues has consistently shown relationships between psychological stressors and changes at the physiological level in markers such as cortisol and adrenaline. However, in addition to investigating the response to stressors in general, Dienstbier (1991) observed a within-person change over time, when repeatedly exposed to physiological stressors. His conceptualisation of stress is consistent with theorists such as Lazarus (1993), and he describes a "stressor" as a situation which an individual *appraises* either as threatening or harmful. This organism-situation interaction would result in an appraisal of either challenge (positive emotions) or stress (negative emotion). Dienstbier examined the work carried out in the area of reactions to stressors and found that in non-human experiments subjects were, in fact, able to be "toughened up" by means of exposure to intermittent stressors (Weiss, Glazer, Pohorecky, Brick & Miller, 1975).

Therefore, it is implicit in his work that the conceptualisation of physiological toughness is the response to stressful situations as an appraisal of challenge. Based on his

observations, Dienstbier proposed that there are four toughening manipulations that influence the physiological mediators, which in turn are the cause of the performance and temperament characteristics. Brief descriptions of these manipulations are as follows: (1) Early experience – the ways in which children have faced extreme stress in early life and its relationship to differences in their resilience (Garmezy, 1983); (2) Passive toughening – Weiss, Glazer, Pohorecky, Brick & Miller (1975) highlighted the impact of repeated exposure to cold water and electric shocks and an increase in stress tolerance; (3) Active toughening – by aerobic exercising self-regulated toughening can occur; (4) Ageing – all effects for ageing are opposite to those of the three other manipulations.

Interestingly, Dienstbier's model has important and counter-intuitive implications for the use of techniques that are currently utilised for long-term coping - These techniques (including relaxation-based interventions e.g. biofeedback, autogenic training, meditation, tranquillisers) may provide short-term relief, but could possibly be removing the very situations which would lead to physiological toughening.

Dienstbier also went further than this and suggested that toughening also operates at the psychological level, elicited by exposure to mental challenges. However, very little research has been carried out in this particular area, because of the practicalities of such research - Problems in manipulating the amount of challenge that individuals have in their life is obviously extremely difficult, therefore real-life research in this area may actually prove unfeasible.

This work clearly has relevance to the current thesis and, in addition to providing some support for the proposition that mental toughness can be developed within individuals, the conceptualisation of physiological toughness may provide a further basis for the development of the mental toughness concept.

1.5 Mental toughness

As stated throughout this introduction, the concept of mental toughness already exists, both within modern day parlance, applied sporting and occupational contexts and within the research domain. Therefore, any attempt to develop further the concept must consider existing conceptualisations and evidence. The following sections will consider mental toughness from three perspectives: First, the preliminary work carried out by Loehr and others, which was based on the emergence of the concept, indirectly from grounded work with athletes; secondly, the breadth of qualitative research which has attempted to conceptualise the construct and, finally, the existing psychometric work which has attempted to develop mental toughness measures.

1.5.1 The beginnings of mental toughness research

As stated earlier in this chapter, the term mental toughness has become increasingly common across a number of domains, including sporting and occupational contexts. Within the context of the psychology literature, the usage of this term can be traced back to the work of Loehr (1982) who was a sports psychologist working with athletes with the principal goal of improving sporting performance. In this capacity he found that athletes and coaches were beginning to use the term mental toughness to describe a desired trait. This led Loehr to investigate the construct and attempt to identify what this 'mental toughness' actually is. In his book "The New Toughness Training for Sports" (1986), he defined mental toughness as "the ability to consistently perform toward the upper range of your talent and skill regardless of competitive circumstances", and from his interactions with athletes Loehr expanded upon this definition by identifying four key markers in respect of toughness:

(1) *Emotional Flexibility* - "the ability to absorb unexpected emotional turns and remain supple, non defensive, and balanced, able to summon a wide range of positive

emotions to the competitive battle. Inflexible athletes are rigid and defensive in emotional crisis and therefore are easily broken."

(2) *Emotional Responsiveness* – "the ability to remain emotionally alive, engaged, and connected under pressure. Responsive competitiveness are not calloused, withdrawn, or lifeless as the battle rages."

(3) *Emotional Strength* – "the ability to exert and resist great force emotionally under pressure, to sustain a powerful fighting spirit against impossible odds."

(4) *Emotional Resiliency* – "the ability to take a punch emotionally and bounce back quickly, to recover quickly from disappointments, mistakes, and missed opportunities and jump back into battle fully ready to resume the fight."

On the basis of this model, he prepared a 42 item questionnaire consisting of seven scales, which he called the Psychological Performance Inventory (PPI). This questionnaire has been used in a number of studies, and will be discussed in detail later in this chapter. However, it should be noted that Loehr's model of mental toughness and the resulting questionnaire were both generated from informal interactions with athletes and Loehr made no attempt to scientifically test the model or develop his questionnaire into a psychometric instrument.

Following the work of Loehr, a number of further researchers have offered alternative conceptualisations of the mental toughness concept. For example, in their review Williams and Krane (1993) suggested that mentally tough athletes possess a greater ability to concentrate, higher levels of self confidence, less anxiety before and during competition, and the ability to rebound from mistakes. However, Williams and Krane also recognised that the majority of recent research in sport psychology has focused on the psychological skills and strategies that are used by successful athletes rather than profiling their personality characteristics. This clearly highlights the practical importance of sports psychology interventions, however, if one of the goals of applied sports psychologists is to enhance mental toughness, then the concept must be soundly developed first. Once there is some agreement about what mental toughness

is, then attention can be turned to considering if this is something that can be developed, and what should constitute effective training programs. The following two sections outline the qualitative and quantitative work that has been carried out thus far.

1.5.2 Qualitative Approach

As can be seen from the previous section, Loehr uses very emotive language when describing the key markers of mental toughness. These have no doubt been obtained from his many years' experience working with elite athletes. However, no matter how valid this approach is in providing grounded preliminary work, it only represents the beginnings of scientific conceptual development.

In more recent years, research into the concept of mental toughness has become more scientifically rigourous (e.g. Jones, Hanton & Connaughton, 2002; Golby, Sheard & Lavallee, 2003; Golby & Sheard, 2004; Middleton, Marsh, Martin, Richards, Savis & Perry, 2004). This body of research has mostly used a qualitative approach to examine a range of issues, using mainly interviews and focus group techniques.

This work has further contributed to the wide variety of mental toughness definitions, and the research of Jones *et al,* reiterates the fact that the concept is well used in terms of both applied sport psychology and in the wider arena of professional sport. However, the wide ranging definitions of mental toughness have served to confuse the area and inhibited the development of an operational concept. These definitions range from an *ability to rebound from failures* (Dennis 1981; Gould, Petlichkoff, Simons & Vevera, 1987; Taylor, 1989; Woods, Hocton & Desmond 1995), *acquisition of superior mental skills* (Bull, Albinson & Shambrook,1996; Loehr, 1995), *an ability to cope with pressure, stress, and adversity* (Goldberg, 1998; Williams, 1988) and an *insensitivity to severe pressure* (Alderman, 1974; Tutko & Richards, 1976).

Further characteristics that have been identified as being under the general umbrella of the term mental toughness are *consistent performance* (Gould et al., 1987; Graham & Yocom, 1990; Loehr, 1982); *focus* (Jones, 1982; Luszki, 1982; Tunney, 1987); *concentration* (Loehr, 1982; Goldberg, 1998); *high levels of self-belief, confidence and optimism* (Bull et al., 1996; Favret & Benzel, 1997; Hodge, 1994; Pankey, 1993; Taylor, 1989), *drive and determination* (Bull *et al*, 1996; Graham & Yocom, 1990; Williams, 1988); and *control and motivation* (Bull *et al*, 1996; Gould *et al*, 1987; Hodge, 1994).

It would seem from the previous paragraph that any, if not all, positive psychological characteristics have at sometime been linked with the attributes of a mentally tough performer, and this work was summarised by Jones et al, (2002) who stated that this range of characteristics implies that a mentally tough athlete is generally someone who has an "ability to cope with stress and resultant anxiety associated with high pressure competitive situations" (page 206).

Of the work presented above, the most notable study is that of Jones *et al,* who actively aimed to provide a some degree of, previously lacking, rigour in their investigation of the mental toughness concept. Their aim was to define and identify key attributes in the concept of mental toughness and they selected qualitative methods because they, among others, argued that this would provide the opportunity to probe people's responses and establish detailed information, especially with regard to new research questions (Gould, Eklund & Jackson, 1993; Fourie & Potgieter, 2001, Hanton & Connaughton, 2002; Hanton & Jones, 1999; Patton, 1990). The study incorporated both interviews and focus groups, and focused on the view of elite athletes, in order to generate data for a profile of a mentally tough athlete. This approach, described in more detail below, can be considered to have by-passed the "pop" sport psychology approach which "emphasize macro-components such as

confidence and coping with adversity as underpinning the construct and to identify the micro-components of mental toughness" (Jones *et al,* 2002, p207). Conversely, Jones *et al,* were able to elicit from the athlete their complex construction of what constitutes a mentally tough performer, a process which has been effectively undertaken in a number of specific athletic areas such as athletics, cycling, rowing, and modern pentathlon among others (Butler, 1989; Butler & Hardy, 1992; Dale & Wrisberg, 1996; Jones, 1993).

In the Jones *et al,* study, the participants consisted of ten current or retired athletes who had reached an elite level of sport, from wide ranging sports including triathlon, trampolining and netball. The procedure for the study was divided into three main sections: Stage 1: Focus Groups; Stage 2: Individual Interviews; Stage 3: Individual ratings of mentally tough attributes.

- Stage 1 consisted of three participants brainstorming and discussing (1) a definition of mental toughness; and (2) a list of attributes relating to the mentally tough performer. These three participants were asked to reach a consensus of the definition of mental toughness, a procedure adapted from studies undertaken by Butler *et al,* (1993) and Dale and Wrisberg (1993). The remaining seven participants were asked to generate their own ideas regarding mental toughness, before being given the focus group definitions.

- Stage 2 involved interviewing all participants either face-to-face or by telephone on a one-to-one basis (a methodological approach utilised by Gould, Finch & Jackson, 1993), with the aim of developing a complete profile of a mentally tough athlete. Participants were then asked to "identify, describe, and explain with examples what the attributes meant to them" Jones *et al,* (2002)

- Stage 3 involved the reviewing of the participants' definitions of mental toughness by the researchers. The researchers then reached a consensus on

the key attributes of a mentally tough performer. These factors were then ranked by the same participants in respect of their importance to the ideal of the mentally tough performer. The participants also rated the extent to which they agreed with the overall definition of mental toughness.

The resulting definition of mental toughness was as follows:

Mental toughness is having the natural or developed psychological edge that enables you to:

1. *Generally, cope better than your opponents with the many demands (competition, training, and lifestyle) that sport places on a performer.*
2. *Specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure.*

The attributes developed by Jones *et al*, were as follows (ranked in order of importance):

1. *Having an unshakable self-belief in your ability to achieve your competition goals.*
2. *Bouncing back from performance set-backs as a result of increased determination to succeed.*
3. *Having an unshakable self-belief that you possess unique qualities and abilities that make you better than your opponents.*
4. *Having an insatiable desire and internalized motives to succeed*
5. *Remaining fully focused on the task at hand in the face of competition-specific distractions.*
6. *Regaining psychological control following unexpected, uncontrollable events.*
7. *Pushing back the boundaries of physical and emotional pain, while still maintaining technique and effort under distress in training and competition.*
8. *Accepting that competition anxiety is inevitable and knowing that you can cope with it.*
9. *Not being adversely affected by others' good and bad performances.*
10. *Thriving on the pressure of competition.*
11. *Remaining fully-focused in the face of personal life distractions.*
12. *Switching a sport focus on and off as required.*

This is clearly a broad conceptualisation with a focus on the key characteristics to be found within the mentally tough athlete; however this research does potentially provide fertile ground for further investigation.

An interesting point is made within this definition of mental toughness in that it is considered both to be a natural phenomenon as well as being a trait that can be developed with the appropriate psychological interventions. A further point of interest is the fact that the participants acknowledged the complex interaction of the life/sport domains: the importance of dealing with life situations outside of the sporting context, and that this aspect plays an important part in the development of mental toughness. Situations considered include time management skills, social and personal demands, and balancing their training regime. Both of these issues will be returned to later in the thesis.

Although the study represented a strong attempt to inject scientific rigour into the research area of mental toughness, there are still a number of issues, some highlighted by the researchers themselves, which need addressing if the concept of mental toughness is to be fully operationalised. First, the sample size of ten participants can be at best described as inadequate and unlikely to be truly representative of the target audience; secondly, this is bound to have a knock on effect on the range of sporting activities covered in the study; thirdly, the use of only one (3 participant) focus group is again questionable; fourthly, although focus groups can certainly be considered to be appropriate methods for such enquiry, they have been criticised as they are clearly dependent on the moderating skills of the researcher as it is easy to misinterpret or misrepresent the data.

However, the study has provided a strong basis for further development and also highlights the need for the concept of mental toughness to be investigated in a more scientific manner, using a wide range of methods.

1.5.3 Psychometric approach

The use of psychometric instruments in research is common place. For example, psychometric methods can be used with the aim of developing psychometric instruments which are capable of reliably and validly assessing a given construct; questionnaires can be devised with the different, but obviously closely related, aim of examining the underlying structure of a construct, by assessing the nature of relationships between different items and also, psychometric instruments can be used to address research questions relating to the extent different populations possess given traits. Such approaches are obviously common in psychology, and, within the field of mental toughness there are a number of existing studies which can provide some further insight, and support the development of the construct.

Golby *et al* (2003) used psychometric methods to compare mental toughness across a number of cultures and across different playing standards (i.e. first division, second division). The driving force for this research was the apparent performance gulf between northern and southern hemisphere rugby league teams. Previous research had not found any significant differences in the tactical or physical attributes of the players (Brewer & Davis, 1995) which has lead to questions about the psychological profiles of the athletes as an explanation for performance differences. In brief, Golby and his colleagues examined the potential cultural differences in both mental toughness and hardiness between rugby nations (Wales, France, Ireland and England) competing in the World Cup of 2000. This work utilised two measures, one was Loehr's PPI, 'designed' in 1986, which claims to assess the mental toughness of an athlete by asking questions in the following categories; Self-confidence, Negative emotion, Attention control, Visualisation and Imagery control, Motivation, Positive energy, and Attitude control. The inventory consists of 42 Likert-type items designed to

measure each of his six categories of mental toughness. Despite the inadequate psychometric properties of this instrument (see Mahoney, Gabriel & Perkins, 1987), this particular inventory is in common usage within the field of applied sport psychology.

In addition to the PPI, the second instrument used in this study was the Personal Views Survey III-R (Maddi & Khoshaba, 2001). This instrument aims to measure hardiness, and possesses three subscales of control, commitment, and challenge. The psychometric properties of this instrument have been soundly validated with acceptable internal consistency of between .60 and .84 for the subscales and .88 for total hardiness.

In summary, the results showed that the Welsh team reported higher levels of commitment and control (hardiness scale) in comparison with the French team. These results were interpreted as the Welsh team demonstrating a more active involvement in progressing in the tournament, as well as feeling that their efforts on the pitch would influence the outcome of a match. Further analysis indicated a strong relationship between the PPI and the PVS III-R. It was suggested by Golby *et al,* that both of the inventories used in the study were probably measuring related but distinct attributes of psychological skills. However, no firm conclusions could be reached from the analysis undertaken. Although, one interesting issue highlighted in the study was the fact that the majority of athletes scored well above the average scores for both mental toughness and hardiness. This was explained by the fact that there is a "natural filtering" that takes place, whereby only athletes who possess high levels of both hardiness and mental toughness would reach a position where they could be selected to represent their country. Two explanations for this are given by Golby *et al*, first, different psychological factors have a highly significant (and maybe undervalued) impact on performance, and secondly, the measures used possess insufficient discriminative power. Finally, it was highlighted that significant differences were only

found with the hardiness scale, therefore giving support for the robust psychometrics properties of the PVS III-R.

A similar study was undertaken by Golby and Sheard (2004) which again aimed to compare athletes' measures of mental toughness and hardiness across differing standards of rugby league (international, super league and division one). The results again highlighted a highly significant difference of both mental toughness (PPI) and hardiness (PVS III-R) across playing standards. In respect of the hardiness measure, it was found that the international players scored significantly higher in the areas of commitment and challenge compared to both super league and division one players, as well as scoring significantly higher than division one players in the control scale. On the other hand, in regard to the measure of mental toughness, the international players scored significantly higher on the areas of negative energy control and attentional control compared to super league and division one players. There were found to be no significant differences between super league and division one players.

This work highlights the importance of the constructs of commitment, challenge and control in the successful performance of high level athletes, and furthermore, this work also demonstrated the relationships between these conceptualisations of mental toughness and hardiness, as there was a significant but fairly small correlation between the total scores on the PPI and the PVS III-R ($r=0.384$; $p<0.001$). However, the fact that this is a fairly small correlation could suggest either that these are distinct constructs, or that one (or both) of these measures is not particularly valid. Further analysis provides some insight into this issue, as the measure of hardiness was found to be of greater importance when discriminating between the standards of the players. The variance in playing standard was accounted for by the following scales; commitment 46%, control 35%, and challenge 19%. Whereas, mental toughness was only able to explain 9% and 6% of the variance in playing standard by the categories of negative energy control and attention control. Golby further proposes that the

mental toughness measure used (PPI) "possesses insufficient discriminative power (only two of the seven mental toughness subscales revealed significant differences compared to all three hardiness subscales)."

Therefore, it would appear that the use of this model of hardiness may provide a strong basis for considering mental toughness further – it may in fact be that the term mental toughness is simply another name for hardiness. However a thorough investigation of this issue is required before such a conclusion could be reliably drawn.

The findings of Golby *et al,* have certainly been replicated outside the sporting environment with studies highlighting the effectiveness of hardiness in numerous settings, e.g. health care professionals (Topf, 1989), business executives (Kobasa, Maddi & Kahn, 1982), student teachers (Thomas & Wendt, 1995), public sector employees (Rush, Schoel & Barnard, 1995) and military personnel (Westman, 1990). Although, the term 'mental toughness' continues to be utilised across a broad range of contexts.

However, as previously mentioned, the current body of literature which directly attempts to address the mental toughness concept appears to be flawed: Recent research undertaken on Loehr's PPI has also found unsurprising weaknesses in the psychometric properties of the instrument (Middleton *et al*, 2004). Middleton's study aimed to assess the construct validation of Loehr's PPI using within-network studies to explore the internal structure of the concept, as well as between-network studies that attempt to establish a logical, theoretically consistent pattern of relations between measures of a particular construct. 263 student-athletes from an elite sports high school (USA) initially completed a whole battery of tests including the PPI.

Confirmatory factor analysis was carried out on the PPI and the results showed a poorly defined first-order factor structure underlying the seven components of the PPI. Further analysis (exploratory factor analysis) proposed a five-factor solution that explained a high proportion of the variance, demonstrated fewer cross-loadings and higher target loadings, and was conceptually feasible. Although, when both models were related to a battery of key correlates, the PPI factors were found to be more strongly correlated to these measures than the alternative five-factor model. In light of these inconclusive analyses, Middleton proposes that any future measure of mental toughness must fulfil the following three criteria:

1. Strong in terms of conceptual or theoretical bases
2. Robust within-network properties
3. Robust between-network properties

Neither the PPI nor the alternative five-factor model qualified on these criteria. Indeed Middleton's latest research provides an attempt to marry both the qualitative and quantitative approaches to propose a new measure of mental toughness (Mental Toughness Inventory – MTI) which has psychometric properties described as reliable and valid (Middleton *et al,* in press). Further work on this instrument is necessary to examine the important aspect of predictive validity.

While the Middleton study may not have provided a clear direction for further development of the mental toughness construct itself, it was conclusive in its criticism of current models, conceptualisations and instruments. He concludes that while "Loehr offered an intuitively appealing discussion of the instrument and the rationale for the seven scales, the conceptual and theoretical basis for the instrument was not strong and, in particular, he presented no psychometric support for its use" (Middleton *et al*, 2004. p. 93). In further support of Middleton, Murphy and Tammen (1998) added

that the PPI lacked norms, validity, and reliability data and, in fact, did not have a clear rationale as to the selection of the items in the questionnaire.

Furthermore, Middleton also has drawn attention to the surprising volume of research and applied sport psychology that has been undertaken using the PPI (Allen, 1988; Dongsung & Kang-Heon, 1994; Gallagher, 1999; Gould, Tuffey & Loehr, 1996; Hanrahan, Grove & Lockwood, 1990). Finally, Middleton *et al,* and others (see Gould & Dieffenbach, 2002; Norris, 1999; Williams, 1988) have all highlighted the importance of mental toughness as a major factor in sporting performance.

1.6 Directions for further research into mental toughness

There is a large body of evidence to support the relevance of the mental toughness construct. While this term was initially generated by professionals working in the sporting domain (coaches, athletes and performance enhancing practitioners) the term has appeared with increasing regularity within the domain of academic literature. However, a significant body of this literature has been highly critical with regards to the conceptual underpinnings of the construct and the attempts to develop tools to measure it. As outlined above, current researchers in this field have highlighted the need for a comprehensive investigation of the construct, and the development of psychometric instruments which are capable of measuring the construct with defensible degrees of reliability and validity.

The literature outlined within this chapter has provided a very strong initial framework. Among the most significant work is that of Loehr, in which he built upon his practical experience with athletes and coaches, to provide a strong starting point for examining mental toughness. However, he obviously stopped well short of carrying out scientifically sound research or employing psychometric methods to the development

of his questionnaire. Other particularly notable sources of insight can be gained from the closely related constructs of hardiness and resilience. In fact, it could be argued that mental toughness and hardiness are the same thing, just with different labels. However, in response to such a claim, it could also be argued that hardiness is inadequate to address the unique characteristics which are important in a sporting domain and with regards to sporting performance[1]. Specifically, hardiness does not account for the unique context in which sport takes place, and the language of the items in measures such as the PVS III-R may not be suitable in a sporting domain. Furthermore, aspects of emotional suppression which are seen as negative within the hardiness literature may well have positive consequences for sporting individuals, although the long term impact for these individuals is yet to be determined. Each one of these factors may prove to be important in the way Mental Toughness needs to be defined, and the extremes of both physical training and ultra competitiveness found in the sporting domain add new dimensions to that addressed in the hardiness research, which has examined mainly occupational environments. Therefore, a useful conceptualisation of mental toughness has to embody these factors as well as incorporating previous research, and investigating the relevance of other related constructs such as hardiness. With this in mind, this thesis has four general goals

1. to develop a model of mental toughness which has relevance for both sporting and occupational domains and is based on sound research principles,
2. to develop an instrument capable of measuring the construct within the required domains and with acceptable levels of reliability and validity,
3. to utilise the measure of mental toughness to further investigate the impact of varying degrees of this trait on performance, and

---

[1] While it is not suggested that the construct of mental toughness only has relevance in the sporting domain, it has been highlighted as being particularly important within this context, and hence, any conceptualisations or measures of mental toughness should take into account the unique aspects of this setting.

4. to consider the stability of the trait and the extent to which mental toughness can be developed.

1.7 Thesis plan

The work reported in this thesis is divided into seven chapters:

Chapter One provides an introduction to the central issues of the thesis and the background research upon which a model of mental toughness could be developed.

Chapter Two focuses on the investigation of the aspects of mental toughness which should be incorporated into the model and also outlines the development of a psychometric measure, including the preliminary field research and scale development. The underlying model of the instrument is investigated through factor analysis and the psychometric properties of reliability and validity are also incorporated in this chapter.

Chapter Three presents the first of the experimental studies which aims to consider the impact of differing levels of mental toughness on performance and subjective experience of stress. In particular, this chapter aims to examine the ways in which mental toughness impacts on individuals' performances and subjective states during physical exercise.

Chapter Four also reports experimental work which focuses on the cognitive aspects of performance, as opposed to the response to physical stressors. This study considers the potential moderating effects of mental toughness on continuous negative feedback on performance.

Chapter Five reports on a field study which examines the environmental impact on mental toughness levels on two diverse occupational groups.

Chapter Six reports on a field study which aims to investigate the impact of a mental toughness training programme on performance and the development of mental toughness on sub-elite swimmers.

Chapter Seven provides a general discussion of the findings and issues considered throughout the thesis. Implications for a comprehensive model of mental toughness are discussed and recommendations for future research are offered.

In summary, this thesis aims to ask what mental toughness is, whether it can be measured, what impact it has on performance and whether it can be developed. These issues obviously have relevance to both sporting and occupational domains and the work presented here is aimed at developing a conceptualisation of mental toughness which can be useful in both settings.

Chapter 2:

Development and validation of a scale to measure mental toughness

2.1 Summary

The aim of this chapter is to report the development of a psychometrically sound instrument to measure mental toughness. The chapter describes the preliminary research which uses interviews and questionnaires to investigate the nature of the construct in question. The following analysis then adopts a psychometric approach to the development of an instrument capable of measuring mental toughness: Factor analysis of the mental toughness questionnaire revealed clear and robust distinctions between the six subscales, namely; challenge, commitment, life control, emotional control, confidence in abilities and interpersonal confidence. This factor structure was further supported by a range of construct and criterion related validity evidence and reliability statistics reached acceptable levels.

2.2 Introduction

As discussed in Chapter 1 the term "mental toughness" has been regularly used in the sporting arena for more than 25 years. The term is such that it can have distinctly different meanings for every individual, whether it is athletes, coaches, commentators or the media. Practicing Sport Psychologists are often asked to "develop" mental toughness within either a team environment or with individual

athletes. However, without defining and operationalising the construct it is difficult to work towards strategies for developing this "mental toughness".

Most sports psychologists are content to use the term "mental toughness" as a generic clump of psychological characteristics which may or may not have an impact on the performance of an athlete. As previously discussed, the earliest research into the area was undertaken by Loehr (1986) in his book "Mental Toughness Training for Sports - Achieving athletic excellence". Although Loehr's work was welcomed in the arena of Sport Psychology, its primary aim was to provide athletes and coaches with psychological skills in order to improve the mental aspects of their performance. While this goal was often achieved, any changes in performance can not necessarily be attributed to the change in mental toughness, as this concept was never specifically defined or operationalised. Therefore, any changes in performance could, in fact be unrelated to the mental toughness of the athletes.

In recognition of this need to develop the construct there have been countless attempts to identify the different facets of mental toughness, including: "the ability to perform toward the upper range of your talent" (Loehr, 1995); "ability to cope with intense pressure" (Williams, 1988); "ability to cope better than your opponents with the demands of competitive sport" (Jones, Hanton & Connaughton, 2002).

Although there are clearly some common elements to these conceptualisations, the current research attempts to clarify this milieu of definitions and offer a model of the construct based on scientific research from related areas of health (both psychological and physiological) as well as incorporating the invaluable knowledge obtained from the field of applied sport psychology. This research based approach has not always been adopted, and, as stated by Clough, Earle and Sewell (2002)

"Many applied sport psychologists users appear to have relatively little interest in the research context and pedigree of tools and techniques, preferring to take a far more pragmatic approach".

Once a sound and research-based definition of mental toughness had been obtained, then the process of accurate measurement can be addressed. This approach has a long history in psychology, with regard to the measurement of a broad range of personality variables (e.g. Cattell, 1947). However, the field of sport psychology has not always adopted these scientifically sound traditions. Nonetheless, there is an increasing recognition of the importance of well-defined constructs and psychometrically developed instruments for use specifically in the sporting context, and support for this view is embodied by researchers such as Middleton *et al,* (2004) who stated that "There now exists general agreement among sport and exercise psychology researchers for the need to develop sports psychology instruments that are relevant to sport settings (rather than to adopt general instruments from other areas of research) and to evaluate them within a construct validity framework" (p93-94). This involves a basis of theory, followed by item and reliability analysis, factor analysis, tests of convergent and divergent validity, validation in relation to external criteria, and application in research and practice. It is this process which provides the framework for the current chapter.

At this stage it is necessary to reconsider the literature outlined in Chapter 1. This work will contribute an important part of the complete explanation of the mental toughness phenomena: The concept of hardiness (Kobasa, 1979) has its roots firmly in the health psychology literature of the 1970s and 1980s. Kobasa's model is well defined and, therefore, seems a promising starting point to examine the aspects of personality which may relate to sporting (and cognitive) performance. In its simplest terms an individual who is considered to be 'hardy' is able to deal with

stressful situations in a more productive and efficient manner. This ability to buffer stressors in a more effective way is paramount when in the 'cauldron' of elite sporting performance. It is argued that the hardy person will perceive situations to be less stressful and more controllable and thus be able to deal with the situation, which will produce a more efficient decision making mechanism (Kobasa *et al,* 1985). In the long term this is said to lead to an improved physiological state with the avoidance of illness-provoking biological states such as adaptational exhaustion (Seyle, 1956) or depressed immunological surveillance (Kobasa, Maddi & Kahn, 1982). While these two issues could clearly have a role to play in the performance of athletes, the role of hardiness in sporting performance is clearly more complex. To consider this further it is necessary to examine the three components of Kobasa's model:

- *Control* is expressed as "a tendency to feel and act as if one is influential in the face of the varied contingencies of life" (Averill, 1973; Seligman, 1975; Kobasa, Maddi and Kahn, 1982). Control provides the cognitive ability to incorporate stressful events into "an ongoing life plan" (Kobasa, 1979) using knowledge, skill and choice, thus influencing how situations are appraised.
- *Commitment* is a "tendency to involve oneself in, rather than experience alienation from whatever one is doing, or encounters" (Maddi, Hoover and Kobasa, 1982). It is relevant to cognitive appraisal as it helps to identify and give meaning to new situations in the individual's environment. At the action level it makes the person proactive rather than passively accepting of the situation.
- *Challenge* is expressed as "the belief that change, rather than stability, is normal in life and that the anticipation of changes are interesting incentives to growth rather than threats to security" (Kobasa, Maddi and Kahn, 1982). Seeing potentially stressful occurrences as being challenging has the effect of mitigating the stressfulness of the situation. In relation to coping strategies, the challenge disposition empowers the individual to develop and grow instead of protecting what the individual already has.

Therefore the concept of hardiness and its related benefits (e.g. stress buffering, decision-making, coping strategies etc.) would appear to have an integral place at the heart of sporting performance and appears close to the layman's definition of what mental toughness is all about. In terms of the impact of these components of hardiness on the individual, previous research has shown that hardiness may be a more significant factor in stress buffering than either social support or physical exercise (Kobasa *et al,* 1985). Even more interesting is the relationship between hardiness and the efficiency of physiological responses (Contrada, Dimsdale, Levy & Weiss, 1991). Contrada *et al,* found that physiological processes, namely heart rate and blood pressure, were negatively affected with reduced hardiness. This clearly has a role to play in issues of general performance, but, while there have been a large number of studies examining the relationship between hardiness and performance in the organisational context (e.g. Rush, Schoel & Barnard, 1995; Maddi *et al,* 1998), there have been relatively few studies investigating hardiness in the sporting arena. However, in a Maddi and Hess (1992) study a significant relationship was found between key performance indicators in basketball and a total hardiness score, and, in a further sporting performance study Golby, Sheard and Lavallee (2003) also found evidence relating hardiness with performance in rugby league players. However, while the components of hardiness (control, commitment and challenge) have clear relevance in the sporting domain, because of the way in which the construct has been operationalised, hardiness may not be sufficient to explain mental toughness and the tools may be inappropriate in this context. Nonetheless, it is argued here that the concept of hardiness should be central to any conceptualisation of mental toughness.

While the work of Kobasa and colleagues provides a solid foundation for developing the mental toughness concept, further insight into physiological and psychological toughening can be gained from the work of Dienstbier (1991). He examined a series

of individual confrontations with stress which were recognised to evoke both central and peripheral physiological arousal. Dienstbier argued that this organism-situation interaction can either lead to an appraisal of 'challenge' (a positive emotion) or an appraisal of 'stress' (a negative emotion). Furthermore, he proposed that there are four toughening manipulations that can influence this process, which in turn cause the performance and temperament characteristics (see Chapter 1). This area of psycho-physiological research needs to be incorporated into any new model of mental toughness and as such should also be a factor in the development of such a construct.

It is at this point that the concept of mental toughness needs to be placed within a practical context. Although the concepts outlined above are located within the field of health/occupational psychology, they clearly have considerable general relevance for the mental toughness concept and the sporting domain. However, the limitation with these models is that they do not take into account the unique nature of elite sport in respect of the mental and physical demands that high level competitive sport now places on the athlete. This environment could be argued to combine levels of physical and mental stressors that are not present in other typical professions. The implications of poor performance are very great as every minute aspect of performance and behaviour is likely to be both scrutinised and broadly publicised. Furthermore, at the national level, the involvement of whole populations in sporting events and the incredibly high expectations are quite different from the working environment and pressures experienced by most individuals.

Therefore, while the construct of mental toughness can build on existing frameworks and models, it must go beyond these to be useful in a sporting domain. It must consider the unique pressures faced by athletes and incorporate views from a range

of professionals working within this context. It is with these issues in mind that the work reported in the remainder of this chapter was carried out. The preliminary work used a series of interviews to investigate the views of relevant professionals and the findings were incorporated into a questionnaire to investigate the underlying structure of mental toughness.

2.3 Conceptual and scale development

2.3.1 Preliminary Field Research

The existing research into mental toughness and related constructs clearly provides a significant volume of information on which to base a further investigation into the nature and breadth of the construct. However, past research and existing questionnaires have been beset with inconsistencies and psychometric anomalies, such as the utilisation of a whole range of different hardiness measures, all from the same researchers. However, it is argued here that they are insufficient to truly represent a full and comprehensive foundation on which to consider the range of experiences which could be incorporated within a mental toughness model. Considering this, it was decided that a grounded approach should be used (Glaser & Strauss, 1967). This method focuses on the emergence of theory from unstructured data collection, rather than relying wholly on pre-existing theory with its inherent problem of restriction of data collection. It was intended that this approach would ensure that the new model of mental toughness was developed from the bottom up, rather than potentially perpetuating a limited framework.

To this end, an exploratory study was undertaken which investigated the extensive range of personal experiences of situations with relevance to mental toughness. This also allowed the researcher to consider the way individuals utilised the terms

relating to the different aspects of this construct. Twelve in-depth interviews were then carried out with sports-people. This included three rugby coaches, one rugby chief executive, two rugby players, two golfers, two footballers and two squash players. The interviews last for an average of 45 minutes, with the shortest being 25 minutes with one of the rugby coaches and the longest lasting 90 minutes, which was held with one of the squash players. All interviewees were either professional or playing at an elite level. The aims of the process were twofold, first to identify notions of mental toughness and secondly to identify circumstances and events which necessitated mental toughness.

Although the interviews raised many questions, they also met their broad goal, which was to provide a grounded basis for the development of the construct. The most striking aspect of the interviews was the importance all interviewees placed on having a high level of mental toughness. All interviewees stated that they thought this was a vital ingredient in the profile of a successful athlete. When asked to state what they thought this 'mental toughness' was, however, all interviewees found this difficult to define. A sample list of descriptions is presented in the table below.

Table 2.1 Interviewees descriptions of mental toughness

1	The ability to carry on when the world seems to have turned against you, AND keep your "troubles" in proper perspective.
2	Capacity to face all pressures and deal with them internally, delivering the same level of performance outwardly regardless of what pressures one feels internally.
3	The ability to keep going when the world seems to be against you and keep a true sense of perspective on your situation.
4	Resistance under pressure (and including when working in new areas).
5	To maintain effective personal control over your own stress levels and effective working relationships whilst handling a whole range of complex and sensitive issues/problems.
6	The ability to change when necessary, to be flexible when necessary and to resist when necessary in order to get the job done.
7	The ability to maintain effective control over the environment by displaying commitment to deliver, confidence in their ability, resilience to negative pressures, ability to see change as a positive opportunity and a recognition of their own limits to handle stress.
8	The ability to be reliable, in control, effective and composed under pressure.

9	The ability to handle events, planned and unplanned, and any conflict emotional or otherwise which arise from those events.
10	The ability to remain emotionally stable and make rational decisions under pressure.
11	The ability to appear calm and in control when everything is going wrong.
12	Ability to withstand the unexpected diverse challenges of (i) management (ii) the pressures of legal work and (iii) personal and professional disappointments in a pressured working environment.
13	The ability to be able to continue to focus on long term outcomes and deliver an effective performance in the face of real or potential obstacles maintaining perspective and a balanced, objective view.
14	Resilient - not easily balked in the face of opposition/adversity.
15	Ability to think clearly under pressure together with determination to achieve a solution.
16	Intellectual resilience, ability to deal with difficult situations, taking forward ideas which may be subject to resistance. Flexibility and adaptability responding to changing circumstances are competencies (stubbornness to be actively discouraged).
17	Being able to remain objective and complete the task irrespective of impact on feelings and emotions.
18	To do what hurts because you know it to be right.
19	Ability to cope and perform under a variety of situations and circumstances.
20	Ability to accept change, resist unacceptable change, be flexible enough to get the job done.
21	Ability to defend arguments and reason situations intellectually.
22	Being resilient to pressures, changes and feedback.
23	A person who is able to stay focussed on important issues when change is rampant and is able to make difficult decisions affecting others, even when they don't like it themselves.
24	The ability to produce quality work, remaining evenly tempered, without changing own attitudes and standards.
25	Ability to absorb pressure without impacting upon performance.
26	The ability to react positively to setbacks whether personal or physical that affects your thought processes. Not to have fear of failure.
27	Determination to see tasks through in all circumstances whether under internal or external pressure.
28	Resistance to pressure, forcefulness, ability to deal with problems.
29	Ability to deal effectively with stressful situations.

Interestingly, two recurrent themes covering new aspects of mental toughness were highlighted during the interviews. First, most of the interviewees considered confidence as playing a large part in dealing successfully with the immense problems and setbacks that are faced by professional athletes. Secondly, the ability to suppress emotions during play was also considered to be a key factor for athletes to perform at the top of their ability range. Both athletes and coaches alike considered emotional suppression as an important part of professional sport, and proposed that

athletes who showed such emotions would be showing weaknesses which would have negative consequences for their own performance and potentially beneficial consequences for the opposing player or team.

2.3.2 Development of the four factor model

Two sources of data now exist on which to begin to develop a model of mental toughness: First, the existing published research on mental toughness and related constructs and, secondly, the interviews with 12 sports people. Broadly speaking, all the data points to a four factor model – The model of hardiness put forward by Kobasa seems to incorporate most of the elements generated by the literature. Most of the elements can be summarised under the broad headings of *control*, *commitment* and *challenge*. The interviews provided support for all of these elements and provided a fourth element of confidence. Thus far, none of the research in this field has incorporated this aspect of personality in mental toughness or the related constructs discussed in Chapter 1. However, confidence was mentioned by half of the interviewees and it is an intuitively comfortable aspect of mental toughness. Therefore, these two sources of data have provided a four factor model of mental toughness. However, the interviews provided evidence to support the subdivision of two of these factors into four further subscales. Two distinct aspects of confidence were generated, i.e. interpersonal confidence and confidence in one's ability, and two distinct aspects of control were also proposed, i.e. emotional control in addition to the well recognised element of locus of control.

This work combined has led on to a comprehensive definition of the concept of mental toughness:

"Mentally tough individuals tend to be sociable and outgoing as they are able to remain calm and relaxed, they are competitive in many situations and have lower

anxiety levels than others. With a high sense of self-belief and an unshakeable faith that they control their own destiny, these individuals can remain relatively unaffected by competition or adversity." (Clough, Earle & Sewell, 2002, p38.)

2.3.3 Preliminary Scale Development

On the basis of this model, a broad range of items were generated (via a panel of experts). The aim was to develop items which could encapsulate each of the four components of the model (challenge, commitment, confidence and control). Data from the interviews and existing questionnaires were considered in an attempt to sample the full breadth of the construct and different aspects of each factor were incorporated in an attempt to be as comprehensive as possible. Each item consisted of a statement followed by a 5-point Likert scale with verbal anchors ranging from (1) *strongly disagree* to (5) *strongly agree*.

The initial questionnaire consisted of 66 items which were written in accordance with the guidelines proposed by Kline (1986): This ensures that all items are understandable, unequivocal and specific. The items were piloted with 20 athletes who examined every item to ensure each was unambiguous and clear. All the items examined were thought to be suitable to be understood by the general population.

2.3.4 Sample Characteristics

Two hundred and fifteen questionnaires were then completed. The sample consisted of 60% students (n=129) of which 54 were sports science students. The remaining 86 respondents comprised 52 professional athletes and 34 were administration/managerial staff. The sample consisted of 123 (57%) males and 92 (43%) females. The age range of the sample was 18 to 57 (mean = 24.65; sd = 8.35).

2.4 Data treatment and Results

2.4.1 Initial statistical investigation

All data were coded appropriately and then entered into SPSS to undergo a process of data reduction. Principal components analysis with varimax rotation was used and eigenvalues greater than one were accepted. A scree plot was initially used to determine the possible numbers of factors before rotated solutions were studied. For the initial solution, 18 factors had eigenvalues greater than one and accounted for 64.5% of the variance. However, not unexpectedly, this particular solution provided no meaningful psychological explanation. Upon examination of the scree plot, a six or seven factor solution appeared to offer a more accurate description of the data. In order to investigate fully the latent factor structure obtained, four solutions were investigated ranging from four to seven factors. To assist in the interpretation of the factor structures obtained, varimax rotation was used. The four factor solution accounted for 28% of the total variance. The first rotated factor, accounting for 8.7% of the variance, did not generate a particularly coherent cluster, with items relating to confidence incorporated within the same factor as items relating to responses to challenge. Therefore the four factor solution did not appear to provide a meaningful description of mental toughness. The five factor solution produced accounted for more of the total variance (30.1%) but suffered from similar inadequacies to the previous model. The six factor model accounted for 38.9% of the total variance and represents a more satisfactory solution.

The first factor, **Commitment,** accounted for 8.5% of the variance. All 11 commitment-related items loaded onto the first factor. In addition to the 11 commitment items (factor loadings ranging from .31 to .69) one of the Emotion Control items ("When I am feeling tired I find it difficult to get going") loaded onto

commitment, although this item was found to also load onto its target factor. Therefore, these items were retained to represent their original factor.

The second factor, **Challenge**, accounted for 7.1% of the variance. Only eight of the challenge items loaded strongly onto this factor (factor loadings ranged from .33 to .62). In addition to the eight challenge items, one commitment item also loaded on this factor; "I don't usually give up under pressure". However, this factor possessed a higher loading on the commitment factor. Three further items did not reach the cut-off level of .3 and therefore were removed from further analysis.

The third factor, **Emotional Control,** accounted for 6.7% of the variance. Unfortunately four of items did not reach the .3 cut-off level. The remaining seven items had factor loading ranging from .37 to .70.

The fourth factor, **Life Control**, accounted for 6.0% of the variance. Only seven of the Life Control items loaded onto this factor (factor loadings ranged from .412 to .609). As with the previous factor, one further item; "I often wish my life was more predictable" was also loaded on the on this factor, but as before it was more heavily loaded on the challenge factor. Surprisingly, four items failed to load onto the Life Control factor above the cut-off level of .3 and therefore were removed from further analysis.

The fifth factor of **Interpersonal Confidence** accounted for 5.4% of the variance. Only six of the items loaded strongly onto this factor (factor loadings ranged from .43 to .69). However, there were another two items which also loaded on this factor; "When I am upset or annoyed I usually let others know" and "I generally hide my emotion from others". Both these items factored more highly on this factor than their target factor but it was decided not to incorporate them into the interpersonal confidence factor due to the fact that the items can clearly be seen as having aspects of both emotional control and interpersonal confidence, but on the basis of face validity were retained as items within the factor of emotional control.

The final factor, **Confidence in Abilities,** accounted for 5.2% of the variance. The allowable factor loadings ranged from .39 to .60. However, two items did not reach the .3 cut-off level and therefore were removed.

2.4.2 The Mental Toughness Questionnaire

Therefore, a six factor mental toughness model had emerged on the basis of the following; related theoretical perspectives; existing questionnaires relating to mental toughness; qualitative data from the interviews and the analysis of the various factor solutions of the questionnaire. On the basis of this six factor model, a Mental Toughness Questionnaire was developed (see appendix 2.1), which comprised of 48 items: Challenge (8 items), Commitment (11 items), Emotional Control (7 items), Life Control (7 items), Confidence in Abilities (9 items) and Interpersonal Confidence (6 items).

2.4.3 Second Development Sample

To investigate further the factor structure proposed, a second development sample was obtained and subjected to analysis. Nine hundred and sixty three questionnaires were completed. The sample consisted of the following; Students 619, Administrators/Managers 136, Engineers 42 and Athletes 166. It consisted of 338 (35.1%) males and 376 (39%) females and 249 (25.9%) did not state their gender (see table 2.2). The age range of the sample was 18 to 59 (mean = 24.21; sd = 5.23). This data (see table 2.2) was used to create the normalised scores for the MTQ48.

Table 2.2 Mean scores for mental toughness factors by gender

	Gender	*Mean*	*Standard Deviation*	*N*
Challenge	Female	3.66	.49	376
	Male	3.86	.44	338
	Not specified	3.63	.48	249
	Total	**3.72**	**.48**	**963**
Commitment	Female	3.55	.52	376
	Male	3.72	.54	338
	Not specified	3.40	.56	249
	Total	**3.57**	**.55**	**963**
Emotion control	Female	2.93	.58	376
	Male	3.27	.51	338
	Not specified	3.02	.57	249
	Total	**3.07**	**.57**	**963**
Life control	Female	3.54	.50	376
	Male	3.67	.49	338
	Not specified	3.44	.52	249
	Total	**3.56**	**.51**	**963**
Control	Female	3.23	.45	376
	Male	3.47	.41	338
	Not specified	3.44	.52	249
	Total	**3.56**	**.51**	**963**
Confidence	Female	3.28	.57	376
Abilities	Male	3.54	.50	338
	Not specified	3.31	.57	249
	Total	**3.38**	**.56**	**963**
Confidence	Female	3.51	.65	376
Interpersonal	Male	3.83	.60	338
	Not specified	3.60	.71	249
	Total	**3.65**	**.66**	**963**
Confidence	Female	3.38	.50	376
	Male	3.66	.45	338
	Not specified	3.43	.52	249
	Total	**3.49**	**.50**	**963**
Total MT	Female	3.42	.41	376
	Male	3.65	.37	338
	Not specified	3.40	.42	249
	Total	**3.50**	**.41**	**963**

A preliminary analysis of the gender data revealed statistically significant differences in total MT as well as all the subscales. However, in order to ascertain the practical significance of these findings, effect calculations were carried out using the guidelines provided by Cohen (1988). Even the largest differences produced small effect sizes e.g. MT: eta squared = 0.001. Expressed as a percentage only 0.1 per cent of the variance of mental toughness is explained by gender. It should be noted that when the MTQ48 is used for non research purposes the scores produced for the

scales are converted to stens, these stens are clustered into three broad groupings (low = 1,2,3; medium= 4,5,6,7; high = 8,9,10). None of the gender differences noted in table 2.2 would impact in any significant way on the reported score.

This sample was subjected to the same approach as the first sample. Principal components analysis with varimax rotation was used and eigenvalues greater than one were accepted. Six factors had eigenvalues greater than one, which together accounted for 62.7% of the variance. Only factor loadings above .3 were acknowledged.

2.4.4 Analysis of the six factor solution

The first rotated factor, accounting for 15.1% of the variance, comprised all but 4 of the challenge items (e.g. I usually look forward to changes in my routine). The second rotated factor, life control, accounted for 13.5% of the variance. The third factor, accounting for 11.3% of the variance, was composed of the items primarily relating to commitment (e.g. I can generally be relied upon to complete the tasks I am given), although two of the challenge items also loaded onto this factor. The fourth rotated factor, confidence in ability, accounted for 9.3% of the variance. Factor 5, emotional control, accounted for 7.4% of the variance. The final factor of interpersonal confidence accounted 6.1% of the total variance.

Item selection for each factor followed the procedures set out by Kline (1993): Therefore, factor loading, item mean and variance were all incorporated into the decision to include items within the questionnaire. Due to the strict process of initial item writing, none of the 48 items had to be excluded on the basis of an extreme mean or low variance. On a five point scale, item means ranged between 2.46 (*I do not usually criticise myself even when things go wrong*) and 4.10 (*When faced with difficulties I usually give up*) and all items had a standard deviation of above 0.75.

2.4.5 Scale reliability

2.4.5.1 Internal consistency

Cronbach's alpha was calculated for each sub scale as a measure of internal consistency (see table 2.3).

Table 2.3 Scale Reliability of the Mental Toughness Questionnaire 48 (MTQ48)

MTQ48 Sub Scales	No. Of Items	Cronbach's alpha
Challenge	8	.71
Commitment	11	.80
Control	14	.74
Emotional Control	7	.70
Life Control	7	.72
Confidence	15	.81
Confidence in Abilities	9	.75
Interpersonal Confidence	6	.76
Whole scale	**48**	**.91**

All subscales reached the minimum acceptable level (0.70) recommended by Kline (1999) when investigating the reliability of psychological constructs. This supports the homogeneity of each subscale and the MTQ48 as a whole.

2.4.5.2 Test-Retest Reliability

The test-retest reliability measured by Pearson's correlation coefficient was high for all scales, with a range from .80 for challenge to .87 for emotional control. The r value for overall MTQ48 was .83. The sample consisted of 108 psychology undergraduates (mean age=19.22, SD=2.81) tested at a six week interval.

2.4.6 Construct Validation of the Mental Toughness Questionnaire 48 (MTQ48)

The following sections outline the validation process of the MTQ48. This includes construct and criterion related validity evidence. The construct validation constituted a range of evidence which demonstrates that the MTQ48 relates to the particular constructs it is supposed to (Kline, 1993).

2.4.6.1 Various personality scales and MTQ48

A sample of 106 individuals completed both the MTQ48 and a variety of personality measures (see table 2.4). The sample consisted entirely of undergraduate students, who completed the battery of measures during a research methods lecture. There were 45 (42.5%) males and 61 (57.5%) females. The age range of the sample was 18 to 23 (mean = 20.12; sd = 1.92).

Table 2.4 Correlations table for MTQ48 and various personality scales

	Life Orientation Test	Satisfaction with Life Scale	Self-Esteem Scale	Self-Efficacy Scale	State Trait Anxiety Inventory
Overall MT	0.48**	0.56**	0.42*	0.68**	-0.57**
Challenge	0.39*	0.59**	0.45*	0.66**	-0.54**
Commitment	0.45*	0.52**	0.40*	0.69**	-0.59**
Control	0.49**	0.55**	0.41*	0.64**	-0.61**
Control: Life	0.53**	0.59**	0.49**	0.66**	-0.63**
Control: Emotions	0.46*	0.56**	0.34*	0.59**	-0.61**
Confidence	0.47*	0.50**	0.39*	0.70**	-0.58**
Confidence: In Abilities	0.49**	0.49**	0.45*	0.74**	-0.60**
Confidence: Interpersonal	0.41*	0.56**	0.37*	0.69**	-0.61**

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Summary of results

Significant correlations were found with the MTQ48 and all of the five scales investigated. Interestingly, the highest correlations were found with the Self-Efficacy scale with a whole scale correlation of r=0.68. This is an expected finding as the concept of self-efficacy has strong associations with that of the confidence which is a subscale of the MTQ48, indeed the correlation with the subscale confidence in abilities was r=0.74. Another relevant finding was the correlation with the STAI (r=0.57), with the strongest correlation of the subscales being control (r=-0.61). Again, this finding was expected as the control subscale does include the element involving the ability to control oneself in stressful experiences.

2.4.6.2 General Tiredness Questionnaire (GTQ) and MTQ48

In addition to the above scales, an additional data set was collected to investigate the relationships between the MTQ48 and a 22 item measure of trait fatigue: the General Tiredness Questionnaire (Earle, 2004).

Sample

One hundred questionnaires were distributed within four organisations, of which 85 were returned (85% response rate). The participants comprised of bank workers (n=22), high school teachers (n=25), workers from a printing firm (n=22) and students from the psychology department at Hull University (n=25). There were 40 males and 45 females: age range 18-58; mean age 37.76 (s.d.=11.87).

Results

Table 2.5 presents the correlations between the six MTQ48 scales and the six GTQ scales. As expected, the mental toughness subscales were found to have negative relationships with the subscales of the GTQ.

Table 2.5 Correlations table for MTQ factors and GTQ factors

	GTQ General	GTQ Morning	GTQ Evening	GTQ Physical	GTQ Mental	GTQ Strategies
Challenge	-0.40*	-0.18	-0.17	-0.20	-0.08	-0.13
Commitment	-0.43*	-0.38*	-0.20	-0.25*	-0.33*	-0.24*
Control: Emotions	-0.32*	-0.25*	-0.18	-0.24*	-0.18	-0.24*
Control: Life	-0.39*	-0.26*	-0.32*	-0.09	-0.15	-0.12
Confidence: In Abilities	-0.31*	-0.14	-0.20	-0.04	-0.24*	0.01
Confidence: Interpersonal	-0.24*	-0.03	-0.15	-0.22*	-0.05	0.12

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

The general pattern of relationships between the two sets of subscales provides evidence of good construct validity. All subscales of the MTQ48 show significant correlations with the GTQ general fatigue scale. This is interesting as this subscale aims to measure the extent to which individuals are tired in general, i.e. high in trait fatigue. One would expect this subscale to negatively correlate with aspects of mental toughness, as this construct is about being resilient and not giving up. Within the subscales the strongest relationships were found in the area of commitment. This is another interesting finding as this suggests that the less tired a person is, the more likely they are to show commitment, or, alternatively, the more mentally tough a person is, the more they are likely to 'stick' to a task, irrespective of physiological tiredness.

2.4.6.3 Prevue assessment battery and MTQ48

To investigate the convergent and divergent validity of the MTQ48 further, Pearson's correlations were calculated for the total scores for MTQ48 and the eight sub-scales of the PREVUE personality scale. A sample of 205 individuals completed both the MTQ48 and the PREVUE personality scale. The sample consisted of the following; Administrators/Managers 167, Engineers 14 and Clerical staff 24. It consisted of 124 (60.5%) males and 81 (39.5%) females. The age range of the sample was 20 to 54 (mean = 35.65; sd = 9.34).

The Prevue battery is designed to provide a reliable means of assessing *Interests*, *Abilities* and *Personality* (ICES). It includes:

- An ability scale represented by a set of three ability tests designed to assess numerical, verbal and spatial capabilities.
- An inventory of interests which assesses occupational interest in relation to working with People, Data and Things.
- A Personality Assessment Instrument (ICES) which covers four major personality dimensions (Independence, Conscientiousness, Extraversion and Stability) each of which is represented by two 'minor' scales.

Results

Table 2.6 Correlations table for MTQ48 and Prevue Ability scales and Prevue Inventory of Interests.

	Abilities				**Motivation to work with**		
	General	Verbal	Numerical	Spatial	People	Data	Things
Overall MT	-0.02	-0.13	-0.03	0.09	0.33**	-0.13	-0.08
Challenge	0.13	-0.02	0.11	0.19*	0.29**	0.25*	-0.02
Commitment	-0.09	-0.15	-0.10	0.04	0.30**	0.02	-0.15
Control	0.07	-0.03	0.06	0.14	0.14	-0.09	0.09
Control: Life	0.10	0.11	0.06	0.09	0.16	-0.05	-0.06
Control: Emotions	0.03	-0.05	-0.02	0.19*	0.11	0.02	0.07
Confidence	-0.11	-0.21*	-0.09	-0.06	0.37**	-0.10	-0.14
Confidence: In Abilities	-0.09	-0.14	-0.09	-0.02	0.25*	-0.15	-0.05
Confidence: Interpersonal	0.01	-0.12	0.02	0.11	0.23*	-0.05	-0.12

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Summary of correlations

There were no significant correlations between the MTQ48 and the ability scales, which possibly signifies a key aspect of the concept, namely; it is not purely one's innate ability to perform any given task, but your ability to perform close to your potential on a consistent basis.

In respect of the inventory of interests the only relationship of note was that of the motivation to work with people (r=0.33), which again relates well with the factor of interpersonal confidence, which was considered to be a key factor in the mental toughness concept.

Summary of Prevue personality correlations (see appendix 2.2)

As expected, the MTQ48 was found to significantly correlate with the four major scales of Prevue, namely; Independent, Conscientious, Extrovert, and Stable. Interestingly, the strongest correlations were found to be with the major scales of extroversion (0.33) and stability (0.43). This highlights the important aspects within mental toughness regarding the ability to deal confidently with people, as well as the ability to control anxiety and nervous tension.

2.4.7 Criterion Validation of the MTQ48

The following section reports the findings of three criterion related validity studies. The first aims to investigate the impact of rehabilitation from sporting injury, the second investigates the influence of mental toughness on vigilance and stress resistance, and the third investigates the reactions of individuals to a test taking experience.

2.4.7.1 Criterion study 1: Mental toughness and rehabilitation from sport injury

Athletes' ability to cope with physical injuries and successfully adhere to rehabilitative regimes is of great interest to those looking to improve rehabilitation success and ensure continued participation. The present study followed 70 athletes (44 males, 26 females, mean age 32.5, SD = 10.2) throughout a 10 week rehabilitative regime for sports injuries (Levy, Polman, Clough, Marchant & Earle, 2006).

Method

In the initial stages of rehabilitation, participants completed the Sport Injury Rehabilitation Belief Survey (SIRBS), the MTQ48 and the Sport Inventory for Pain 15 item (SIP-15). Physiotherapists measured adherence via attendance and

completion of clinic rehabilitation activity using the Sport Injury Rehabilitation Adherence Survey (SIRAS). Participants were informed to record their adherence to home based rehabilitation activities.

Measures

Adherence - Attendance to scheduled rehabilitation appointments was calculated by dividing the number of rehabilitation sessions attended by the number of rehabilitations sessions scheduled. The SIRAS (Brewer *et al,* 2000) was used to assess adherence during clinic-based rehabilitation sessions. This instrument requires the physiotherapist to evaluate the patient's behaviour on a 5-point Likert scale regarding the intensity with which the participants complete their prescribed exercise, the frequency with which participants followed instructions, and their receptiveness to changes toward the programme.

Sport Injury Rehabilitation Beliefs

The SIRBS (Taylor & May, 1996) is a 19-item questionnaire assessing severity, susceptibility (threat appraisals), treatment efficacy, and self-efficacy (coping appraisals). Ratings are made on a 7-point Likert type scale.

Pain

To assess pain the SIP-15 (Bourgeois, Meyers, LeUnes, Middendorf, under review) was used. This measures three factors concerning how athletes respond psychologically when in pain. These include direct coping, catastrophizing, and somatic awareness. Items are rated on a 5-point Likert scale.

Results

Table 2.8 Correlations table for MTQ48 and rehabilitation measures

Measure	Mental Toughness	*M*	*SD*
Susceptibility	-0.31*	23.01	3.83
Treatment efficacy	0.20	71.21	2.46
Rehabilitation value	0.22	5.10	1.10
Severity	-0.30	20.10	2.62
Pain – direct coping	0.43**	17.53	3.55
Pain – catastrophising	-0.32**	15.46	1.79
Pain – somatic awareness	0.07	10.30	2.16
Clinic adherence	-0.30*	273.10	74.96
Home adherence	-0.28*	89.46	33.95
Attendance	0.25*	91.77	9.04

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

In summary, these findings suggest that the more mentally tough an individual is, the less susceptible they believe they will be to further injury. This finding was replicated with regard to pain in that more mentally tough individuals were better able to cope with pain during rehabilitation by using more direct coping methods. In contrast, low mental toughness individuals were found to be more likely to dwell upon the pain during rehabilitative and potentially despair when the pain is unbearable. In respect of rehabilitation adherence, greater attendance at rehabilitation sessions was displayed by those who had higher levels of mental toughness and individuals higher in mental toughness also demonstrated higher levels of adherence to procedures whilst within the clinical environment. Importantly, mental toughness was associated with greater adherence to home based exercises and procedures as well.

Conclusions and Implications

The finding that individuals who are low in mental toughness were less able to cope with their injuries and were also less likely to participate in rehabilitation has important implications for both sporting and occupational settings. Of particular importance are the lower perceptions of future injury risks.

For athletes and sport rehabilitators, the knowledge that high levels of mental toughness are associated with successful participation in rehabilitation regimes is important for promoting future programme success. By identifying low mental toughness individuals, appropriate efforts can be made to support them to ensure successful rehabilitation outcomes. This finding also adds weight to the proposition that highly mentally tough individuals are better able to deal with stresses and setbacks. This is clearly a central issue for the mental toughness construct.

In occupational settings, it would be important to note that low mental toughness individuals could potentially be vulnerable to poor health outcomes following illnesses, which represents a double detriment for such individuals: first, low mental toughness individuals are more likely to report worse health outcomes; secondly, these individuals seem less likely to be able to deal with illnesses and successfully adhere to advice. High mental toughness individuals on the other hand may be less likely to report poorer health and are more likely to adhere successfully to any advice given to return from such injuries.

2.4.7.2 Criterion study 2: The Influence of mental toughness on vigilance and stress resistance

An important aspect of most sporting and occupational environments is that of sustained attention or vigilance, which involves maintaining focus and awareness for extended periods of time. This has clear links to the construct of mental toughness, e.g. Nakamura (2001) reported that individuals who are high in mental toughness

have higher levels of concentration that low mentally tough individuals. In light of this, the study reported below aimed to investigate the relationship between mental toughness and vigilance (as a measure of performance maintenance under mental stress).

Method

Twenty two healthy participants (8 males and 14 females; mean age = 21.0; SD = 2.81) took part in this study. Participants were grouped using a median split, into high and low mental toughness.

Participants were required to carry out a vigilance task under both normal and stressed conditions. The vigilance task consisted of watching a computer screen on which a circle of 20 points progressively illuminated one-by-one, similar to the second hand advancing round a clock face (Mackworth Clock task). Participants watched for a 'missed' advancement, where the point that was supposed to illuminate does not, and the next one does. When this event occurred, participants were to respond as quickly as possible. The task lasted 10 minutes, during which each point was highlighted for 0.7 seconds and 40 'misses' were programmed to occur. Two measures of error were calculated: omissions and commissions. Following completion of the first experimental ten minute stage, participants were asked to place their hand into the cold water bath, keeping it open, for three minutes, but were informed that they were free to withdraw their hand at any time if it became too uncomfortable. This is known as the cold pressor test. The second stage of the Mackworth Clock task was identical to the first stage, and was completed immediately after the end of the cold pressor test.

Heart rate variability (HRV) was taken as a measure of physiological response, with lower levels of HRV indicating higher levels of stress response.

Results

To investigate the moderating effects of mental toughness on a vigilance task, the data was submitted to a 2 (MT) x 2 (time period) mixed design ANOVA (see table 2.9).

Table 2.9 Mean numbers of composite errors on a vigilance task

Stage	***Mental Toughness***	***Mean***	***Standard Deviation***	***N***
One (normal)	High	5.64	1.57	11
	Low	8.27	2.94	11
Two (stressed)	High	6.82	2.96	11
	Low	10.73	4.34	11

The analysis revealed a significant main effect of time period, $F(1, 20) = 6.92$, $p < 0.05$, with more errors occurring in the task following the cold pressor test, and there was also a main effect of mental toughness $F(1, 20) = 6.92$, $p < 0.05$ (see figure 2.1), with the mentally tough participants performing better. There was no interaction, although figure 2.1 suggests that the performance of participants who were low in mental toughness deteriorated more following the cold pressor test,

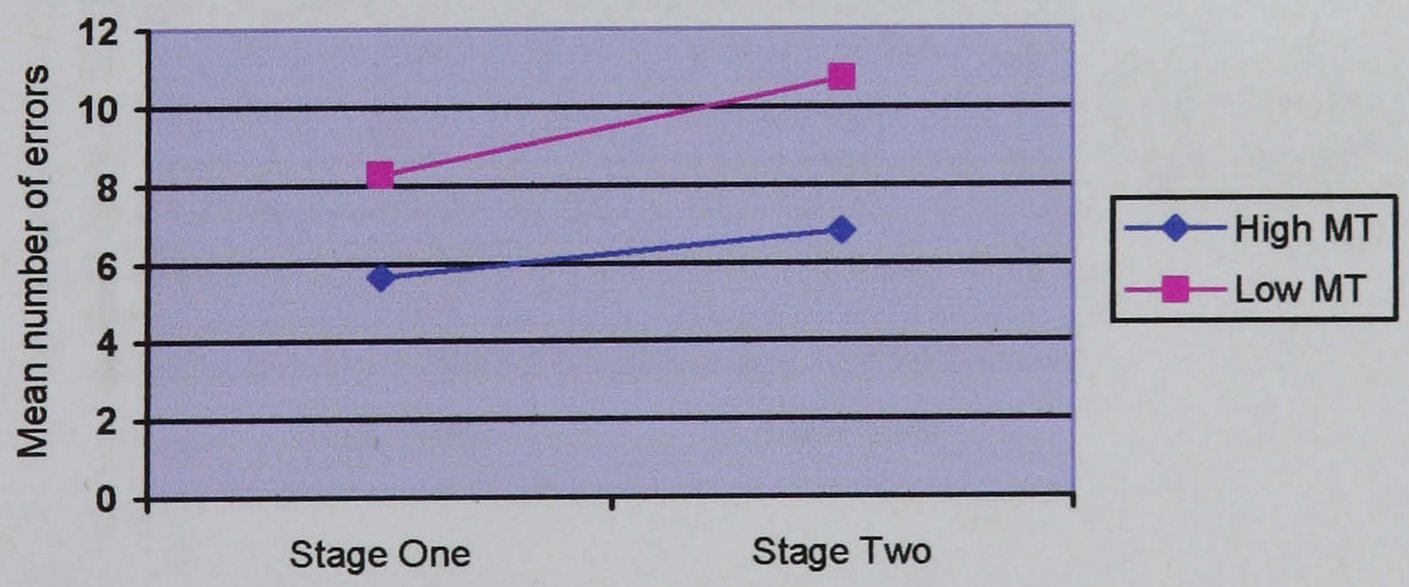


Figure 2.1: Mean number of errors in a vigilance task

To investigate the moderating effects of mental toughness on heart rate variability, the data was again submitted to a 2 (MT) x 2 (time period) mixed design ANOVA (see table 2.10).

Table 2.10 Mean heart rate variability during vigilance task

Stage	***Mental Toughness***	***Mean***	***Standard Deviation***	***N***
One (normal)	High	60.28	22.33	11
	Low	44.72	8.81	11
Two (stressed)	High	79.49	29.68	11
	Low	48.54	10.01	11

The analysis revealed a significant main effect of mental toughness, $F(1, 20) = 10.75$, $p < 0.01$ (see figure 2.2), with the mentally tough experiencing a higher level of HRV. There was no main effect of time period and no interaction. However, figure 2.2 suggests a trend towards an interaction, with the HRV of the mentally tough increasing following the cold pressor test.

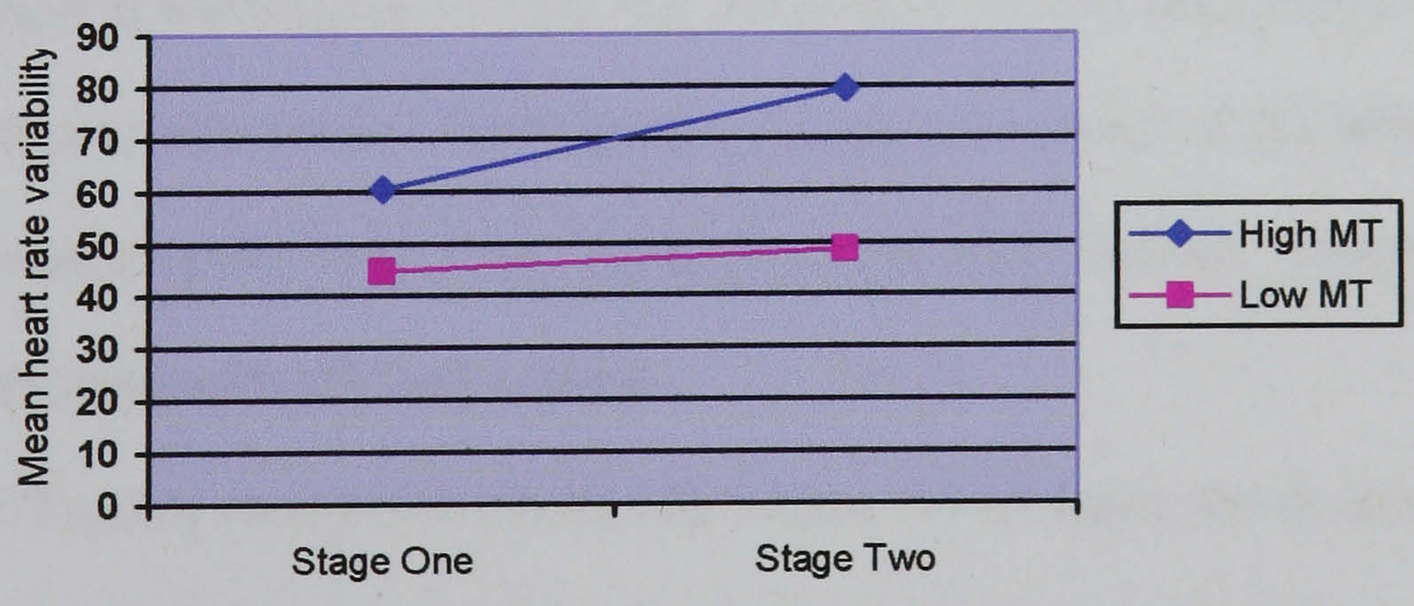


Figure 2.2: Mean heart rate variability during a vigilance task

Conclusions and Implications

The main finding relating to the number of errors made on the vigilance task was that individuals who are were high in mental toughness made fewer mistakes under both conditions. Furthermore, it was of particular interest that the difference in errors made was greater in the stressed stage, thus added support to the notion that "when the going gets tough, the tough get going". In summary, it would appear that the more mentally tough tended to perform better on the vigilance task. This finding again adds support to the proposition that mentally tough individuals are able to deal with stressful situations in a more positive and successful way.

In respect of the physiological data obtained the results indicated that mentally tough individuals are better able to cope with potentially stressful environments.

In conclusion, the study gives further support to the moderating effects, both physiologically and performance-related, of mental toughness.

2.4.7.3 Criterion study 3: Mental toughness and reaction to a test environment - Appraisal and physiological response

This study aimed to investigate individuals' responses to and appraisal of taking a test in a stressful environment. Participants' subjective ratings of the test were measured as well as their heart rate response to the environment. These measures were then correlated with MTQ48 scores.

Participants : Twenty nine participants (15 males, 14 females, mean age = 21.0; SD = 2.1) took part in the study. Participants were all university students, and were participating to gain experience of the graduate recruitment process. As such, it is argued that they were motivated to perform well on the test.

Task and measures: Each participant carried out a standardised psychometric test of verbal and numerical abilities under formal test conditions. To ensure participant

involvement in the test environment, they were informed that they would receive feedback on their performance later and that the time limits would be strictly adhered to. The test was split into two halves of 30 minutes, the first was for verbal ability, the second for numerical ability. Participants' heart rate was measured throughout the test, measures of state anxiety were taken before and after the test, and measures of subjective experiences were taken post-test. This bespoke subjective measure consisted of three questions: How stressful was it? How much effort did the test require? How much time pressure did you feel?

Results:

Table 2.11 Correlations table for MTQ48 and state anxiety pre and post test

MTQ48 Subscales	State Anxiety – Pre Test	State Anxiety – Post test
Overall MT	-0.42*	-0.38*
Challenge	-0.24	0.02
Commitment	-0.26	-0.51*
Control	-0.48*	-0.42*
Control: Emotions	-0.47*	-0.32
Control: Life	-0.34	-0.41*
Confidence	-0.37*	-0.41*
Confidence: In Abilities	-0.37*	-0.42*
Confidence: Interpersonal	-0.25	-0.26

* Correlation is significant at the 0.05 level (2-tailed)

Again, as expected, the MTQ48 provided evidence of the negative relationship with anxiety in respect of both pre and post measures. The strongest relationships found within the study were those surrounding the subscale of control, which once more highlights the importance of the ability to control nerves when faced with pressurised environments.

Table 2.12 Correlations table for MTQ48 subscales and subjective test experience

	Subjective Ratings			Heart Rate Data		
	Stressful	**Effort**	**Time Pressure**	**Pre-test**	**During Verbal Test**	**During Numerical Test**
Challenge	0.16	0.02	0.11	-0.19	-0.18	-0.24
Commitment	-0.32	-0.11	-0.13	0.06	-0.05	-0.06
Control	-0.35	0.39*	0.37*	-0.48	-0.46*	-0.32
Control: Life	-0.33	-0.35	-0.26	-0.39	-0.36*	-0.21
Control: Emotions	-0.27	-0.33	-0.40*	-0.43*	-0.45*	-0.36
Confidence	-0.38*	-0.28	-0.24	-0.22	-0.18	-0.08
Confidence: In Abilities	-0.16	0.03	0.04	-0.16	-0.11	-0.12
Confidence: Interpersonal	-0.47*	-0.48	-0.43	-0.20	-0.19	-0.02

* Correlation is significant at the 0.05 level (2-tailed)

Conclusions and Implications

The results from the study provide further evidence as to the relationship between the subscales of mental toughness (namely; control and confidence) and both subjective ratings and physiological responses. Worthy of note are the significant relationships found between the subscales of control and the heart rate data.

Significant negative relationship are reported here which adds support to the work previously reported suggesting a physiological bases to the concept of mental toughness.

A further interesting finding involves the relationship between confidence and the subjective ratings of stress. This finding has wide ranging implications, especially when individuals are placed in stressful environments, and perceive the situation to be less ego threatening, as they have faith in themselves. This positive attitude is indicative of likely success in both the sporting arena and in the workplace.

2.5 Discussion

2.5.1 Initial thoughts

In layman's terms mental toughness is an important component of the personality of the successful athlete - It is a widely held belief that the mentally tough athlete will be more likely to come out on top. In recent years there has been some focused research efforts into mental toughness (e.g. Golby, Sheard & Lavallee, 2003). However, the majority of research has either examined the concept in a purely descriptive manner (e.g. Jones *et al*, 2002) or used non-psychometric questionnaires in conjunction with other measures (e.g. Golby & Sheard, 2004). The continued search for this "holy grail" of sports performance has led to claims that mental toughness is a purely descriptive entity and the term is destined to be used in different ways by the range of people trying to find it. The work presented in this chapter represents an attempt to define the concept in a sound way and develop a reliable and valid instrument for measuring it within an applied context. It was also intended that this questionnaire should provide a research tool for future investigations into mental toughness and enable researchers to progress with the

development of this important construct. It is argued here that the process of qualitative and quantitative development work has shown that the concept of mental toughness is a meaningful one which can be defined and measured.

In summary, the development of the MTQ48 integrates a number of essential elements to enable further meaningful research in this area. First, the roots of the MTQ48 are firmly bedded in existing scientific research (e.g. hardiness) as well as in the more applied areas of professional sport. This approach has led to an instrument which is both psychometrically sound (although not all correlations reached the 0.55 cut-off as per PCT guidelines), as well as having good face validity (due to the involvement of amateur and professional sports people in both the conceptual development and the development of the instrument itself). Concerns levelled at other similar measures (e.g. The Psychological Performance Inventory – Loehr, 1996) do not apply here and this development work has led to an instrument with a sound psychometric structure along with items which have been developed within a concrete conceptual/theoretical framework.

With regard to the emergent model of mental toughness, which underpins the questionnaire (four major factors, and 4 minor subscales) this model builds on the Kobasa model of Hardiness and further incorporates the important component of confidence. This is an intuitively 'comfortable' model and, from a psychometric perspective, has good evidence supporting its structure.

2.5.2 Next steps

Two applied issues arise at this point, first, what impact does this mental toughness have on performance and secondly, can mental toughness be developed in individuals, or is this a relatively stable trait. The remainder of this thesis attempts to address these two issues. The following two chapters utilise experimental methods to consider the moderating effect of mental toughness on individuals under different conditions of strain and Chapters 5 & 6 consider the impact of challenging circumstances and training on the development of mental toughness. These are clearly important questions which have potential consequences in a wide variety of sporting and occupational domains, and the results will provide a strong starting point for developing our understanding of mental toughness.

With regard to the use of MTQ48, one of the initial intentions of the current research was the measurement of mental toughness within a sporting individual, with the ultimate intention of enhancing performance. However, this may be a suitable point to report that this instrument has been adopted principally in the occupational domain: The work presented in this thesis has led to the development of a computerised version of the MTQ48 which is currently commercially available and being utilised in 11 countries.

Chapter 3:

Physical Workload and Mental Toughness

3.1 Summary

The experiment described and discussed in the current chapter aimed to investigate the moderating effect of mental toughness on the response to different levels of physical workload. While the research on the concept of mental toughness is in its infancy, and, in general, fairly limited, there is a complete absence of any experimental research on the moderating effect of mental toughness on the response to stressors. This chapter utilises different levels of physical workload to generate physical strain.

In summary, evidence was found to support the view that mental toughness had a moderating effect on a wide range of subjective states. Although not all these effects were found to be significant, there was an overwhelming trend towards the position that high levels of mental toughness are protective or beneficial, in terms of both performance and subjective state. In general, the greatest effects were found in the conditions where workload was at its highest.

3.2 Introduction

In general, it could be argued that the research into mental toughness is in its infancy, and the majority of the existing research has focused on questions relating to definition and measurement. However, there are a small number of studies which consider constructs relating to mental toughness and performance. One of the first studies examining performance on an aspect related to the construct of mental toughness was by Maddi and

Hess (1992). This study investigated the relationship between *hardiness* and performance in a number of basketball skills. In summary there was found to be support for the hypothesis that hardiness does in fact correlate with basketball performance and Maddi and Hess concluded that "this study adds to the construct validity of hardiness as a general characteristic of personality contributing to a range of areas, such as health-illness status, and effective performance". They further propose that hardy (mentally tough) individuals, when confronted with problems, challenges or disruptions, are more likely to cope by transforming them mentally into something less stressful (Maddi, 1991; Rhodewalt & Agostsdottir, 1984). Further studies examining hardiness and performance effectiveness found that high levels of hardiness related to both success in graduating through an officer training school for the Israeli military (Westman, 1990) and increased gross income for businesses (Schneider, 1986). However, these studies have typically been correlational in nature and hence, conclusions can be no more than tentative.

From both an applied and theoretical perspective, there are many important questions which still need attention: For example, it is a central assumption in the mental toughness literature that mental toughness somehow 'offsets' or reduces the impact of stressors on the individual (Jones *et al*, 2002). However, such assumptions are currently untested and the literature relating to the moderating effect of mental toughness in response to stressors is very limited.

There are two general classes of stressors which are of interest here. From a sporting perspective, there is a clear need to consider varying responses to *physical* stressors – consider the high degrees of physical workload faced by athletes across all sporting domains. However, athletes can also face a high degree of cognitive demand, particularly in sports where focus and attention are important. Furthermore, from an occupational perspective, the moderating effect of mental toughness on responses to cognitive demand

is also a highly relevant issue. Therefore, the current chapter will consider mental toughness and physical stressors and the following chapter will consider cognitive stressors.

While the literature relating to mental toughness and experimental manipulations of physical workload is non-existent, the literature investigating the impact of physical work on other psychological variables is vast and has been extremely varied in scope. The general question of the impact of physical exercise (or workload) has been addressed repeatedly for many years, with considerations of the impact on long term health, short term subjective state and cognitive processes. Although researchers have focused on the apparently straightforward task of whether the effects of exercise are psychologically facilitative or debilitative, and whether certain personality factors have a mediating effect on both subjective state measures and objective performance measures, the problematic nature of the operationalisation of 'exercise' and the diverse use of psychological variables has led to inconclusive and contradictory findings. As the experiment presented in the current chapter manipulates physical workload, with the intention of investigating the moderating effect of mental toughness on a range of psychological variables, the following section will consider some of the ways this has been approached previously.

3.2.1 Exercise and psychological effects

As previously stated, the operationalisation of exercise and the effect of psychological variables had led to equivocal research findings. These findings have impacted on the theoretical development in this area. Tomporowski and Ellis (1986) attempted to remedy this by embarking on a systematic review of the area, focusing on the key distinctions and similarities of previous research and classifying them into a number of key dimensions:

(1) Nature of psychological task; (2) Timing of administration of psychological task; (3) Intensity and duration of physical work; and (4) Prior level of fitness. All the issues relating to these four dimensions are discussed in relation to the current study.

3.2.1.1 Nature of the psychological task

It is broadly considered that the nature of the psychological task has a significant and differentiating impact on performance during physical exercise. The range of cognitive tasks utilised have varied from intellectual tasks (Weingarten & Alexander, 1970) memory-based tasks (Sjoberg, 1980; Tomporowski, Ellis & Stevens, 1987) reaction time (Meyers, Zimmerli, Farr & Baschnagel, 1969) and simple mental arithmetic (Gupta, Sharma & Jaspal, 1974). Therefore, maybe it should not be surprising that the effects that have been found have been extremely varied, some showing improvements and some showing a decline.

An explanation for the diverse research findings has centred on the distinction between differing stages of information processing, and examined the sensitivity of each stage to the effects of exercise (Fery, Ferry, Vom Hofe & Rieu 1997). Fery *et al,* proposed that the discrepancy in research findings were due in part to the simple dependent variables used, e.g. reaction time, which are generally utilised as single indices. This could result in any effects being minimised, as it is widely recognised that individuals can increase effort to maintain performance (Teichner, 1968). Fery *et al,* suggested that the use of a concurrent secondary task would aid this area of research, and enable researchers to measure the more subtle effects of the stressors on the individual. Following this recommendation, this current study incorporated a secondary task into the experimental design.

3.2.1.2 Timing of task administration

The question of the impact of physical exercise/stressors on performance is also influenced by the timing of when the task is given to participants, in relation to the physical work. Previous research in this area has included psychological tasks administered either during or after the exercise manipulation. The impact of the timing would appear to be dependent on two key dimensions highlighted by Tomporowski and Ellis (1986), namely; duration of the exercise and prior level of physical fitness. Without these factors being controlled for it would be very difficult to interpret the impact of time of test in isolation, for example, if a very unfit individual is asked to carry out a task following exercise, their performance is likely to be worse than their base level performance. However, for a very fit individual, a bout of exercise may improve their performance.

3.2.1.3 Duration and intensity of exercise manipulation

The factor of the *duration* of the exercise appears to be of key significance. Exercise durations have varied from individual sessions of very brief exercise, e.g. Ash (1914); Schwab (1953); Flynn (1972); Gupta, Sharma and Jaspal (1974), to individual sessions of more protracted aerobic exercise, e.g. Lichtman and Posner (1983); Gliner, Matsen-Twisdale, Horvath and Maron (1983); McMorris and Graydon (1997), to exposure over lengthy periods of time in excess of months e.g. Petruzzello, Landers and Hatfield (1991); Martinsen (1993); Craft and Landers (1998). The impact of long-term exercise programmes have tended to find beneficial effects on a number of important "quality of life" factors, such as subjective well-being, energy and depression (see Morgan, 1997, for a review), however the impact on cognitive processes still appears debatable (Etnier et al, 1997). Studies investigating the acute effects of a single session during varying levels of exercise intensity have found interesting results. It was found in a study by Davey (1973) that an inverted U relationship occurred between exercise and cognition. Davey found that the performance on a short-term memory task improved after two minutes of

stationary cycling, but performance reduced significantly after ten minutes. Research by Gupta, Sharma and Jaspal (1974) also found a similar pattern in which initial performance of an arithmetical task was improved before the five minute mark but was impaired after ten minutes.

These findings fall in line with the research of Yerkes and Dodson (1908) (see chapter 1 for further details) who proposed the inverted U theory to explain the relationship between arousal and psycho-motor task performance. Later work carried out by Easterbrook (1959) attempted to explain the effect of physical arousal on performance as a narrowing of attention, this research led to the development of the Cue Utilisation theory. Easterbrook proposed that a narrowing in attention would occur when arousal levels were increased. This attentional narrowing is then likely to have a significant impact on the individual's ability to select appropriate task-relevant cues. Support for this theory is plentiful (e.g. Kahneman, 1973), in that evidence suggests that attentional capacity varies during cognitive tasks and that potential capacity is affected by physical arousal levels.

In respect of the present study it is a necessity to ensure the exercise levels of the participants are sufficiently intense in order to generate a strain experience rather than simply being 'activated' by the exercise – for an investigation into the moderating impact of mental toughness on response to physical stressors, this is vital.

3.2.1.4 Prior level of participant fitness

Investigations into the effects of physical work on performance and other psychological variables, has (rather bizarrely) largely ignored the level of fitness of the participants (Davey, 1973; Gupta, Sharma & Jaspal, 1974). This is clearly an important variable as exercise is likely to have very different effects on individuals with differing degrees of fitness. However, some researchers have paid attention to this important variable and assessed maximal strength (Andreassi, 1965) and aerobic capacity (Sjoberg, 1980;

Weingarten & Alexander, 1970). This variable will be carefully considered and controlled in the current study.

3.2.2 Experimental rationale

The current study aims to investigate the moderating effects of mental toughness on responses to physical work. The manipulation of physical workload is undertaken using varying intensities of stationary cycling. The participants for all conditions are required to cycle at a constant speed but will be cycling at three different resistance levels. Performance will be assessed using both concurrent and post-test measures and a range of subjective variables will be measured.

3.3 Method

3.3.1 Design

The experiment utilised a mixed design with two independent variables (IV); *physical workload* and *mental toughness*. Physical workload was a repeated measures variable encountered at three differing levels; low, medium and high, determined by the level of resistance programmed into a stationary cycle. The second IV was mental toughness, which was a between groups variable. The manipulation of the independent variables resulted in three experimental sessions.

The experimental session lasted less than one hour. In order to minimise carryover effects, a minimum of a three day break before completing another session was enforced. The maximum delay was seven days.

3.3.2 Participants

Advertisements were placed in the Sports Centre at the University of Hull in order to recruit participants. A total of 26 students volunteered to take part in the study which was described as 'an experiment investigating the effects of physical exercise on performance'. All volunteers were required to be of a 'reasonable level' of fitness and regular exercisers.

Before being accepted as participants the students were required to undertake an assessment of their maximum oxygen uptake (VO_2 max) as an indicator of cardio-respiratory fitness (Astrand & Rodahl, 1986). The VO_2 max tests were carried out initially to verify the students' suitability for the study and secondly to ascertain their level of fitness which was used to determine individual levels of workload. Two of the volunteers were unable to meet the minimum requirements of fitness (as set by a Sport and Exercise Physiologist).

The experimental sample consisted of 15 males and 9 females, aged 18-36 (mean = 24.35, SD = 3.32).

3.3.3 Experimental Procedure

3.3.3.1 Pre-experimental testing

The assessment of the participants' fitness level was undertaken using the VO_2 max test. In the area of Sport Science this method is frequently utilised and is a broadly recognised method of reliably assessing fitness. The procedure assesses maximum oxygen consumption from the performance on a standardised protocol of incremental exercise to volitional exhaustion (Astrand & Rodahl, 1986). The cycle method was selected for the

VO_2 max test, as this was the method of workload manipulation selected for the experiment. The test and the experiment utilised the Monarch 824E, which allowed for easy and reliable manipulation of resistance levels.

The fitness testing protocol requires the participant to begin pedalling at a constant speed of 60RPM. The first three minutes of the test is classified as the warm up. After this, the resistance load is increased by 0.5 kg every three minutes, until the participants are physically incapable of continuing.

Mental toughness was also assessed during this session (prior to fitness testing), to enable participants to be categorised as either high or low in mental toughness before they attended the experimental sessions.

3.3.3.2 Experimental Procedure

Heart rate monitors were fitted to all participants at the start of all the sessions.

Participants were then asked to find a comfortable cycling position, and, when this position was obtained, it was noted for future sessions in order to reduce the potential impact of differing seating positions. At this point the experimenter fully explained the aims of the study and outlined the experimental procedure. A measure of the participants' resting heart rate was then taken.

The participants were asked to complete the state fatigue (Earle, 2004) and state anxiety questionnaires (Spielberger, 1983; see section 3.3.5.2). The participants were then fitted with a reaction time device (described in section 3.3.5.1 below) and given five practice trials of the task to facilitate familiarisation.

Participants were required to cycle for 30 minutes either in the low, medium or high physical workload conditions, which was followed by the completion of the state questionnaires.

3.3.4 Independent Variables

This study involved the manipulation of two IVs; physical workload and mental toughness.

Physical workload was manipulated by varying the intensity of the physical load thus producing the three workload levels (low, medium and high). This was achieved by varying the resistance weight on the ergometer, while maintaining the cycling speed at a consistent rate, in this case 60 RPM at all workload levels. The workload conditions required the participants to work at the following rates:

- Condition 1: Low workload – 30 minutes at the minimum resistance (approximately 30% of the maximum capacity of each individual participant)
- Condition 2: Medium workload – 30 minutes at exactly 50% maximum capacity
- Condition 3: High workload – 30 minutes at exactly 70% maximum capacity.

Participants were randomly allocated to one of the six possible experimental schedules, which determined the order in which they experienced the three workload conditions.

With regard to mental toughness, participants were categorised as either high or low in mental toughness on the basis of a median split. This resulted in 12 high MT and 12 low MT. This IV was balanced across the allocation of workload schedules to ensure that there was no confounding of these variables.

3.3.5 Dependent Variables

3.3.5.1 Performance-related dependent variable

Secondary task: Simple reaction time

As stated previously, this study incorporated a simple reaction time task. The primary task of the participant was to maintain cycling speed at 60 RPM, and it was decided that a concurrent secondary task should be incorporated as a more sensitive measure of the

impact of the primary task. For the purpose of this study, the secondary task was an auditory reaction time task. This involved an auditory alarm randomly sounding in each of the twenty 1.5 minute periods. Participants were required to respond, as quickly as possible, by pinching forefinger and thumb together. The reaction time was measured via electrodes attached to the forefinger and thumb.

3.3.5.2 Subjective measures

Subjective state was assessed in a number of ways. State anxiety and state fatigue were assessed at the start and end of the cycling period. Changes in state within these two dimensions were then gained by subtracting the pre-test scores from the post-test scores. State anxiety was measured using the STAI Form Y-2 (Spielberger, 1983) and state fatigue was measured with the 15 item Feelings Questionnaire (Earle, 2004). Workload was assessed in two ways. An overall workload assessment was gained from the NASA TLX (Hart & Staveland, 1988), which was completed at the end of the cycling and was used to assess the extent of the overall demands associated with the task.

The participants were also required to complete a further (concurrent) workload questionnaire, based on the Borg scale (1978). This required participants to rate *physical demands, mental demands* and *effort* on a 20 point scale, with verbal anchors of 'very low' (1) and 'very high' (20). The scale was shown to the participants at 3 intervals during the cycling: after 10 minutes, 20 minutes and 29 minutes.

3.3.5.3 Physiological measures

Heart rate was measured throughout the sessions using a radio-telemetry pulse monitor (Polar Electro OY). Cardiac activity was recorded via a chest strap, which then transmitted the data to a wrist 'watch'. After each experimental session the heat rate data was downloaded onto a computer.

3.3.6 Data treatment

Analysis of Variance was the main method of data analysis. In the cases where sphericity has been violated, degrees of freedom were corrected using either Greenhouse-Geisser (< 0.75) or Huynh-Feldt (> 0.75) estimates of sphericity, in accordance with Field (2005).

Heart rate data was primarily used to ensure that participants were working at physiologically different intensities during the three workload conditions.

The auditory response time data was log transformed prior to analysis because of positive skew. However, for clarity of interpretation, the data presented in the tables and figures reflect untransformed data. This data was further split into two time periods for each cycling session, to investigate any effects of time on task.

All questionnaire data was reduced into their relevant factors: The workload questionnaire was reduced into a single index of overall workload; state fatigue was reduced into five factors of mental, physical and sleep-related fatigue, boredom and negative affect, and difference scores were then obtained by subtracting pre- from post-factor scores. Data from the state anxiety and mental toughness questionnaires were reversed where necessary and reduced into a single index score.

3.3.7 Ethical Procedures

Ethical approval was obtained for all experimental work undertaken throughout the thesis.

3.4 Results

3.4.1 *Physiological data: Heart rate*

To investigate the impact of the three levels of physical workload and mental toughness on heart rate, this data (see table 3.1) was submitted to a 3 (workload) x 2 (mental toughness) mixed design ANOVA.

Table 3.1 Mean scores for average heart rate on the 3 workload conditions

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l	Low	88.81	12.98	11
	High	83.60	15.64	10
	Total	**86.33**	**14.19**	**21**
Medium w/l	Low	139.81	12.47	11
	High	132.40	13.19	10
	Total	**136.28**	**13.05**	**21**
High w/l	Low	158.90	12.45	11
	High	158.10	11.52	10
	Total	**158.52**	**11.72**	**21**

This analysis revealed a highly significant main effect of workload, $F(2, 38) = 308.53$, $p < 0.001$, $r = .94$, with heart rate increasing with increasing physical load (see Figure 3.1). To confirm that each level of workload was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between all levels of physical workload (low - medium workload, mean difference = -49.90, $p < 0.001$; low – high workload, mean difference = -72.29, $p < 0.001$; medium - high workload, mean difference = -12.32, $p < 0.001$).

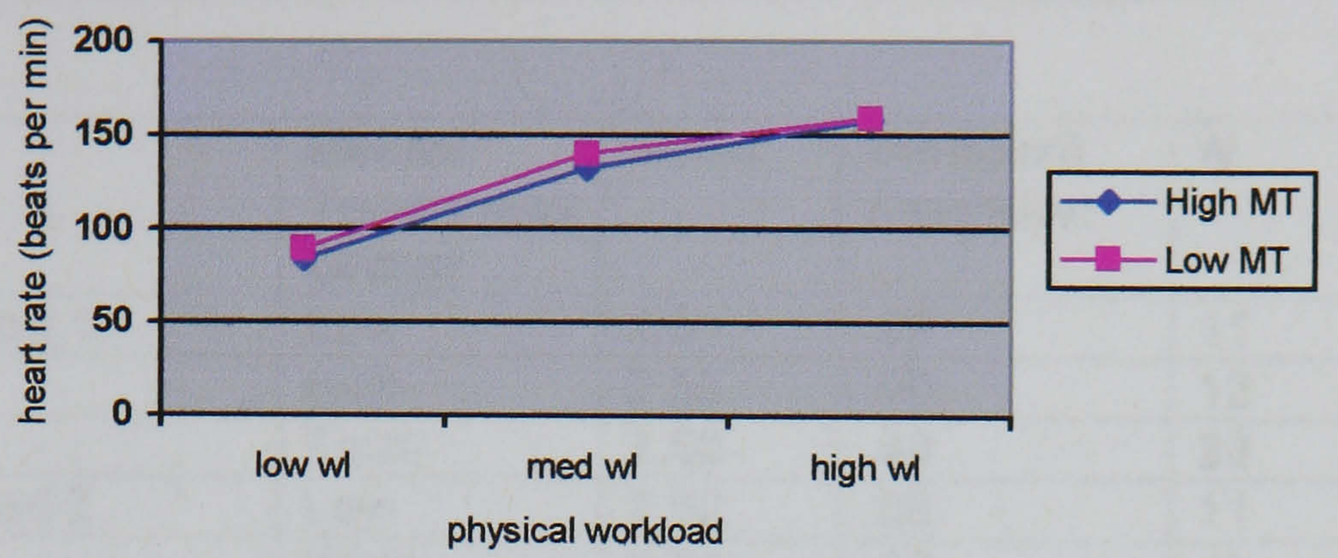


Figure 3.1: Mean heart rate as a function of workload and mental toughness

As also suggested by Figure 3.1, there was no significant main effect of mental toughness, $F(1, 19) < 1$, $p > 0.05$, $r = .04$ and there was also no significant interaction $F(2,38) < 1$, $p < 0.05$, $r = .03$.

3.4.2 Secondary task data: Auditory response time

To provide an index of the cognitive resources required to maintain performance on the primary task of cycling at a constant speed, participants were required to carry out a secondary task of responding to an auditory tone sounded at random intervals throughout the cycling session. Response times were log transformed and subjected to a 3 x 2 x 2 mixed design ANOVA (see table 3.2).

Table 3.2 Mean reaction times as a function of time and mental toughness

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l - period 1	Low	2.51	.09	11
	High	2.53	.06	12
	Total	**2.52**	**.08**	**23**
Low w/l - period 2	Low	2.52	.08	11
	High	2.54	.08	12
	Total	**2.53**	**.08**	**23**
Medium w/l - period 1	Low	2.54	.11	11
	High	2.53	.07	12
	Total	**2.53**	**.09**	**23**
Medium w/l - period 2	Low	2.56	.09	11
	High	2.54	.08	12
	Total	**2.55**	.08	**23**
High w/l - period 1	Low	2.58	.07	11
	High	2.56	.10	12
	Total	**2.57**	.09	**23**
High w/l - period 2	Low	2.60	.11	11
	High	2.55	.86	12
	Total	**2.57**	.10	**23**

This analysis did reveal a significant main effect of workload, $F(2, 42) = 7.69$, $p < 0.001$, $r = .26$, with response time increasing with increasing physical load (see Figure 3.2). To confirm that each level of workload was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed only one significant difference between the three levels of workload (low-high workload, mean difference = -4.83). This difference was significant at the 1% level. The effect of time period failed to reach significance, $F(1, 21) = 1.49$, $p > 0.05$, $r = .06$ (see figure 3.2).

There was also no significant main effect of mental toughness, $F(1, 21) < 1$, $p > 0.05$, $r = .00$, and no significant interactions: Workload x period, $F(2, 42) < 1$, $p > 0.05$, $r = .01$; workload x mental toughness, $F(2, 42) = 2.04$, $p > 0.05$, $r = .08$; period x mental toughness, $F(1, 21) = 1.3$, $p > 0.05$, $r = .05$; workload x period x mental toughness, $F(2, 42) < 1$, $p > 0.05$, $r = .01$. However, figure 3.2 does reveal an interesting trend: Whilst under low workload the impact of time on task was the same for the high and low mental

toughness groups, the same pattern was not found under high workload. When workload was high, time on task had a different effect on the two mental toughness groups, with mentally tough participants improving response time, whereas the performance of the low mental toughness group deteriorated with time on task.

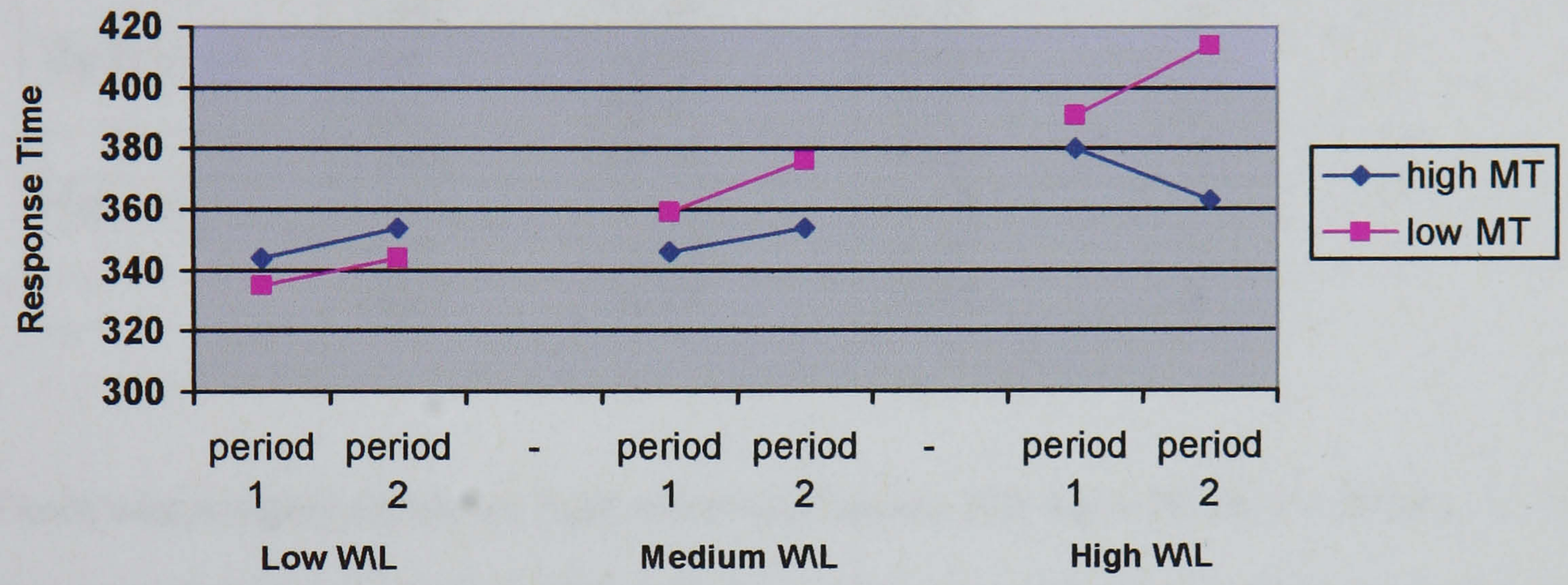


Figure 3.2: Mean alarm response times in milliseconds for the two time periods as a function of low/medium/high physical workload and mental toughness

3.4.3 Subjective post-task workload assessment

3.4.3.1 Overall post-task workload assessment

To investigate subjective evaluations of the loading task (cycling at a specified rate and responding to auditory tones), the overall ratings of workload (outlined in section 3.3.5.2) were subjected to a 3 x 2 mixed design ANOVA (see table 3.3).

Table 3.3 Mean scores for workload assessment as a function of workload and mental toughness

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l	Low	53.45	22.40	11
	High	52.58	18.60	12
	Total	**53.00**	**20.03**	**23**
Medium w/l	Low	72.09	22.02	11
	High	66.41	16.21	12
	Total	**69.13**	**18.98**	**23**
High w/l	Low	105.72	28.04	11
	High	88.58	19.80	12
	Total	**96.78**	**25.10**	**23**

There was a highly significant main effect of workload $F(2, 42) = 69.54$, $p < 0.001$, $r = .76$, revealing that increasing physical load had a major impact on overall ratings of workload (see Figure 3.3). To confirm that each level of workload was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between all levels of physical workload (low - medium workload, mean difference = -16.24, $p < 0.001$; low – high workload, mean difference = -44.14, $p < 0.001$; medium - high workload, mean difference = -27.90, $p < 0.001$). However, there was (disappointingly) no main effect of mental toughness, $F(1, 21) = 1.03$, $p > 0.05$, $r = .04$, and the interaction between workload and mental toughness failed to reach significance [$F(2, 42) = 2.43$, $p > 0.05$, $r = .10$.

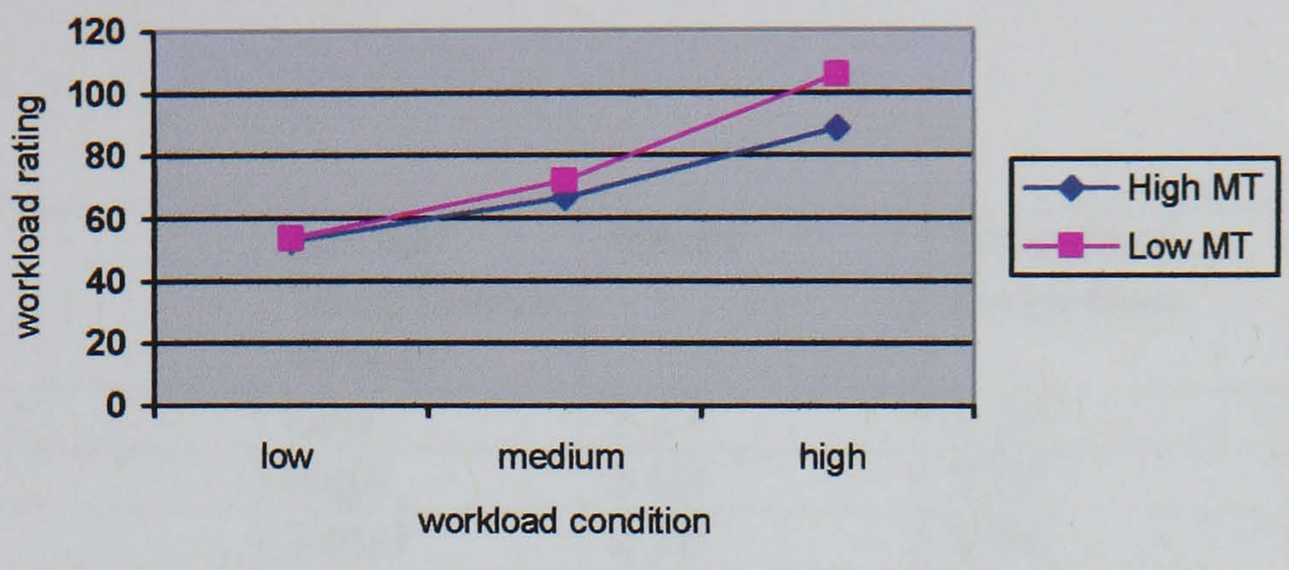


Figure 3.3: Mean workload ratings as a function of physical workload and mental toughness

3.4.4 Subjective mid-task workload assessment

To investigate further the subjective evaluations of the physical workload task, the concurrent ratings of physical workload, mental workload and effort were subjected to a 3 (wl) x 3 (period) x 2 (mental toughness) mixed design ANOVA.

3.4.4.1 Concurrent ratings of physical workload

The descriptive data from this dependent variable are shown overleaf in table 3.4

Table 3.4 Mean physical workload rating as a function of workload, time and mental toughness

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l - time 1	Low	2.27	1.34	11
	High	3.08	2.02	12
	Total	**2.70**	**1.74**	**23**
Medium w/l - time 1	Low	6.64	3.90	11
	High	6.08	2.02	12
	Total	**6.35**	**1.74**	**23**
High w/l - time 1	Low	11.64	3.66	11
	High	9.67	2.77	12
	Total	**10.61**	**3.31**	**23**
Low w/l - time 2	Low	3.09	1.81	11
	High	3.08	1.88	12
	Total	**3.09**	**1.80**	**23**
Medium w/l - time 2	Low	9.09	4.23	11
	High	7.83	2.29	12
	Total	**8.43**	**3.34**	**23**
High w/l - time 2	Low	15.36	2.50	11
	High	12.92	3.26	12
	Total	**14.09**	**3.11**	**23**
Low w/l - time 3	Low	3.27	2.05	11
	High	3.42	1.92	12
	Total	**3.35**	**1.94**	**23**
Medium w/l - time 3	Low	10.82	4.66	11
	High	8.83	2.40	12
	Total	**9.78**	**3.71**	**23**
High w/l - time 3	Low	17.45	2.01	11
	High	14.75	3.54	12
	Total	**16.04**	**3.16**	**23**

With regard to ratings of physical workload, there was a highly significant main effect of physical load, $F(2, 42) = 126.36$, $p < 0.001$, $r = .85$, revealing that increasing physical load had a major impact on ratings of physical workload. To confirm that each level of workload was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between all levels of physical workload (low - medium workload, mean difference = -5.18, $p < 0.001$; low – high workload, mean difference = -10.60, $p < 0.001$; medium - high workload, mean

difference = -5.41, p < 0.001). There was also a main effect of period $F(2, 42) = 56.92$, $p < 0.001$, $r = .73$, revealing that ratings of physical workload increased throughout the session (see figure 3.4), despite the actual load remaining constant. To confirm that each level of time period was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between all levels of time period (time 1 – time 2, mean difference = -2.00, p < 0.001; time 1 – time 3, mean difference = -3.19, $p < 0.001$; time 2 – time 3, mean difference = -1.19, p < 0.001). There was no main effect of mental toughness, $F(1,21) = 2.29$, $p > 0.05$, $r = .10$ (see figure 3.5).

With regard to interactions, there was a significant workload x period interaction $F(2.69, 56.60) = 21.67$, $p < 0.001$, $r = .50$, revealing that ratings of physical demands increased with time to a greater extent under high workload (see Figure 3.5). However, there were no further interactions: workload x mental toughness, $F(2, 42) = 2.05$, $p > 0.05$, $r = .08$; period x mental toughness, $F(2,42) = 1.28$, $p > 0.05$, $r = .05$; workload x period x mental toughness, $F(4, 84) < 1$, $p > 0.05$, $r = .01$.

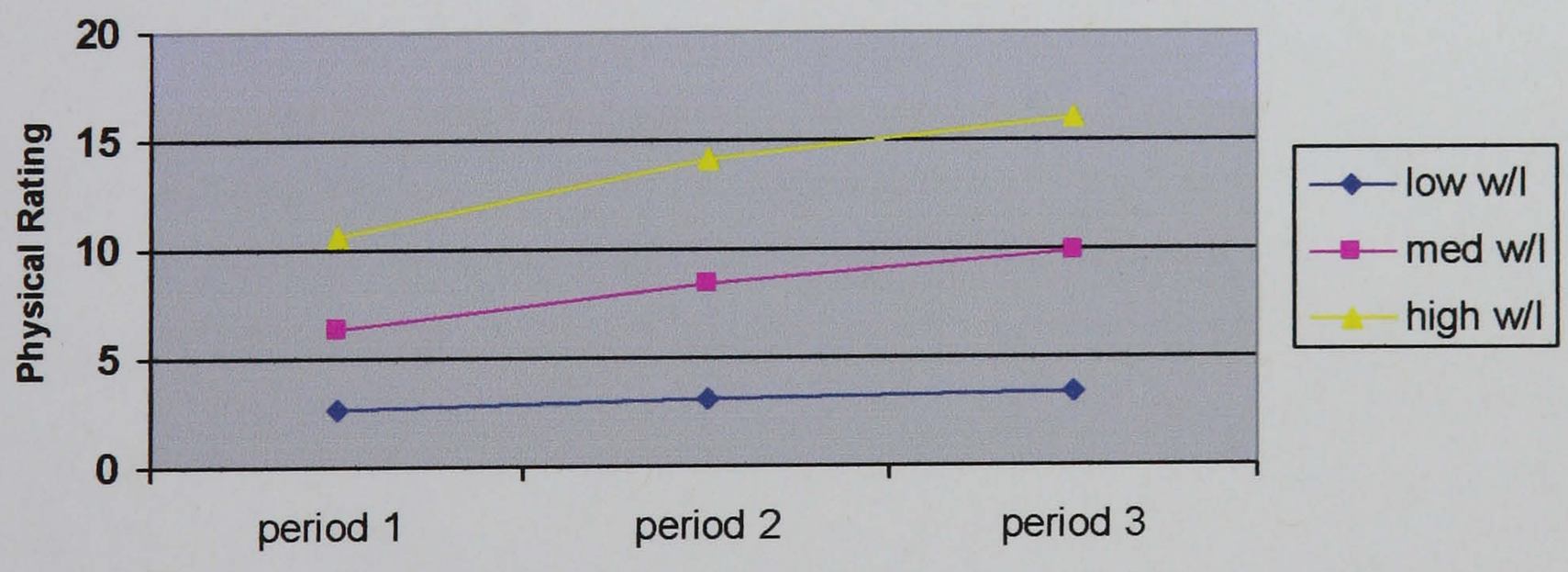


Figure 3.4: Mean physical demand ratings as a function of time period

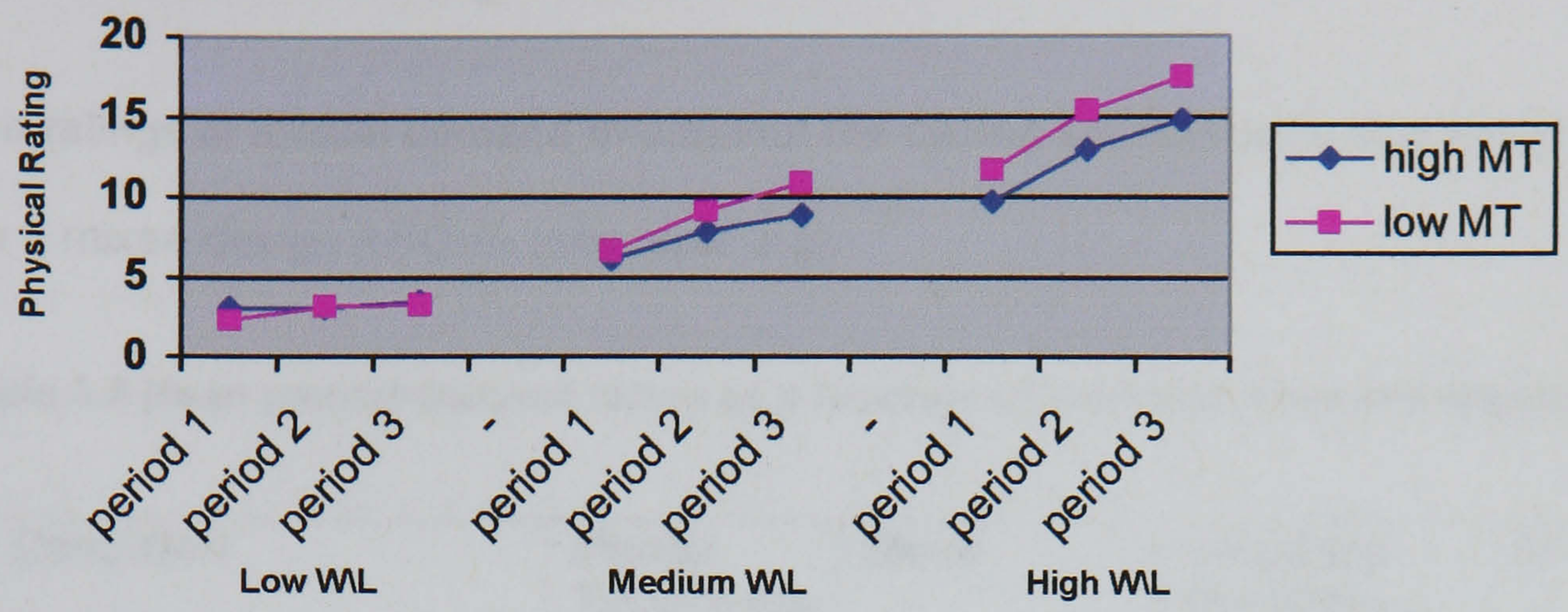


Figure 3.5: Mean physical demand ratings as a function of physical workload, period and mental toughness

3.4.4.2 Concurrent ratings of mental demand

The ratings of mental demand throughout the cycling session were also subjected to a 3 x 2 x 3 mixed design ANOVA (see table 3.5).

Table 3.5 Mean mental demand rating as a function of workload, time and mental toughness

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l - time 1	Low	3.55	2.01	11
	High	2.50	1.38	12
	Total	**3.00**	**1.75**	**23**
Medium w/l - time 1	Low	4.64	2.11	11
	High	3.50	1.50	12
	Total	**4.04**	**1.87**	**23**
High w/l - time 1	Low	5.73	2.76	11
	High	4.50	2.23	12
	Total	**5.09**	**2.52**	**23**
Low w/l - time 2	Low	3.64	2.61	11
	High	2.58	1.67	12
	Total	**3.09**	**2.19**	**23**
Medium w/l - time 2	Low	5.00	2.86	11
	High	4.25	1.48	12
	Total	**4.61**	**2.23**	**23**
High w/l - time 2	Low	7.64	4.34	11
	High	6.17	4.23	12
	Total	**6.87**	**4.25**	**23**
Low w/l - time 3	Low	3.73	2.68	11
	High	2.75	1.91	12
	Total	**3.22**	**2.31**	**23**
Medium w/l - time 3	Low	6.18	4.89	11
	High	4.58	1.44	12
	Total	**5.35**	**3.55**	**23**
High w/l - time 3	Low	8.64	5.31	11
	High	6.92	4.10	12
	Total	**7.74**	**4.69**	**23**

There was again a highly significant main effect of workload $F(1.30, 27.32) = 17.67$, $p < 0.001$, $r = .46$, revealing that increasing physical load had a major impact on ratings of mental demand (see figure 3.6). To confirm that each level of workload was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc

test. This revealed a highly significant difference between all levels of physical workload (low - medium workload, mean difference = -1.57, $p < 0.001$; low – high workload, mean difference = -3.47, $p < 0.001$; medium - high workload, mean difference = -1.90, $p < 0.05$). There was also a main effect of period $F(1.22, 25.60) = 12.69$, $p < 0.001$, $r = .38$, revealing that ratings of mental workload also increased throughout the session. To confirm that each level of time period was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between all levels of time period (time 1 – time 2, mean difference = -.81, $p < 0.01$; time 1 – time 3, mean difference = -1.39, $p < 0.01$; time 2 – time 3, mean difference = -.59, $p < 0.05$).

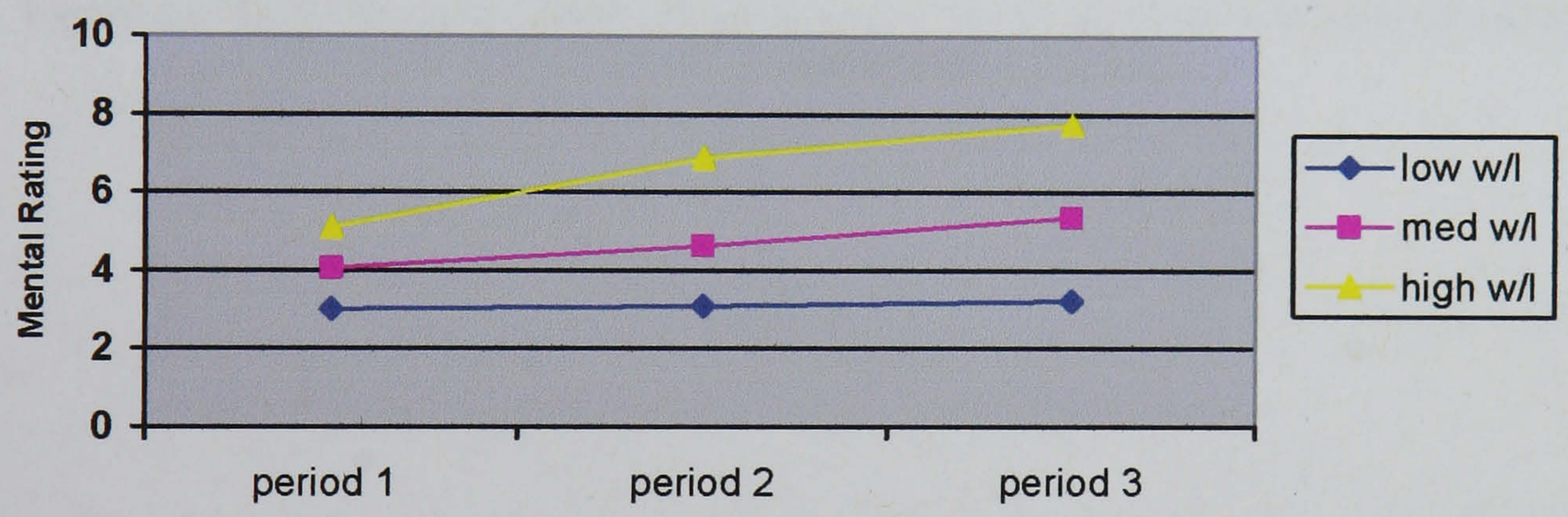


Figure 3.6: Mean mental demand ratings as a function of physical workload and mental toughness

However, while there was no main effect of mental toughness, $F(1, 21) = 1.64$, $p > 0.05$, $r = .07$, mental workload was rated higher for the low mental toughness group under each level of workload (see Figure 3.7). With regard to interactions, there was a significant workload x period interaction $F(2.43, 51.03) = 7.25$, $p < 0.001$, $r = .26$, revealing that mental workload ratings increased more over the session, in the higher workload conditions (see Figure 3.6). However, there were no further interactions: workload x

mental toughness, $F(1.30, 27.32) < 1$, $p > 0.05$, $r = .00$; period x mental toughness, $F(1.22,25.60) < 1$, $p > 0.05$, $r = .01$; workload x period x mental toughness, $F(2.43, 51.03) < 1$, $p > 0.05$, $r = .15$.

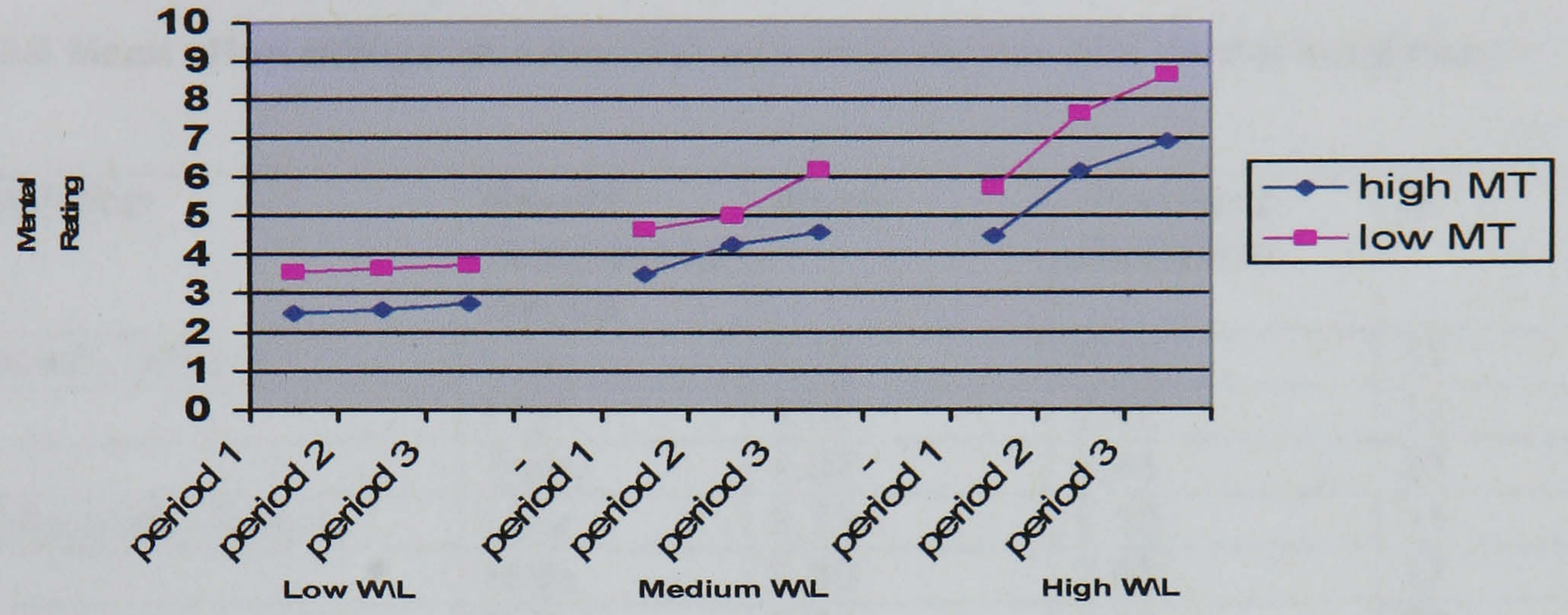


Figure 3.7: Mean mental demand ratings as a function of physical workload, period and mental toughness

3.4.4.3 Concurrent ratings of effort

The ratings of effort throughout the cycling session were also subjected to a 3 x 2 x 3 mixed design ANOVA (see table 3.6).

Table 3.6 Mean effort ratings as a function of workload, time and mental toughness

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l – time 1	Low	5.18	5.75	11
	High	4.00	2.92	12
	Total	**4.57**	**4.44**	**23**
Medium w/l - time 1	Low	9.73	5.15	11
	High	6.50	2.06	12
	Total	**8.04**	**4.11**	**23**
High w/l - time 1	Low	12.73	3.79	11
	High	10.25	3.10	12
	Total	**11.43**	**3.60**	**23**
Low w/l - time 2	Low	5.55	5.95	11
	High	3.92	2.87	12
	Total	**4.70**	**4.57**	**23**
Medium w/l - time 2	Low	10.18	5.19	11
	High	7.25	3.13	12
	Total	**8.65**	**4.40**	**23**
High w/l - time 2	Low	15.45	2.33	11
	High	12.50	3.47	12
	Total	**13.91**	**3.28**	**23**
Low w/l - time 3	Low	5.73	5.69	11
	High	4.08	3.11	12
	Total	**4.87**	**4.50**	**23**
Medium w/l - time 3	Low	11.36	5.20	11
	High	8.42	1.88	12
	Total	**9.83**	**4.04**	**23**
High w/l - time 3	Low	17.91	1.92	11
	High	14.00	4.28	12
	Total	**15.87**	**3.85**	**23**

There was again a highly significant main effect of workload $F(1.46, 30.71) = 62.89$, $p < 0.001$, $r = .75$, revealing that increasing physical load had a major impact on ratings of effort. To confirm that each level of workload was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly

significant difference between all levels of physical workload (low - medium workload, mean difference = -4.16, p < 0.001; low – high workload, mean difference = -9.06, *p* < 0.001; medium - high workload, mean difference = -4.90, p < 0.001). There was also a main effect of period $F(1.71, 35.96) = 34.25$, $p < 0.001$, $r = .62$, revealing that ratings of effort also increased throughout the session. To confirm that each level of time period was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between all levels of time period (time 1 – time 2, mean difference = -1.08, p < 0.001; time 1 – time 3, mean difference = -2.19, *p* < 0.001; time 2 – time 3, mean difference = -1.11, p < 0.001). But there was again no main effect of mental toughness, $F(1, 22) = 3.84$, $p > 0.05$, $r = .15$. With regard to interactions, there was a significant workload x period interaction $F(2.42, 50.73) = 20.64$, $p < 0.001$, $r = .56$, revealing that ratings increased more over the session, in the higher workload conditions (see Figures 3.8 and 3.9).

There was no significant interaction between workload and mental toughness, $F(2, 42) < 1$, $p > 0.05$, $r = .03$, and there were no further interactions: period x mental toughness, $F(2, 42) < 1$, $p > 0.05$, $r = .02$; workload x period x mental toughness, $F(4, 84) = < 1$, $p > 0.05$, $r = .04$.

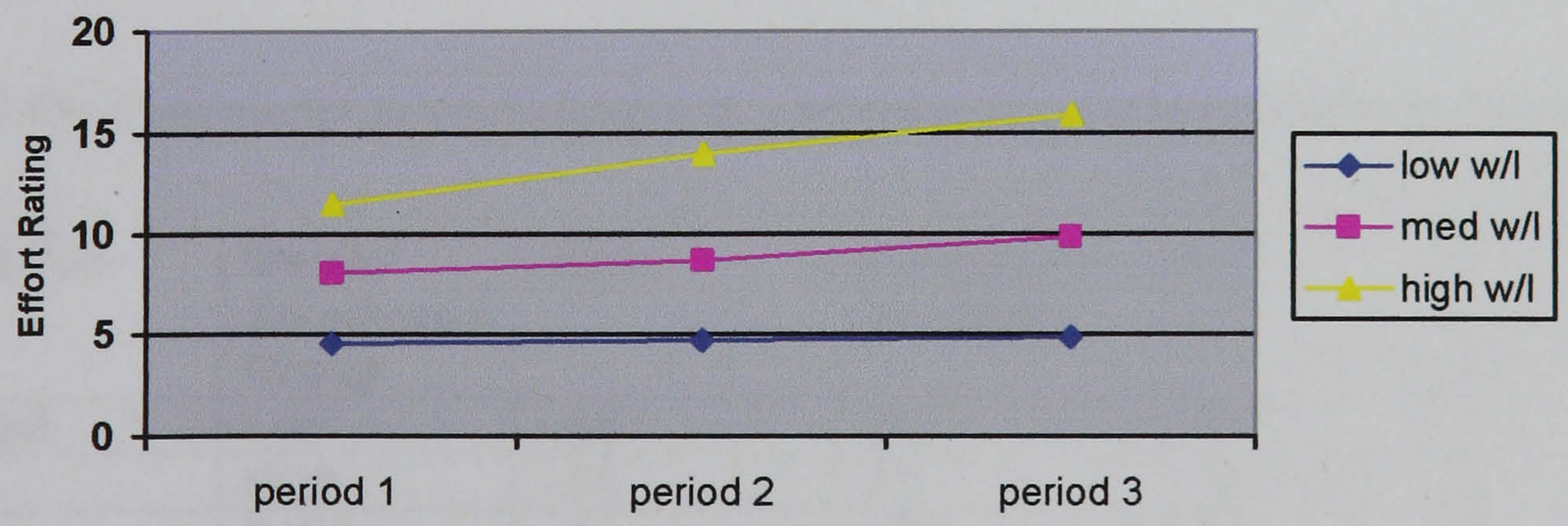


Figure 3.8: Mean effort ratings as a function of physical workload and mental toughness

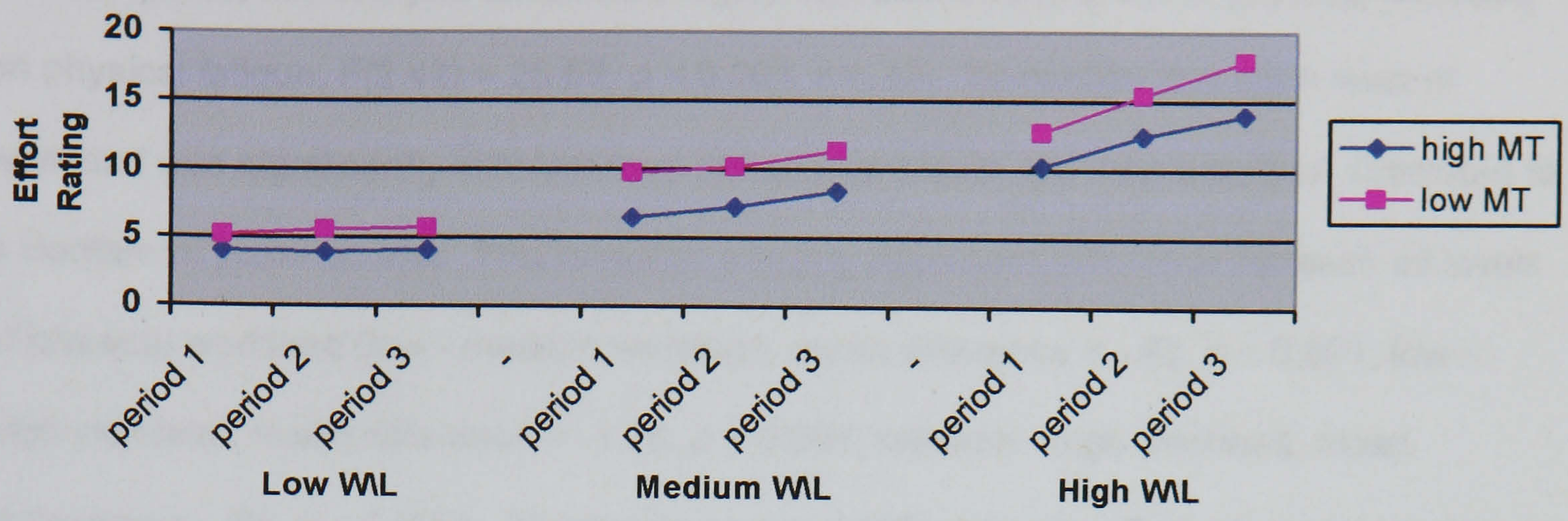


Figure 3.9: Mean effort demand ratings as a function of physical workload, period and mental toughness

3.4.5 Subjective state

Changes in state fatigue were again calculated by subtracting pre- from post-cycling scores to produce a difference variable for each of the different types of fatigue.

To analyse changes in subjective state, under the different levels of workload and mental toughness, two 3 x 2 mixed design ANOVAs were carried out on the two types of fatigue.

Changes in subjective physical fatigue: Subjective physical fatigue scores are presented in table 3.7 below

Table 3.7 Mean scores for physical fatigue as a function of workload and mental toughness

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l	Low	-.63	.80	11
	High	-.20	.75	12
	Total	**-.41**	**.79**	**23**
Medium w/l	Low	.54	.75	11
	High	.45	.54	12
	Total	**.50**	**.63**	**23**
High w/l	Low	2.13	.74	11
	High	.58	1.04	12
	Total	**1.32**	**1.19**	**23**

As anticipated, this analysis revealed a highly significant main effect of physical workload on physical fatigue, $F(2,42) = 25.62$, $p < 0.001$, $r = .55$. To confirm that each level of workload was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between all levels of physical workload (low - medium workload, mean difference = -.92, $p < 0.001$; low – high workload, mean difference = -1.78, $p < 0.001$; medium - high workload, mean difference = -.86, $p < 0.005$). There was also a significant main effect of mental toughness on changes in physical fatigue $F(1, 21) = 6.34$, $p = 0.05$, $r = .23$ (see Figure 3.10), with the low mentally tough group reporting higher levels of physical fatigue. There was also a significant interaction $F(2,42) = 8.51$, $p = < 0.001$, $r = .28$: As illustrated in Figure 3.10 ratings of physical fatigue increase with workload but under high workload this increase is only present for the low mental toughness group.

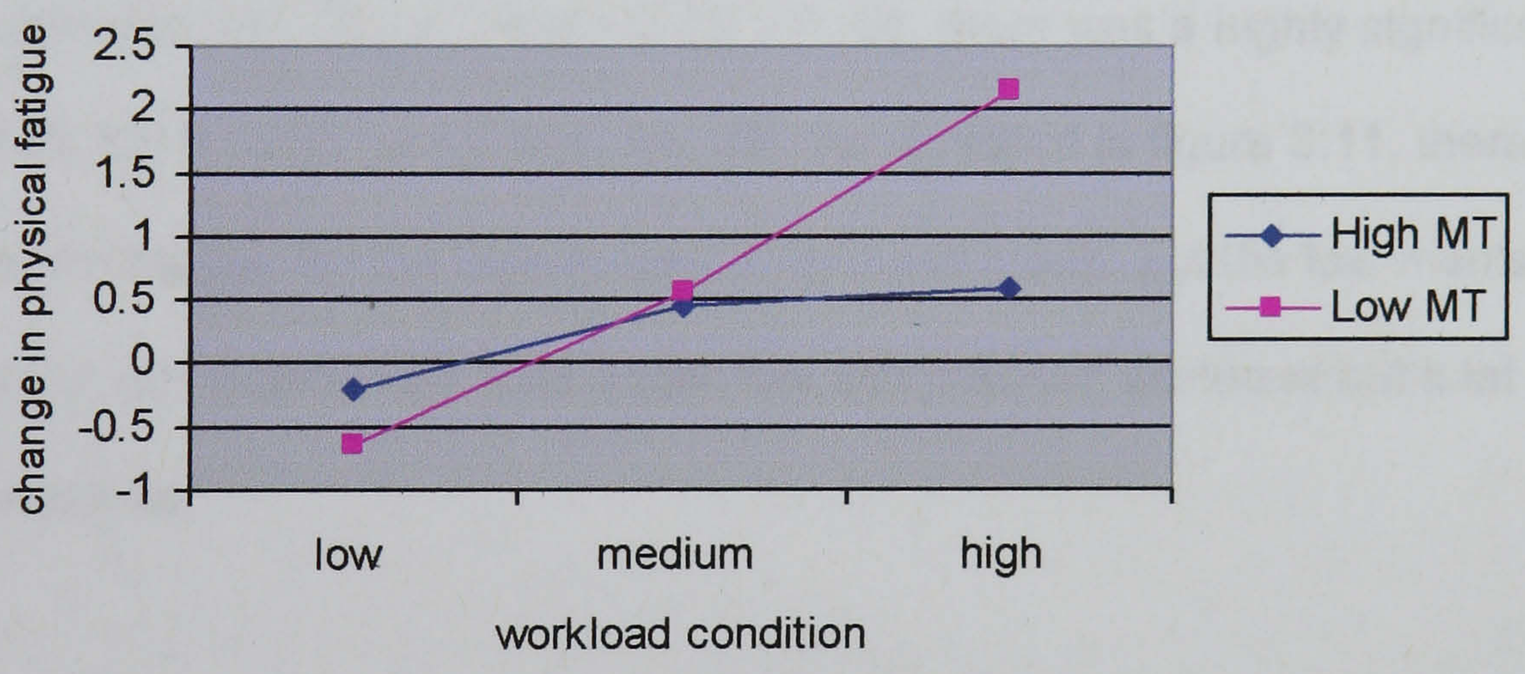


Figure 3.10: Mean change in physical fatigue as a function of workload and mental toughness

Changes in subjective mental fatigue:

There were only very small average changes in mental fatigue: In the low and medium workload conditions, participants reported slightly less mental fatigue, and slightly more under the high physical workload condition (see table 3.8).

Table 3.8 Mean scores for mental fatigue as a function of workload and mental toughness

Condition	*Mental Toughness Group*	*Mean*	*Standard Deviation*	*N*
Low w/l	Low	-.13	.39	11
	High	.02	.72	12
	Total	**-.05**	**.58**	**23**
Medium w/l	Low	-.25	.51	11
	High	.04	.32	12
	Total	**-.10**	**.44**	**23**
High w/l	Low	.83	.58	11
	High	-.17	.31	12
	Total	**.30**	**.68**	**23**

Despite these very small changes, the main effect of workload was found to be significant $F(1.75, 36.82) = 6.02$, $p < 0.01$, $r = .22$. To investigate this difference further, the data was then submitted to a Bonferroni post-hoc test, which revealed only one significant difference between the three levels of workload (medium-high workload, mean difference = -0.437). This difference was significant at the .1% level. However, while there was no main effect of mental toughness, $F(1, 21) = 1.8$, $p > 0.05$, $r = .08$, there was a highly significant interaction, $F(2, 42) = 13.81$, $p < 0.001$, $r = .39$: As revealed in figure 3.11, there is little change in mental fatigue for the high mental toughness group, but the low mental toughness group get slightly less tired under low and medium workload but a lot more tired under high workload.

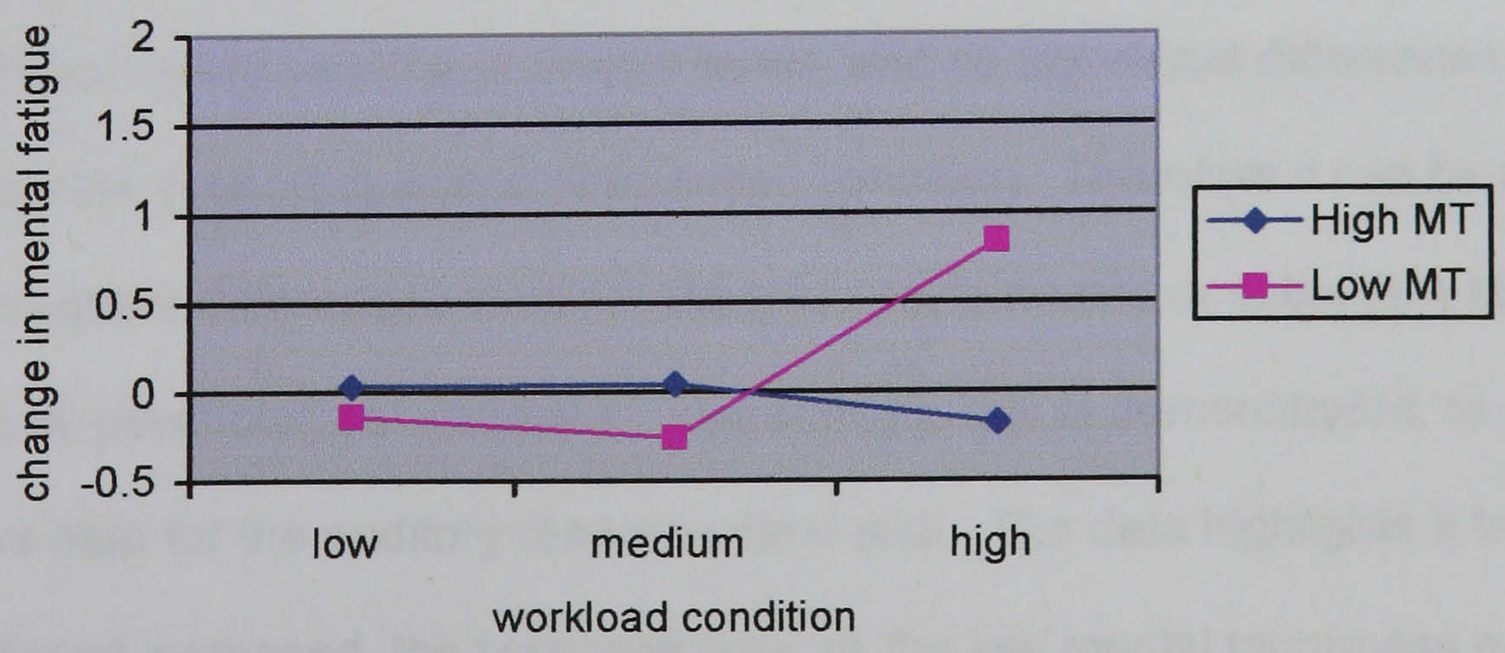


Figure 3.11: Mean change in mental fatigue as a function of physical workload and mental toughness

3.5 Discussion

3.5.1 Summary of findings

The primary aim of this experiment was to investigate the moderating effect of mental toughness on a range objective and subjective measures during and following physical exercise. To ensure the validity of this study, it was important to confirm that the participants were subjected to levels of workload that could be classified as 'stressful', as opposed to simply being energised by the exercise experience. This is because it is central to the definition of mental toughness that mental tough individuals are less adversely affected by stress (Middleton *et al*, 2004).

The confirmation that the levels of physical load were actually physiologically different and highly demanding was gained, firstly, by the heart rate data showing significantly differing levels during the three workload sessions, and secondly by the changes in subjective state and task evaluation. At the high levels of load, the average ratings of demand and effort were towards the upper end of the scale and the general pattern of results highlighted a substantial increase in effort and physical and mental demands when the levels of physical workload were increased.

Furthermore, the physiological data illustrated the point that both groups (high and low mental toughness) were working at similar levels, and no significant differences were found in heart rate data irrespective of workload condition. Therefore it can be surmised that any subsequent differences in either objective performance or subjective ratings may be explained by psychological variables. Interestingly, this is demonstrated, to some degree, in the data for the auditory response time task. The data highlights a trend that as physical workload increased, the response time for the low mental toughness group increases steadily whereas, for the high mental toughness group, the response times are relatively static, irrespective of workload condition. The largest difference (in respect of

mean scores) in reaction times between the two groups occurred in the high physical workload period. However, these differences were found to be not significant. This provides the first layer of evidence that individuals with increased mental toughness can perform more effectively in adverse conditions. This is in support of Loehr's original proposition (1982, and 1986).

This objective performance data is further supported by the subjective data of post-task overall workload assessment. As one would expect there was a significant impact of physical workload on overall ratings of workload. However, the positive impact of mental toughness was highlighted when the individuals were working at the highest physical workload - There was an increasing divergence in workload ratings, and, although not statistically significant, this is a thought provoking trend.

Similar trends were also established with the mid-task workload assessments. As with the previous data, the mean scores highlighted that both groups exhibited increased physical demands as the workload increased. However, more importantly, the mean score differences in physical demand ratings were at their greatest in the high workload trial.

These trends were further replicated in ratings for both mental and effort demands. This series of trends give further support to findings previously mentioned, which together suggest that individuals with higher mental toughness are consistently reporting subjective demands (physical, mental and effort) as less challenging especially as workload increases.

Another interesting finding related to changes in state fatigue: These data showed that subjective physical fatigue increased as workload increased in the case of the low mental toughness group. However, while physical fatigue in the high mental toughness group did increase from low to medium workload conditions, it did not increase from medium to high workload conditions. This finding is replicated with mental fatigue, as there was little

change in mental fatigue for the high mental toughness group, but the low mental toughness group got significantly more tired under high workload.

3.5.2 Broader implications of the findings

The implications of these findings have far reaching consequences in both the environs of sport and the workplace. The ability to perceive demands to a lesser extent has positive implications for the performance of tasks. This viewpoint is further supported by Dienstbier (1989) in his consideration of the mind/body relationship in terms of physiological changes. He states that an individual's perception of any given situation will most likely lead to neuroendocrine changes that in turn result in physiological changes. These physiological changes will influence emotional and motivational states which, in turn, modify an individual's perceptions and cognitions. Dienstbier further suggests that because of the "toughness" of certain individuals this leads, in general terms, to more successful outcomes on tasks, this history of success will lead to optimistic appraisals of future situations where either a threat or challenge could be perceived. This dispositional optimism has previously been noted to influence physical and psychological well-being in a multitude of different ways (Scheier & Carver, 1992; Scheider, 2001).

Although it makes intuitive sense that the reduced perception of demands is likely to correlate with enhanced performance, there has been little research in this area to substantiate this claim. Furthermore, it is also worth considering the possibility of the long term effects, both physical and psychological, of potentially underestimating the challenges that individuals may encounter. Further research in examining this particular area is imperative to ensure that the short-term positive effects in the sporting and occupational environments are not disproportionate to the long-term costs.

3.5.3 Limitations of the study

One limitation of the study could be the way in which the participants were split into their mental toughness groups. The use of median split to separate the groups has the potential effect of not discriminating sufficiently the participants in the study. However, due to the relatively low number of participants taking part in the study this was considered the most appropriate method. Future research should possibly investigate the area by comparing individuals at the extremes of mental toughness; this would hopefully produce more significant findings.

A further limitation relates to the way in which the physical stressor was imposed on the participants. Due to the nature of the tasks needed to be undertaken it was considered that cycling was the best way to conduct the experiment. However, the ecological validity of the protocol is debatable, specifically when compared to what athletes are typically exposed to on the football pitch, for example. However, due to fact that the control of workload was essential in this study the experimental protocol was considered to be sufficient to produce the desired physical stress.

The next chapter will investigate in more detail the moderating effect of mental toughness on cognitive performance.

Chapter 4:

Cognitive Performance and Mental Toughness

4.1 Summary

This chapter reports two experiments which aimed to investigate the moderating effect of mental toughness on the impact of cognitive stressors. The first experiment aimed to generate cognitive stress by submitting participants to a cognitive task and providing either negative or positive feedback regarding performance. While this experiment generated some promising findings, it was argued that the level of cognitive stress was not sufficient to investigate fully the moderating effect of mental toughness. Therefore, the second experiment aimed to increase the level of cognitive stress by adding a time pressure element to the task. This chapter also provides an overview of the literatures relating to the performance-related and subjective effects of feedback and also the importance of time pressure as a psychological variable. Although a full review of this work is considered to be beyond the scope of this thesis, the issues relevant to the current programme of research are discussed.

In summary, evidence was found to support the view that mental toughness had a moderating effect on cognitive performance and confidence after differential feedback. Although not all effects were found to be significant, there was an overwhelming trend towards the position of the protective effect of being more mentally tough.

4.2 Introduction

Chapter Three aimed to consider the moderating effect of mental toughness on the impact of a physical stressor. As previously discussed, this work clearly has relevance for the sporting domain. However, the current chapter aims to extend this work to consider the impact of mental toughness on the pattern of effects following cognitive stressors. It is intended that the issues addressed here are of relevance for both the occupational domain and the sporting domain, as individuals operating in both environments will be exposed to cognitive demands and experience cognitive strain. However, the majority of the published research that is considered relevant has been carried out in a workplace context.

There is a huge and historical literature investigating the performance-related and subjective effects of cognitive stressors. Variables that have been addressed include *environmental stressors*, such as noise (Broadbent, 1958), light (Megaw, 1992) and heat (Ramsey, 1995); *task-related variables,* such as control (Hackman & Oldham, 1976), mental workload (Wickens, 1992) and time pressure (Edland & Svenson, 1993) and the effect of *individual differences,* such as trait anxiety (Spielberger, 1983) and need for achievement (McClelland,1961). The current study aimed to utilise a task-related variable of negative feedback to induce cognitive strain. The reason for the selection of this variable is the pertinence of this to a central component of the mental toughness construct. It is argued within the mental toughness literature, and very strongly within this thesis, that mentally tough individuals have the ability to 'bounce back'. They are less susceptible to setbacks in life and less likely to be adversely affected by negative events. Therefore, attempting to generate cognitive strain by exposing participants to negative feedback seems a suitable approach.

4.2.1 Task-related feedback

The importance of feedback to human beings is undeniable. Research by Latham and Locke (1991) suggests the basic mechanism in behaviour regulation is evaluation of feedback and the subsequent reaction to it. However, while there is a huge body of research investigating the impact of both negative and positive feedback on performance, the findings are somewhat equivocal. This may be a consequence of a whole range of different variables, including (1) the different types of task that have been used within the research, e.g. physical versus cognitive tasks, (2) individual differences in the participants, e.g. novice versus expert, and (3) the nature of the feedback, e.g. negative versus positive, and also simple knowledge of results versus evaluative feedback. The different ways that feedback has been operationalised will clearly have had some impact on research findings. The following section aims to provide an overview to the effects of feedback, initially with a focus on performance effects and then with a focus on confidence. The differences between male and female responses to feedback will also be considered.

4.2.2 Feedback effects on performance

4.2.2.1 Positive consequences of feedback

Early research into feedback on performance supported the suggestion that general feedback (or knowledge of results) had positive effects on performance. Research by Macpherson, Dees and Grindley (1949), for example, discovered that performers have improved behaviour after receiving negative feedback, as modifications of performance were consequently made. Further, Lorge and Thorndike (1935) investigated performance with and without feedback, reporting substantially poorer performance when feedback was removed.

Additional investigations examined the effects of negative feedback in the form of error detection on performance. Research conducted by Busby (1999) identified that negative feedback is essential for error correction. Describing error as the discrepancy between the intended and the achieved, Busby (1999) argued for the necessity of providing negative feedback in order to make successful expert decisions. Further, Busby (1999) asserted that both laboratory and field investigations conducted in which feedback errors were provided to induce some failure, resulted in improvements in measurements of performance. A final advantage identified by Busby (1999) postulated the provision of negative feedback as a form of motivation, in which negative feedback revealing failure in performance led to a greater amount of effort in future tasks. Busby (1999) did however recognise this motivation principle to be dependent on individual factors, such as self-efficacy.

The above research therefore provides evidence for the advantages of knowledge of outcomes on future performance, particularly when provided in the form of negative feedback. However, as outlined in the following section, not all research has found positive consequences to feedback.

4.2.2.2 Negative consequences of feedback

Following their detailed analysis of previous literature into feedback effects on performance, Kluger and DeNisi (1996) criticised early researchers for failing to consider the level of performers. For example, those people already working at high performance levels may be less affected by feedback, whilst lower level performers may be found to have decreased levels of motivation. Harris and Rosenthal (1985) also discovered further evidence which was contradictory. Through their meta-analysis investigating expectations on performance they revealed that feedback has only minute effects on performance, while other variables, such as the learning environment, were found to have a more

influential effect. Other meta-analyses carrying out similar investigations were also found to reveal weak links between knowledge of results and performance (Fried & Ferris, 1987).

With such results questioning the idea that feedback generally improves performance, Kluger and DeNisi (1996) hypothesised the existence of negative effects of feedback on performance. Consequently, through their meta-analyses, beginning with 3000 papers, a total of 131 of these were examined after being corrected for various features such as insufficient participants. Of the remaining 131 articles, Kluger and DeNisi (1996) identified further controversial findings that although overall feedback interventions do improve task performance, they also found that over one third of the feedback interventions had detrimental effects on performance.

In addition to Kluger and DeNisi (1996) research, Busby (1999) further questioned the positive effects, suggesting the potential of feedback to interfere with decision models resulting in distraction from the use of appropriate strategies when approaching a task. Also, in terms of the type of feedback provided, Busby (1999) reported on laboratory studies that have generally shown more success inducing positive feedback to be more effective than failure inducing negative feedback and more frequent feedback to be more advantageous than less (Ilgen & Moore, 1987).

4.2.2.3 Feedback effects determined by task characteristics

Considering the breadth of task parameters that have been utilised in the above research, it may not be surprising that findings have been contradictory. In an attempt to shed some further light on this issue, Annett (1969) investigated the effects of feedback on different task characteristics. He reported that knowledge of results can have very different effects on performance and that this is, to some degree, dependent on whether tasks were motor, perceptual or verbal in nature. Other task characteristics have also been identified, e.g. Kluger and DeNisi (1996) investigated the effects of variables such as novelty, complexity

and time constraints on task performance. For example, time constraint conditions were argued to decrease the impact of feedback. Further feedback effects have been studied by Salmoni, Schmidt and Walter (1984) investigating the effects of different amounts of feedback on performance. Salmoni *et al* (1984) argued that, although in some cases feedback enhanced performance and acted as guidance, if given too frequently, performance may in fact be degraded.

The picture regarding the impact of feedback on performance remains a little murky, and, similarly, attempts to explain the mechanisms potentially underlying this process have also been varied. Locke and Latham (1990) have stated that people use feedback to evaluate their performance relative to their own goals. They argue that, once this evaluation has taken place, the person is then motivated to achieve the goal. It is typically suggested that there are four ways in which feedback is dealt with; first, one can endeavour to achieve their optimum performance; secondly, one can readjust the previous goal to a more achievable level; thirdly, one can reject the feedback that is received; or finally one can abandon any form of commitment to the goal.

Further research has considered the intervening variable of mood, and examined the effect that feedback has on mood and in turn its relationship with performance (Forgas, Bower & Moylan, 1990). Forgas *et al.* suggest that unpleasant moods are linked to the inhibition of cognitive flexibility. Contrary to this, if pleasantness is induced (e.g. positive feedback) it is argued that this has beneficial effects on cognitive processing (Forgas *et al*, 1990).

In an alternative attempt to explain the link between feedback and performance, some researchers have hypothesised that the effect can be linked to the increase in arousal and the resulting effects that this entails (Kluger & DeNisi, 1996). This arousal enhancement will, according to cue-utilization hypothesis (Easterbrook, 1959) increase attention to focal cues but inhibit attention to peripheral cues. This may go some way to explain the

feedback/performance relationship. Building further on an arousal based explanation, work by Lewinsohn and Mano (1993) also revealed evidence to link increased arousal to a debilitating effect on judgement strategies. However, whatever the underlying mechanisms for this process are, there is a substantial body of evidence to support the view that feedback can impact on performance.

4.2.2.4 The influence of personality variables

In addition to the task related variables discussed above, work by Kluger and DeNisi (1996) has highlighted the importance of personality variables which may influence the effect of feedback on performance. Further to this, research by Ilgen, Fisher, and Taylor (1979) outlined a number of personality variables that are considered to be moderators of feedback on performance. These included self-esteem and locus of control. They argue that the way in which this can manifest in performance variations is when an individual, with high anxiety for example, is more likely to regard negative feedback as more salient and to devote more cognitive energy in trying to interpret the feedback in relation to self-image, whereas a less anxious individual is argued to be more task focused. This work is clearly relevant to the current thesis, and will be discussed later in the chapter.

4.2.3 Feedback effects on confidence

Feedback not only has a potential impact on performance, but it is also intuitive that feedback can affect confidence. The effects of feedback on confidence have also received much investigation (e.g. Shrauger & Rosenberg, 1970). One of the first major contributions to this area of research involved the work of Feather (1966). He investigated the effects of prior success and failure on subsequent expectations on anagram tasks. Investigations of confidence ratings through trial by trial studies found that participants who received induced failure feedback were found to have lower confidence ratings than those who received induced success feedback. Further research indicated confidence ratings

change more in any direction after initial failures rather than after initial success, indicating overall effects to be more influenced by negative feedback. A further discovery made by Feather (1966) highlighted the importance of individual differences in the impact of feedback on confidence. He found that participants who were 'success oriented' were more subject to confidence changes when positive rather than negative feedback was provided, whilst 'failure oriented' participants were more influenced by negative rather than positive feedback. Feather (1966) explained such a finding on the assumption that confidence levels were more likely to vary in accordance with familiar experiences.

Additional research, conducted by Feather and Saville (1967) provided a replication and extension of Feather's (1966) findings, investigating the effects on confidence when a lesser amount of positive or negative feedback was provided. Again using an anagram task, the initial effects of increased confidence after induced success and decreased confidence after induced failure were found to be highly significant. However in this study, Feather and Saville were also able to conclude the effects of previous feedback on confidence to be localised - specifically, findings indicated the effects of limited prior positive or negative feedback to result in only small effects on confidence in which only the early future performance was affected.

A final follow up investigation of Feather's (1966) research involved further work by Feather (1968), examining the effects of changes in confidence due to prior success or failure as a predictor of future performance. Through his research using genuine performance feedback on anagram tasks, results again provided support for the previous findings, as well as claiming a novel finding. This study was able to identify a significant relationship in which those participants who either became more confident after initial positive feedback or less confident after initial negative feedback to perform better than participants whose confidence ratings stayed at a more constant level. Findings of this study therefore supported a view that feedback that increasing confidence levels is more

advantageous on performance, however feedback decreasing confidence was found to be more advantageous than feedback in which confidence levels were not altered at all.

The above research findings have all supported the proposition that feedback to induce success increases confidence and feedback to induce failure decreases confidence. However, as with the literature on feedback and performance, some additional factors have been identified which have an impact on this. Research by Diggory, Riley and Blumenfield (1960) for example investigated environmental factors and discovered that confidence levels are more likely to decrease under time pressure.

In conclusion, the previous research conducted into the effects of feedback on confidence has generally provided much support for the assertion that positive feedback increases future confidence and negative feedback decreases future confidence. Nonetheless, this picture is not quite as simple as this, as there are a number of individual differences which may moderate the process. For example, there has been a substantial body of research investigating the differential effects of feedback on males and females, e.g. Manolis and Milich (1993). In summary, the majority of findings suggest negative feedback in general to adversely affect both sexes, although this may have a greater impact on the confidence in females, whereas, positive feedback was found to be more important for the motivation of males.

4.2.4 Experiment One Rationale

As discussed above, there is a large literature relating to feedback, cognitive performance and confidence. The current study aims to investigate the impact of performance feedback on individuals who are of different levels of mental toughness. Performance on a subsequent task and confidence levels will be assessed. It is anticipated that mentally tough individuals will be less influenced by negative feedback.

4.3 Method

4.3.1 Design

The experimental design was a 2 x 2 between groups design. *Feedback* was a between groups variable which varied at two levels; positive and negative. The second IV was *mental toughness*, which was also a between groups variable. The manipulation of the independent variables resulted in only one experimental session per participant.

4.3.2 Participants

For this study, participants were recruited through advertisements placed around the campuses at the Universities of Hull and Lincolnshire. All participants were paid £15 on completion of the study which was approximately two hours. Although forty students initially volunteered to participate in the experiment, two participants did not possess sufficient English language skills to understand the experimental instructions, so their data was removed prior to analysis. The final experimental sample of 38 consisted of 22 men (mean age = 22.74, SD = 3.43) and 16 women (mean age = 22.43, SD = 3.85).

4.3.3 Experimental Procedure

4.3.3.1 Pilot study

Prior to the formal data gathering, pilot samples were run on a small sample of 3 participants in order to identify any potential errors that may have occurred in the research design (Coolican, 1994). Minor ambiguities concerning the experimental procedure were identified and amendments were made before commencing with the present study. This involved increasing the perceived difficulty of the shooting, and reducing the difficulty of the snooker task so that novice players could still participate.

4.3.3.2 Pre experimental session

All participants were required to complete the MTQ48 in advance of the experimental session. A median split was then used to categorise people as either high mental toughness or low mental toughness.

4.3.3.3 Experimental tasks

Three experimental tasks were utilised in the current experiment.

Task 1 – Shooting task

The shooting task required participants to fire a bespoke 'gun' machine at six targets, placed on levers along the back of the machine. These six levers corresponded to six light bulbs which were activated to highlight the required target for the participants. Further switches at the back of the machine enabled the experimenter to manipulate which target would fall – while this did not reflect performance, participants believed their shooting action to relate directly to the activity of the targets. The gun was attached to the machine

by a long wire. The participants were then required to stand beyond the room and make their shot through a window. Instructions for the gun task are shown in appendix 4.1 and the positive and negative feedback statements are presented in appendix 4.2.

Further materials required involved the conversion table for negative feedback manipulated scores on the gun task at 20% lower than initially estimated (see appendix 4.3).

Task 2 – Snooker task

The snooker task required the use of a small snooker table, one cue, one white cue ball, and 3 target balls, as well as a metre rule and chalk in which targets were measured and marked on the table. Instructions for this task were also required, with practice shot instructions shown in appendix 4.4 and actual task instructions found in appendix 4.5.

Task 3 – Planning exercise

The instructions for the planning exercise, a form of cognitive test, can be found in appendix 4.6. The specific planning exercise was devised by Clough (2002) and originally used for selection of post office workers. The task was designed to be adequately completed by 75% of users in 20 to 35 minutes. The main task was to arrange the details of a training event, including providing appropriate dates for trainers, candidates and availability for a venue to hold the training sessions. There was only one correct answer in which all details would fit into the timetable. Participants were instructed to complete it to the best of their ability and two measures of performance were gained: The length of time participants took to complete the task (or give up) and the accuracy of the solution. This was rated on a 4 point rating scale according to the original task guidelines. A stopwatch was required to measure the time taken on this task.

4.3.3.4 Experimental Procedure

Task 1 - The shooting task entailed shooting a gun at targets (that lit up). Prior to the participant's turn, the task was initially and successfully demonstrated by the experimenter. Each participant was then asked to estimate the number of targets they would successfully hit out of 30 attempts. This estimate was recorded by the experimenter and provided the first of the confidence related variables. For each of the 30 trials, the experimenter then switched on the appropriate light bulb and the participants were asked to shoot. Dependent on the feedback category the participants was allocated to, the participants either scored 20% less than estimated (negative feedback group) or one higher than estimated (positive feedback group). The success rate was manipulated by the experimenter as (unbeknown to the participant) the gun manipulation was not related to the reaction of the targets. When all 30 trails have been completed the participants were fed back their manipulated results. There were no measures of performance on this task as the actual accuracy of shooting was not recorded by the gun machine.

Task 2 - Immediately after the first task, the participants were asked to complete a motor skill task which involved playing a number of snooker shots. At the beginning of this task each participant was asked to rate their snooker ability on a 1 -10 scale (confidence rating two) and then asked to complete five practice shots. They were shown what shot they had to play, and were asked for a rating on how confident they felt in playing the shot successfully, this information was again recorded. Finally, they carried out the five actual shots and each shot was rated as to its success. These five confidence ratings were combined to provide a composite measure of snooker confidence (confidence rating three). Performance scores on this task were gained by combining experimenter ratings.

At the end of this task the participants were again given feedback in accordance with their group (either positive or negative). Descriptions of negative and positive feedback are presented in appendix 4.7

Task 3 - Straight after the snooker task, the participants undertook a planning exercise (cognitive task). Prior to the actual task they were asked to rate their own level of ability on planning (0=low ability, 10=high ability – confidence rating four). At the beginning of the exercise, participants were provided with all relevant information and were able to work through the information in any order they chose. Two performance ratings on this measure were gained from the task. The first was a score of accuracy, which was gained by using a pre-existing scoring system on a 1-4 rating scale. The second was a speed rating, gained from the length of time taken before completion (or giving up).

All confidence measures and performance ratings were entered on a bespoke answer sheet (see appendix 4.8).

4.3.5 Dependent Variables

4.3.5.1 Performance-related dependent variables

There were three performance related variables, one from the snooker task and measures of both speed and accuracy at the planning task.

4.3.5.2 Confidence measures

There were four confidence ratings; the gun task provided one confidence rating, the snooker task provided two ratings and the planning task provided one more confidence rating.

4.3.6 Data treatment

Analysis of Variance was again the main method of data analysis. Continuing with the principles of data treatment, where sphericity had been violated, degrees of freedom were corrected using either Greenhouse-Geisser (< 0.75) or Huynh-Feldt (> 0.75) estimates of sphericity, in accordance with Field (2005).

4.4 Results

4.4.1 Introduction

The results in this chapter are based on a series of 2 and 3 factor between groups ANOVAs investigating four confidence-related dependent variables and three performance-related dependent variables.

4.4.2 Estimated number of successful shots

The first rating of confidence was taken before participants had any exposure to the feedback manipulation. Therefore the analysis carried out on this dependent variable was a 2 (gender) x 2 (mental toughness) between groups ANOVA.

Analysis of the descriptive data presented in table 4.1 revealed a significant main effect of gender $F(1,34) = 4.26$, $p < 0.05$, $r = .11$, with males reporting a higher degree of confidence in their shooting ability than females. However, there was no main effect of mental toughness $F(1,34) < 1$, $p > 0.05$, $r = .00$, and no significant interaction $F(1,34) = 1.03$, $p > 0.05$, $r = .03$.

Table 4.1 Mean scores for estimated successful gun shots

Mental Toughness Group	*Gender*	*Mean*	*Standard Deviation*	*N*
Low	Female	15.33	4.92	6
Low	Male	17.08	3.59	13
Low	**Total**	**16.53**	**4.00**	**19**
High	Female	13.10	3.95	10
High	Male	18.22	7.15	9
High	**Total**	**15.53**	**6.12**	**19**
Total	Female	13.94	4.32	16
Total	Male	17.55	5.21	22
Total	**Total**	**16.03**	**5.12**	**38**

4.4.3 Self rating of ability at snooker

A 2 (gender) x 2 (mental toughness) x 2 (feedback) ANOVA, carried out to investigate self ratings of general ability at snooker, showed a significant main effect of gender $F(1,30) = 5.03$, $p < 0.05$, $r = .14$; with males rating themselves significantly more highly than females. However, there were no significant main effects of feedback $F(1,30) = 1.33$, $p > 0.05$, $r = .04$ or mental toughness $F(1,30) < 1$, $p > 0.05$, $r = .00$, and there were also no significant interactions; feedback x mental toughness $F(1, 30) < 1$, $p > 0.05$, $r = .02$; feedback x gender $F(1, 30) < 1$, $p > 0.05$, $r = .00$; mental toughness x gender $F(1, 30) < 1$, $p > 0.05$, $r = .01$; feedback x mental toughness x gender $F(1, 30) < 1$, $p > 0.05$, $r = .01$.

The descriptive data from this dependent variable are shown in table 4.2 below.

Table 4.2 Mean scores for self rating of snooker ability

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	4.75	1.25	4
Positive	Low	Male	5.40	1.34	5
Positive	**Low**	**Total**	**5.11**	**1.26**	**9**
Positive	High	Female	3.67	1.50	6
Positive	High	Male	5.75	2.63	4
Positive	**High**	**Total**	**4.50**	**2.17**	**10**
Positive	Total	Female	4.10	1.44	10
Positive	Total	Male	5.56	1.87	9
Positive	**Total**	**Total**	**4.79**	**1.78**	**19**
Negative	Low	Female	3.00	1.41	2
Negative	Low	Male	4.63	2.06	8
Negative	**Low**	**Total**	**4.30**	**2.00**	**10**
Negative	High	Female	3.75	1.70	4
Negative	High	Male	5.20	2.16	5
Negative	**High**	**Total**	**4.56**	**2.00**	**9**
Negative	Total	Female	3.50	1.51	6
Negative	Total	Male	4.85	2.03	13
Negative	**Total**	**Total**	**4.42**	**1.95**	**19**
Total	Low	Female	4.17	1.47	6
Total	Low	Male	4.92	1.80	13
Total	**Low**	**Total**	**4.68**	**1.70**	**19**
Total	High	Female	3.70	1.49	10
Total	High	Male	5.44	2.24	9
Total	**High**	**Total**	**4.53**	**2.03**	**19**
Total	Total	Female	3.88	1.45	16
Total	Total	Male	5.14	1.95	22
Total	**Total**	**Total**	**4.61**	**1.85**	**38**

4.4.4 Confidence ratings of snooker tasks

The next measure of confidence was a composite measure of 5 ratings of confidence for each snooker shot taken (see table 4.3).

Table 4.3 Mean scores for confidence ratings of snooker tasks

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	23.25	3.68	4
Positive	Low	Male	23.60	8.98	5
Positive	**Low**	**Total**	**23.44**	**6.74**	**9**
Positive	High	Female	16.67	3.20	6
Positive	High	Male	28.00	8.90	4
Positive	**High**	**Total**	**21.20**	**8.14**	**10**
Positive	Total	Female	19.30	4.66	10
Positive	Total	Male	25.56	8.69	9
Positive	**Total**	**Total**	**22.26**	**7.40**	**19**
Negative	Low	Female	14.50	6.36	2
Negative	Low	Male	21.00	9.16	8
Negative	**Low**	**Total**	**19.70**	**8.79**	**10**
Negative	High	Female	21.00	5.77	4
Negative	High	Male	26.00	8.00	5
Negative	**High**	**Total**	**23.78**	**7.17**	**9**
Negative	Total	Female	18.83	6.27	6
Negative	Total	Male	22.92	8.76	13
Negative	**Total**	**Total**	**21.63**	**8.11**	**19**
Total	Low	Female	20.33	6.05	6
Total	Low	Male	22.00	8.81	13
Total	**Low**	**Total**	**21.47**	**7.91**	**19**
Total	High	Female	18.40	4.67	10
Total	High	Male	26.89	7.92	9
Total	**High**	**Total**	**22.42**	**7.60**	**19**
Total	Total	Female	19.13	5.12	16
Total	Total	Male	24.00	8.62	22
Total	**Total**	**Total**	**21.95**	**7.66**	**38**

As with the previous rating of confidence there was a main effect of gender, with males showing greater confidence in their ability $F(1,30) = 5.07$, $p < 0.05$, $r = .14$. However, there were no significant main effects of feedback $F(1,30) = 1.33$, $p > 0.05$, $r = .02$, or mental toughness $F(1,30) < 1$, $p > 0.05$, $r = .02$. But, while the interaction between feedback and mental toughness failed to reach significance, $F(1,30) = 1.76$, $p > 0.05$, $r = .05$, Figure 4.1 shows an interesting trend towards an interaction, with negative feedback having no adverse impact on those in the high MT condition but reducing confidence of those low in MT.

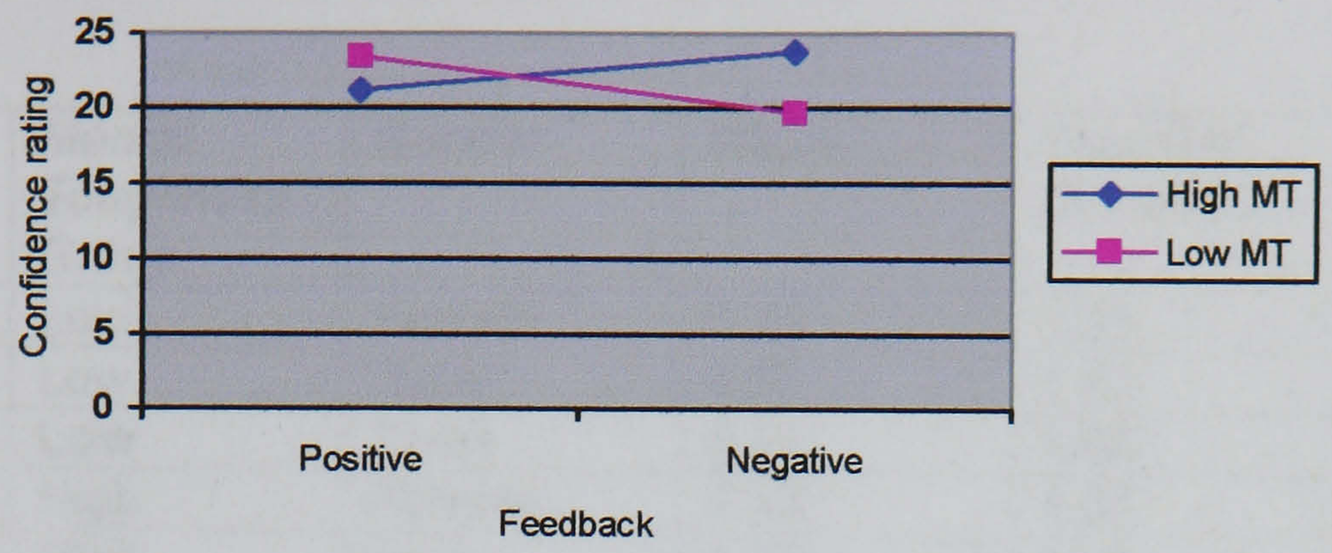


Figure 4.1: Mean confidence ratings of snooker ability as a function of feedback and mental toughness

There were also no further significant interactions; feedback x mental toughness $F(1, 30) = 1.76$, $p > 0.05$, $r = .06$; feedback x gender $F(1, 30) < 1$, $p > 0.05$, $r = .00$; mental toughness x gender $F(1, 30) < 1$, $p > 0.05$, $r = .03$; feedback x mental toughness x gender $F(1, 30) = 1.47$, $p > 0.05$, $r = .05$.

4.4.5 Self rating of planning ability

The next confidence-related rating was self-rating of planning ability (see table 4.4). There were no main effects of feedback $F(1,30) = 1.93$, $p > 0.05$, $r = .06$; mental toughness $F(1,30) < 1$, $p > 0.05$, $r = .00$; or gender $F(1,30) < 1$, $p > 0.05$, $r = .02$.

Table 4.4 Mean scores for self rating of planning ability

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	6.25	1.25	4
Positive	Low	Male	4.60	1.67	5
Positive	**Low**	**Total**	**5.33**	**1.65**	**9**
Positive	High	Female	4.33	1.36	6
Positive	High	Male	5.75	0.50	4
Positive	**High**	**Total**	**4.90**	**1.28**	**10**
Positive	Total	Female	5.10	2.59	10
Positive	Total	Male	5.11	1.36	9
Positive	**Total**	**Total**	**5.11**	**1.44**	**19**
Negative	Low	Female	7.00	0.00	2
Negative	Low	Male	5.13	1.95	8
Negative	**Low**	**Total**	**5.50**	**1.90**	**10**
Negative	High	Female	6.00	0.81	4
Negative	High	Male	6.20	2.36	5
Negative	**High**	**Total**	**6.11**	**2.01**	**9**
Negative	Total	Female	6.33	1.04	6
Negative	Total	Male	5.54	1.80	13
Negative	**Total**	**Total**	**5.79**	**1.74**	**19**
Total	Low	Female	6.50	1.04	6
Total	Low	Male	4.92	1.80	13
Total	**Low**	**Total**	**5.42**	**1.72**	**19**
Total	High	Female	5.00	1.41	10
Total	High	Male	6.00	2.17	9
Total	**High**	**Total**	**5.47**	**1.83**	**19**
Total	Total	Female	5.56	1.45	16
Total	Total	Male	5.36	1.98	22
Total	**Total**	**Total**	**5.45**	**1.76**	**38**

However, there was a significant interaction between mental toughness and gender $F(1,30) = 4.45$, $p < 0.05$, $r = .13$. As illustrated in figure 4.2, females with low mental toughness rated their planning ability as higher than females with high mental toughness, whereas males with low mental toughness rate their planning ability lower than those with high mental toughness.

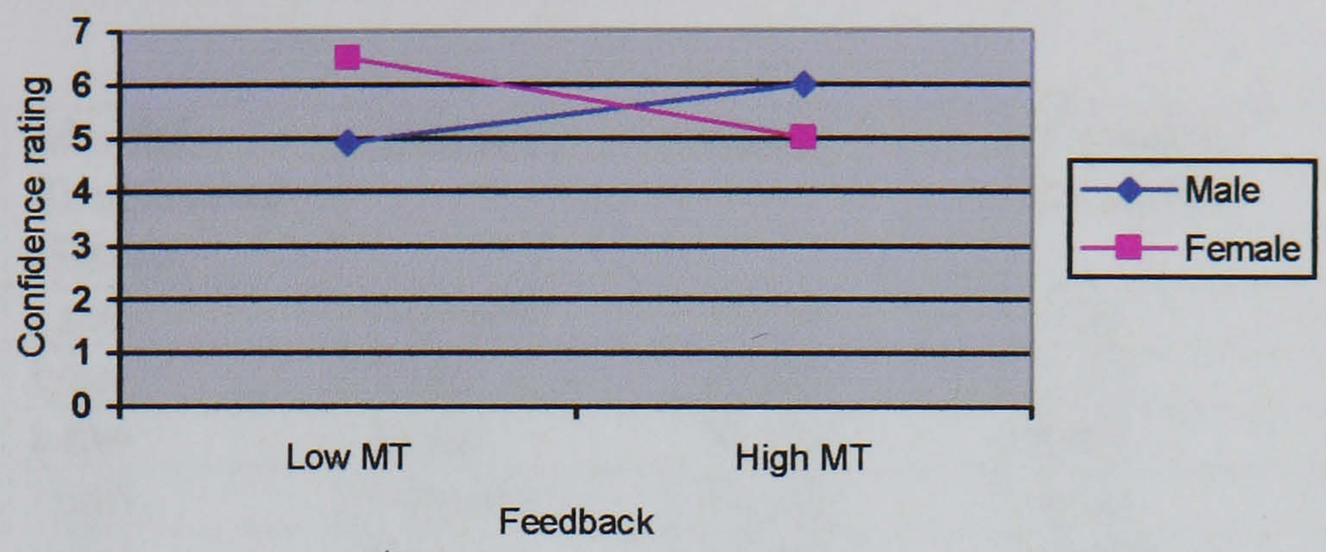


Figure 4.2: Mean self rating of planning ability as a function of gender and mental toughness

There were no further significant interactions; feedback x mental toughness $F(1, 30) < 1$, $p > 0.05$, $r = .00$; feedback x gender $F(1, 30) < 1$, $p > 0.05$, $r = .01$; feedback x mental toughness x gender $F(1, 30) < 1$, $p > 0.05$, $r = .00$.

4.4.6 Performance ratings of snooker

Performance ratings on the snooker tasks were generated by totaling the observer ratings to give a possible score of between 5 and 40.

The descriptives presented in table 4.5 were subjected to a 2 (gender) x 2 (mental toughness) x 2 (feedback) between group ANOVA.

Table 4.5 Mean scores for snooker performance

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	15.25	7.97	4
Positive	Low	Male	20.00	3.53	5
Positive	**Low**	**Total**	**17.89**	**6.03**	**9**
Positive	High	Female	14.00	4.00	6
Positive	High	Male	22.25	10.27	4
Positive	**High**	**Total**	**17.30**	**7.88**	**10**
Positive	Total	Female	14.50	5.52	10
Positive	Total	Male	21.00	6.87	9
Positive	**Total**	**Total**	**17.58**	**6.88**	**19**
Negative	Low	Female	7.00	0.00	2
Negative	Low	Male	21.12	5.93	8
Negative	**Low**	**Total**	**18.30**	**7.93**	**10**
Negative	High	Female	21.25	7.50	4
Negative	High	Male	25.80	3.34	5
Negative	**High**	**Total**	**23.78**	**5.69**	**9**
Negative	Total	Female	16.50	9.37	6
Negative	Total	Male	22.92	5.46	13
Negative	**Total**	**Total**	**20.89**	**7.33**	**19**
Total	Low	Female	12.50	7.50	6
Total	Low	Male	20.69	5.00	13
Total	**Low**	**Total**	**18.11**	**6.90**	**19**
Total	High	Female	16.90	6.45	10
Total	High	Male	24.22	6.97	9
Total	**High**	**Total**	**20.37**	**7.52**	**19**
Total	Total	Female	15.25	6.97	16
Total	Total	Male	22.14	6.00	22
Total	**Total**	**Total**	**19.24**	**7.21**	**38**

This revealed a significant main effect of mental toughness $F(1,30) = 5.58$, $p < 0.05$, $r = .15$; with the more mentally tough performing better at snooker. However, while there was no significant main effect of feedback $F(1,30) < 1$, $p > 0.05$, $r = .00$; there was a significant interaction between feedback and mental toughness $F(1,30) = 4.52$, $p < 0.05$, $r = .13$. As illustrated in figure 4.3, for low mentally tough participants their performance was similar in both feedback conditions, whereas for the high mental toughness group, performance was better for those participants who were exposed to the negative feedback condition. There

were no further significant interactions; feedback x gender $F(1, 30) < 1$, $p > 0.05$, $r = .01$; mental toughness x gender $F(1, 30) < 1$, $p > 0.05$, $r = .01$; feedback x mental toughness x gender $F(1, 30) = 2.40$, $p > 0.05$, $r = .07$.

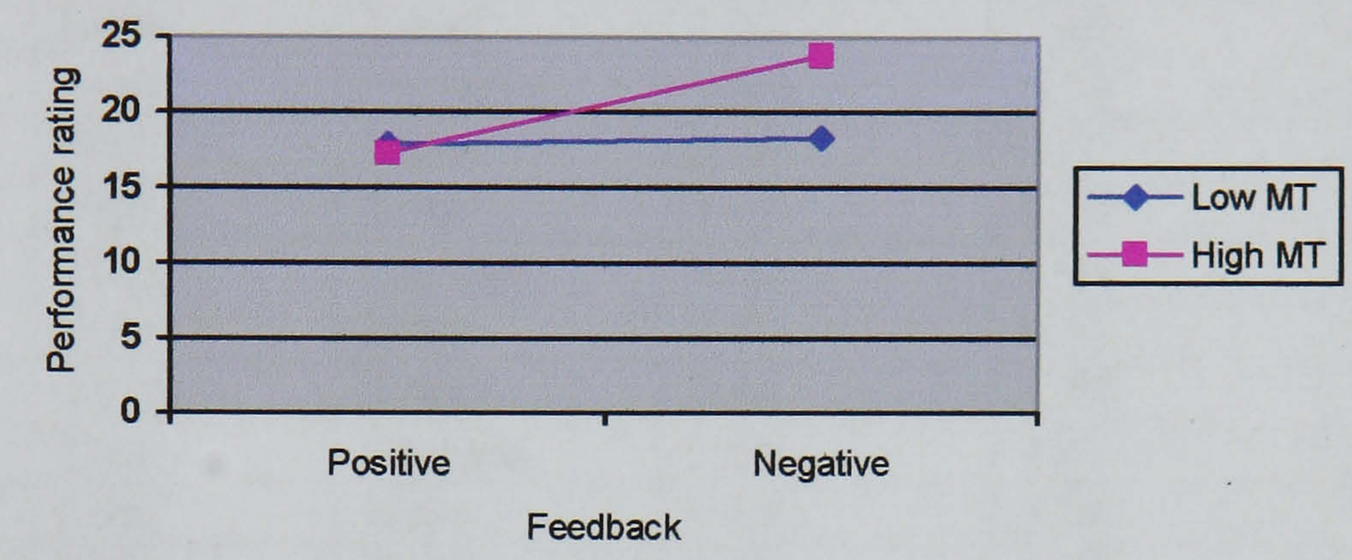


Figure 4.3: Mean performance ratings of snooker as a function of feedback and mental toughness

4.4.7 Performance rating on planning exercise

Performance scores on the planning exercise are presented in table 4.6.

Table 4.6 Mean scores for planning exercise

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	3.00	1.15	4
Positive	Low	Male	1.80	1.09	5
Positive	**Low**	**Total**	**2.33**	**1.22**	**9**
Positive	High	Female	3.50	0.83	6
Positive	High	Male	2.50	0.57	4
Positive	**High**	**Total**	**3.10**	**0.87**	**10**
Positive	Total	Female	3.30	0.94	10
Positive	Total	Male	2.11	0.92	9
Positive	**Total**	**Total**	**2.74**	**1.09**	**19**
Negative	Low	Female	2.00	1.41	2
Negative	Low	Male	1.63	1.06	8
Negative	**Low**	**Total**	**1.70**	**1.05**	**10**
Negative	High	Female	2.75	0.95	4
Negative	High	Male	3.60	0.54	5
Negative	**High**	**Total**	**3.22**	**0.83**	**9**
Negative	Total	Female	2.50	1.04	6
Negative	Total	Male	2.38	1.32	13
Negative	**Total**	**Total**	**2.42**	**1.21**	**19**
Total	Low	Female	2.67	1.21	6
Total	Low	Male	1.69	1.03	13
Total	**Low**	**Total**	**2.00**	**1.15**	**19**
Total	High	Female	3.20	0.91	10
Total	High	Male	3.11	0.78	9
Total	**High**	**Total**	**3.16**	**0.83**	**19**
Total	Total	Female	3.00	1.03	16
Total	Total	Male	2.27	1.16	22
Total	**Total**	**Total**	**2.58**	**1.15**	**38**

A 2 (gender) x 2 (mental toughness) x 2 (feedback) between group ANOVA revealed a significant main effect of mental toughness $F(1,30) = 8.77$, $p < 0.01$, $r = .22$; with mentally tough participants providing a more complete response to the planning exercise. However, there were no main effects of feedback $F(1,30) < 1$, $p > 0.05$, $r = .01$; or gender $F(1,30) = 1.69$, $p > 0.05$, $r = .05$.

As illustrated in figure 4.4 there was a significant interaction between gender and feedback $F(1,30) = 4.07$, $p = 0.05$, $r = .12$; with males being largely unaffected by negative feedback, whilst females were found to benefit from positive feedback.

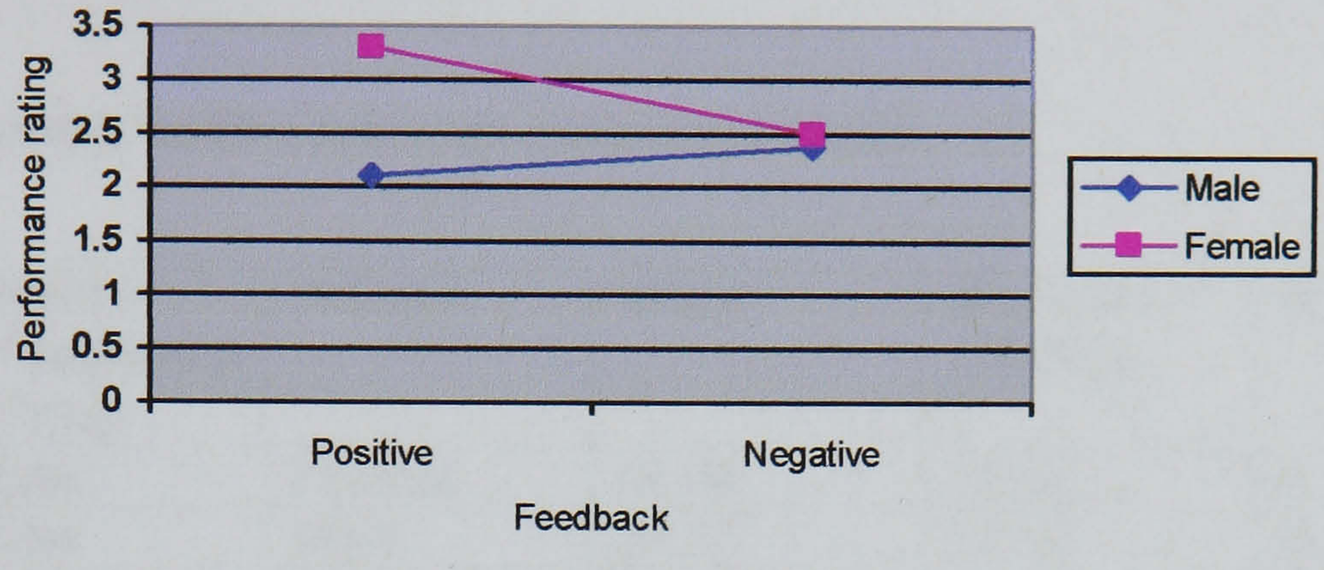


Figure 4.4: Mean performance rating on planning exercise as a function of feedback and gender

The interaction between mental toughness and feedback failed to reach significance $F(1,30) = 1.32$, $p > 0.05$, $r = .04$ (see figure 4.5).

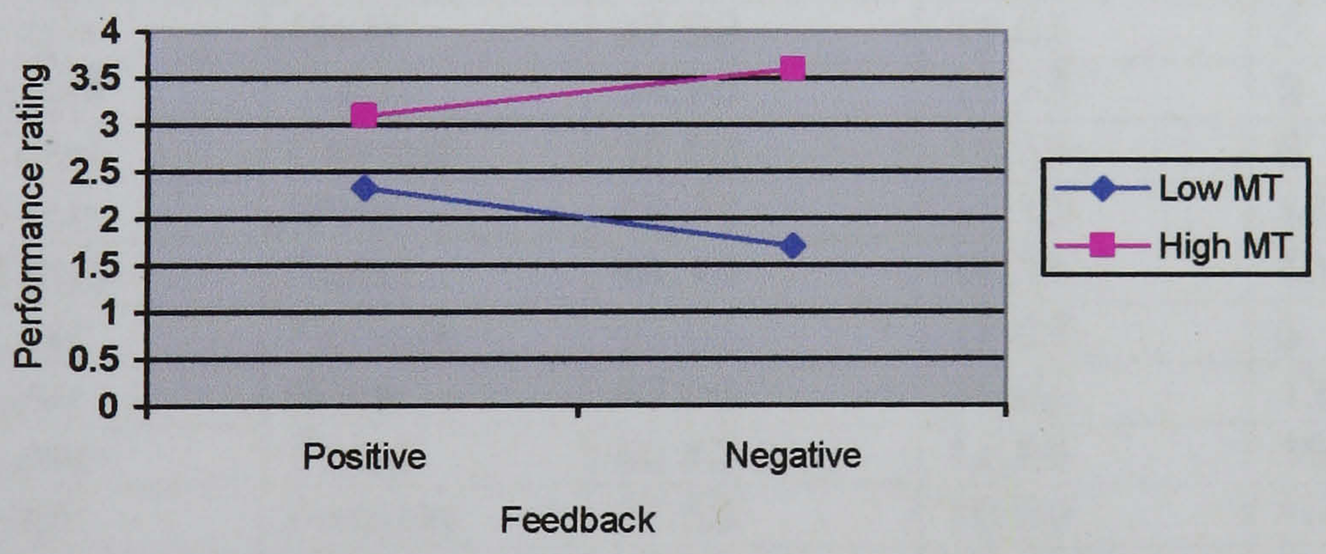


Figure 4.5: Mean performance rating of planning exercise as a function of feedback and mental toughness

4.4.8 Time taken on planning exercise

The final measure of performance was time taken on the planning exercise. This data presented in table 4.7 was subjected to a 2 (gender) x 2 (mental toughness) x 2 (feedback) between group ANOVA.

Table 4.7 Mean scores for time taken on planning exercise

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	34.75	12.55	4
Positive	Low	Male	38.20	14.09	5
Positive	**Low**	**Total**	**36.67**	**12.71**	**9**
Positive	High	Female	42.83	6.94	6
Positive	High	Male	51.75	5.73	4
Positive	**High**	**Total**	**46.40**	**7.67**	**10**
Positive	Total	Female	39.60	9.83	10
Positive	Total	Male	44.22	12.75	9
Positive	**Total**	**Total**	**41.79**	**11.23**	**19**
Negative	Low	Female	56.50	2.12	2
Negative	Low	Male	52.50	6.11	8
Negative	**Low**	**Total**	**53.30**	**5.69**	**10**
Negative	High	Female	29.50	8.81	4
Negative	High	Male	37.60	11.65	5
Negative	**High**	**Total**	**34.00**	**10.73**	**9**
Negative	Total	Female	38.50	15.55	6
Negative	Total	Male	46.77	11.13	13
Negative	**Total**	**Total**	**44.16**	**12.84**	**19**
Total	Low	Female	42.00	14.88	6
Total	Low	Male	47.00	11.85	13
Total	**Low**	**Total**	**45.42**	**12.68**	**19**
Total	High	Female	37.50	10.00	10
Total	High	Male	43.89	11.65	9
Total	**High**	**Total**	**40.53**	**11.00**	**19**
Total	Total	Female	39.19	11.78	16
Total	Total	Male	45.73	11.59	22
Total	**Total**	**Total**	**42.79**	**11.97**	**38**

There were no significant main effects of mental toughness $F(1,30) = 2.39$, $p > 0.05$, $r = .07$; feedback $F(1,30) < 1$, $p > 0.05$, $r = .01$; or gender $F(1,30) = 1.58$, $p > 0.05$, $r = .05$, the mentally tough participants did perform slightly better overall. However, there was crucial

and significant interaction between feedback and mental toughness $F(1,30) = 23.53$, $p < 0.01$, $r = .44$. As illustrated in figure 4.6 those who were high in mental toughness were quicker following negative feedback, whereas the low mental toughness group were much slower under negative feedback. However, there were no further significant interactions; feedback x gender $F(1, 30) < 1$, $p > 0.05$, $r = .01$; mental toughness x gender $F(1, 30) = 1.79$, $p > 0.05$, $r = .05$; feedback x mental toughness x gender $F(1, 30)$, 1, $p > 0.05$, $r = .07$.

.

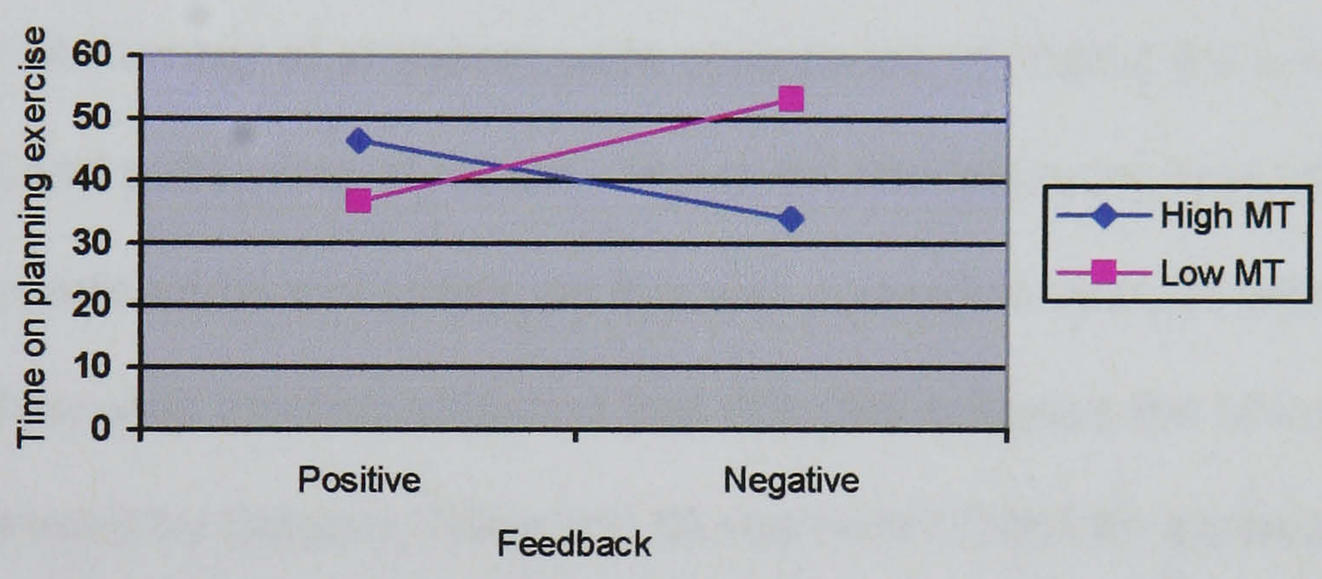


Figure 4.6: Mean time on planning exercise as a function of feedback and mental toughness

4.5 Discussion

4.5.1 Summary of findings

In general, the confidence ratings in most areas were found to be rated higher by the males. However, no significant gender differences were found in the self-ratings for the planning exercise. Furthermore, there were no significant main effects of mental toughness on confidence. However, there were a few interesting findings, for example the trend towards an interaction with negative feedback having no adverse impact on those in the high MT condition but reducing confidence of those low in MT, although it should be noted that some of the comparisons were carried out on small groups. In respect of

performance measures, the participants who were categorised as high in mental toughness performed significantly better in both the snooker and planning tasks, although, there was no main effect of negative feedback throughout the first part of the study. However, while the results did suggest a trend towards the buffering effect of mental toughness on negative feedback, this finding failed to reach statistical significance.

Therefore, although the study found a small number of significant effects, there was still a relatively small impact of both negative feedback and mental toughness on confidence and performance. With this in mind a second study was planned. The main aim of study two was to replicated the methods employed in study one, but with an additional layer of cognitive stress. A number of stressors were considered, including the environmental stressor of noise and publicising of results. However, time pressure was selected as the variable to manipulate additional stress, as this was a sensible variable within the confines of the task and there was existing evidence that this may enhance the effects on confidence. Research by Diggory, Riley and Blumenfield (1960) for example investigated environmental factors and discovered that confidence levels are more likely to decrease under time pressure.

In addition to the changes to the task parameters (e.g. time pressure) it was intended that the sample for study two would be split more equally to enable the investigation of gender differences with greater effect.

Further discussion of the results for study one will be presented at the end of the chapter, in conjunction with study two results.

4.6 Experiment Two

4.6.1 Introduction

As mentioned in the previous section it was felt necessary to increase the amount of stress in the study in order to explore fully the moderating effects of mental toughness on negative feedback. Therefore it was decided that the added stress of time pressure on the final task (planning exercise) was an appropriate measure to incorporate. The following section outlines some of the research in this particular area.

4.6.2 Time pressure research

Research into time pressure has highlighted the importance of this variable in occupational settings. It is argued that this has an impact on decision making and performance judgements. Time pressure is present in many everyday occupations, in which deadlines and timescales are of great necessity (Edland & Svenson, 1993). For example, Janis and Mann (1977) identified time constraints as one of a range of variables capable of inducing a stress state. This is argued to have consequences for shifts in strategy choice (Rabbitt, 1981) which can have consequences for efficiency of judgements and decision making. Further, research by Holsti (1971) identified time pressure to act as a crisis-induced stressor, providing an unanticipated threat to decision making. Hence, under such conditions, the impairment of the ability to make judgements resulted and consequently performance suffered. Similarly, when under time pressure, it is argued that greater attention is given to more negative features when making decisions and consequently resulting in detrimental effects on performance (Edland & Svenson, 1993). Interestingly, the investigations into the effects of time pressure on judgements and performance have stemmed from a broad spectrum of theoretical approaches.

Consequently, no definitive pattern of effects of time pressure has emerged. However, some general findings in the research can be identified from a review of literature from the past three decades (see Maule & Svenson, 1993, for a review). The following sections will provide a brief summary of the effects of time pressure on performance and confidence.

4.6.2.1 Time pressure effects on cognitive tasks

Concerning the research area of problem solving under time pressure, an historical and influential study was conducted by Luchins (1942). In this study, problem solving strategies were investigated under time pressure manipulations, where those under time constraints were hypothesised to rely upon specific problem solving strategies. The results supported such a hypothesis, in which those under no time pressure conditions were found to be more open to considering alternative decision strategies, whereas those under time pressure were found to utilise one problem solving strategy only. Further, Luchins was able to conclude that for the time pressured groups, once a specific problem solving strategy was found to have failed, unlike conditions of no time pressure no further attempts to solve a problem were made. Therefore, such findings indicated decreased competence in completing cognitive tasks under conditions of time constraints.

Further research into time pressure effects on cognitive task performance has involved the work of Bruner, Goodnow and Austin (1956). Bruner *et al,* investigated the effects of time constraints on adopting either focusing strategies (in which hypotheses are based on whole instances, followed by focusing on the order of investigation) or scanning strategies (in which instances are hypothesised and tested one at a time). Bruner discovered that for conditions under no time pressure, problem solving was achieved by equal numbers of focusing and scanning strategists. However, under time pressure, scanning strategies were found to be half as effective as focusing, indicating time pressure to have added to the strain of keeping a mental record of the alternative scanning hypotheses considered, again leading to decrements in performance.

The above research therefore has revealed time pressure to be generally associated with poorer cognitive performance, with such overall effects influenced more by negative dimensions. However, not all work has found a negative effect of time pressure on performance; for example, Maule and Svenson (1993) were able to conclude that decreasing deadlines had resulted in increases in the processing and speed of responses, consequently indicating time pressure to have positive effects on decision making and performance.

4.6.2.2 Effects of time pressure on confidence

A limited number of studies have been conducted into the effects of time pressure on confidence ratings. As mentioned above, research by Diggory et al, discovered that confidence levels were more likely to decrease under time pressure. There are a small number of further studies, including the work of Smith, Mitchell and Beach (1982) that investigated time pressure and found while more complex decision rules were adopted by participants under time pressure, confidence levels in these conditions were found to have decreased. However, due to such limited research to date, the effects of time pressure on confidence are yet to be established.

Therefore, study two also aims to investigate the moderating effect of mental toughness on performance and confidence, but this experiment improves on the sampling of study one and increases the cognitive stress of the task.

4.7 Method (Study 2)

4.7.1 Participants

For this study, participants were again recruited through advertisements placed around the campuses at the Universities of Hull and Lincolnshire. Participants were again paid £15 on completion of the study which lasted approximately two hours. The new advertisements specified good English language skills as an imperative. The experimental sample of 41 consisted of 20 men (mean age = 21.51, SD = 3.24) and 21 women (mean age = 22.05, SD = 3.54).

4.7.2 Experimental procedure

The procedure for this study was exactly the same as for study one, except for the time pressure element in the planning exercise. This degree of replication was required in order to validate the results found in study one.

The time pressure condition in the present study was set at 20 minutes in order to provide a time limit in which the task could be completed - but at its most demanding level. Finally, a stopwatch was required to measure the time taken on this task. Therefore, while study one provided two measures of performance for the planning task, study two only provided the measure of accuracy; the extent to which the participant provided a complete solution.

For study 2, improvements were also made to the sampling make-up. A more equal split between male and female in the participants was achieved.

4.8 Results (Study 2) Time pressure

The results in this chapter are based on a series of between groups ANOVAs investigating four confidence-related dependent variables and two performance-related dependent variables.

4.8.1 Estimated number of successful shots

The analysis carried out on this confidence-related dependent variable was a 2 (gender) x 2 (mental toughness) between groups ANOVA.

The descriptive data is presented in table 4.8. While the previous experiment found only a main effect of gender on shot confidence, the current experiment found significant main effects of gender $F(1,37) = 6.47$, $p < 0.05$, $r = .14$, mental toughness $F(1,37) = 6.47$, $p < 0.05$, $r = .14$, and a significant interaction of mental toughness and gender $F(1,37) = 4.40$, $p < 0.05$, $r = .10$. Therefore with the current sample, males were more confident as were the more mentally tough, and with regard to the interaction, mental toughness had no moderating effect on females, but males who were also high in mental toughness were very confident (see figure 4.7).

Table 4.8 Mean scores for estimated successful gun shots

Mental Toughness Group	*Gender*	*Mean*	*Standard Deviation*	*N*
Low	Female	10.09	3.50	11
Low	Male	10.80	2.48	10
Low	**Total**	**10.43**	**3.01**	**21**
High	Female	10.80	6.08	10
High	Male	18.20	7.06	10
High	**Total**	**14.50**	**7.45**	**20**
Total	Female	10.43	4.79	21
Total	Male	14.50	6.40	20
Total	**Total**	**12.41**	**5.93**	**41**

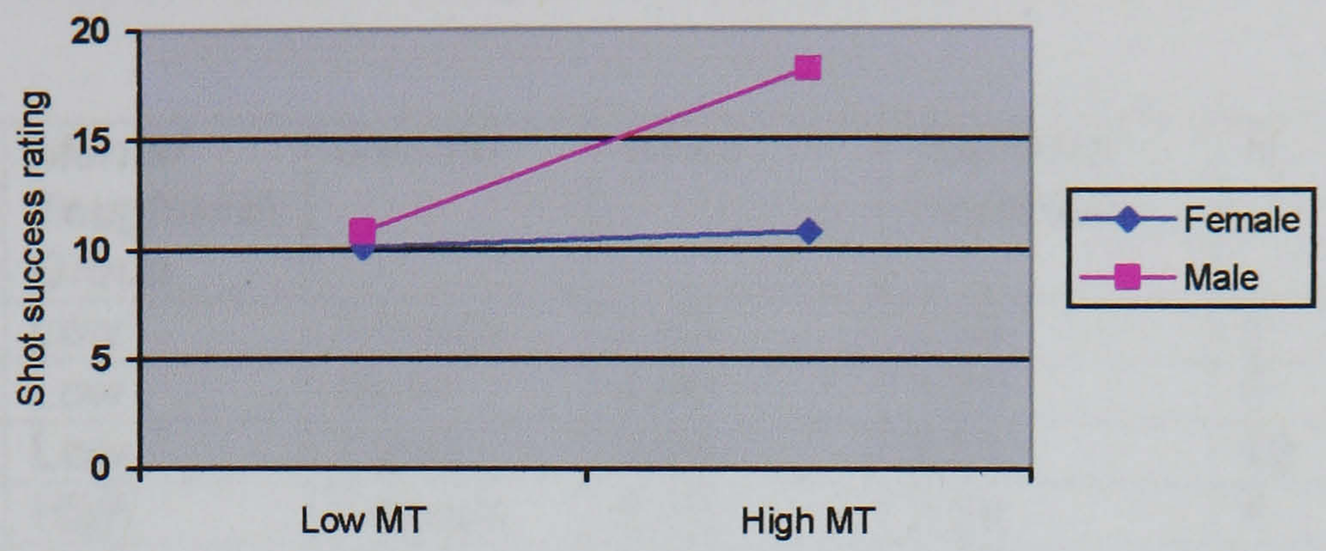


Figure 4.7: Mean shot success rating as a function of gender and mental toughness

4.8.2 Self rating of ability at snooker

A 2 (gender) x 2 (mental toughness) x 2 (feedback) ANOVA was again carried out to investigate self ratings of general ability at snooker (snooker confidence). The descriptive data from this dependent variable are shown below in table 4.9.

Table 4.9 Mean scores for self rating of snooker ability

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	2.40	0.54	5
Positive	Low	Male	4.60	1.81	5
Positive	**Low**	**Total**	**3.50**	**1.71**	**10**
Positive	High	Female	3.00	2.58	4
Positive	High	Male	5.33	1.36	6
Positive	**High**	**Total**	**4.40**	**2.17**	**10**
Positive	Total	Female	2.67	1.65	9
Positive	Total	Male	5.00	1.54	11
Positive	**Total**	**Total**	**3.95**	**1.95**	**20**
Negative	Low	Female	4.00	0.89	6
Negative	Low	Male	3.60	2.19	5
Negative	**Low**	**Total**	**3.82**	**1.53**	**11**
Negative	High	Female	2.83	1.47	6
Negative	High	Male	6.25	2.87	4
Negative	**High**	**Total**	**4.20**	**2.65**	**10**
Negative	Total	Female	3.42	1.31	12
Negative	Total	Male	4.78	2.72	9
Negative	**Total**	**Total**	**4.00**	**2.09**	**21**
Total	Low	Female	3.27	1.10	11
Total	Low	Male	4.10	1.96	10
Total	**Low**	**Total**	**3.67**	**1.59**	**21**
Total	High	Female	2.90	1.85	10
Total	High	Male	5.70	2.00	10
Total	**High**	**Total**	**4.30**	**2.36**	**20**
Total	Total	Female	3.10	1.48	21
Total	Total	Male	4.90	2.10	20
Total	**Total**	**Total**	**3.98**	**2.00**	**41**

Despite the improved sampling the only significant finding with the current experiment was the main effect of gender on snooker confidence, $F(1,33) = 11.46$, $p < 0.01$, $r = .25$; this is the same picture as revealed in the previous experiment. There were no significant main effect of mental toughness $F(1,33) = 1.59$, $p > 0.05$, $r = .04$ or feedback $F(1,33) < 1$, $p > 0.05$, $r = .01$, although the mentally tough did rate themselves as slightly more confident. Therefore, feedback provided on the gun task had no impact on self ratings of snooker ability, in fact the average scores of confidence following positive and negative feedback were almost the same (positive mean = 3.95, negative mean = 4.00). There was no

significant interaction between gender and mental toughness $F(1, 33) = 3.13$, $p = 0.86$, $r = .08$ (see figure 4.8). This is consistent with the results presented in figure 4.7. Details of the other interactions are as follows; feedback x mental toughness $F(1, 33) < 1$, $p > 0.05$, $r = .00$; feedback x gender $F(1, 33) < 1$, $p > 0.05$, $r = .01$; feedback x mental toughness x gender $F(1, 33) = 2.72$, $p > 0.05$, $r = .07$.

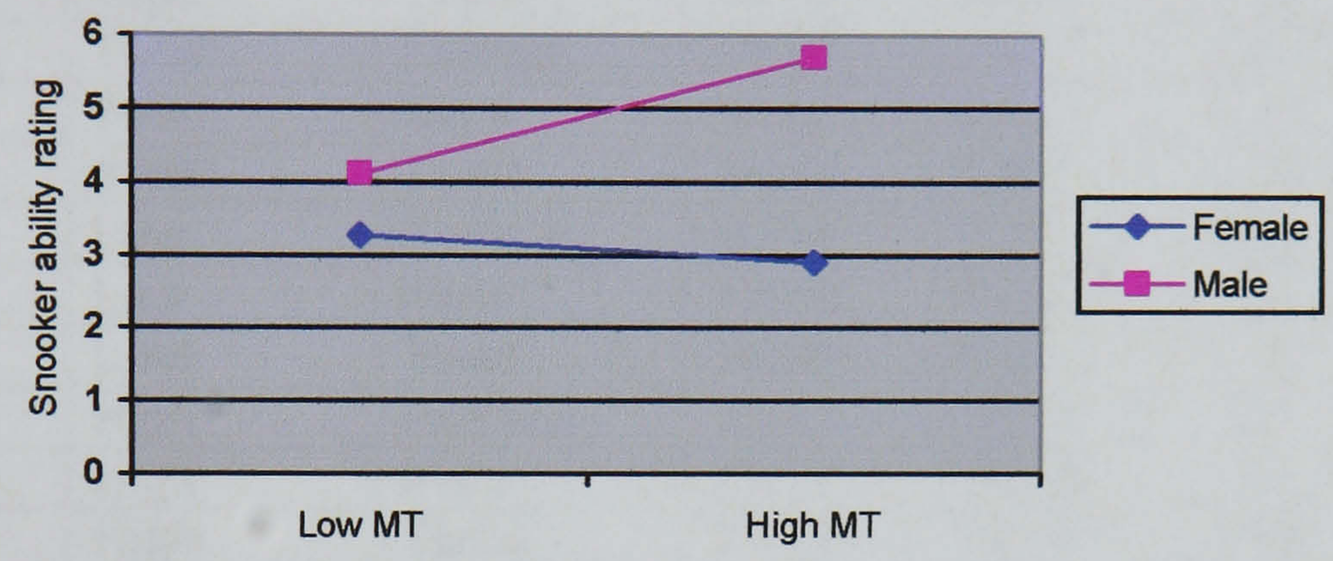


Figure 4.8: Mean snooker ability rating as a function of gender and mental toughness

4.8.3 Confidence ratings of snooker tasks

A 2 (gender) x 2 (mental toughness) x 2 (feedback) ANOVA was again carried out to investigate the composite measure of confidence on the snooker shots. The descriptive data from this dependent variable are shown below in table 4.10.

Table 4.10 Mean scores for confidence ratings of snooker tasks

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	15.80	5.76	5
Positive	Low	Male	9.80	3.42	5
Positive	**Low**	**Total**	**12.80**	**5.47**	**10**
Positive	High	Female	10.25	8.01	4
Positive	High	Male	19.83	8.13	6
Positive	**High**	**Total**	**16.00**	**9.09**	**10**
Positive	Total	Female	13.33	7.01	9
Positive	Total	Male	15.27	8.07	11
Positive	**Total**	**Total**	**14.40**	**7.48**	**20**
Negative	Low	Female	10.50	7.23	6
Negative	Low	Male	18.20	10.49	5
Negative	**Low**	**Total**	**14.00**	**9.29**	**11**
Negative	High	Female	16.67	10.98	6
Negative	High	Male	27.75	13.15	4
Negative	**High**	**Total**	**21.10**	**12.54**	**10**
Negative	Total	Female	13.58	9.43	12
Negative	Total	Male	22.44	12.05	9
Negative	**Total**	**Total**	**17.38**	**11.28**	**21**
Total	Low	Female	12.91	6.86	11
Total	Low	Male	14.00	8.58	10
Total	**Low**	**Total**	**13.43**	**7.55**	**21**
Total	High	Female	14.10	9.97	10
Total	High	Male	23.00	10.54	10
Total	**High**	**Total**	**18.55**	**10.98**	**20**
Total	Total	Female	13.48	8.28	21
Total	Total	Male	18.50	10.43	20
Total	**Total**	**Total**	**15.93**	**9.61**	**41**

As with the previous experiment there was a significant main effect of gender $F(1,33) = 4.08$, $p = 0.05$, $r = .11$, but while there were no significant main effects of mental toughness $F(1,33) = 3.33$, $p > 0.05$, $r = .09$, or feedback $F(1,33) = 2.48$, $p > 0.05$, $r = .07$, the more mentally tough produced a higher rating of confidence (HMT mean = 18.55, LMT mean = 13.43). The significant interaction between mental toughness and feedback found in the previous experiment was not replicated here $F(1,33) = 1.03$, $p > 0.05$, $r = .11$, and there were no further significant

interactions; feedback x gender $F(1, 33) = 1.88$, $p > 0.05$, $r = .05$; mental toughness x gender $F(1, 33) = 2.93$, $p > 0.05$, $r = .08$; feedback x mental toughness x gender $F(1, 33) = 1.21$, $p > 0.05$, $r = .03$.

4.8.4 Self rating of planning ability

A 2 (gender) x 2 (mental toughness) x 2 (feedback) ANOVA was again carried out to investigate self ratings of planning ability. The descriptive data from this dependent variable are shown below in table 4.11.

Table 4.11 Mean scores for self rating of planning ability

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	4.80	2.49	5
Positive	Low	Male	5.60	1.14	5
Positive	**Low**	**Total**	**5.20**	**1.87**	**10**
Positive	High	Female	4.50	1.29	4
Positive	High	Male	5.50	2.07	6
Positive	**High**	**Total**	**5.10**	**1.79**	**10**
Positive	Total	Female	4.67	1.93	9
Positive	Total	Male	5.55	1.63	11
Positive	**Total**	**Total**	**5.15**	**1.78**	**20**
Negative	Low	Female	4.83	1.47	6
Negative	Low	Male	5.20	1.48	5
Negative	**Low**	**Total**	**5.00**	**1.41**	**11**
Negative	High	Female	6.17	2.63	6
Negative	High	Male	6.25	3.30	4
Negative	**High**	**Total**	**6.20**	**2.74**	**10**
Negative	Total	Female	5.50	2.15	12
Negative	Total	Male	5.67	2.34	9
Negative	**Total**	**Total**	**5.57**	**2.18**	**21**
Total	Low	Female	4.82	1.88	11
Total	Low	Male	5.40	1.26	10
Total	**Low**	**Total**	**5.10**	**1.60**	**21**
Total	High	Female	5.50	2.27	10
Total	High	Male	5.80	2.48	10
Total	**High**	**Total**	**5.65**	**2.32**	**20**
Total	Total	Female	5.14	2.05	21
Total	Total	Male	5.60	1.93	20
Total	**Total**	**Total**	**5.37**	**1.98**	**41**

Similar to the previous experiment there were no significant main effects of feedback $F(1,33) < 1$, $p > 0.05$, $r = .01$; mental toughness $F(1,33) < 1$, $p > 0.05$, $r = .01$; or gender $F(1,33) < 1$, $p > 0.05$, $r = .02$, and no significant interactions; feedback x mental toughness $F(1, 33) = 1.1$, $p > 0.05$, $r = .03$ (see figure 4.9); feedback x gender $F(1, 33) < 1$, $p > 0.05$, $r = .00$; mental toughness x gender $F(1, 33) < 1$, $p > 0.05$, $r = .00$; feedback x mental toughness x gender $F(1, 30) < 1$, $p > 0.05$, $r = .00$.

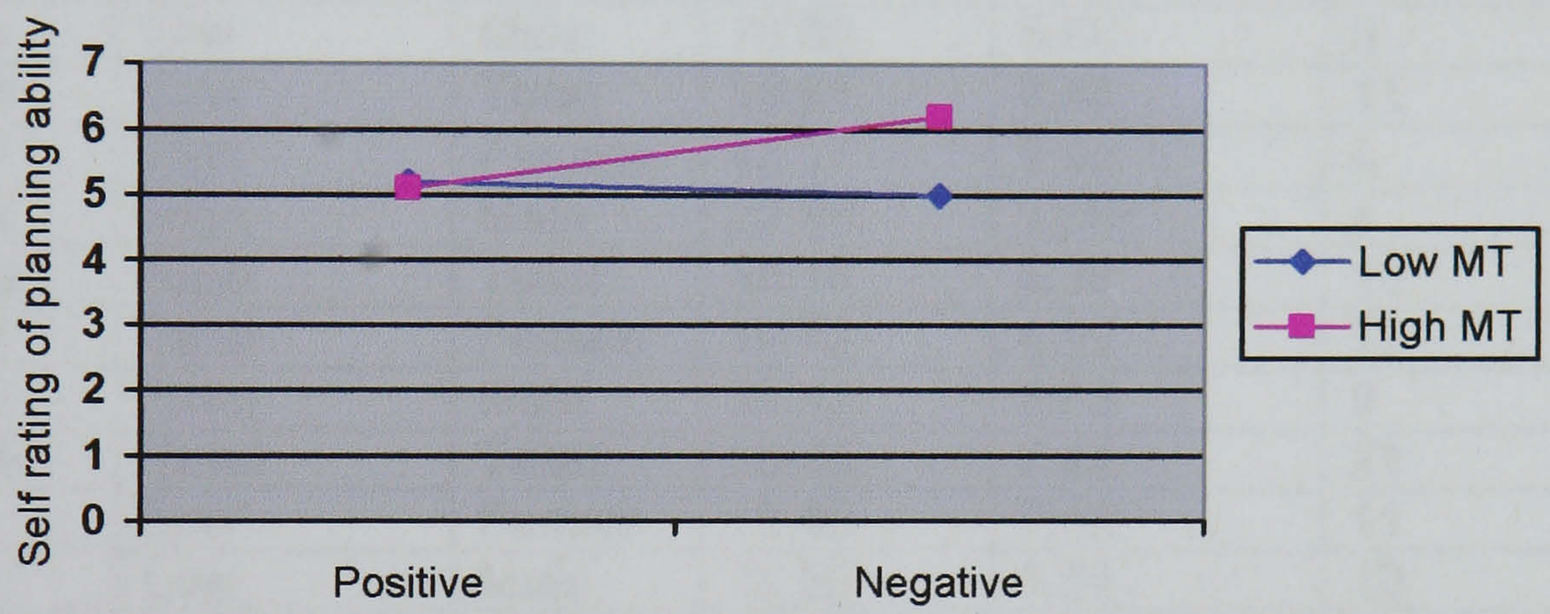


Figure 4.9: Mean self rating of planning ability as a function of feedback and mental toughness

4.8.5 Performance ratings of snooker

The descriptives presented in table 4.12 were subjected to a 2 (gender) x 2 (mental toughness) x 2 (feedback) between group ANOVA.

While the previous experiment found a significant main effect of mental toughness, the current experiment found only a slightly higher performance score for the mentally tough (HMT mean = 17.75, LMT mean = 16.90). However, a significant main effect of gender $F(1,33) = 4.47$, $p < 0.05$, $r = .11$ was found with males performing better (females, mean = 15.05; males, mean = 19.70). There were no significant main effect for mental toughness $F(1, 33) < 1$, $p > 0.05$, $r = .00$; or feedback $F(1, 33) < 1$, $p > 0.05$, $r = .00$.

Table 4.12 Mean scores for snooker performance

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	17.60	8.84	5
Positive	Low	Male	18.40	6.06	5
Positive	**Low**	**Total**	**18.00**	**7.16**	**10**
Positive	High	Female	13.75	6.94	4
Positive	High	Male	19.83	7.13	6
Positive	**High**	**Total**	**17.40**	**7.36**	**10**
Positive	Total	Female	15.89	7.83	9
Positive	Total	Male	19.18	6.38	11
Positive	**Total**	**Total**	**17.70**	**7.07**	**20**
Negative	Low	Female	13.67	6.71	6
Negative	Low	Male	18.60	5.68	5
Negative	**Low**	**Total**	**15.91**	**6.48**	**11**
Negative	High	Female	15.17	2.92	6
Negative	High	Male	22.50	12.01	4
Negative	**High**	**Total**	**18.10**	**8.19**	**10**
Negative	Total	Female	14.42	4.99	12
Negative	Total	Male	20.33	8.63	9
Negative	**Total**	**Total**	**16.95**	**7.24**	**21**
Total	Low	Female	15.45	7.62	11
Total	Low	Male	18.50	5.54	10
Total	**Low**	**Total**	**16.90**	**6.73**	**21**
Total	High	Female	14.60	4.62	10
Total	High	Male	20.90	8.85	10
Total	**High**	**Total**	**17.75**	**7.59**	**20**
Total	Total	Female	15.05	6.23	21
Total	Total	Male	19.70	7.29	20
Total	**Total**	**Total**	**17.32**	**7.08**	**41**

The key interaction between mental toughness and feedback found in the previous experiment was replicated here, with negative feedback having a positive influence on the high mentally tough and a negative influence on the low mentally tough, however this finding was not significant $F(1, 33) = 2.45$, $p > 0.05$, $r = .08$ (see figure 4.10).

There were no further significant interactions; feedback x gender $F(1, 33) < 1$, $p > 0.05$, $r = .01$; mental toughness x gender $F(1, 33) < 1$, $p > 0.05$, $r = .02$; feedback x mental toughness x gender $F(1, 33) < 1$, $p > 0.05$, $r = .00$.

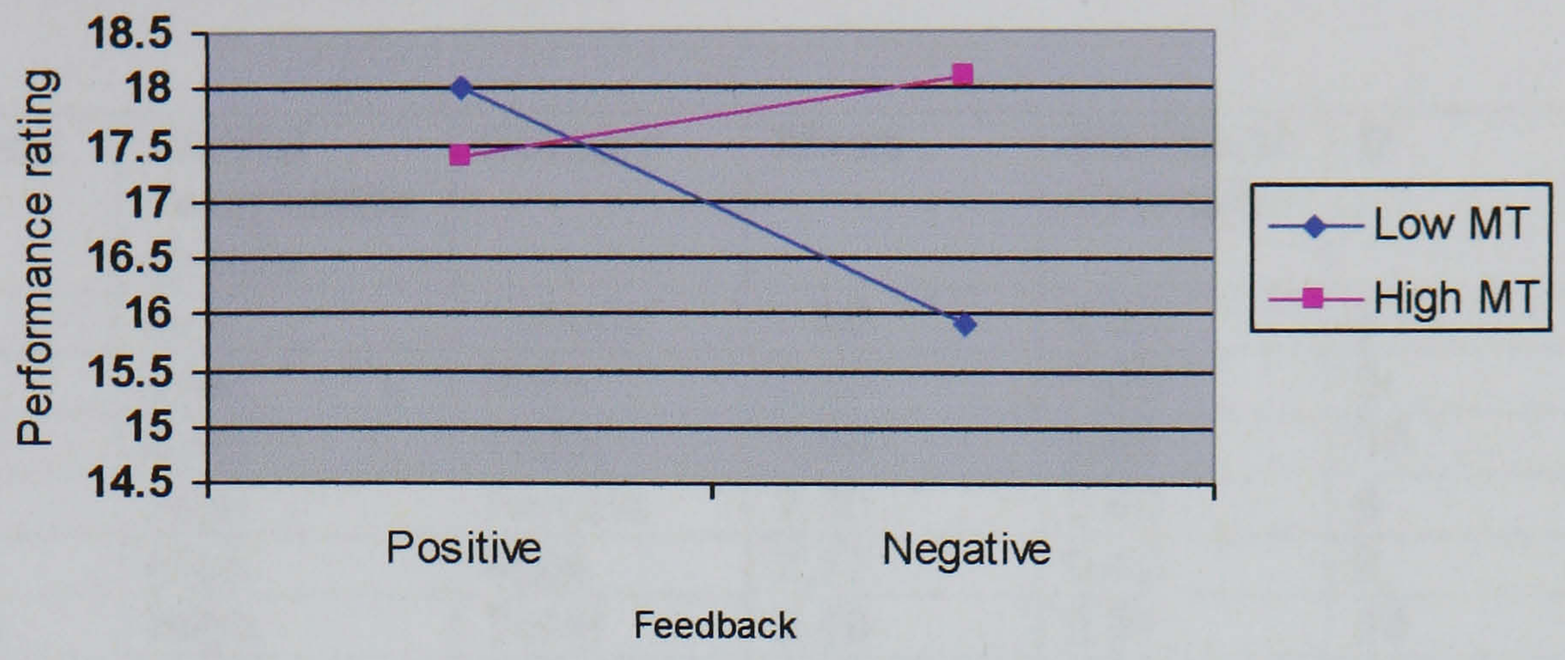


Figure 4.10: Mean performance ratings of snooker as a function of feedback and mental toughness

4.8.6 Performance rating on planning exercise

Performance scores on the planning exercise are presented in table 4.13.

Table 4.13 Mean scores for planning exercise

Feedback	*Mental Toughness Group*	*Gender*	*Mean*	*Standard Deviation*	*N*
Positive	Low	Female	1.80	0.83	5
Positive	Low	Male	2.00	1.00	5
Positive	**Low**	**Total**	**1.90**	**0.87**	**10**
Positive	High	Female	2.00	0.00	4
Positive	High	Male	2.17	0.40	6
Positive	**High**	**Total**	**2.10**	**0.31**	**10**
Positive	Total	Female	1.89	0.60	9
Positive	Total	Male	2.09	0.70	11
Positive	**Total**	**Total**	**2.00**	**0.64**	**20**
Negative	Low	Female	1.83	0.98	6
Negative	Low	Male	1.20	0.44	5
Negative	**Low**	**Total**	**1.55**	**0.82**	**11**
Negative	High	Female	2.33	0.51	6
Negative	High	Male	2.25	1.25	4
Negative	**High**	**Total**	**2.30**	**0.82**	**10**
Negative	Total	Female	2.08	0.79	12
Negative	Total	Male	1.67	1.00	9
Negative	**Total**	**Total**	**1.90**	**0.88**	**21**
Total	Low	Female	1.82	0.87	11
Total	Low	Male	1.60	0.84	10
Total	**Low**	**Total**	**1.71**	**0.84**	**21**
Total	High	Female	2.20	0.42	10
Total	High	Male	2.20	0.78	10
Total	**High**	**Total**	**2.20**	**0.61**	**20**
Total	Total	Female	2.00	0.70	21
Total	Total	Male	1.90	0.85	20
Total	**Total**	**Total**	**1.95**	**0.77**	**41**

A 2 (gender) x 2 (mental toughness) x 2 (feedback) between group ANOVA was carried out on the data. The previous experiment found an important significant main effect of mental toughness on planning performance. This main effect was replicated here $F(1,33) = 3.91$, $p = 0.05$, $r = .10$; with mentally tough participants performing better. There were no main effect of feedback $F(1,33) < 1$, $p > 0.05$, $r = .00$; or gender $F(1,33) < 1$, $p > 0.05$, $r = .00$.

However, of greatest interest here is the potential interaction between mental toughness and feedback $F(1,33) = 1.49$, $p > 0.05$, $r = .04$. This relationship presented in figure 4.11 suggests that negative feedback has a detrimental effect on the low mentally tough, but has a positive effect on those with high mental toughness. As stated above this was not a significant finding but may represent an important trend.

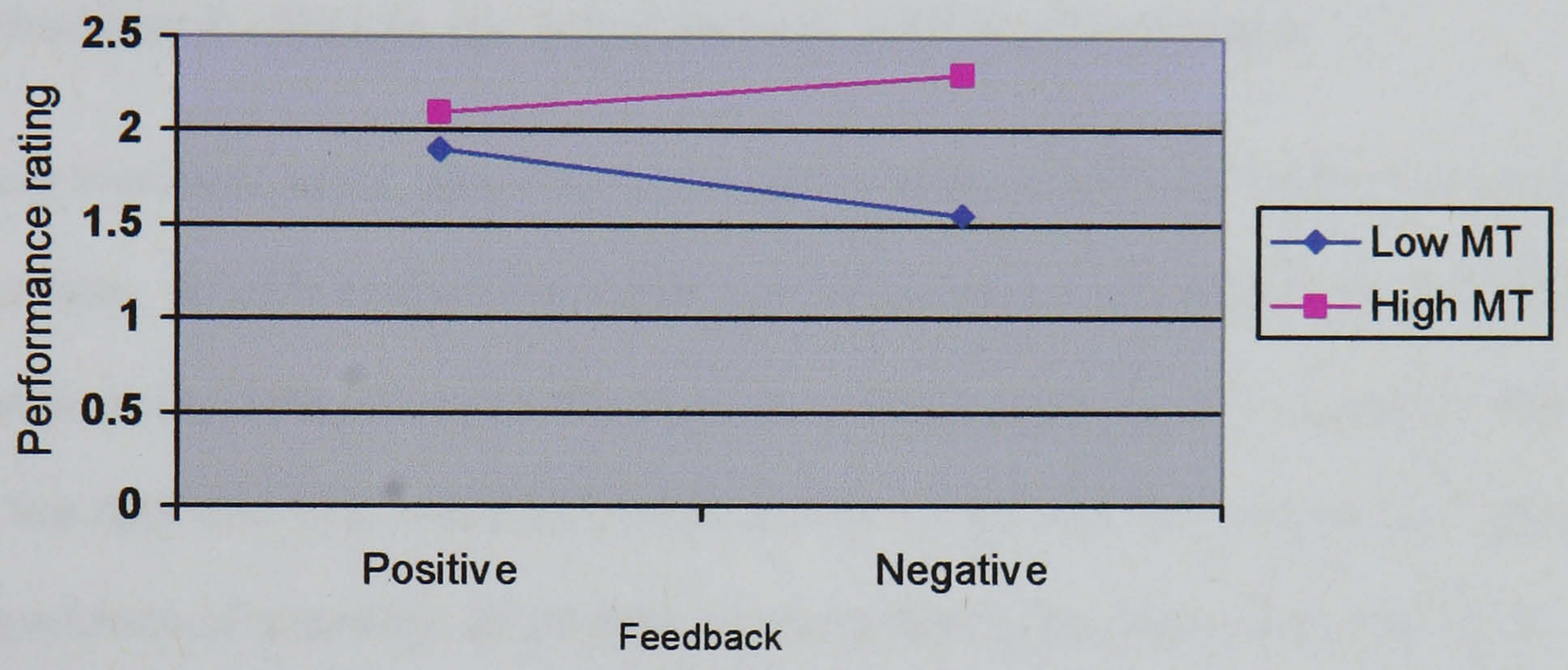


Figure 4.11: Mean performance rating on planning exercise as a function of feedback and mental toughness

There were no further significant interactions; feedback x gender $F(1, 33) = 1.25$, $p > 0.05$, $r = .03$; mental toughness x gender $F(1, 33) < 1$, $p > 0.05$, $r = .00$; feedback x mental toughness x gender $F(1, 33) < 1$, $p > 0.05$, $r = .01$.

4.9 Discussion

The primary aim of the work presented in this chapter was to examine the effects of positive and negative feedback on performance, and investigate the moderating effect that mental toughness has on both performance-related variables and confidence ratings.

4.9.1. Feedback effects on confidence and performance

Prior to any feedback being given the participants were asked to estimate their success on a shooting task. In both studies the males reported themselves as being more confident in this particular task. This particular finding may not be surprising due to gender 'specific' nature of the task and resultant expectation levels. (However, this can not be explained by actual experience of shooting, as all participants reported having no experience of shooting). Similar findings occurred in the self ratings of snooker and confidence in the snooker tasks where males reported greater ability; again this may be down in part to the nature of the task. This was supported by the lack of a gender main effect on the planning exercise, which may be considered to be more gender neutral. Therefore, the current experiment does not support a view that males have a higher degree of confidence, but may go some way to supporting the view that females have a lower degree of expectation for their performance in traditional male tasks. A full enquiry as to whether this difference in confidence related to a real difference in ability (and the expectation of success is realistic and based on their past experience) is clearly beyond the scope of this thesis. However, Hall (1990) found that females had equal confidence to males on video game performance when skills were controlled for, which may suggest that this confidence is a consequence of the current sample of men being stronger on snooker skills. Further to this, the fact that males performed significantly better on the more 'male-oriented' task of

snooker, but slightly less well on the planning provides some degree of further insight. However, nonetheless, this is clearly a correlational study, and therefore, the nature of causality with regards to confidence and ability is unclear.

In all measures of performance and confidence, feedback had no effect. Contrary to expectation, it was found in both studies that the groups receiving negative feedback rated themselves higher (in terms of mean scores) on ability at planning exercises than individuals who received positive feedback, although these differences were not significant. These results offer, in part, a counter argument to research by Ilgen and colleagues (1979) who suggested that individuals who received negative feedback would allocate more cognitive energy in trying to deal with the feedback. However, performance-related results in the actual task conversely supported the arguments proposed by Ilgen *et al*, where the individuals who had previously received positive feedback performed significantly better.

4.9.2 Mental toughness as a moderator of confidence

The first indicator (mean score differences) of the moderating effect of mental toughness was found in the confidence ratings of the snooker tasks, where the adverse impact of negative feedback was only apparent in the low mentally tough, whereas the high mentally tough participants were not affected by the feedback, however, these findings were not statistically significant. In fact there was a greater confidence rating in the negative feedback group suggesting that there is a positive reaction/appraisal of the negative feedback, indicating an ability to deal with stressful situations within a challenging/non-threatening framework. So in the context of the four possible options for dealing with feedback presented by Latham and Locke (1991 - covered previously in section 4.2.2.3) this may suggest that mentally tough individuals are more likely to reject negative feedback, or use this as a motivational tool, whereas, those who are lower in mental toughness may be more likely to either abandon commitment to a goal or lower their

expectation. This is an interesting proposition and may provide a potential avenue for further research.

With regards the gender and confidence, further investigation in this area highlights an interesting dichotomy whereby the females in the LMT group reported higher confidence in their planning ability as compared to the HMT group. The explanations for this may be either due to sampling error, or possibly there is an alternative explanation - females with high mental toughness may be less detail conscious (low anxiety levels) and approach situations with from the perspective of a "big picture" outlook. However, this trend is not supported in relation to the male participants who rated higher planning skills in the HMT group.

Another interesting, but not significant, finding relating to confidence in planning ability was found in the second study where highly mentally tough participants scored higher in the negative feedback condition, again this may be a sampling error but is still nonetheless an interesting observation. The possibility of participants performing better under adverse conditions may suggest differential approaches to motivating sportspeople/workers with diverse personality traits.

4.9.3 Mental toughness as a moderator of performance

In respect of snooker performance, both studies found promising results with the more mentally tough performing at a superior level and, importantly, the results also highlighted a strikingly lower level of performance in the LMT group under the negative feedback condition. Therefore, the negative feedback appears to have had a real impact on the performance of those in the low mental toughness category. For the planning exercise both studies gave support to the beneficial effect of mental toughness with significant greater performances by the HMT groups (this also provides some evidence to counter possible claims that mental toughness was confounded with gender and ability, as the

females scored higher overall on the planning). Most striking of all was the highly detrimental effect of negative feedback on performance levels in the LMT, while the effect on the HMT group was in fact a minimal improvement. Finally, further support was found in the time taken on the planning exercise in study one where the slowest group were the LMT in the negative feedback condition. Further investigation showed that the LMT performed slower under negative feedback whereas the HMT group performed quicker under negative feedback conditions.

These findings taken together lend support to the work of researchers (e.g. Maddi & Hess, 1992) who propose that performance outcomes are superior in individuals with certain personality profiles. Again this finding provides support for researchers (e.g. Ilgen *et al,* 1979) who stated that certain personality variables can buffer the effects of negative feedback thus preserving self-esteem and confidence.

In respect of the increased stress of time pressure applied to the second study, the results found were similar to those in the study one. This potential increase in the stressor therefore appeared to have no further effects on the performance measure of the planning task. However, the results of study two did replicate those found in the first study, thus highlighting again the beneficial nature of high mental toughness. Further studies may wish to consider ways of increasing the stressor throughout the whole experiment in order to exert an extreme amount of pressure which may fully utilise the positive benefits of being mentally tough.

4.9.4 Conclusion

Overall the results highlight the beneficial effects of being mentally tough on performance as well as self-confidence. These findings fall very much in line with previous work extolling the benefits of possessing such a personality trait. However, further studies examining and comparing the extremes of mental toughness levels may provide more substantial and significant findings.

So future research must now examine the effectiveness of sport psychology interventions which purport to enhance mental toughness. In this vein, the next chapter will investigate the nature and stability of mental toughness through a longitudinal study examining the impact of exposure to two different occupational settings.

Chapter 5:

The influence of police training and student life upon mental toughness

5.1. Summary

The study described and discussed in the current chapter aimed to investigate the pre-existing differences in mental toughness in two diverse groups and the environmental impact of two differing occupational environments.

The participants included two groups, the first being University students and the second being Police Officer recruits. Measures of mental toughness were taken at the beginning of the first academic year and the beginning of a course in Police training and again six months later in both groups. The study found Police recruits to be more mentally tough than the students at the outset, although this difference was reduced at the second time point. Furthermore, these differences were only small and not significant. Surprisingly, both populations reported significantly reduced levels of mental toughness after the six month time period.

The results of the study do indicate that changes in environment can impact upon mental toughness, but, in this case, not as anticipated. Explanations of the findings are discussed in detail and ideas for further research are considered.

5.2 Introduction

The work presented in the thesis thus far has considered the nature of the mental toughness construct, whether this can be measured and whether mental toughness has any moderating effects in response to physical and cognitive stressors. The work presented in this chapter investigates whether there are any differences in the mental toughness of two different populations of new students and Police recruits, and whether the different types of environmental changes facing these groups will impact upon mental toughness levels.

5.2.1 The development of mental toughness

There is a theme throughout the mental toughness literature and related areas that resilience, mental toughness, hardiness etc. can develop over time as a consequence of facing personal challenges or adversity. In layman's terms this is embodied by the saying that 'what doesn't kill you makes you stronger' and it would appear that this old adage is consistent with a range of theoretical perspectives. Within the health related arena, the concept of resilience has been viewed as a dynamic concept capturing positive adaptation and *growth* in the face of stress and trauma (Bonano, 2004). Similarly, the conceptualisation of physiological toughening by Dienstbier (1989), supports the view that 'the tough should get tougher' as a 'tough' individual is more likely to seek out and overcome challenges. This issue is at the heart of the current chapter as the study reported here aims to investigate the impact of challenges presented in two very different environments.

5.2.2 Teamwork, social support and mental toughness

It is proposed here that the presence of a team network can have a positive impact on mental toughness. It is argued that membership of a team can serve to increase mental toughness by providing a more concrete social network, to which individuals may turn to in times of stress or adversity. Team members can provide encouragement and advice which can help the individual to remain focussed and actively oriented when facing challenge or adversity. This is clearly not a new proposition and relates closely to elements of the stress and health literature, which suggests social support can engender a beneficial response to stress and adversity (Lynch, 1977). Interestingly, research has provided evidence that females are more likely to seek this support, as noted by Crossman (2001) who found that gender influenced the degree of social support sought by injured athletes. Furthermore, Crossman (2001) found that the seeking of social support was linked to the development of social adjustment amongst athletes - athletes who enjoyed greater social support also demonstrated a more successful response to rehabilitation. It is an interesting question as to whether this would also be replicated in occupational settings, when injury is not the primary concern; it could be argued that the nature of police work can place great emotional strain on the individual, which may cause a stress response similar to that brought about by injury. Thus the team environment engendered with the police training environment may reduce the effects of stress and facilitate learning from adversity, and provide the basis for the development of mental toughness. Whilst it is recognised that students may develop a support network during their first six months, this is not an aim of the student experience. Therefore, it is unlikely that the students will be part of a team structure which will tie the participants together and increase the likelihood that they will influence one another.

5.2.3 Coping, problem solving and mental toughness

In addition to the effects of support and encouragement on the development of mental toughness, the very process of coping with problems and difficult situations is argued to be another mechanism by which mental toughness can develop. Again, this is not a new proposition and task-oriented coping has been shown to promote effective recovery from many types of stressful situation (Penley, Tomaka & Wiebe, 2002). With respect of mental toughness, the active engagement of oneself in challenges and adversity one faces may develop mental toughness. This could be considered as the reverse of learned helplessness, in which the perception of a failed attempt to overcome difficulties leads to a state of pessimism for facing future challenges (Aronson, Wilson & Akert, 2002). This is likely to result in the individual failing to develop mental toughness as they do not rise to challenges and adversity. This again links with the work presented above which suggests that the tough get tougher. Interestingly, in order for an individual to attain the desired outcome, they must believe they can achieve it. This can clearly become a self-fulfilling prophecy, as the more one believes they can achieve a certain outcome the more likely they are to achieve it (Aronson *et al,* 2002). This active orientation toward a challenge is therefore regarded as being critical in the development of mental toughness.

In summary, perceived control over the environment, leads the individual to take an active role in coping with stressors. This allows for personal development and a sense of self fulfilment to emerge, which in turn further develops toughness as the individual perceives that he has greater control to confront adversity (Drenth, Thierry & Wolff, 1998). With regard to the current study, it could be argued that both the Police recruits and the students should in fact develop a higher level of mental toughness as both groups are taken outside of their comfort zone and are required to face (albeit different) personal and professional challenges. However, the research outlined above would suggest that, in both groups, the tough are more likely to get more tough!

5.2.4 Experimental rationale

The current study aims to investigate the differences in mental toughness in students starting a degree programme and Police training new recruits. Given the nature of the two environments and the likelihood that there is a substantial degree of self selection for these career paths, it is anticipated that the Police trainees will have a higher baseline level of mental toughness. Furthermore, it is suggested in the literature above that the tough will get tougher in the face of challenges. If the Police trainees are in fact tougher to begin with, and likely to face a higher degree of personal challenge than the group of new students, it is also anticipated that their increase in mental toughness will be greater than that of the students. Therefore, the aim of the current study is to investigate baseline measures of mental toughness and consider the impact of two different environments.

5.3 Method

5.3.1 Design

The experimental design was a 2 x 2 mixed design with two sample populations (Police recruits and University students) and measurement of mental toughness at two time points (time point one = week one of police training / University course; time point two = end of police training / University semester one.

5.3.2 Participants

Participants were drawn from two populations: Police recruits (n=30) and undergraduates from the University of Hull (n=23). All participants were selected according to the following criterion: At time point one, police participants were all brand new recruits (at the start of their police training) and undergraduates were within their first week of University life. The

mean age for police recruits was 30.37 years (SD=8.75) and the mean age of the students was 18.65 years (SD=0.88). The Police population comprised seven females and 23 males and the student population comprised 13 females and ten males.

Following the six month time lapse, a number of participants from the Police (N=3) and Student (N=4) cohorts were unable to complete the second questionnaire. This resulted in the following sample for time point two: Police recruits (n=27, mean= 30.10, SD=8.89) and undergraduates from the University of Hull (n=19, mean=18.74, SD=0.93).

5.3.3 Measures

The *Mental Toughness Questionnaire 48 (MTQ48)* multidimensional questionnaire was used to measure mental toughness (see Appendix 2.1 for a copy of the questionnaire).

5.3.4 Qualitative analysis

In addition to the use of MTQ48, two types of qualitative data were collected to facilitate the interpretation of the questionnaire results. Following some unexpected findings (presented in the following section) a focus group with the students was considered to be worthwhile to help interpret the findings and provide an additional level of explanation. Therefore, one month after the second time point, a focus group methodology (Wilkinson, 2004) was used to identify feelings and issues surrounding University life. This involved five of the participants from the questionnaire study, and served to identify reasons for trends identified in the data gleaned from the MTQ48. For a period of one hour the participants were encouraged to discuss their feelings towards University, the challenges and benefits associated with being away from home and balancing academic workload with social life. Participants were encouraged to consider the answers given as being their opinions as opposed to being viewed as right or wrong. The use of a focus group method

to investigate similar issues with the Police group was not possible as the recruits were no longer working as a group, but a short consultation was possible with two Police recruit training officers and, although this was not a particularly scientific method of data collection, this provided a very good opportunity to discuss the attitudes and behaviours of the recruits with a supervising officer. As this data was collected following the questionnaire study in an attempt to interpret the findings, the qualitative findings will be discussed at the end of the discussion.

5.3.5 Independent Variables

The study involved the use of three independent variables; group (Police and student), time period (start and end of a six month time period) and gender. Gender was included as an IV following the findings in chapter 4.

5.3.6 Dependent Variables

Mental toughness was measured by the 48 item Mental Toughness Questionnaire 48 (MTQ48). For the purposes of this study, the subscales of the multidimensional questionnaire were of particular relevance, as some subscales may be more influenced by environmental changes than others. Therefore, dependent variables included the overall MT score and the scores on the subscales of Challenge, Commitment, Control and Confidence. Where work presented earlier in this thesis has categorised participants as being within one of two groups (high or low mental toughness) the current work uses the scores on the overall scale and subscales as the dependent variables.

5.3.7 Data treatment

Analysis of Variance was again the main method of data analysis. Continuing with the principles of data treatment where sphericity has been violated, degrees of freedom were corrected using either Greenhouse-Geisser (< 0.75) or Huynh-Feldt (> 0.75) estimates of sphericity, in accordance with Field (2005).

5.4 Results

The results reported in this chapter represent the findings from a series of 2 way ANOVAs.

5.4.1 Total mental toughness

To investigate the effects of time, gender and population on MTQ48 scores, the data was submitted to a 2 (time) x 2 (gender) x 2 (population) mixed design ANOVA (see table 5.1).

Table 5.1 Mean mental toughness scores as a function of time, population and gender.

Condition	*Gender*	*Mean*	*Standard Deviation*	*N*
Police - time 1	Male	3.61	.33	17
	Female	3.61	.35	10
	Total	**3.61**	**.33**	**27**
Students - time 1	Male	3.46	.27	8
	Female	3.46	.29	11
	Total	**3.46**	**.27**	**19**
Totals - time 1	Male	3.56	.32	25
	Female	3.53	.32	21
	Total	**3.55**	**.32**	**46**
Police - time 2	Male	3.52	.25	17
	Female	3.46	.21	10
	Total	**3.50**	**.23**	**27**
Students - time 2	Male	3.38	.20	8
	Female	3.40	.22	11
	Total	**3.40**	**.20**	**19**
Totals - time 2	Male	3.47	.24	25
	Female	3.43	.21	21
	Total	**3.45**	**.22**	**46**

There was a significant main effect of time period, $F(1, 42) = 4.70$, $p < 0.05$, $r = .10$, where participants got significantly less mentally tough over the time period (see figure 5.1 and 5.2).

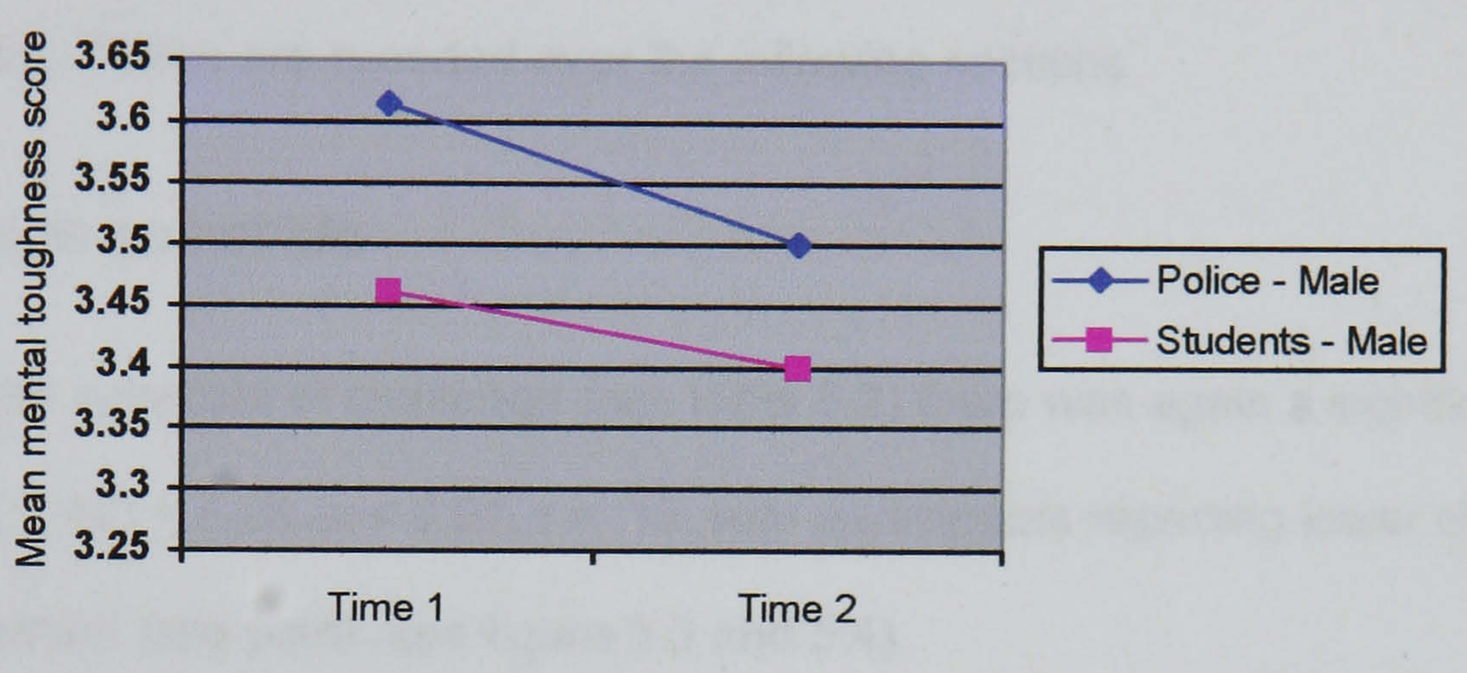


Figure 5.1: Mean mental toughness score as a function of population and time (for male participants)

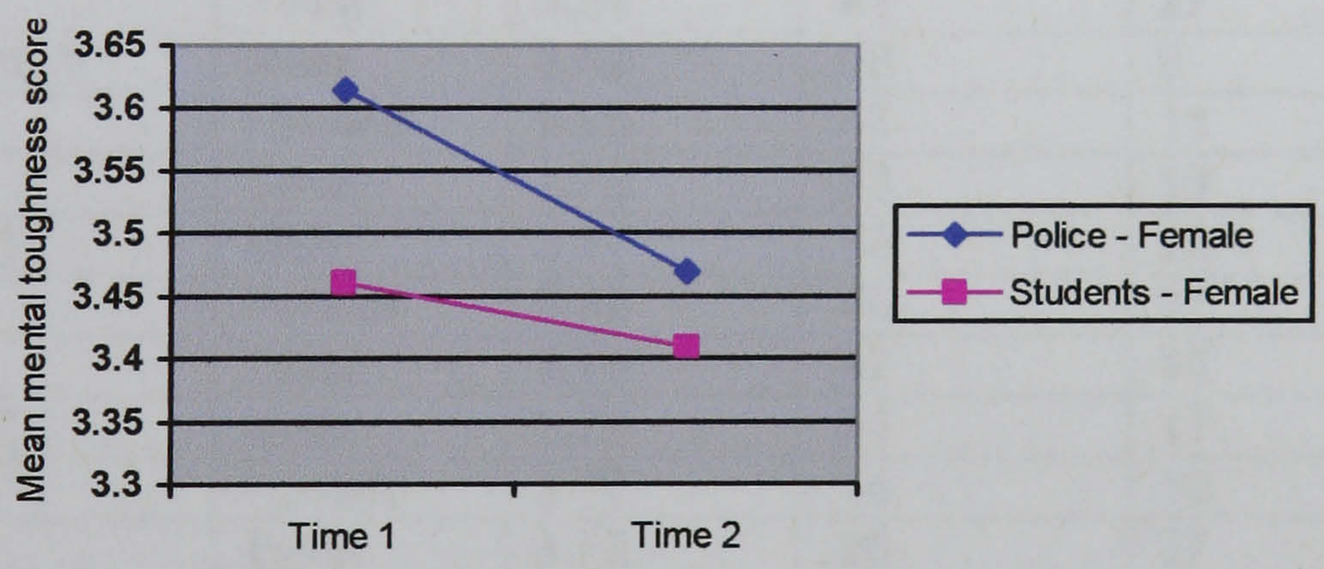


Figure 5.2: Mean mental toughness score as a function of population and time (for female participants)

While both graphs illustrate that police were more mentally tough than the students, this effect did not reach significance, $F(1, 42) = 2.79$, $p > 0.05$, $r = .06$. With regard to gender there was no main effect, $F(1, 42) < 1$, $p > 0.05$, $r = .00$.

There were no significant interactions: time x population, $F(1, 42) < 1$, $p > 0.05$, $r = .01$; population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$.

To further investigate the effects of time, gender and population on mental toughness, a series of 2 (time) x 2 (gender) x 2 (population) mixed ANOVAs were carried out on each of the six subscales. These are reported over the following sections.

5.4.2 Challenge subscale

With regard to the subscale of challenge (see table 5.2) there was again a significant main effect of time $F(1, 42) = 7.28$, $p < 0.01$, $r = .15$, with participants reporting lower challenge scores at the second time point (see figure 5.3 and 5.4).

Table 5.2 Mean challenge scores as a function of time, population and gender.

Condition	*Gender*	*Mean*	*Standard Deviation*	*N*
Police - time 1	Male	3.80	.33	17
	Female	3.91	.54	10
	Total	**3.84**	**.41**	**27**
Students - time 1	Male	3.68	.68	8
	Female	3.75	.43	11
	Total	**3.72**	**.53**	**19**
Totals - time 1	Male	3.77	.46	25
	Female	3.82	.48	21
	Total	**3.79**	**.47**	**46**
Police - time 2	Male	3.72	.31	17
	Female	3.72	.14	10
	Total	**3.72**	**.26**	**27**
Students - time 2	Male	3.51	.50	8
	Female	3.45	.28	11
	Total	**3.48**	**.38**	**19**
Totals - time 2	Male	3.66	.38	25
	Female	3.58	.26	21
	Total	**3.62**	**.33**	**46**

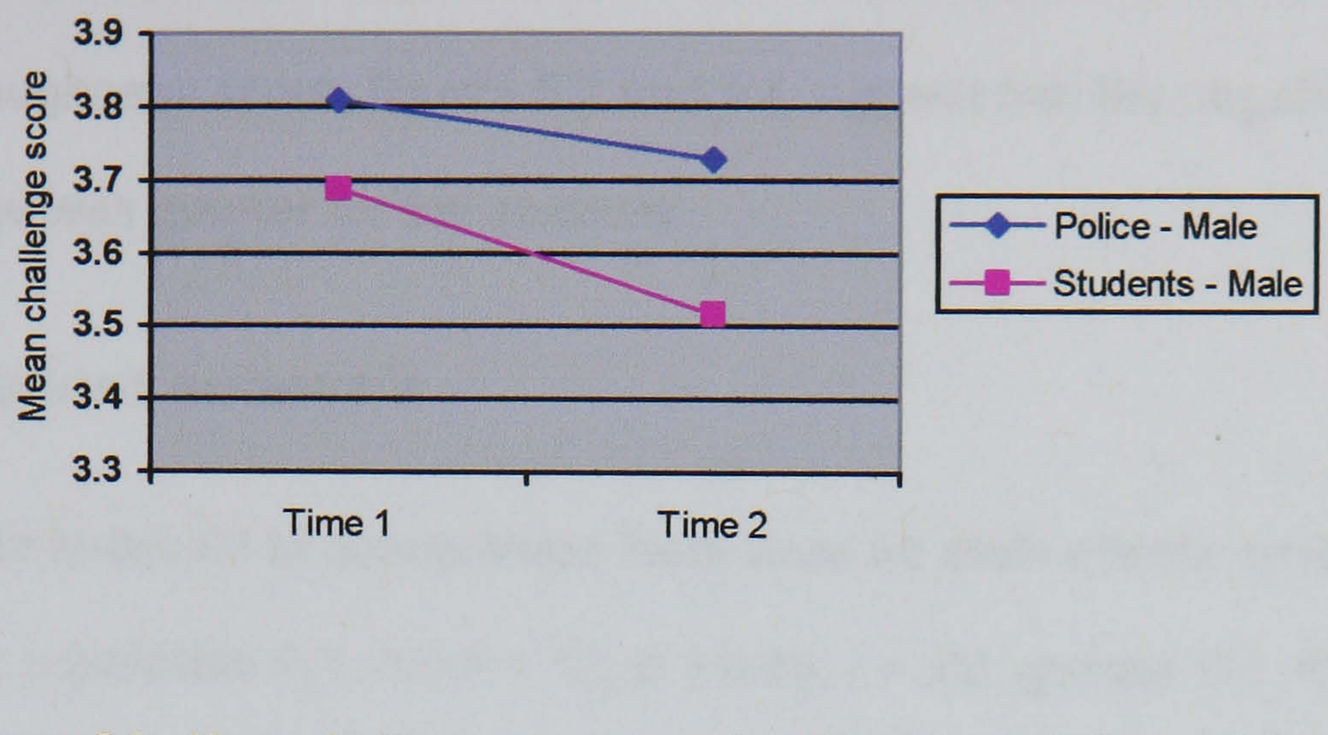


Figure 5.3: Mean challenge score as a function of population and time (for male participants)

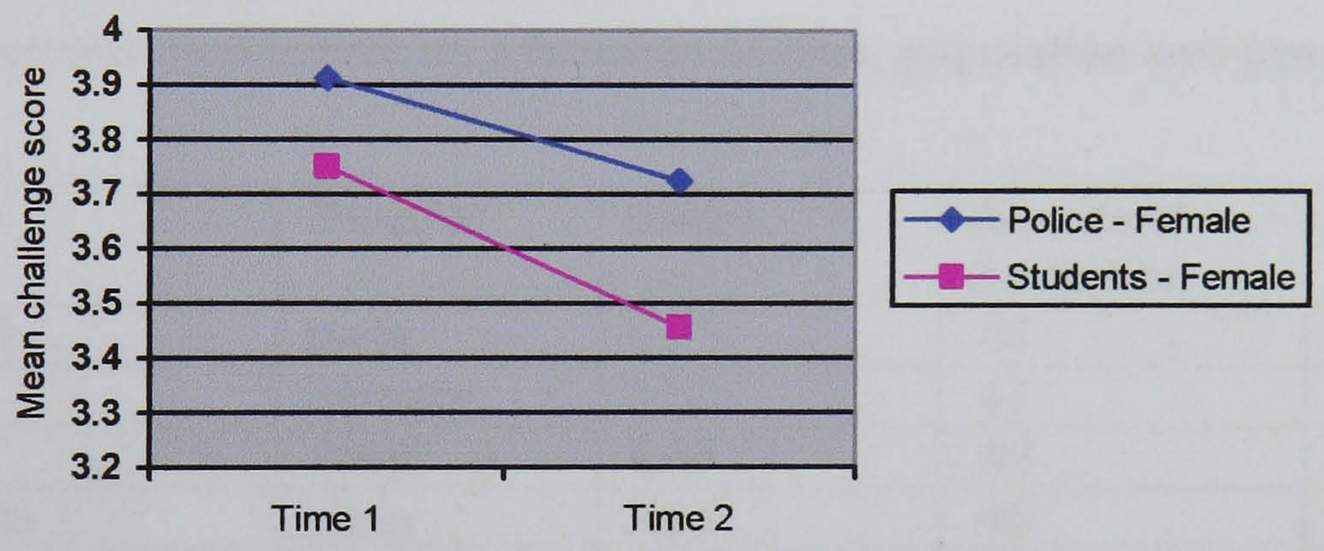


Figure 5.4: Mean challenge score as a function of population and time (for female participants)

Again, as illustrated by both graphs the police sample scored higher on the challenge subscale, although this difference failed to reach significance at the 5% ($F(1, 42) < 1$, $p > 0.05$, $r = .00$). With regard to gender, there was no main effect of gender $F(1, 42) < 1$, $p > 0.05$, $r = .00$, and no significant interactions: time x population, $F(1, 42) < 1$, $p > 0.05$, $r = .01$; population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .02$; time x

population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$. However, not consistent with the overall mental toughness score, figures 5.3 and 5.4 suggest that the negative impact of time on challenge was greater for the students.

5.4.3 Commitment subscale

With regard to the subscale of commitment there were no main effects: time $F(1, 42) < 1$, $p > 0.05$, $r = .00$; population $F(1, 42) = 1.12$, $p > 0.05$, $r = .03$; gender $F(1, 42) < 1$, $p > 0.05$, $r = .00$; and no significant interactions: time x population, $F(1, 42) = 2.31$, $p > 0.05$, $r = .05$ (see figure 5.5); population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .02$; time x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .02$; time x population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$ (see table 5.3).

Table 5.3 Mean commitment scores as a function of time, population and gender.

Condition	*Gender*	*Mean*	*Standard Deviation*	*N*
Police - time 1	Male	3.71	.41	17
	Female	3.60	.47	10
	Total	**3.67**	**.42**	**27**
Students - time 1	Male	3.39	.46	8
	Female	3.51	.29	11
	Total	**3.46**	**.36**	**19**
Totals - time 1	Male	3.61	.44	25
	Female	3.55	.38	21
	Total	**3.58**	**.41**	**46**
Police - time 2	Male	3.54	.36	17
	Female	3.55	.35	10
	Total	**3.54**	**.35**	**27**
Students - time 2	Male	3.43	.44	8
	Female	3.62	.45	11
	Total	**3.54**	**.44**	**19**
Totals - time 2	Male	3.50	.38	25
	Female	3.59	.40	21
	Total	**3.54**	**.39**	**46**

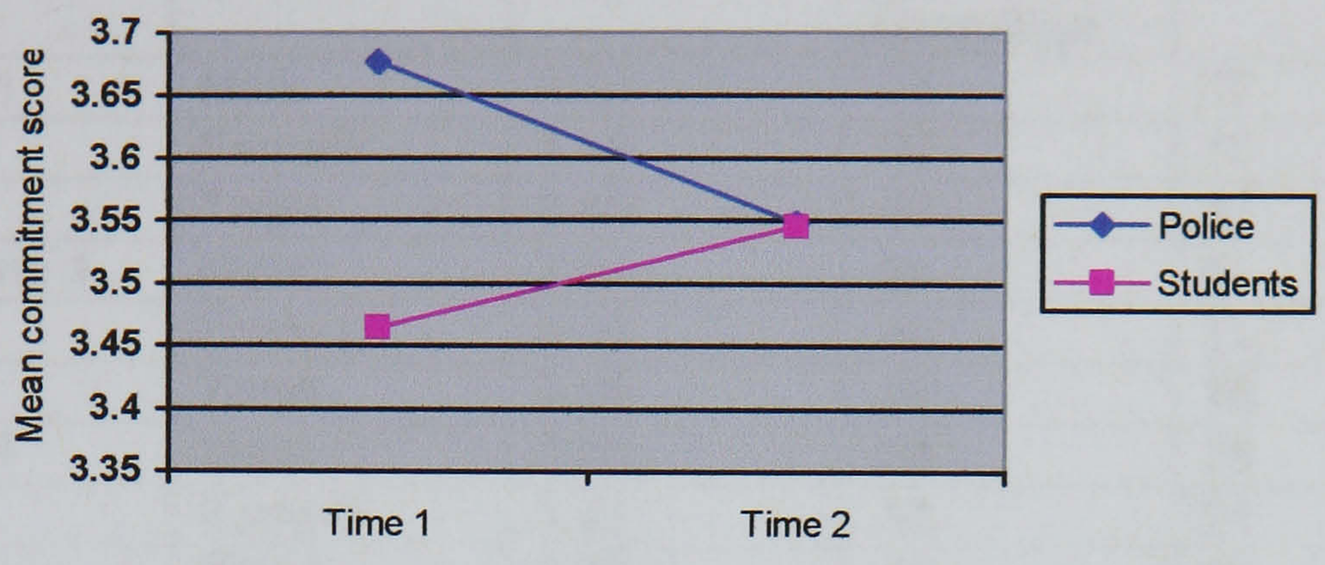


Figure 5.5: Mean commitment score as a function of population and time

5.4.4 Control of emotions subscale

With regard to the subscale of control of emotions, there were no main effects: time $F(1, 42) < 1$, $p > 0.05$, $r = .00$; population $F(1, 42) < 1$, $p > 0.05$, $r = .00$; and gender $F(1, 42) < 1$, $p > 0.05$, $r = .01$; and no significant interactions: time x population, $F(1, 42) < 1$, $p > 0.05$, $r = .02$; population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$ (see table 5.4).

Table 5.4 Mean control of emotions scores as a function of time, population and gender.

Condition	*Gender*	*Mean*	*Standard Deviation*	*N*
Police - time 1	Male	3.50	.38	17
	Female	3.48	.37	10
	Total	**3.49**	**.37**	**27**
Students – time 1	Male	3.44	.26	8
	Female	3.36	.48	11
	Total	**3.39**	**.40**	**19**
Totals - time 1	Male	3.48	.34	25
	Female	3.42	.42	21
	Total	**3.45**	**.38**	**46**
Police - time 2	Male	3.50	.29	17
	Female	3.38	.30	10
	Total	**3.46**	**.29**	**27**
Students – time 2	Male	3.48	.26	8
	Female	3.45	.51	11
	Total	**3.46**	**.41**	**19**
Totals - time 2	Male	3.49	.28	25
	Female	3.42	.41	21
	Total	**3.46**	**.34**	**46**

Table 5.4 and figures 5.6 and 5.7 illustrate there were almost no changes in control of emotions for males and females in both populations.

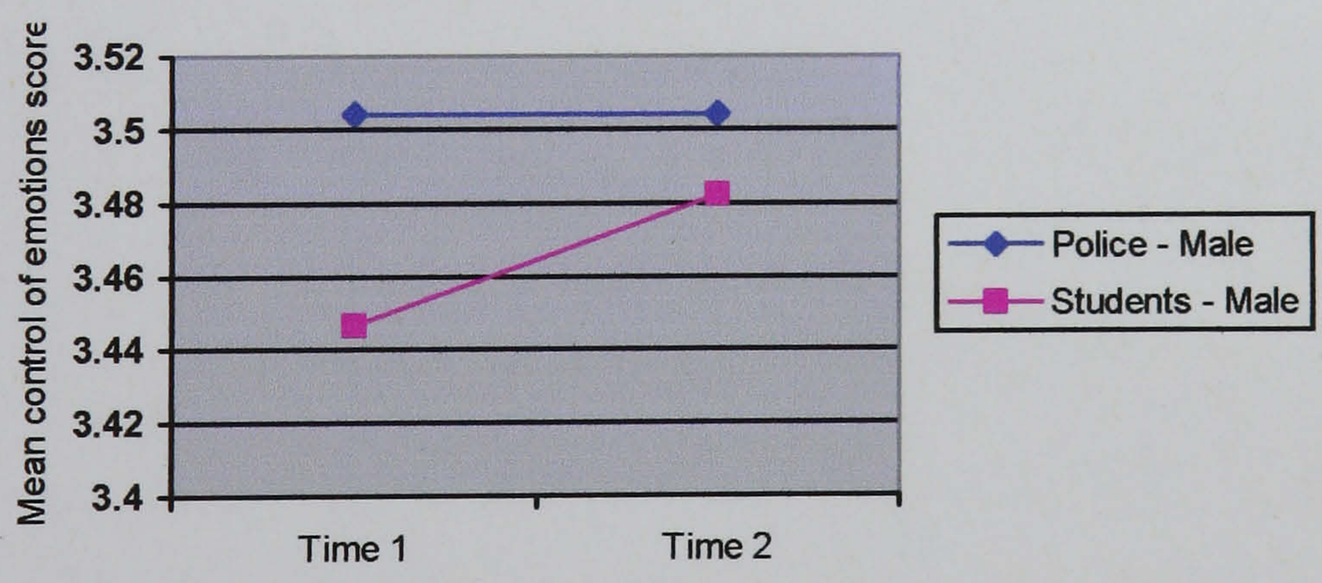


Figure 5.6: Mean control of emotions score as a function of population and time (for male participants)

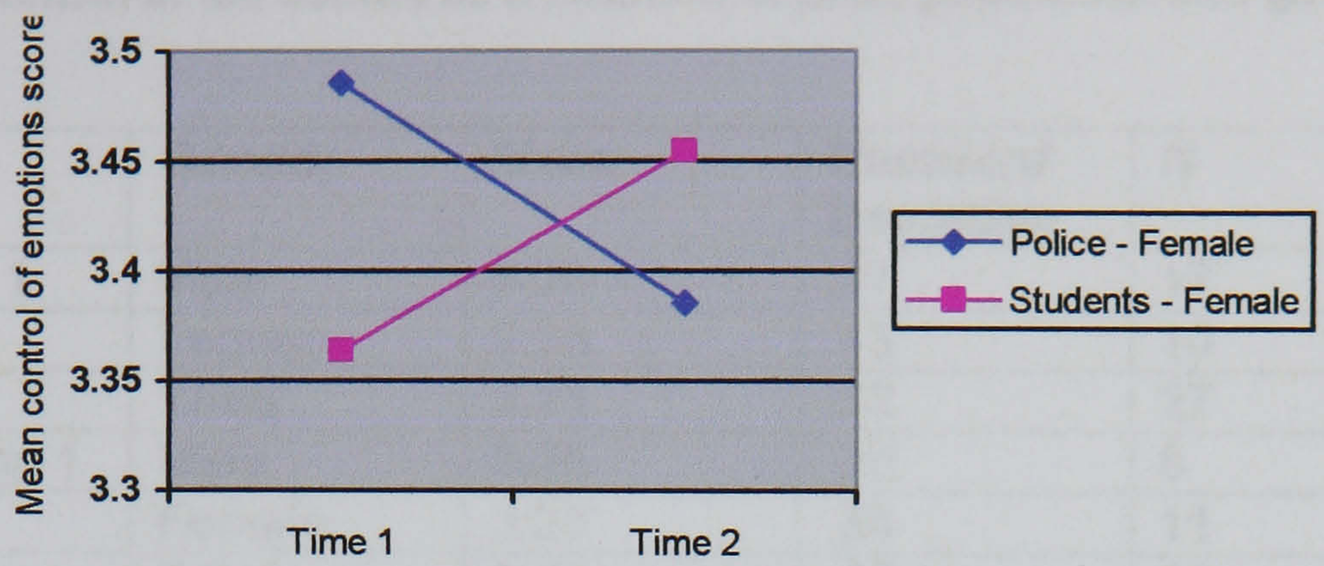


Figure 5.7: Mean control of emotions score as a function of population and time (for female participants)

5.4.5 Control of life subscale

With regard to the subscale of control of life there were no main effects: time $F(1, 42) = 1.15$, $p > 0.05$, $r = .03$; population $F(1, 42) < 1$, $p > 0.05$, $r = .01$; gender $F(1, 42) < 1$, $p > 0.05$, $r = .00$; and no significant interactions: time x population, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .01$; time x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .02$; time x population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$ (see table 5.5).

Table 5.5 Mean control of life scores as a function of time, population and gender.

Condition	*Gender*	*Mean*	*Standard Deviation*	*N*
Police – time 1	Male	3.26	.57	17
	Female	3.38	.43	10
	Total	**3.31**	**.52**	**27**
Students - time 1	Male	3.26	.30	8
	Female	3.23	.34	11
	Total	**3.24**	**.32**	**19**
Totals – time 1	Male	3.26	.49	25
	Female	3.30	.38	21
	Total	**3.28**	**.44**	**46**
Police – time 2	Male	3.26	.26	17
	Female	3.20	.35	10
	Total	**3.23**	**.29**	**27**
Students - time 2	Male	3.25	.33	8
	Female	3.11	.33	11
	Total	**3.17**	**.33**	**19**
Totals – time 2	Male	3.25	.28	25
	Female	3.15	.34	21
	Total	**3.21**	**.31**	**46**

Again, there was almost no difference between the groups and no changes over time in control of life. As shown in figures 5.8 and 5.9 the scores on this subscale decrease a little over time for both groups, with the police reporting higher life control at each time point. However, these differences are very small indeed.

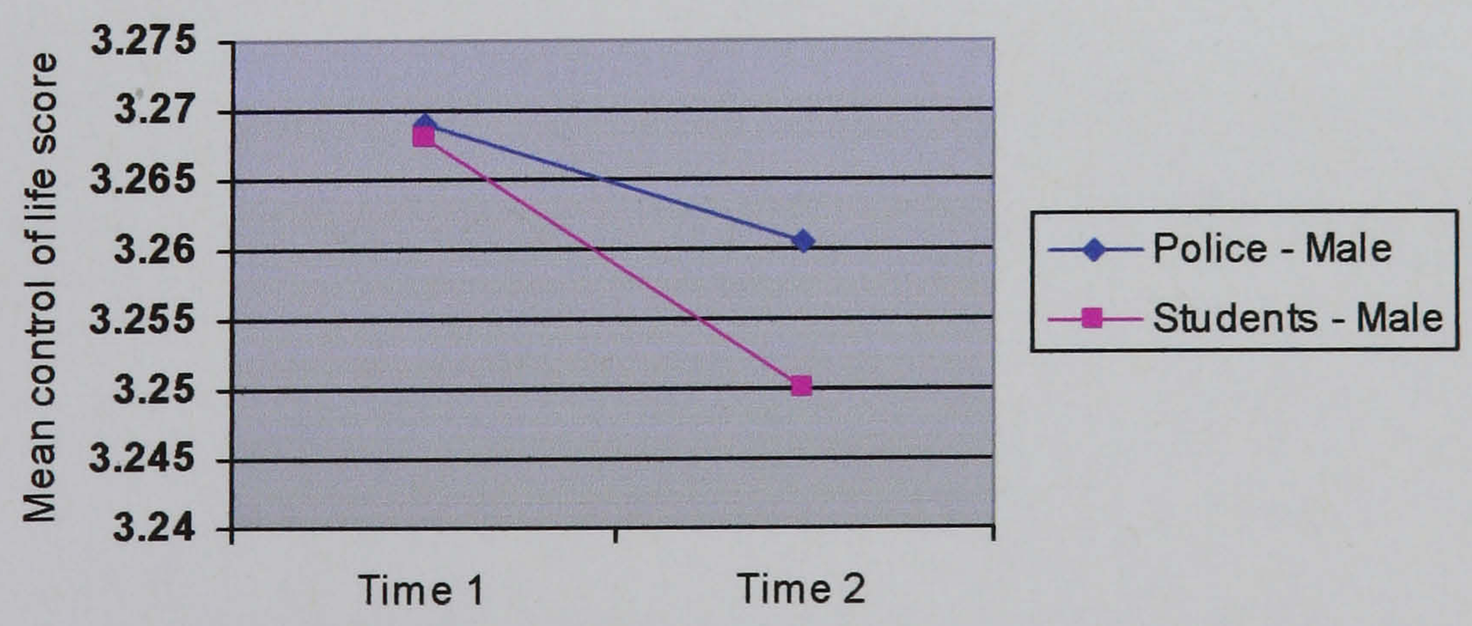


Figure 5.8: Mean control of life score as a function of population and time (for male participants)

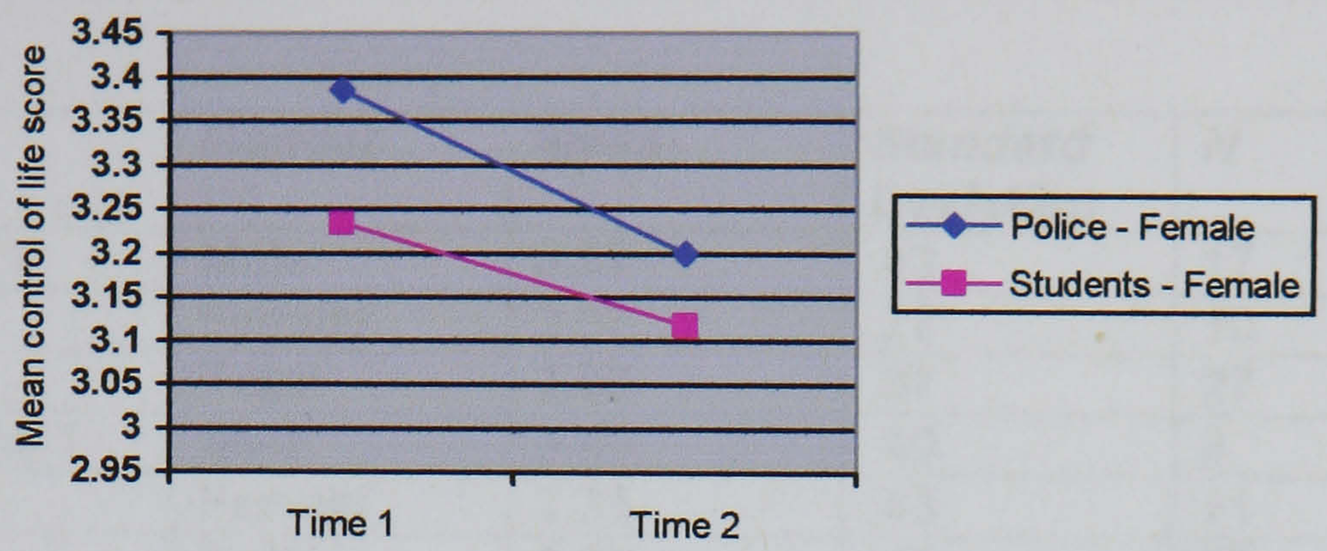


Figure 5.9: Mean control of life score as a function of population and time (for female participants)

5.4.6 Confidence in abilities subscale

There were no main effects in the confidence in abilities subscale: time $F(1, 42) < 1$, $p > 0.05$, $r = .02$; population $F(1, 42) = 3.06$, $p > 0.05$, $r = .07$; gender $F(1, 42) < 1$, $p > 0.05$, $r = .00$; and no significant interactions: time x population, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$ (see table 5.6, and figures 5.10 and 5.11).

Table 5.6 Mean confidence in abilities scores as a function of time, population and gender.

Condition	*Gender*	*Mean*	*Standard Deviation*	*N*
Police – time 1	Male	3.57	.43	17
	Female	3.57	.27	10
	Total	**3.57**	**.37**	**27**
Students - time 1	Male	3.40	.40	8
	Female	3.35	.43	11
	Total	**3.37**	**.41**	**19**
Totals – time 1	Male	3.52	.42	25
	Female	3.46	.37	21
	Total	**3.49**	**.40**	**46**
Police – time 2	Male	3.50	.43	17
	Female	3.44	.37	10
	Total	**3.48**	**.41**	**27**
Students - time 2	Male	3.34	.27	8
	Female	3.34	.31	11
	Total	**3.34**	**.29**	**19**
Totals – time 2	Male	3.45	.39	25
	Female	3.39	.34	21
	Total	**3.42**	**.37**	**46**

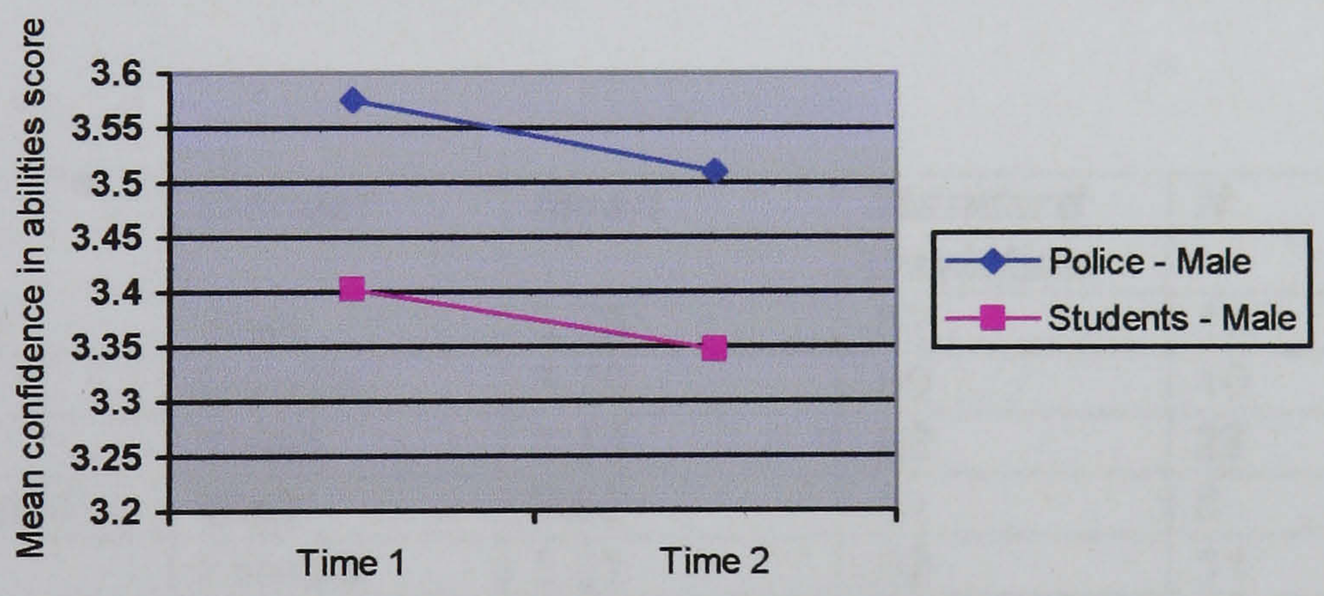


Figure 5.10: Mean confidence in abilities score as a function of population and time (for male participants)

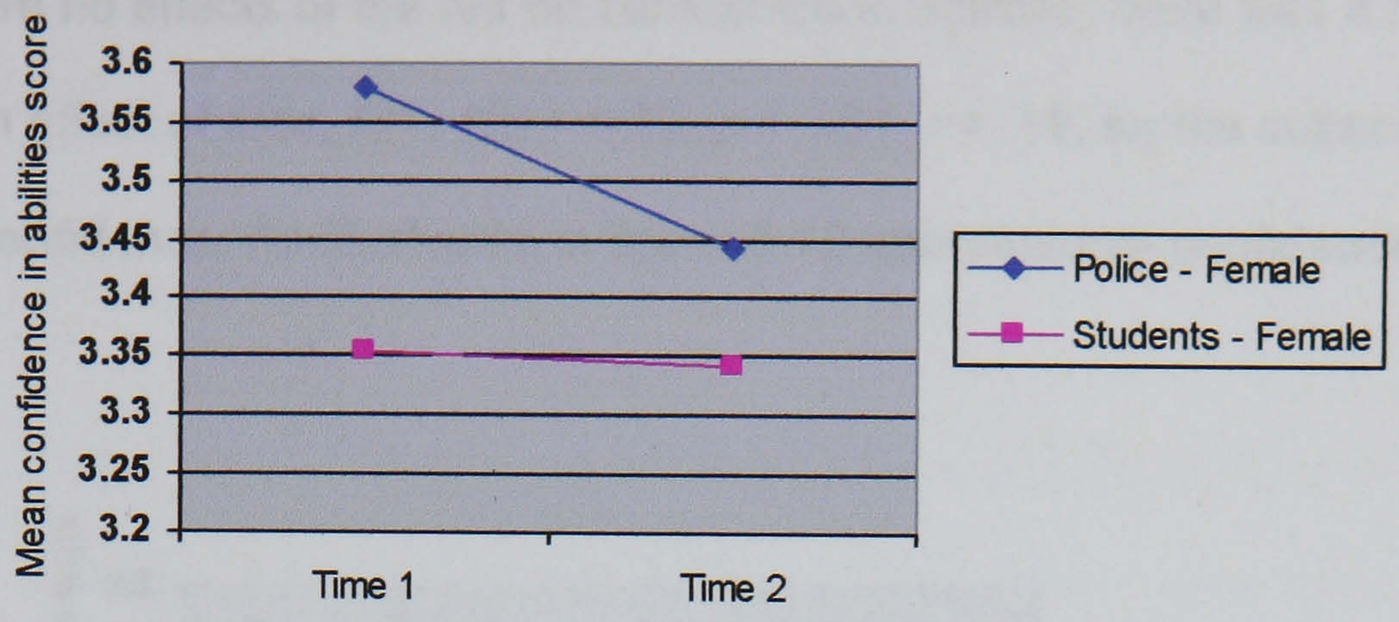


Figure 5.11: Mean confidence in abilities score as a function of population and time (for female participants)

5.4.7 Interpersonal confidence subscale

The descriptives for the interpersonal confidence subscale are shown below in table 5.7.

Table 5.7 Mean interpersonal confidence scores as a function of time, population and gender.

Condition	*Gender*	*Mean*	*Standard Deviation*	*N*
Police - time 1	Male	3.76	.52	17
	Female	3.70	.80	10
	Total	**3.74**	**.62**	**27**
Students - time 1	Male	3.62	.61	8
	Female	3.51	.82	11
	Total	**3.56**	**.72**	**19**
Totals - time 1	Male	3.72	.54	25
	Female	3.60	.79	21
	Total	**3.66**	**.66**	**46**
Police - time 2	Male	3.53	.31	17
	Female	3.41	.65	10
	Total	**3.49**	**.46**	**27**
Students - time 2	Male	3.25	.44	8
	Female	3.33	.38	11
	Total	**3.29**	**.40**	**19**
Totals - time 2	Male	3.44	.37	25
	Female	3.37	.51	21
	Total	**3.41**	**.44**	**46**

While there were no effects of the IVs on confidence in abilities, there was a highly significant main effect of time, $F(1, 42) = 9.82$, $p < 0.01$, $r = .19$, for the subscale of interpersonal confidence. As illustrated in figure 5.12 interpersonal confidence decreases with time.

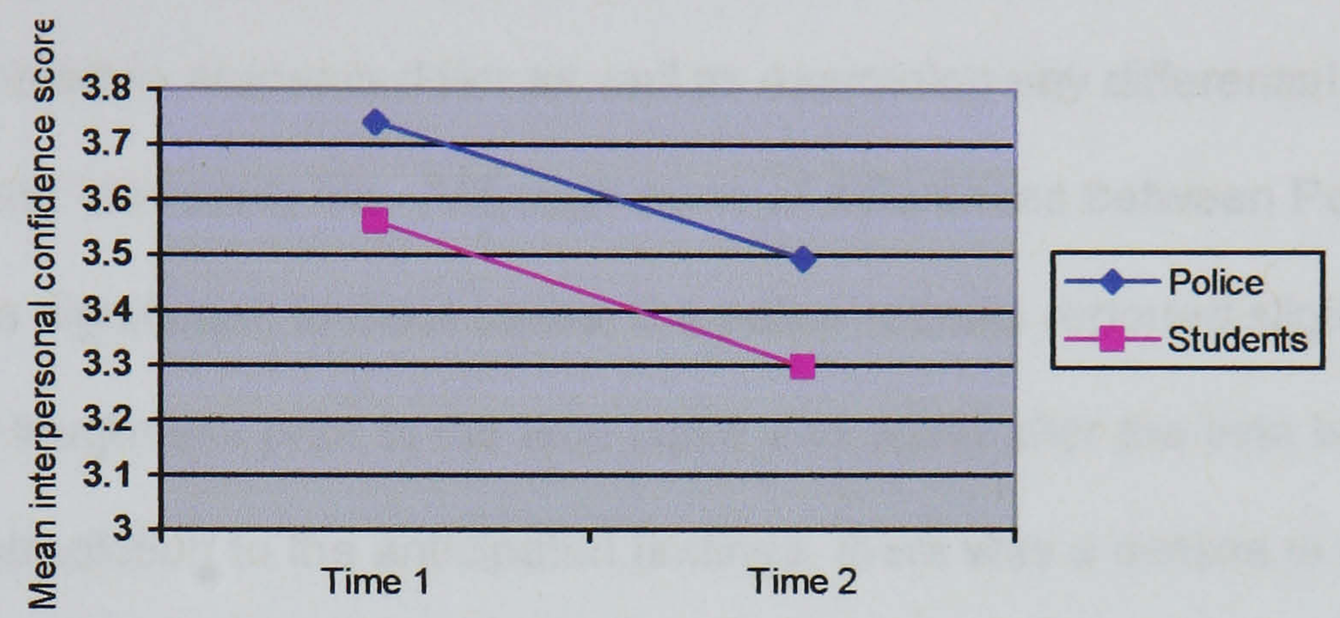


Figure 5.12: Mean interpersonal confidence score as a function of population and time

Figure 5.12 also shows that the police population have a higher degree of interpersonal confidence than the students at both time points, but the main effect of population failed to reach significance $F(1, 42) = 1.27$, $p > 0.05$, $r = .03$. There was also no main effect of gender $F(1, 42) < 1$, $p > 0.05$, $r = .00$.

There were also no significant interactions: time x population, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .00$; time x population x gender, $F(1, 42) < 1$, $p > 0.05$, $r = .01$.

5.5 Discussion

5.5.1 Summary of findings

The aims of this study were to investigate whether the mental toughness of Police recruits and first year University students differ as well as examining any differential impact of Police training and University life. Although none of differences between Police/student were found to be significant, in most cases, the police recruits reported slightly higher levels of mental toughness prior to the time lapse and again after the time lapse. However, in contradiction to the anticipated findings, there was a decline in overall mental toughness and challenge. In fact the police population recorded at least slight reductions in all subscales, whereas the students showed an increase in the subscales of commitment and control of emotions.

In contradiction to the literature described in the introduction to this chapter, the exposure to the potential 'environmental stressors' of the two new environments did not result in a subsequent rise in mental toughness. With regard to the Police recruits, the reverse was recorded. This trend was also recorded amongst the student population, though the subsequent degradation of mental toughness over time was, in most cases, less severe. Considering the findings of earlier research (e.g. Luther & Cicchetti, 2000), two findings might have been anticipated. First, that the more challenging environment of the Police training would lead to a greater rise in the mental toughness of the Police recruits, and, secondly, that the more mentally tough group (the Police) would be more likely to benefit from the challenge. This again was not supported by the findings, and it appeared that the challenge may have had a slightly negative impact on mental toughness. However, it should also be noted that the second evaluation point coincided with the exam period of the students, who were likely to be experiencing apprehension over the potential consequences of passing or indeed failing to meet academic requirements. A final

consideration may go some way to explaining the unexpected findings of the reductions in mental toughness in the Police recruits: One's view of one's self is always tempered by comparison with others, and, as human beings, we are prone to evaluating ourselves by reference to those around us. It is quite possible that the Police recruits considered themselves to be tough in comparison to their pre-existing norm groups of friends, family and old colleagues, but, having spent time with a group who may be more tough, reported themselves as less tough in comparison to their new norm group – small fish/big pond scenario! However, this is clearly supposition and can not be tested within the confines of the current study, nonetheless, there may be some support for this from the focus group – and this will be discussed in more detail below.

With regard to the subscales, there are a number of findings worthy of discussion. In consideration of *commitment,* the Police recruits mean scores were higher than the student sample at the first testing point (not statistically significant), though this difference was removed at the second time point. Interestingly, student *commitment* increased though the intervention phase whereas Police recruit *commitment* actually reduced. The high levels of *commitment* recorded in the Police Recruits and the subsequent fall present a quandary. It may be contested that prior to training, the Police Recruits were well motivated and positively oriented towards the prospect of a new career in which they saw themselves being respected as highly valued members of the community, presenting a positive image of the Police force as a whole (Poczwardowski & Conroy, 2002). Though following their training, their view of the future career may have been more realistic and, possibly, less positive. This was again supported by the consultation with the Police recruit training officers (see section 5.5.3), who stated that there are often some negative reactions to the reality of the job, particularly with regard to shift systems and excessive paperwork.

Similar to *commitment,* the Police recruits' *challenge* scores highlighted a slightly reduced response. This is echoed by the student population who also illustrate a fall in *challenge*. This decline across each population was surprising and interesting. However, it should be mentioned again that these differences represented only small changes. Nonetheless, the changes were in the opposite direction than anticipated. While it may be explained by the earlier point that the participants were faced with a new norm group, there is also another explanation. Maybe the positive effects of the challenges faced by both groups had yet to manifest. Given the short six month time scale, it is possible that the benefits of facing these challenges are less immediate and will manifest later on within their career and life. However, while this is again supposition, this does present an interesting hypothesis for further research.

With regard to *Emotional control*, the changes were again very small, but there was a slight increase in the emotional control in the student group. This may be a consequence of the new life circumstances facing the students. Unlike the Police recruits, they are more likely to have just moved away from home at time point one, but, by time point two, may have developed in maturity and ability to deal with the challenges their new circumstances have brought. Furthermore, the age difference between the groups may also have had some influence over the findings, as the younger student group may be developing at a faster rate.

The single biggest change from time point one→two was within the confidence subscales. *Interpersonal confidence significantly reduced* over the course of the six months, which was not expected. Both of the new environments would have provided participants with opportunities to develop their confidence in dealing with a broad range of new people. It is possible that the variety of personalities and new individuals may have overwhelmed the participants. Upon scrutiny of the participant details, it is evident that the average age of the student population is below nineteen years, which indicates that the greater majority

have recently left school or Sixth Form College. Within these previous environments the students would have been regarded as senior amongst the other pupils. Therefore this perceived seniority may have given the students elevated *interpersonal confidence*. This *interpersonal confidence* thus declines as the student becomes acutely aware of their new surroundings, in which they are no longer the senior figures. Again this may refer to the small fish/big pond effect, and the same could be said for the Police sample who become the lowest rank of a very hierarchical profession. On a positive note, this may represent only a temporary decline and time may prove that mental toughness is enhanced in the medium-long term following challenges and new situations. Again this is purely supposition.

The decline in *interpersonal confidence* is observed again in reports of the mean scores for *confidence in ability*, which is similarly reduced across both populations, again these reductions were not statistically significant. However, there could be alternative explanations within the different environments. The student decline could possibly be attributed to academic demands, such as the need to produce assignments. Whilst the students may have experience of such academic skills from earlier institutions, the more advanced requirements of University may test the ability of the students beyond the limits to which they have previously been exposed, thus resulting in a reduction in *confidence in ability.* In relation to *confidence in ability* amongst Police recruits, the cause for the decline may be more complex, as the demands placed upon the Police recruit are perceivably more varied than are placed upon the student. Demands such as the need to learn the many skills required to be an efficient Police officer are expected to extend beyond any previous work experience the recruits are likely to have. For example the recruit may have clerical experience, though lack experience of dealing with aggressive individuals. This is in addition to the academic demands of the training course involving understanding of specific laws and protocol. It is evident therefore that the demands placed upon the Police officer are high and the result is the *confidence in ability* of the Police recruit being tested

to extremes. Though it is accepted that the mentally tough only benefit when demands are high (Clough and Earle, 2001), the high demands placed upon the Police officer do not appear to have been beneficial to the mental toughness levels of the participants in this study. Therefore it is plausible that the Police recruits were not sufficiently mentally tough in order to benefit from the demands of Police training. Compared to the norm group, Police recruits were considered to be only slightly above average in respect of their mental toughness levels.

5.5.2 Gender differences

The study has illustrated that are some minor differences between males' and females' mental toughness, including interpersonal confidence and commitment, but this falls in line with previous studies. However, it should again be stressed that the differences were surprisingly small and not statistically significant. Both males and females report similar trends within the subscales of the study in both the first and second test. Interestingly, this finding provides some support for the use of MTQ48 as a viable measure of mental toughness as it was not found to prejudice favourably or negatively against males or females.

5.5.3 Qualitative findings

Oddly, the results of quantitative analysis were not supported by the focus group (held with the student population) and the consultation with two police recruit training officers. The trends and opinion expressed largely support the study hypothesis that mental toughness should have developed.

Student Focus Group: The students in general reported that they felt more confident in talking to and approaching new people, which was further supported by the students typically reporting that they had more friends at University than at home. As expected, the students felt they had greater control over their lives, and were able to direct their leisure

time more freely than they had previously experienced. In consideration of the financial limitations imposed upon the students, the students largely expressed that whilst this was an issue, it was not a barrier to social lives and lifestyle, most agreed they had learnt to budget more appropriately to accommodate the reduced available funds. In consideration of the academic demands placed upon the students, the consensus was that whilst it was more demanding, the workload was not sufficient to cause the students to feel overwhelmed, though the new knowledge and understanding to be learnt was beyond anything they had previously been expected to achieve. From an emotional standpoint, the students expressed that they had, on occasion, felt homesick, though as time progressed, experiences gradually lessened. In coping with homesickness, most found that they were able to overcome this feeling through communication with parents at home. As discussed, the students found that whilst living with others was occasionally stressful, they had learnt to adjust and did not allow issues which previously caused upset, to develop into a source of stress. This for example was manifested in noise from other residents returning late at night and waking the student; previously this caused aggravation, though as the student adjusted to the living conditions, they found they were able to reappraise the disturbance and did not respond in a negative manner as was previously done. This corresponds with the rise observed in *emotional control* and was further supported by students suggesting they felt more confident in talking to others and did not feel as anxious talking to new people, though this contrasts with the recorded fall in *interpersonal confidence*.

Consultation with two Police recruit training officers: Further to the Focus Group with the students, and to provide some insight into the unexpected findings from the Police sample, a small consultation was held with two Police recruit training officers. This proved to be an insightful process; the training officers supported the research findings, and explained that the falls of overall mental toughness and the subscales could have been expected. This was related to the Consciously Incompetent model (Chapman, 1995)

which predicts that the Police recruits enter training with high self expectations and are unconsciously incompetent as to how little they know. Thus upon commencing the steep learning curve of training, the Police recruit become conscious of how little they know, resulting in a decline in *confidence, commitment* and therefore MT. As time passes, the Police recruit gradually becomes consciously competent and consequently *confidence* begins to rise along with MT. The training officers remarked that this typically did not occur until the recruit was approaching the end of the probationary period lasting ninety weeks; thus supporting the proposition above, that there may be hidden benefits in the future, which are currently masked by the proximity of the participants to the stressors. Regarding the observed fall in *emotional control*, the training officer commented upon the Police recruits' lack of experience in dealing with emotive crimes and the more gruesome aspects of Policing, though remarked that as time passed the Police recruit learnt to deal with such scenarios with coping mechanisms. As previously discussed, the fall of *life control* was attributable to the nature of the work environment, being that shift structures impacted upon social and personal lives. The information gleaned from this consultation is important within the context of this study as it provides some good explanations regarding the unexpected findings. Furthermore, the training officer commented that the trends identified by this research were a typical pattern and observed with every training group undergoing Police recruit training.

The information garnered from the consultation with the Police training officer suggests that the present study was not of sufficient time to record a rise in mental toughness and other subscales. This, due to the duration of the training and the consciously incompetent model taking time for the Police recruit to adjust to new vocational requirements.

Further research should attempt to investigate this proposition, by attempting to measure mental toughness again in a further six months.

Chapter 6:

The effects of a programme of psychological skills training on performance and mental toughness in non-elite swimmers

6.1 Summary

The experiment described and discussed in the current chapter aimed to investigate the impact of a mental toughness training programme involving goal setting, imagery and relaxation on mental toughness and swimming performances in 24 swimmers from Hull University Swimming Club. The participants were allocated to one of two groups (mental toughness training and non-mental toughness training).

Mental toughness was assessed using pre and post-intervention MTQ48s and performance effectiveness by weekly swimming performances measured over six weeks. Additional data regarding mental toughness training was received from a subgroup of participants in the form of questionnaire responses and a focus group with six participants.

The mental toughness training intervention was found to be an effective method of improving both mental toughness and swimming performances. Results of this study have theoretical implications for the sport psychology field, to athletes interested in improving mental toughness, and also, potentially to other domains, such as occupational psychology and health psychology.

6.2 Introduction

The work presented in Chapter 5 considered the impact of exposure to a challenging environment on reported mental toughness levels. Contrary to expectation, exposure to two different challenging environments did not raise mental toughness. In fact, there was a general decline in mental toughness over the six month period. A number of explanations were considered, but the most convincing explanation was that the positive benefits of facing difficult challenges do not manifest within the time period considered.

The current chapter aims to address this issue further, but while the previous chapter considered the effects of a naturally occurring change in circumstances, the work presented in this chapter investigates whether training - which has been specifically designed to improve the components of mental toughness – can improve mental toughness ratings and performance.

6.2.1 Psychological Skills Training - The development of mental toughness

Mental toughness has been reported as being both a naturally occurring and developed phenomenon (Thelwell, Weston & Greenlees, 2005). In their investigation of soccer players and perceptions surrounding mental toughness, the majority of players claimed they *developed* mental toughness from the varying environments they found themselves in during the early formative stages of their career. These environmental and development factors have been suggested to include parental influences, childhood background, opportunities to survive early setbacks, exposure to foreign sports competition and needing to earn success (Bull, Shambrook, James & Brooks, 2005). Thelwell *et al* (2005) suggest that it is essential that the sporting community develop their understanding of the extent to which mental toughness can be developed, and state this to be more critical for players not experiencing "tough environmental challenges". The clear message here is

that, should athletes not develop mental toughness as a result of early experiences, they may use psychological skills training to improve certain aspects and as a result their mental toughness. This suggests that mental toughness can in fact be developed, and is not simply an innate and stable trait.

This position was echoed by Gould, Dieffenbach and Moffett (2002), who found key psychological skills such as self-regulation of arousal, high confidence, focus and positive imagery to be possessed by champion athletes, but, crucially, that these attributes should be the focus of programs designed to enhance psychological skills. Furthermore, many authors have shown psychological skills training to be effective in enhancing sports performances (Golby, Sheard & Lavallee, 2003), with the most common mental preparation strategies emphasised in the literature being goal-setting, imagery, anxiety control and relaxation skills (Sewell, 1996). Whilst these preparation and training strategies are not explicitly designed to improve mental toughness, it is argued here that this training should impact on the components of mental toughness (as it is defined in the current thesis). For example, goal setting should influence commitment, and imagery and relaxation skills should influence confidence and control.

Goal setting: According to Hodge and McKenzie (2002), goal-setting should be the starting point for the motivation and confidence required for continued peak performances. Structuring goals based on performance, rather than outcome, ensures that success is evaluated on the one aspect of competition athletes have complete control over - their own performances (Burton, 1989). In implementing a rigid goal-setting intervention with four female speed skaters, Wanlin, Hrycaiko, Martin and Mahon (1997) found it to be effective in influencing skaters to work harder, show less off-task behaviour and positively enhance sprint race times.

Imagery: Other commonly used performance enhancing techniques include the use of imagery as part of pre-performance preparation. Furthermore, when athletes come to understand that these skills can also be used for concentration and relaxation, there is evidence to suggest that they increase their sense of control (Ravizza, 2001). Sewell (1996) conducted a study with 10 competitive youth swimmers, each were asked to perform in four conditions: control, stroke count, positive image and focusing on one technique element. Following each condition, swimmers rated the condition in terms of interest and perceived physical effort and upon completion of all four, ranked the conditions in order of preference. No significant differences were found in the perceived effort or interest between the conditions, but all swimmers produced faster times in the experimental conditions than the control, with the positive image condition yielding the fastest times. Furthermore, imagery has been found to be an effective psychological skill used in many ways and having many positive effects including increasing confidence, motivation, relaxing and reducing anxiety, and pre-competition preparations (Murphy & Martin, 2002).

Relaxation: It has long been recognised that increased tension and anxiety can be detrimental to sports performances (Bell, 1976) and relaxation is seen as a valuable skill for dealing with anxiety and stress naturally accompanying pre-race competitive swimming environments. This approach is promoted by Williams and Harris (2001) who suggest that relaxation can reduce excessive tension and anxiety provoking stimuli, allowing the athletes to return to the point of controlled balance, in which every performance aspect is enhanced (Williams & Harris, 2001).

Although good evidence supports the use of general mental preparation strategies, most comes from studies using highly skilled athletes or those which have required training in specific techniques. Very few studies have reported findings with non-elite athletes or

athletes who have not received training (Sewell, 1996). Nonetheless, it is suggested that anyone can use psychological skills training to help them thoroughly enjoy their sport and perform to their maximum potential (Hodge & McKenzie, 1999).

6.2.2 Significance of mental toughness attributes to swimming:

At the elite level, competitive swimming requires many hours of repetitive practice and considerable personal sacrifice. In addition to these attributes, swimming has a long competitive season involving a large number of competitions and, therefore, swimmers must find ways to maintain their commitment and dedication (Lyles, 1989). Furthermore, there is typically an unfavourable coach/athlete ratio as there are often a large number of swimmers to a small number of coaches and, as a consequence of this, swimmers must take responsibility for monitoring their own behaviour and maintaining focus. They must also have the ability to cope with the immense pressures of elite swimming competitions.

A further issue of relevance is that performance improvements at the elite level, especially over short, sprint distances, are difficult to achieve. Therefore any advantages that can be gained above the physical level would be of great benefit. Many elite swimmers would be interested in psychological skills training if it was found to improve performance.

6.2.3 Experimental rationale

The emphasis of the current study is on investigating the impact of psychological skills training on the mental toughness and performance of a group of competitive swimmers. Specifically, this study aims to investigate both quantitatively (using the MTQ48 and a number of weekly swimming performances) and qualitatively (gaining subjective information from participants about their mental toughness training), the effectiveness of a mental toughness training intervention involving goal-setting, imagery and relaxation.

6.3 Method

6.3.1 Design

The experiment utilised a 2 x 2 x 6 mixed design. The three independent variables were; *mental toughness training,* m*ental toughness* and *time period*. Training was a between groups variable encountered at one of two levels; training and control, and the second IV was mental toughness, which was again a between groups variable. The third IV was time period, and performance data were collected at six time points throughout the experiment period of approximately six weeks.

6.3.2 Participants

Twenty-four participants were recruited from Hull University Swimming Club. The sample included eight females and sixteen males (mean age = 19.79, SD = 1.35). The participants were counterbalanced, and 12 participants (3 females and 9 males) were randomly allocated to the training condition. This group had an average mental toughness score of 3.39, compared to the control group, whose average score was 3.46. The mental toughness training group were informed that they would receive psychological skills training (the construct of mental toughness was not mentioned in order to avoid demand characteristics).

6.3.3 Experimental Procedure

6.3.3.1 Overview of experimental procedure

During week one, participants completed the MTQ48 and baseline performance measures were taken and recorded. Once all participants had completed their baseline test, the training group attended a session of mental toughness training. Weekly post-intervention performance measures were then conducted for the next five weeks. Following the fifth post-intervention performance test the MTQ48 was again completed during the training

session. All twelve members of the training group were then invited to attend a focus group to examine their experiences over the course of the experiment. The composition of the focus group was six participants (3 male and 3 female).

6.3.3.2 Mental Toughness Training

Training was given to all participants allocated to the training condition. Participants attended a session during which advice and instructions regarding three techniques (goal-setting, imagery and relaxation) were provided. Following the session, participants were provided with an accompanying booklet including a performance profile for goal setting, imagery and relaxation scripts, and advice and tips on how to use and practice each technique (see Appendix 6.1). Participants were asked to practice regularly during each week of the study and were reminded to do so via email at weekly intervals and during the performance assessment sessions carried out weekly.

6.3.3.3 Swimming Performance Assessment

Performance assessment was carried out during the normal training sessions of the University Swimming Club (25 metre pool). Participants selected the training session they were to be tested at each week, but they occurred as close to weekly as possible. For consistency, all participants performed the freestyle stroke and participants were instructed to carry out their individual warm-up and pre-performance routines as they would if performing at an official competition.

Once all participants were ready, testing began. Participants in both conditions were subjected to the same assessment (50 metres swim) - asked if they were ready and tests started on the instructions "ready, take your marks, go". Each participant was timed over two lengths of the pool by a qualified Amateur Swimming Association timekeeper, who used a standard stopwatch. On completion of the performance measure, time was recorded and participants were told the time they had achieved. Informing participants of

their time ensured the performance test was as close to competition situations as possible, and it is recognised that providing immediate performance feedback may have had an impact on both groups.

6.3.3.4 Qualitative analysis: Bespoke questionnaire and Focus Group

Following completion of the performance assessment phase, a bespoke questionnaire was devised to gain information from the training group participants regarding their experience of the mental toughness training. Participants were asked to complete the questionnaire in as much detail as possible. The information was analysed using a basic content analysis, to identify key points and themes. Following this, participants took part in the final phase. The focus group was run in accordance with the method recommended by Wilkinson (2004); this involved the development of a framework of questions based on the key points of the questionnaire. The central aim of this phase was to gain greater insight into (1) how effective the participants had found the mental toughness training, (2) how the techniques were practised and used, and (3) how the participants felt the techniques had helped. The focus group approach was selected to allow for more detailed discussion amongst the group rather than shorter answers that may result from individual interviews (Wilkinson, 2004). Notes were taken during the focus group and greater detail was added immediately following completion of the focus group.

Therefore, this study adopted a method of using both quantitative and qualitative data, with the data from the questionnaires and focus group being used primarily to add depth to the quantitative findings and to add valuable participant insight into the use of mental toughness training interventions.

6.3.4 Independent Variables

This study involved the manipulation of three IVs; *Mental toughness training* was varied at two levels; training and control groups. Both groups completed two MTQ48s at the start and end of the experiment and were subjected to five weeks of performance assessment, but the training group were required to undergo a training programme and training evaluation questionnaire and some participants from the training group also took part in a focus group. With regard to *mental toughness*, participants were categorised as either high or low in mental toughness on the basis of a median split. This resulted in 12 high MT and 12 low MT. This IV was balanced across the allocation of training groups to ensure that there was no confounding of these variables. The third IV was *time period* of performance data collection and was varied over six points; a baseline measure and five weekly measures in the consecutive weeks.

6.3.5 Dependent Variables

6.3.5.1 Performance-related dependent variables

Swimming performance times

As previously mentioned, a baseline swimming performance time was taken as well as 5 subsequent training sessions.

6.3.5.2 Subjective measures

Mental toughness was measured by the 48 item Mental Toughness Questionnaire 48 (MTQ48 – see Appendix 2.1)

6.3.6 Data treatment

Analysis of Variance was again the main method of data analysis. Continuing with the principles of data treatment where sphericity has been violated, degrees of freedom were corrected using either Greenhouse-Geisser (< 0.75) or Huynh-Feldt (> 0.75) estimates of sphericity, in accordance with Field (2005).

6.4 Results

6.4.1 The effect of training on performance

To investigate the impact of training on performance, the data was submitted to a 2 (training) x 6 (time period) mixed design ANOVA (see table 6.1)

Table 6.1 Mean swimming performance times as a function of time and training group.

Condition	*Training Group*	*Mean*	*Standard Deviation*	*N*
Baseline	MT	32.85	3.23	12
	Non-MT	32.25	3.90	12
	Total	**32.55**	**3.52**	**24**
Swim - time 1	MT	32.22	3.12	12
	Non-MT	32.36	4.09	12
	Total	**32.29**	**3.56**	**24**
Swim - time 2	MT	32.27	3.00	12
	Non-MT	32.59	4.45	12
	Total	**32.43**	**3.71**	**24**
Swim - time 3	MT	31.92	3.14	12
	Non-MT	31.96	4.64	12
	Total	**31.94**	**3.88**	**24**
Swim - time 4	MT	31.32	2.98	12
	Non-MT	32.11	4.42	12
	Total	**31.72**	**3.71**	**24**
Swim - time 5	MT	31.15	3.29	12
	Non-MT	32.08	3.86	12
	Total	**31.62**	**3.54**	**24**

This analysis revealed a highly significant main effect of time period, $F(3.18, 70.02) = 7.41$, $p < 0.001$, $r = .25$, with performance times reducing as the sessions progressed (see figure 6.1). To confirm that each level of performance was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between the following levels of performance (p1-p5, mean difference = .836, $p < 0.05$; p1-p6, mean difference = .936, $p < 0.001$; p3-p5, mean difference = .716, $p < 0.001$; p3-p6, mean difference = .816, $p < 0.001$).

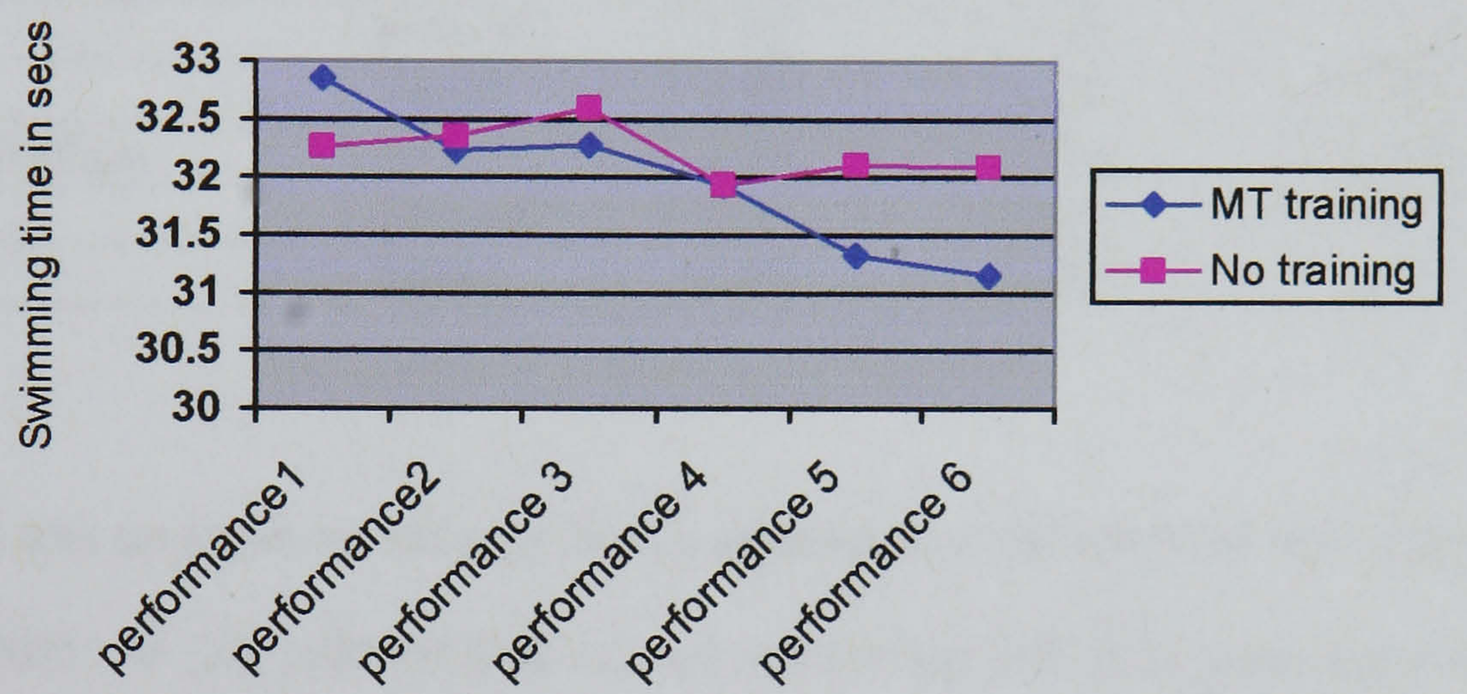


Figure 6.1: Performance times as a function of training group

As also suggested by Figure 6.1, there was no significant main effect of training, $F(1, 22) < 1$, $p > 0.05$, $r = .001$. However, there was an interesting and significant interaction $F(5,110) = 3.77$, $p < 0.01$, $r = .25$, revealing that performance improved to a greater extent in the mental toughness training group over time.

6.4.2 The effect of mental toughness training on MTQ48 scores

To investigate the impact of training on MTQ48 scores, the data was submitted to a 2 (training) x 2 (pre and post MTQ48 scores) mixed design ANOVA (see table 6.2).

Table 6.2 Mean mental toughness scores pre- and post- intervention.

Condition	***Training Group***	***Mean***	***Standard Deviation***	***N***
Pre-intervention	MT	3.39	.52	12
	Non-MT	3.46	.53	12
	Total	**3.42**	**.51**	**24**
Post-intervention	MT	3.65	.43	12
	Non-MT	3.52	.58	12
	Total	**3.56**	**.50**	**24**

As expected, this analysis revealed a highly significant main effect of time period, $F(1, 22) = 12.65$, $p < 0.01$, $r = .36$, with MTQ48 scores increasing with time (see figure 6.2).

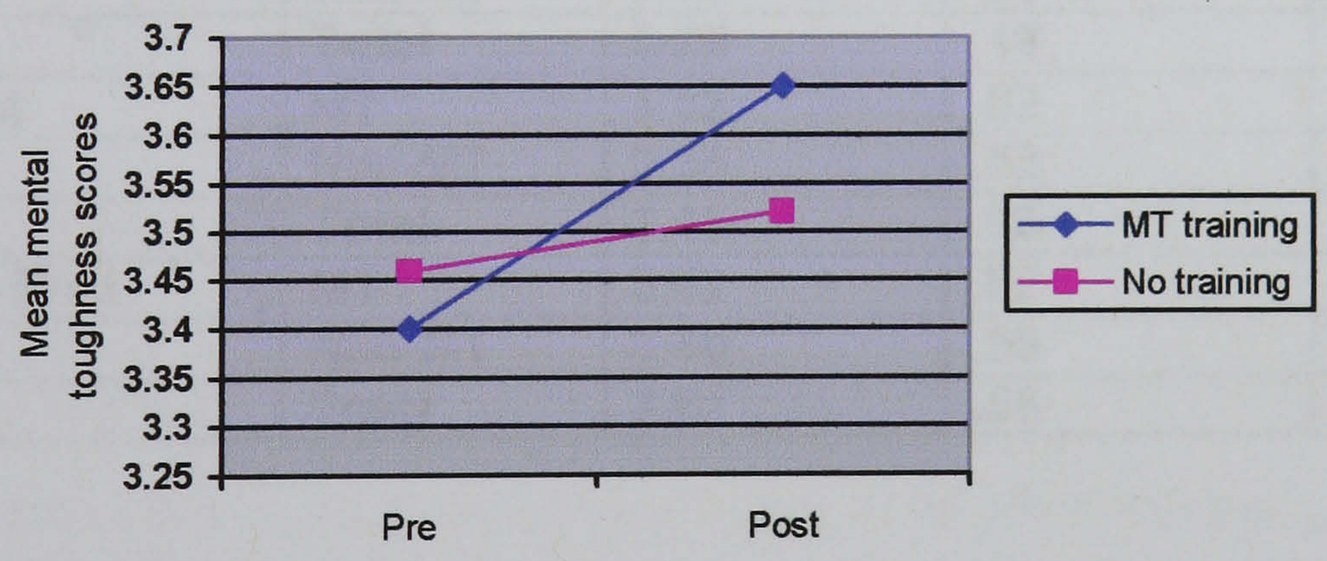


Figure 6.2: Mean mental toughness scores pre and post training

As also suggested by Figure 6.2, there was no significant main effect of training group, $F(1, 22) < 1$, $p > 0.05$, $r = .001$. However, there was again a significant interaction $F(1,22) = 4.65$, $p < 0.05$, $r = .18$, revealing that MTQ48 scores in the training group improved to a greater extent than scores in the non training group.

6.4.3 Comparison of MTQ48 subscales

To investigate the four subscales of the MTQ48 scores a series of related t-tests were carried out on both the training group and the control group's scores (see table 6.3).

Table 6.3 Mean MTQ subscales pre- and post- intervention.

Condition	***Training Group***	***Mean***	***Standard Deviation***	***N***
Challenge – Pre	MT	3.60	.59	12
	Non-MT	3.58	.48	12
	Total	**3.59**	**.52**	**24**
Commitment – Pre	MT	3.58	.66	12
	Non-MT	3.68	.62	12
	Total	**3.63**	**.63**	**24**
Control – Pre	MT	3.26	.55	12
	Non-MT	3.35	.61	12
	Total	**3.31**	**.56**	**24**
Confidence – Pre	MT	3.27	.79	12
	Non-MT	3.32	.55	12
	Total	**3.30**	**.61**	**24**
Challenge – Post	MT	3.78	.46	12
	Non-MT	3.71	.41	12
	Total	**3.75**	**.43**	**24**
Commitment – Post	MT	3.74	.48	12
	Non-MT	3.77	.54	12
	Total	**3.76**	**.49**	**24**
Control – Post	MT	3.52	.63	12
	Non-MT	3.34	.53	12
	Total	**3.43**	**.60**	**24**
Confidence – Post	MT	3.62	.62	12
	Non-MT	3.40	.55	12
	Total	**3.51**	**.58**	**24**

The analysis revealed the following results:

Training group - Challenge, $t(11) = -2.24$, $p < 0.05$, $r = .19$; Commitment, $t(11) = -1.44$, $p > 0.05$, $r = .09$; Control, $t(11) = -2.16$, $p = 0.05$, $r = .17$; Confidence, $t(11) = -4.73$, $p < 0.001$, $r = .50$.

Non training group - Challenge, $t(11) = -1.82$, $p > 0.05$, $r = .13$; Commitment, $t(11) = -1.09$, $p > 0.05$, $r = .05$; Control, $t(11) = 0.11$, $p > 0.05$, $r = .00$; Confidence, $t(11) = -1.19$, $p > 0.05$, $r = .06$. (see figure 6.3). Therefore there were significant improvements in challenge, control and confidence for the experimental group, and no significant improvements in any of the subscales for the experimental group.

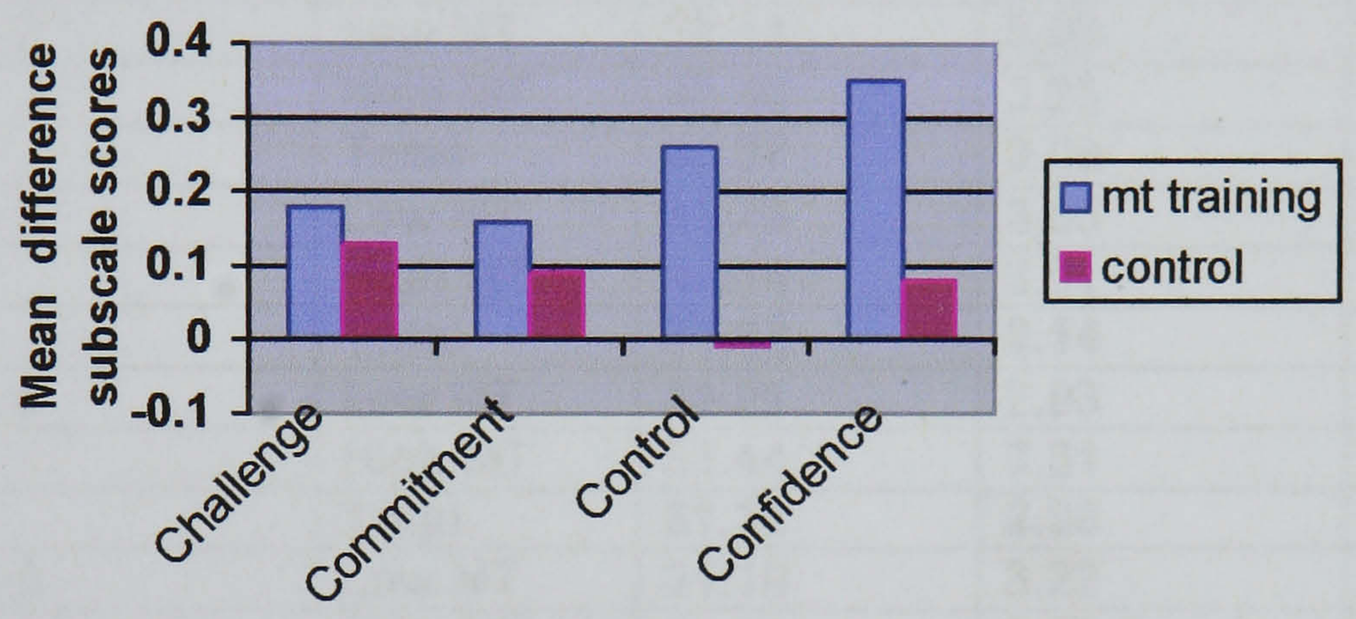


Figure 6.3: Mean mental toughness subscales scores

6.4.4 Mental toughness and the impact of training condition

To investigate whether the mental toughness training had a differential effect on either high or low mentally tough individuals, the performance data from the training group only was subjected to a 2 (high/low MT) x 6 (time period) mixed design ANOVA (see table 6.4).

Table 6.4 Mean swimming performance times as a function of time and mental toughness level.

Condition	*Mental toughness split*	*Mean*	*Standard Deviation*	*N*
Baseline	Low MT	32.73	3.53	6
	High MT	32.97	3.23	6
	Total	**32.85**	**3.23**	**12**
Swim - time 1	Low MT	32.02	3.17	6
	High MT	32.42	3.36	6
	Total	**32.22**	**3.12**	**12**
Swim - time 2	Low MT	32.14	3.05	6
	High MT	32.40	3.23	6
	Total	**32.27**	**3.00**	**12**
Swim - time 3	Low MT	31.70	3.05	6
	High MT	32.14	3.51	6
	Total	**31.92**	**3.14**	**12**
Swim - time 4	Low MT	31.21	2.93	6
	High MT	31.44	3.31	6
	Total	**31.32**	**2.98**	**12**
Swim - time 5	Low MT	31.19	3.22	6
	High MT	31.10	3.66	6
	Total	**31.15**	**3.29**	**12**

This analysis revealed a highly significant main effect of time period, $F(5, 50) = 17.03$, $p < 0.001$, $r = .63$, with performance times reducing as the sessions progressed (see figure 6.4). To confirm that each level of performance was significantly different from the adjacent level, the data was then submitted to a Bonferroni post-hoc test. This revealed a highly significant difference between the following levels of performance (p1-p3, mean difference = .581, $p < 0.05$; p1-p5, mean difference = 1.53, $p < 0.001$; p1-p6, mean difference = 1.70, $p < 0.001$; p2-p5, mean difference = .90, $p < 0.01$; p2-p6, mean difference = 1.07, $p < 0.01$; p3-p5, mean difference = .947, $p = 0.01$; p3-p6, mean difference = 1.12, $p < 0.001$).

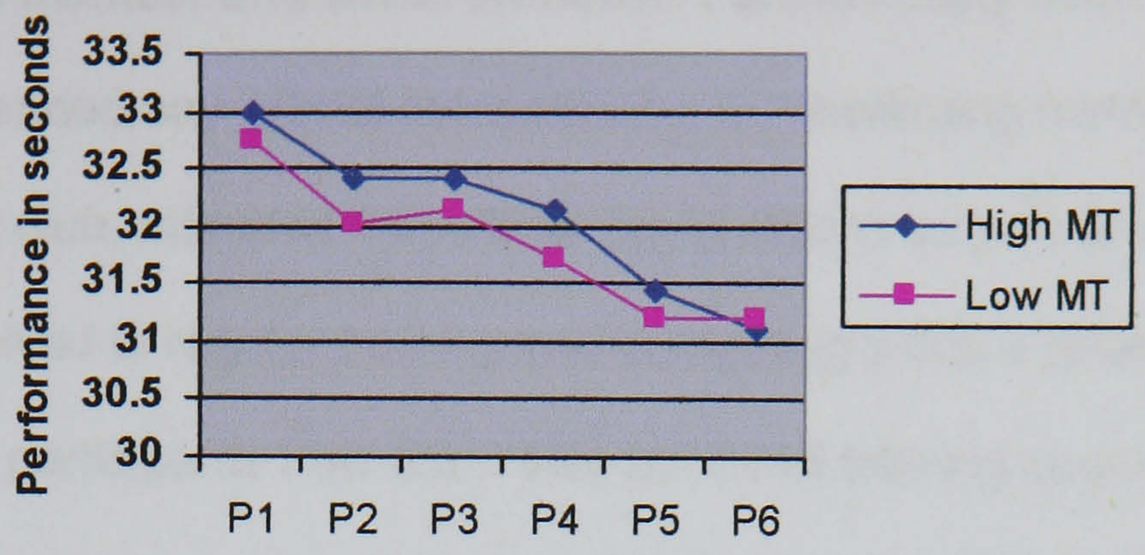


Figure 6.4: Mean swimming times as a function of performance session

As also suggested by Figure 6.4, there was no significant main effect of mental toughness split $F(1, 10) < 1$, $p > 0.05$, $r = .00$, and no significant interaction $F(5,50) = 0.364$, $p > 0.05$, $r = .03$, indicating that the effect of training was the same for both the high and low mental toughness participants within the training condition. Although, it should be noted, that the data in this analysis was performed on only a small group.

6.4.5 Qualitative analysis

6.4.5.1 Questionnaires

The training evaluation questionnaire (see appendix 6.2 for questionnaire and summary of responses) was developed to gain insight into the subjective experience of the mental toughness training intervention. Following analysis of the quantitative data, important key points and trends were established and the questionnaire was developed to ask specific questions that may result in support for the quantitative trends. A number of points were identified as potential factors underlying the individual differences in mental toughness changes and swimming performance changes over the course of the study. These main reasons include differences in experience level of the swimmers, differences in attendance at training over the weeks of the study, and differences in how the individuals practised and used the skills. The swimmers were categorised into one of

three groups (1) new member and social swimmer, not previously been part of a regular training squad or attended any official competitions; (2) continuing member of the University swimming club, attended first official competitions as part of the club; or (3) continuously involved in regular training and competing since a young age. The questionnaire asked participants how often they attended training during the weeks of the study, and how often and by what means they practised the mental toughness skills. More than half the participants attended more than 3 sessions per week throughout the study, with only three participants attending only one session per week. The amount of psychological skills practice varied greatly between the participants, with the majority of participants practicing at least twice per week. Practice environments ranged from at home through to poolside. Nearly all participants found the training session and booklet extremely straightforward and useful.

The questionnaire also asked participants how they had used the mental toughness training to improve performances and whether they felt the training had been beneficial to their weekly swimming perfomance measures in any way. The whole range of techniques was used by the participants, ranging from relaxation, goal setting, and imagery. The beneficial effects of the training ranged from reduced anxiety, improved focus and superior technical ability.

As a competitive swimming club, the mental toughness training may have been beneficial to some individuals to aid performances at any official competitions attended during the course of the study. All participants were asked whether they had attended any competitions, those participants that had then answered questions regarding if and how they had used the mental toughness skills at competitions and whether the skills had helped in any way. The participants' use of the varying techniques resulted in reduced stress during competitions for a number of participants, as well as personal best times for two swimmers.

Overall, the training programme appeared to have a number of beneficial effects for the swimmers, and indeed most of the swimmers stated they would be using the techniques they had learned for future competitions.

6.4.5.2 Focus Group

With a significant difference in pre and post-intervention mental toughness scores and swimming performance improvements, it was decided that these main points needed further investigation. Participants were first asked to make general comments regarding the mental toughness training, and then individually report the routines they had used to practise the mental toughness skills. They were also asked to comment on the use of the skills at any competitions they had attended to gain a more detailed insight into this aspect.

Information from the focus group was recorded during the group session and then reported in greater detail upon completion of the focus group. It was content analysed to identify themes and key points, such as the differences in how the skills were practised between the male and female participants to establish support for the trends already identified in the quantitative data and establish suggestions for future research in this area. Key answers from each of the participants are quoted in Appendix 6.3.

In summary the main points from the focus group centred on the effectiveness of the techniques used. The two broad areas which benefited the swimmers were first; relaxation, which in general terms reduced stress for all users before competition, and secondly; visualisation was found to be effective for a number of performance related elements, e.g. helping reaction times, improved confidence. However, a note of caution is required here as one swimmer found visualising the upcoming race actually increased anxiety levels! The relevance and implications of the above findings are discussed in detail in the section below.

6.5 Discussion

This study aimed to investigate, both quantitatively (using the MTQ48 and a number of weekly swimming performances) and qualitatively (gaining subjective information from participants about their mental toughness training), the effectiveness of a mental toughness training programme in improving mental toughness and performance of competitive level University swimmers.

The following section reviews the main findings and discusses their implications. Results will be discussed in relation to the findings of previous studies into mental toughness and performance effectiveness in sport, and the theoretical implications of this study's findings will also be assessed. Finally, the implications of this study to sport psychology practice and future research will be considered.

The overall pattern of results suggested that mental toughness training was successful in improving the reported levels of mental toughness and swimming performances of the mental toughness training group. The additional qualitative data also supported these main findings, as the majority of the training group reported the training to have been effective.

6.5.1 Mental Toughness

Both groups scored higher for mean mental toughness in the post-intervention MTQ48 than in the pre-intervention MTQ48. This is an interesting finding in itself when considering the findings presented in the previous chapter. However, it should be noted that the changes in scores represented only small changes within the scale. Nonetheless, the improvement was found to be greater in the training condition. The improvement of the non-mental toughness group is not interpreted simply as a Hawthorne effect, but as a positive consequence of simply taking part in the study. In the case of the non-training

group, they were still required to prepare for and repeatedly perform in weekly swimming tests which may have caused these participants to increase their mental toughness, in particular, the challenge and commitment scales.

With regard to the training group, only the subscale of commitment was found to have no significant increase over the course of the six week experiment. This suggests that the programme of psychological skills training that was designed to enhance mental toughness did work. However, it should also be recognised that the support and challenging environment provided to the non-training group also had a small positive (but not significant) impact. This is in line with the work of Bull *et al* (2005) which argues that mental toughness is likely to be higher in athletes who are brought up in a supportive and challenging environment. Therefore, the findings of the study suggest that mental toughness can be enhanced with a programme of skills training, and that a supportive and challenging environment can also provide some level of benefit.

6.5.2 Swimming Performance

Improved swimming performances again occurred in both groups. However, the improvement was, as expected, greater in the mental toughness group. Again, it must be stated that simply by taking part all participants were more likely to attend their regular training sessions in anticipation of their weekly challenge. Furthermore, they received feedback in the form of knowledge of results. Therefore, there was some degree of intervention in both groups.

Support for the positive effects of the mental toughness training programme on performance also comes from the questionnaire responses. All of the mental toughness training participants found the training session and accompanying booklet to be effective to one degree or another; interestingly, they did not all agree that the skills had helped them at the performance *assessments*. Participants did however report the skills to have

helped at competitions; two of the mental toughness participants attended one competition, and four participants attended two competitions during the weeks of the study. Of these six participants, five reported that the skills had helped at the competitions they attended, mainly by increasing focus and reducing anxiety, and four participants reported that as a result of using the mental toughness skills they had achieved personal best performances in the actual competitions. As a competitive club these additional findings are very important to the swimming club as well as to this study as they provide evidence that the mental toughness training intervention positively enhanced swimming performances in actual competitive situations as well as in the weekly performance measures. This additional strand to the study's findings would also be of interest to elite swimmers. As the weekly tests were conducted during normal training sessions, it was hard to recreate the atmosphere associated with actual swimming competitions. Therefore it is likely that the weekly tests would have invoked less stress and anxiety in the experienced performers, this in turn, may have led to these participants reporting that the skills had not helped at the weekly swim tests, but had helped in actual competitions.

Training attendance and mental toughness practise may also have influenced the performance differences of the individuals. Six participants attended three or more training sessions each week; of which four improved their performances, and one performed the same, and six attended two or fewer sessions each week; of which only two improved their swimming performances. Clearly, greater frequency of training is likely to have improved performances; however this may also be the result of increased commitment due to increased mental toughness, and is supported by this group's increased mean commitment score. Participants reported practising the mental toughness skills between one and four times a week, however unlike with attendance, the number of practise times does not appear to have influenced performance improvements. Some performers practised up to four times each week but did not improve performances where

as some participants that did improve reported practising only once each week. This point requires further clarification, but the type of practise, as later discussed, rather than amount may be suggested to have had the most impact.

6.5.3 Mental Toughness and performance effectiveness in sport

This study found the mental toughness intervention to be successful at improving mental toughness and swimming performances in 24 swimmers from Hull University Swimming Club. No previously conducted studies have investigated the application of such an intervention and therefore there is a lack of evidence to provide a wider context to these findings. However, the small number of studies into mental toughness and performance effectiveness that were earlier reviewed (e.g. Thomas, Schlinker & Over, 1996; Maddi & Hess, 1992; Golby, Sheard & Lavallee, 2003; and Golby & Sheard, 2004) provide some support for the findings of the present study, in that greater mental toughness is positively associated with more successful sporting performances. Many different methods of assessing mental toughness were used in the studies above however, and performance measures were not taken. Earlier methods have mainly consisted of using questionnaires to establish mental toughness levels and making comparisons with the success and performance levels of the athletes, rather than using experimental investigations as in this study. The issue of whether self-reporting of psychological skills and mental toughness assesses actual or perceived levels was also highlighted as an issue with questionnaires used in previous studies.

Information from the qualitative aspects of this study also provides support for the relationship between mental toughness and performance effectiveness in sport, with many of the mental toughness group reporting to have benefited from the skills at competitions attended during the weeks of the study. The participants who competed reported that the mental toughness training helped them to relax, reduce both cognitive and somatic anxiety, and increase focus.

6.5.4 Implications for practice and future research: the intervention

The mental toughness training programme was found to be successful in improving mental toughness and swimming performances. However, the interventions for the training group were the same for each participant as the training was provided to the group in one session. Following this, the participants were then asked to practise regularly themselves using the booklet for guidance. This training programme was partially in line with the recommendations of Bull *et al* (2005) who suggested that although the quest for shared qualities is critical, an important message was that there must be room for individual mental toughness development that works for each athlete. The intervention may have led to further improvements had the swimmers been individually assessed as to which skills or mental toughness subscales they needed to develop, and an individual intervention programme designed. Future research should look into the application of individually designed mental toughness training programmes.

Qualitative data regarding the training group also identified a lack of goal-setting application within existing training programmes. The efficacy of goal-setting is widely acknowledged, e.g. Wanlin *et al* (1997) implemented a goal-setting package to four speed skaters, which was found to be highly effective in improving training behaviour and also improving sprint performances. The goal-setting package included a logbook, which was found to be a beneficial component, providing information on both goal achievements and why some goals were not achieved. In light of this, the present study may have benefited from requesting participants to complete the goal setting performance profile at the initial training session, providing logbooks for details regarding practices and goal achievements, and also regularly monitoring participants' practices, as this responsibility fell entirely to the individuals.

Despite the minor intervention flaws regarding goal-setting, monitoring practice, and the lack of individuality, the intervention used in this study was still found to improve mental toughness and swimming performances. Therefore, the current study has provided some direction for further studies in the area of mental toughness and performance effectiveness in sport, and specifically in the importance of mental toughness to swimming, and the use of mental toughness interventions to improve swimming performances. The intervention also provides evidence for the use of mental toughness training in athletes across all experience and performance levels, and agrees with Hodge and McKenzie (1999) in that anyone can use psychological skills training to help them thoroughly enjoy their sport and perform to their maximum potential.

Chapter 7:

General discussion

7.1 Summary

This chapter provides an overview of the findings from the psychometric and experimental work. The conceptual and practical implications of the findings are considered and future directions for further research are suggested.

7.2 Introduction

The thesis has addressed a range of conceptual issues surrounding the construct of mental toughness, namely;

to develop a model of mental toughness which has relevance for both sporting and occupational domains and is based on sound research principles,

to develop an instrument capable of measuring the construct within the required domains and with acceptable levels of reliability and validity,

to utilise the measure of mental toughness to further investigate the impact of varying degrees of this trait on performance and subjective states, and

to consider the stability of the trait and the extent to which mental toughness can be developed.

Following the psychometric investigation reported in Chapter Two, a series of four experiments were undertaken. These are described and discussed in Chapters Three, Four, Five and Six.

The final chapter of the thesis aims to (1) summarise the findings, (2) consider further the issues which have arisen from the psychometric and experimental work, and (3) discuss their conceptual implications.

7.3 Overview of results and conceptual implications

7.3.1 Psychometric work

The psychometric development work undertaken in Chapter 2 provides support for a distinct construct of mental toughness: The underpinning basis of the psychometric work was the initial conceptualisation and defining of mental toughness (see below).

> *Mentally tough individuals tend to be sociable and outgoing as they are able to remain calm and relaxed, they are competitive in many situations and have lower anxiety levels than others. With a high sense of self-belief and an unshakeable faith that they control their own destiny, these individuals can remain relatively unaffected by competition or adversity.*

This definition was developed from existing theory and initial qualitative research. The psychometric work supported the inclusion of the distinct elements of the initial definition, but went on to support the inclusion of an additional element of confidence, and the separation of both confidence and control into two minor subscales.

Initial analysis of the questionnaire with six subscales highlighted appropriate psychometric properties in respect of reliability (coefficient alpha = .91 across the

whole scale) and an appropriately defined structure as confirmed by principal components analysis.

The overarching approach used in the development work was one of construct validation, whereby the instrument was initially based on a theoretical foundation, followed by item and reliability analysis, factor analytical work, validation measures (both construct and criterion related), and applications to both research and real world practice.

It was argued in this thesis that the MTQ48 provides a vital starting point in which future research can further investigate a range of issues associated with the nature of mental toughness and its impact on key indices, such as performance and subjective states. Furthermore, the development of a robust measure of mental toughness allows for the accurate assessment and monitoring of individuals, which clearly has relevance and practical application for the real world in a variety of domains.

7.3.2 Experimental work

The main aim of the experimental work was to investigate the moderating effects of mental toughness on a range of subjective and performance-related criteria.

7.3.2.1 Mental toughness and physical exercise

The overall pattern of results (Chapter 3) provided evidence that, in general, mental toughness does have a moderating effect on both subjective evaluations of demands and objective performance data. Importantly, the differential impact of physical exercise on the high and low mentally tough was at its most diverse when the physical workload was at its most intense. This point was highlighted in the auditory response time task where the individuals who formed the low mental toughness group produced slower reaction times as workload intensified whereas the high

mental toughness group scores remained relatively static irrespective of workload condition. Although there were no statistically findings the mean scores and subsequent trends offer support for the moderating effect of mental toughness.

This was an important aspect in the development of the construct as it has provided excellent insight into the importance and effectiveness of mental toughness. Furthermore, this objective performance data was supported by the data regarding post-task workload assessment, where again the impact of mental toughness was shown to be most beneficial at the highest levels of physical workload, again these results did not reach significance levels.

Consistent with these findings was the data relating to all aspects of subjective demands, namely: physical workload, mental workload and effort. These results gave further support to the notion that individuals with higher mental toughness are likely to report demands as less challenging than those with a lower level of mental toughness - especially as the workload increases. Furthermore, the findings relating to changes in state fatigue also emphasized the advantageous nature of the being more mentally tough.

The implications of these findings have far reaching consequences. A perception of demands as being lower is argued to have a reduced impact on physiological correlates, which in turn influence emotional and motivational states, which further modify an individual's perceptions, cognitions and performance (Dienstbier, 1989). Although it makes intuitive sense that the reduced perception of demands is likely to correlate with enhanced performance, there has to date been little research in this area to substantiate this claim.

7.3.2.2 Mental toughness and response to feedback

The results from both experiments relating to the response to feedback (Chapter 4) indicated that mental toughness had a moderating effect on the impact of feedback on performance.

The results further supported the view that mental toughness has a buffering effect against negative feedback (Kluger & DeNisi, 1996). However, this finding did fail to reach statistical significance. Nonetheless, the results of the planning exercise did reinforce the findings of previous studies (e.g. Ilgen *et al,* 1979), as the high mental toughness group performed significantly better than the low mental toughness group under the negative feedback condition.

7.3.2.3 Mental toughness development

The study in Chapter 5 investigated the differences in mental toughness in two diverse groups and the environmental impact of two differing new occupational situations. In summary, the police recruits were found to have higher levels of mental toughness (although the difference was not statistically significant). However, both groups recorded a decline in mental toughness across a range of scales including overall MT, challenge, control of life and confidence in abilities, but, in most cases, these reductions over time were very small. Possible explanations put forward for this initial difference were, first; the age of the Police recruits (12 years older on average than the students), therefore greater life experience would conceivably increase the mental toughness (Crossman, 2001). Secondly, it was also proposed that the process of recruitment and selection for the Police recruits may have been a factor underlying the differences in mental toughness.

In contradiction to the literature described in the introduction to Chapter 5, the exposure to the potential 'environmental stressors' of the two new environments did

not result in a subsequent rise in mental toughness scores. However, some degree of light was shed on this unexpected finding by the focus group (held with the student population) and the consultation with police recruit training officers. The students in general reported that they subjectively felt more in control of their own lives and were certainly more interpersonally confident. In respect of the Police sample, the training officers supported the research findings, and explained that the falls of overall mental toughness and the subscales were not unexpected. They proposed that the recruits enter training with high self expectations and are 'unconsciously incompetent' as to how little they know. Therefore once exposed to the training environment they become acutely aware of their limitations. However, the training officers stated that this situation invariably changes towards the end of the training period. Further research in this area should examine the longer term effects of such training environments.

The final study, reported in Chapter 6, used quantitative and qualitative analysis to investigate the effectiveness of a mental toughness training programme in improving subjective mental toughness and performance. While both groups in the study reported increased mental toughness following involvement with the study, the improvement was found to be greater in the training group. Support for the training programme also came from the questionnaire responses, in which each of the training group participants stated that they found the training session and accompanying booklet to be effective. Therefore, it was argued the programme of psychological skills training that was designed to enhance mental toughness did have the desired effect. However, it should also be recognised that the supportive and challenging environment provided to the non-training group also had a small positive impact. With regards to performance, improvements in swimming times were found in both groups, however, the greater improvements were again found in the training group.

The implications of this study for sports coaching, and training environments in general, are that coaches and athletes should actively try to enhance mental toughness, and that this can be effective at all levels of competition. Furthermore, the psychological skills interventions used here, including goal setting, imagery and relaxation, may be an effective approach.

7.4 Conceptual issues

The development of the MTQ48 has been undertaken using an amalgamation of qualitative and quantitative research methods, and a foundation of existing and well established research frameworks. The further work reinforced and validated the structure of the mental toughness construct proposed in this thesis.

So, to answer the fundamental question, does mental toughness exist? – Well there does appear to be a set of personality characteristics which relates to meaningful differences between individuals: Adversity is likely to produce calmness, conviction and determination for those who are at one end of the spectrum and anxiety, tension and fear for those at the other end. It is this amalgam of characteristics, which has been labelled as mental toughness, which enables individuals to take control of their own destiny and reach their potential. Mental toughness is a quality that has been exhibited by virtually all leading athletes, as well as successful individuals across all walks of life. It is arguably the drive for each individual to get the most from his or her own set of skills and abilities and could be considered to be the ability to sustain high levels of motivation, activity and confidence in the face of severe adversity. Therefore, the centre of the concept is the interaction between the characteristics of mental toughness and the factors relating to stressors within the environment.

It is worthy of mention here that while the concept as it is defined here is fairly broad in nature, it is intended that it should take into account the differing requirements

necessary in order for individuals to perform at the highest level in their given environment, whether that be sporting or occupational. Indeed, the concept needs to be able to cover the area not just visible 'on the track' (i.e. relating to actual performance of the skill/task) but also needs to incorporate the traits that involve the training, dedication and general lifestyle (Bull *et al,* 2005; Jones *et al,* 2002) which is a prerequisite to any high class performer within any context. Furthermore, with regard to the unique issues of the professional athlete, the concept does not merely take into account the requirements of intense competition (reactive response) but also incorporates the more proactive responses required when undergoing the vast amount of training, in which the stress may not be so acute, but still requires a positive response to this challenging aspect of performance.

A further issue is the underlying basis of the level of an individual's mental toughness. It would be plausible to consider that this 'mental toughness' has to some degree been influenced through genetic factors (although research into this area is in its infancy). Therefore each individual could be considered to have a natural level of mental toughness. However, it is argued here that this does not mean that the innate disposition to toughness will simply evolve. For the development to take place requires both intrapersonal factors (e.g. coaches, parents etc) and environmental factors to act as initial catalysts in developing individual toughness.

7.5 Practical Issues

As previously mentioned, the primary use of the MTQ48 was to be the measurement of mental toughness within a sporting individual. However, the wider reaching use of this instrument has (so far) been in the occupational environment. The links between occupational and sport psychology have been longstanding and this relationship can be further benefited by the use of such a crossover instrument. Although, it is worthy

of note, that the concept of mental toughness may not be as 'politically correct' within the occupational setting: There is an interesting question here as to whether it is *appropriate* to try and make people tougher, to enable them to deal with high levels of stress. The alternative is, of course, to change the job to be less stressful. This would potentially have fewer long term consequences. This leads onto a very interesting issue relating to the long term health and well being of the mentally tough. It is not implausible to consider that, if the tough do not stop when they probably should, are they more likely to suffer in a more major way at a later date? Consideration of such issues should be an important part of future research.

A further practical consideration is the issue of image management in test taking. If the MTQ48 is used within a selection context, decision makers should be aware of the high potential risk of faking good. Unlike some personality instruments it may be obvious to the test taker what the organisation is looking for and how to answer questions accordingly. This can be dealt with in a number of ways, first; other evidence in support of questionnaire responses should be sought, secondly; participants could be informed that a dishonest approach can be transparent, and thirdly; future work could focus on the development of a social desirability scale to minimise the risk of impression management. With these issues in mind, it could be argued that the instrument has more value in a developmental context, in which the disadvantages of a less than honest approach are obvious.

7.6 Future directions

Future studies should continue to investigate the effects of various psychological interventions (Bhambri, Dhillon & Sahni 2006; Driediger, Hall & Callow 2006; Sheard & Golby, 2006) on both the characteristics which encompasses mental toughness as well as focusing on objective performance outcomes (Fourie & Potgieter, 2001). These studies should examine all levels of performers, ranging from keen amateur

through to Olympic champions, as well as examining a broad spectrum of sports ranging from team/individual to sports which require different weightings of physical and cognitive abilities. Alongside this should be the further examination of the subscales of the MTQ48 which may identify specific profiles relating to superior performance in a range of athletes and events, as well as identifying key deficiencies in the mental make up of individual athletes. This should ideally lead to specific and targeted intervention programmes (Gould *et al,* 2002).

Indeed, a related issue highlighted earlier in the thesis considered the negative implications of too much mental toughness and the long term negative affects of such a personality profile. This is potentially an interesting and important area if we are to protect and guide our athletes through a relatively long career at the highest level.

REFERENCES

Alderman, R.B. (1974). *Psychological behaviour in sport.* Toronto: W.B. Saunders Company.

Allen, T.W. (1988). The cognitive bases of peak performance: A classroom intervention with student athletes. *Journal of Counselling & Development,* 67, 202-204.

Allinson, C.W., & Hayes, J. (1996). The cognitive style index: A measure of intuition-analysis for organisational research. *Journal of Management Studies,* 33, 119-135.

Allman, W.F., & Bowermaster, D. (1994). The inner game of winning. *U.S. News & World Report.* 116 (6) p.47-52.

Anderson, C.R. (1976). Coping Behaviours as Intervening Mechanism in the Inverted-U Stress-Performance Relationship. *Journal of Applied Psychology,* 61, 30-34.

Andreassi, J.L. (1965). Effects of induced muscular tension and auditory stimulation of tachistoscope performance. *Perceptual and Motor Skills,* 20, 829-841.

Annett, J. (1969). *Feedback and Human Behaviour.* Harmondsworth, Middlesex, England: Penguin Books.

Aronson, E., Wilson, T.D., Akert, R.M. (2002). *Social Psychology.4th ed.* London: Prentice Hall.

Ash, I.E. (1914). Fatigue and its effect on control. *Archives of Psychology*, 4, 1-61.

Astrand, P.O., & Rodahl, K. (1986). *Textbook of work physiology (3rd ed.).* New York: McGraw-Hill.

Averill, J.R. (1973). Personal control over aversive stimuli and its relationship to stress. *Psychological Bulletin* 80:286-303.

Bailey, D.M. (1991). *Research for the Health Professional: Practical Guide.* Philadelphia, USA: FA Davis Company.

Bandura, A. (1977). Self-efficacy: Towards a unifying theory of behavioural change. *Psychological Review,* 84, 191-215.

Baker, S. (2002). No easy answer to our lack of mental toughness. *Northern Echo. Dec 3.* pg 20.

Bandura, A. (1997). *Self-efficacy in changing societies.* Cambridge: Cambridge University Press.

Barrick, M.R., & Mount, M.K. (1991). The Big-Five personality dimensions in job performance: A meta-analysis. *Personnel Psychology,* 44, 1-26.

Baum, A., & Koman, S. (1976). Differential responses to anticipated crowding: psychological effects of social and spatial density. *Journal of Personality and Social Psychology,* 34, 526-536.

Beach, L.R., & Miutchell, T.R. (1978). A contingency model for the selection of decision strategies. *Academy of Management Review,* 3, 439-449.

Beehr, T.A., & Newman, J.E. (1978). Job stress, employee health and organizational effectiveness: A facet analysis, model, and literature review. *Personnel Psychology,* 31, 665-99.

Bell, K. (1976). Relaxation training for competitive swimming. *Swimming Technique.* 13(2) pp. 41-43.

BenZur, H., & Breznitz, S.J. (1981). The effects of time pressure on risky choice behaviour. *Acta Psychologica,* 47, 89-104.

Bolger, N. (1990). Coping as a personality process: A prospective study. *Journal of Personality and Social Psychology,* 59, (3), 525-537.

Bonano, G.A. (2004). Loss, Trauma and Human Resilience: Have We Underestimated the Human Capacity to Thrive After Extremely Aversive Events. *American Psychologist.* 59 (1) p20-28.

Bond, J., & Sargent, G.I. (1995). Concentration skills in sport: An applied perspective. *In T. Morris & J. Summers (Eds.), Sport Psychology: Theory, applications and issues* (pp.386-419). Chichester: John Wiley.

Borg, G. (1978). Subjective aspects of physical and mental load. *Ergonomics,* 21(3), 215-220.

Bourgeois, A.E., Meyers, M.C., LeUnes, A., & Middendorf, J. The sports inventory for pain: Confirmatory factor validity. Manuscript under review.

Brennan, S. (1998). 'Mental toughness wins out'. *In D.S.Looney, Christian Science Monitor,* 90, Issue 173.

Brewer, J., & Davis, J. (1995). Applied psychology of rugby league. *Sports Medicine,* 13, 129-135.

Brewer, B.W., Van Raalte, J.L., Petitpas,A.J., *et al.* (2000). Preliminary psychometric evaluation of a measure of adherence to clinic-based sport injury rehabilitation. *Phys Ther Sport,* 1:68-74.

Broadbent, D.E. (1958). *Perception and communication*. London: Pergamon Press.

Brownlow, S., Whitener, R., & Rupert, J.M. (1998). "I'll take gender differences for $1000!" Domain-specific intellectual success on "Jeopardy". *Sex Roles,* 38 (314), 269-285.

Bruner, J.S., Goodnow, J.J., & Austin, G.A. (1956). *A Study of Thinking.* New York: Wiley.

Bull, H. (1996). Stress – Fact or Fiction: The assessment and management of workers' compensation claims for stress: A commonwealth perspective. *Proceedings of the 1996 National Occupational Stress Conference,* Brisbane, Australia.

Bull, S.J., Albinson, J.G. and Shambrook, C.J. (1996). *The mental game plan: getting psyched for sport.* Sports Dynamics, Eastbourne.

Bull, S.J., Shambrook, C.J., James, W., and Brooks, J.E. (2005). Towards and understanding of mental toughness in elite English cricketers. *Journal of Applied Sport Psychology. [Internet]* pp. 209-227. Available from www.tandf.co.uk [Accessed March 1st 2006].

Burger, J.M., & Cooper, H.M. (1979). The desirability of control. *Motivation and Emotion,* 3, 381-393.

Burton, D. (1988). Do anxious swimmers swim slower? Re-examining the elusive anxiety-performance relationship. *Journal of Sport and Exercise Psychology.* 10 pp. 45-61.

Busby, J.S. (1999). Problems in error correction, learning and knowledge of performance in design organisations. *IIE Transactions, Norcross,* 31 (1), 49-60.

Butler, R.J. (1989). Psychological Preparation of Olympic boxers. *In J. Kremer & W. Crawford (Eds.), The psychology of sport: Theory and practice* (pp. 78-84). Leicester, UK. British Psychological Association.

Butler, R.J., & Hardy, L. (1992). The performance profile: Theory and Application. *The Sport Psychologist,* 6, 253-264.

Butler, R.J., Smith, M., & Irwin, I. (1993). The performance profile in practice. *The Sport Psychologist,* 5, 48-63.

Campbell-Sills, L. Cohan, S.L. Stein, M.B. (2005). Relationship of resilience to personality, coping and psychiatric symptoms in young adults. *Behaviour Research and Therapy.* In Press.

Cannon, W. B. (1929). Organization for physiological homeostasis. *Physiological Review* 9: 399-431.

Carlson, N.R., Buskist, W., Martin, N.G. (2000). *Psychology: The Science of Behaviour.* London: Pearson Education Limited.

Carson, A. (1988). Personality. *Annual Review if Psychology,* 40:227-248.

Carver, C.S., Scheir, M.F., & Weintraub, J.K. (1989). Assessing coping strategies: a theoretically based approach. *Journal of Personality and Social Psychology,* 56, 267-283.

Cashmore, E. (2002). *Sport Psychology: The Key Concepts.* London: Routledge

Cattell, R.B. (1947). Confirmation and clarification of primary personality factors. *Psychometrica,* 12, 197-220.

Chapman, A. (1995). *http://www.businessballs.com/consciouscomptencelemingmodel.htm*. Accessed 20th February 2006.

Clough, P.J., & Earle, K. (2001). When the going gets tough: a study of the impact of mental toughness on perceived demands. p61 *Annual Conference of the British Association of Sport and Exercise Sciences.*

Clough, P.J., Earle, K., and Sewell, D. (2002). Mental Toughness: the concept and its measurement. *In I. Cockerill (Ed.), Solutions in Sport Psychology* (pp. 32-45). London: Thomson.

Cohen, A., Pargman, D., & Tenenbaum, G. (2003). Critical elaboration and empirical investigation of the Cusp Catastrophe model: A lesson for practitioners. *Journal of Applied Sport Psychology,* 15, 144-159.

Coolican, H. (1994). *Research Methods and Statistics in Psychology.* Hodder and Stoughton: London.

Contrada, R.J., Dimsdale, J., Levy, L. and Weiss, T. (1991). Effects of isoproterenol on T-wave amplitude and heart rate: A dose-response study. *Psychophysiology* 28:458-462.

Cooper, C.L. & Payne, R. (1989). *Causes, coping and consequences of stress at work.* John Wiley & Sons. Chichester.

Cox, R. H. (1990). *Sport Psychology: Concepts and applications. 2nd ed.* Dubuque, IA, Wm. C. Brown Publishers.

Craft, L.L., & Landers, D.M. (1998). The effects of exercise on clinical depression and depression resulting from mental illness: a meta-analysis. *Journal of Sport and Exercise Psychology,* 20, 339-357.

Cropanzano, R., & Randall, M.L. (1993). Injustice and work behaviour: A historical review. *In R. Cropanzano (Ed.), Justice in the workplace: Vol. 1. Approaching fairness in human resource management* (pp. 3-20). Hillsdale, NJ: Lawrence Erlbaum.

Crossman, J. (2001). *Coping with sports injuries.* Oxford: Oxford University Press.

Crust, L., & Clough, P.J. (2005). Relationship Between Mental Toughness and Physical Endurance. *Perceptual & Motor Skills.* 100 (1) p192-195.

Csikszentimichalyi, M. (1990). *Flow: The psychology of optimal experience.* New York: Harper and Row.

Curtis Management Group (1998). *Motivation Lombardi Style,* Celebrating Excellence Publishing, Lombard, IL, p.20.

Dale, G.A., & Wrisberg, C.A. (1996). The use of a performance profiling technique in a team setting: getting the athletes and coaches on the "same page". *The Sport Psychologist,* 10, 261-277.

Davey, C.P. (1973). Physical exertion and mental performance. *Ergonomics,* 16, 595-599.

Deci, E.L. (1971). Effects of externally mediated rewards on extrinsic motivation. *Journal of Personality and Social Psychology,* 18, 105-155.

Dennis, P.W. (1981). Mental toughness and the athlete. *Ontario Physical and Health Education Association,* 7, 37-40.

Dienstbier, R.A. (1989). Arousal and physiological toughness: Implications for mental and physical health. *Psychological Review,* Vol.96, No.1, 84-100.

Dienstbier, R.A. (1991). Behavioral correlates of sympathoadrenal reactivity: The toughness model. *Medicine and Science in Sports and Exercise* 23,7:846-852.

Diggory, J.C., Riley, E.J., & Blumenfeld, R. (1966). Estimated probability of success for affixed goal. *American Journal of Psychology,* 73, 41-55.

Dongsung, S.S., & Kang-Heon, L. (1994). A comparative study of mental toughness between elite and non-elite female athletes. *Korean Journal of Sport Science,* 6, 85-102.

Drenth, P.J.D., Thierry, H., de Wolff, C.J. (1998). *Handbook of Work and Organizational Psychology. 2nd ed.* Hove, UK: Psychology Press Limited.

Durr, K.R. (1996). *Relationship between state anxiety and performance in high school drivers.* Unpublished master's thesis, University of Missouri, Columbia.

Dyer, J.G. & McGuinness, T.M. (1996). Resilience analysis of the concept. *Archives of Psychiatric Nursing,* Vol. X, No.5 (October), pp: 276-282.

Earle, F. (2004). *A construct of psychological fatigue.: A psychometric and experimental analysis.* Unpublished dissertation. University of Hull.

Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organisation of behaviour. *Psychological Review* 66: 183-201.

Edland, A., & Svenson, O. (1993). Judgement and decision making under time pressure. In O. Svenson and J.A. Maule (Eds.). *Time Pressure and Stress in Human Judgement and Decision Making*. Plenum Press. New York.

Eisenhardt, K.M. (1989). Making fast decisions in high velocity environments. *Academy of Management Journal,* 32, 542-575.

Ellertsen, B., Johnsen, T.B., & Ursin, H. (1978). Relationship between the hormonal responses to activation and coping. *In H. Ursin, E. Baade, & S. Levine (Eds.), Psychobiology of stress: A study of coping men* (pp. 105-124). New York: Academic Press.

Endler, N.S., & Parker, J.D.A. (1990). Multidimensional assessment of coping: a critical evaluation. *Journal of Personality and Social Psychology,* 58, 844-854.

Erez, M. (1977). Feedback: A necessary condition for the goal setting-performance relationship. *Journal of Applied Psychology,* 62 (5), 624-627.

Ericsson, K.A. and Charness, N. (1994). Expert performance: Its structure and acquisition. *American Psychologist,* 49, 725-747.

Ericsson, K.A., Krampe, R.T. and Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review,* 100, 363-406.

Etnier, J.L., Salazar, W., Landers, D.M., Petruzzello, S.J., Han, M., & Nowell, P. (1997). The influence of physical fitness and exercise upon cognitive functioning: A meta-analysis. *Journal of Sport and Exercise Psychology,* 19(3), 249-277.

Fairweather, H. (1976). Sex differences in cognition. *Cognition,* 4, 231-280.

Favret, B., & Benzel, D. (1997). *Complete guide to water skiing.* Champaign, IL: Human Kinetics.

Fazey, J., & Hardy, L. (1988). The unverted U-hypothesis: A catastrophe for sport psychology? *British Association of Sports Sciences Monograph No. 1.* Leeds: The National Coaching Foundation

Feather, N.T. (1966). Effects of prior success and failure on expectations of success and subsequent performance. *Journal of Personality and Social Psychology,* 3 (3), 287-298.

Feather, N.T. (1968). Changes in confidence following success or failure as a predictor of subsequent performance. *Journal of Personality and Social Psychology,* 9 (1), 38-46.

Feather, N.T., & Saville, R. (1967). Effects of amounts of prior success and failure on expectations of success and subsequent task performance. *Joumal of Personality and Social Psychology,* 5 (2), 226-232.

Fery, Y.A., Ferry, A., Vom Hofe, A., & Rieu, M. (1997). Effect of physical exhaustion on cognitive functioning. *Perceptual and Motor Skills,* 84, 291-298.

Field, A. (2005). *Discovering Statistics Using SPSS.* Sage Publications Ltd: London: UK.

Florian, V. Mikulincer, M. Taubman, O. (1995). Does Hardiness Contribute to Mental Health During a Stressful Real-Life Situation? The Roles of Appraisal and Coping. *Joumal of Personality and Social Psychology.* 68 (4) p687-695.

Flynn, R. (1972). Numerical performance as a function of prior exercise and aerobic capacity for elementary schools boys. *Research Quarterly,* 43, 16-22.

Folkman, S., & Lazarus, R.S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology,* 48, 150-170.

Fogerty, G.J., Machin, A.M., Albion, M.J., Sutherland, L.F., Lalor, G.I., & Revilt, S. (1991). *Journal of Vocational Behavior,* 54, 429-452.

Forgas, J.P., Bower, G.H., & Moylan, S.J. (1990). Praise or blame? Affective influences on attributions for achievement. *Journal of Personality and Social Psychology*, 59, 809-819.

Fourie, S., & Potgieter, J.R. (2001). The nature of mental toughness in sport. South *African Journal for Research in Sport, Physical Education and Recreation,* 23, 63-72.

Frankenhaeuser, M. (1971). Behavior and circulating catecholamines. *Brain Research* 31 (August 20): 241-262.

Fried, Y., & Ferris, G.R. (1987). The validity of the job characteristics model: A review and meta-analysis. *Personnel Psychology,* 40, 287-322.

Funk, F.C. (1992). Hardiness: A review of theory and research. *Health Psychology,* 11(5), 335-345.

Gallagher, M. (1999). *Psychological skills training programs of successful Division 1 women's swim programs.* Eugene, OR: Microform Publications, University of Oregon.

Garmezy, N. (1983). Stressors of childhood. *In N. Garmezy & M. Rutter (Eds.), Stress, coping and development in children* (pp. 43-84). New York: McGraw-Hill.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory.* Chicago: Aldine.

Glatthorn, A.A. (1998). *Writing the Winning Dissertation: A Step-by-Step Guide.* California: Corwin Press Inc.

Gliner, J.A., Matsen-Twisdale, J.A., Horvath, S.M., & Maron, M.B. (1979). Visual evoked potential and signal detection following a marathon race. *Medicine and Science in Sports,* 11, 155-159.

Golby, J., Sheard, M., and Lavallee, D. (2003). A cognitive behavioural analysis of mental toughness in national rugby league football teams. *Perceptual and Motor Skills.* 96 pp. 455-462.

Golby, J., & Sheard, M. (2004). Mental toughness and hardiness at different levels of rugby league. *Personality and Individual Differences,* 37 (5) p.933-942.

Goldberg, A.S. (1998). *Sports slump busting: 10 steps to mental toughness and peak performance*, Human Kinetics, Champaign, IL.

Gould, D., Petlichkoff, L., Simons, J., & Vevera, M. (1987). Relationship between competitive state anxiety-2 subscales scores and pistol shooting performance. *Journal of Sport Psychology* 9: 33-42.

Gould, D., Eklund, R.C., & Jackson, S.A. (1993). Coping strategies used by U.S. Olympic wrestlers. *Research Quarterly for Exercise and Sport,* 64, 83-93.

Gould, D., Finch, L.M., & Jackson, S.A. (1993). Coping strategies used by national champion figure skaters. *Research Quarterly for Exercise and Sport,* 64, 453-468.

Gould, D., Tuffey, S., Hardy, L., & Lochbaum, M. (1993). Multidimensional State Anxiety and Middle Distance Running Perforamce: An Exploratory Examination of Hanin's (1980) Zones of Optimal Functioning Hypothesis. *Journal of Applied Sport Psychology,* 5, 85-95.

Gould, D., Tuffey, S., Udry, E., & Loehr, J. (1996). Burnout in competitive junior tennis players. 1. A quantitative psychological assessment. *Sport Psychologist,* 10, 322-340.

Gould, D., Udry, E., Bridges, D., and Beck, L. (1997). Psychological strategies for helping elite athletes cope with season-ending injuries. *Athletic Therapy Today 2:* 50-53.

Gould, D., Dieffenbach, K., and Moffett, A. (2002). Psychological characteristics and their development in Olympic champions. *Journal of Applied Sport Psychology.* [Internet] 14 pp. 172-204. Available from www.tandf.co.uk [Accessed March 1st 2006].

Graham, D., & Yocom, G. (1990). *Mental toughness training for golf.* Lexington, MA: The Stephen Greene Press.

Grassi, L., Righi, R., Sighinolfi, M.D., Makoui, S., & Ghinelli, F. (1998). Coping Styles and Psycholosocial-Relaed Variables in HIV-Infected Patients. *Psychosomatics,* 39: 350-359.

Greene, T.C., & Bell, P.A. ((1987). Environmental Stress. *In M.A. Baker (Ed.). Sex differences in human performance.* Wiley: Chichester.

Greenspan, M., & Feltz, D. (1989). Psychological interventions with athletes in competitive situations. *Journal of Sport Psychology,* 3, 219-236.

Gupta,V.P., Scharma, T.R., & Jaspal, S.S. (1974). Physical activity and the efficiency of mental work. *Perceptual and Motor Skills,* 38, 205-206.

Hackman, J.R., & Oldman, G.R. (1976). Motivation through the design of work: Test the theory. *Organisational Behaviour and Human Performance,* 16, 250-279.

Hale, B. and Collins, D. (Eds) (2002). *Rugby Tough.* Illinois, USA: Human Kinetics.

Hall, E.G. (1990). The effects of performer gender, performer skill level, and opponent gender on self-confidence in a competitive situation. *Sex Roles,* 23, (1/2), 33-41.

Hanin, Y. L. (1980). *A study of anxiety in sports.* Ithaca, N.Y., Mouvement.

Hanin, Y. L. (1986). *State and Trait anxiety research on sports in the USSR.* Washington, D.C., Hemisphere.

Hanin, Y. L. (1997). Emotions and athletic performance: Individual zones of optimal functioning. *European Yearbook of Sport Psychology*(1): 29-72.

Hanrahan, S., Grove, J.R., & Lockwood, R.J. (1990). Psychological skills training for the blind athlete: A pilot program. *Adapted Physical Activity Quarterly,* 7, 143-155.

Hanton, S., and Connaughton, D. (2002). Perceived control of anxiety and its relationship to self-confidence and performance. *Research Quarterly for Exercise and Sport.* [Internet] 73(1) pp. 87-97. Available from: www.hull.ac.uk [Accessed December 2nd 2005].

Hanton, S., & Jones, G. (1999). The acquisition and development of cognitive skills and strategies. I: Making the butterflies fly in formation. *The Sport Psychologist,* 13, 1-21.

Hardy, L., & Parfitt, G. (1991). A catastrophe model of anxiety and performance. *British Journal of Psychology,* 82, 163-178.

Hardy, L., Parfitt, G., & Pates, J. (1994). Performance catastrophes in sport: A test of the hystereris hypothesis. *Journal of Sport Sciences,* 12, 327-334.

Hardy, L., Woodman, T., & Carrington, S. (2004). Is self-confidence a bias factor in high-order catastrophe models? *Journal of Sport and Exercise Psychology,* 26, 359-368.

Harris, M.J., & Rosenthal, R. (1985). Mediation of interpersonal expectancies effects: 31 Meta-analyses. *Psychological Bulletin,* 97, 363-386.

Hart, E., Leary, M.R., & Rejeski, W.J. (1989). The measurement of social physique anxiety. *Journal of Sport & Exercise Psychology* 11: 94-104.

Hart, S.G., & Staveland, L. (1988). Development of the NASA task load index (TLX): Results of empirical and theoretical research. *In N.Meshkati, & P.A. Hancock (Ed.) Human mental workload.* Amsterdam: North Holland.

Heath, D. (1959). Stimulus similarity and task familiarity as determinants of expectancy and generalisation. *Journal of Experimental Psychology,* 58, 289-294.

Hodge, K. (1994). Mental toughness in sport: Lessons for life. The pursuit of personal excellence. *Journal of Physical Education,* New Zealand, 27, 12-16.

Hodge, K., & McKenzie, A. (1999). *Thinking Rugby: Training your mind for peak performance.* Auckland, NZ: Reed.

Hodge, K., and McKenzie, A. (2002). Motivation and confidence. *In: B. Hale and D. Collins (Eds) Rugby Tough.* Illinois, USA: Human Kinetics. pp. 36-59.

Holahan, C.J. and Moos, R.H. (1990) Life stressors, resistance factors, and improved psychological functioning: An extention of the stress resistance paradigm. *Journal of Personality and Social Psychology,* **58**, 909–917.

Holmes, T.H., & Rahe, R.H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research,* 11: 213-18.

Holsti, O.R. (1971). Crisis, stress and decision making. *International Social Sciecne Journal,* 23, 53-67.

Hull, C. L. (1943). *Principles of behaviour.* New York, Appleton-Centurty- Crofts,Inc.

Hull, C. L. (1951). *Essentials of behaviour.* New Haven, CT, Yale University Press.

Hull, J., Van Treuren, R., & Virnelli, S. (1987). Hardiness and Health: A critique and alternative approach. *Journal of Personality and Social Psychology,* 53: 518-530.

Humphreys J.C. (2001). Turnings and adaptations in resilient daughters of battered women. *Journal of Nursing Scholarship,* 33, 245–251.

Ilgen, D.R., & Moore, C.F. (1987). Types and choices of performance feedback. *Journal of Applied Psychology,* 72 (3), 401-406.

Ilgen, D.R., Fisher, D.C. & Taylor, M.S. (1979). Consequences of individual feedback on behaviour in organisation. *Journal of Applied Psychology,* 64, 349-371.

Jackson, R. & Watkin, C. (2004). The resilience inventory: Seven essential skills for overcoming life's obstacles and determining happiness. *Selection and Development Review,* Vol. 20, No. 6.

Jackson, S.A. (1992). Athletes in flow: A qualitative investigation of flow states in elite figure skaters. *Journal of Applied Sport Psychology,* 4, 161-180.

Jackson, S.A. (1995). Factors influencing the occurrence of flow state in elite athletes. *Journal of Applied Sport Psychology,* 7, 138-166.

Jackson, S.A. (1996). Toward a conceptual understanding of the flow experiencein elite athletes. *Research Quarterly for Exercise and Sport,* 67, 76-90.

Jackson, S.A., & Marsh, H.W. (1996). Development and validation of a scale to measure optimal experience: The flow state scale. *Journal of Sport and Exercise Psychology,* 18, 17-35.

Janis, I.L., & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice and commitment.* New York: The Free Press.

Johansson, G., & Frankenhaeuser, J. (1973). Temporal factors in sympatho-adrenomedullary activity following acute behavioral activation. *Biological Psychology,* 1, 63-73.

Johansson, G., Frankenhaeuser, M., & Magnusson, D. (1973). Catecholamine output in school children as related to performance and adjustment. *Scandinavian Journal of Psychology,* 14, 20-28.

Johansson, G. & Post, B. (1974). Catecholomine output of males and females over a one-year period. *Acta Physiologica Scandanavian,* 92, 557-565.

Jones, C.M. (1982). Mental toughness. *World bowls,* 30-31.

Jones, G. (1993). The role of performance profiling in cognitive behaviour interventions in sport. *The Sport Psychologist,* 7, 160-172.

Jones, G. and Hanton, S. (1996). Interpretation of competitive anxiety symptoms and goal attainment expectancies. *Journal of Sport and Exercise Psychology.* 18 pp. 144-157.

Jones, G. and Hanton, S. (2001). Pre-competitive feeling states and directional anxiety interpretations. *Journal of Sports Sciences.* 19 pp. 385-395.

Jones, G., Hanton, S., and Connaughton, D. (2002). What is this thing called mental toughness? An investigation of elite sport performers. *Journal of Applied Sport Psychology.* 14 pp. 205-218.

Kahneman, D.E. (1973). *Attention and Effort.* Englewood Cliffs. N.J. Prentice Hall.

Karasek, R.A. (1979). Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign. *Administrative Science Quarterly,* 24, 288-308.

Kimiecik, J.C. and Jackson, S.A. (2002). Optimal experience in sport: A flow perspective. *In: T. Hom (Ed) Advances in Sport Psychology (2nd Edition),* Illinois, USA: Human Kinetics. pp. 501-524.

Kimiecik, J.C. & Stein, G.L. (1992). Examining flow experiences in sports contexts: Conceptual issues and methodological concerns. *Journal of Applied Sport Psychology,* 4, 144-160.

Kline, P. (1986). *A Handbook of Test Construction: Introduction to Psychometric Design:* Methuen & Co Ltd

Kline, P. (1993). *The Handbook of Psychological Testing.* London: Routledge

Kline, P. (1999). *The Handbook of Psychological Testing (2nd edition).* London: Routledge

Kling, K.C. Ryff, C.D. Love, G. Essex, M. (2003). Exploring the Influence of Personality on Depressive Symptoms and Self Esteem Across a Significant Life Transition. *Journal of Personality and Social Psychology.* 85 (5) p922-932.

Kluger, A.N., & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin,* 119 (2), 254-284.

Kobasa, S.C. (1979). Stressful life events, personality, and health: an inquiry into hardiness. *Journal of Personality and Social Psychology.* 37 (1) pp. 1-11.

Kobasa, S.C., Maddi, S.R., and Kahn, S. (1982). Hardiness and health: A prospective study. *Journal of Personality and Social Psychology* 42:168-177.

Kobasa, S.C., Maddi, S.R., Puccetti, M.C. and Zola, M.A. (1985). Effectiveness of hardiness, exercise, and social support as resources against illness. *Journal of Psychosomatic Research* 29:525-533.

Krane, V., Joyce, D., & Rafeld, J. (1994). Competitive anxiety, situation criticality, and softball performance. *The Sport Psychologist,* 8, 58-72.

Lansing, R. W., Schwartz, E., & Lindsley, D.B. (1956). Reaction time and EEG activation. *American Psychologist*(11): 433.

Latack, J.C. (1986). Coping with job stress. *Journal of Applied Psychology,* 71, 377-385.

Latham, G.P., & Locke, E.A. (1991). Self-regulation through goal setting. *Organizational Behavioral and Human Decision Processes,* 50:212-247.

Lazarus, R.S. (1966). *Psychological Stress and the Coping Process.* New York: McGraw-Hill.

Lazarus, R.S. (1968). Emotions and adaptation: Conceptual and empirical relations. *In W.J. Arnold (Ed.), Nebraska Symposium on Motivation* (Vol. 16, pp. 175-266). Lincoln: University of Nebraska Press.

Lazarus, R. S. (1991). From psychological stress to the emotions: A history of changing outlooks. *Annual Review of Psychology*(44): 1-21.

Lazarus, R.S. (1993). Coping theory and research: Past, present, and future. *Psychosomatic Medicine,* 55, 234-247.

Lazarus, R.S., & Cohen, F. (1973). Active coping processes, coping dispositions, and recovery from surgery, *Psychosomatic Medicine,* 35: 375-89.

Lazarus, R.S., & Cohen, J.B. (1977). Environment stress. *In L. Altman and J.F. Wohlwill (eds), Human Behavior and the Environment: Current Theory and Research,* Vol. 2, pp.89-127. New York: Plenum.

Lazarus, R. S., & Folkman, S. (1984). *Stress appraisal and coping.* New York, Springer.

Lazarus, R. S., & Folkman, S. (1987). Transactional theory and research on emotions and coping, *European Journal of Personality,* 1: 141-70.

Lazarus, R.S., & Launier, R. (1978). Stress related transactions between person and environment, in L.A. Pervin and M. Lewis (eds), *Perspectives in International Psychology*, pp. 287-327. New York: Plenum.

Levy, A.R., Polman, R.C.J., Clough, P.J., Marchant, D.C., & Earle, K. (2006). Mental toughness as a determinant of beliefs, pain and adherence in sport injury rehabilitation. *Journal of Sport Rehabilitation,* Vol. 15, No. 3: 246-254.

Lewinsohn, S., & Mano, H. (1993). Multi-attribute choice and affect: The influence of naturally occurring and manipulated moods on choice processes. *Journal of Behavioral Decision Making*, **6**, 33–51.

Licht, B.G., & Dweck, C.S. (1983). Sex differences in achievement orientations: Consequences for academic choices and attainments. *In M. Marland (Ed.). Sex Differences and Schooling.* Heinemann Education Books: London.

Lichtman, D., & Posner, E.G. (1983). The effects of exercise on mood and cognitive functioning. *Journal of Psychosocial Research,* 27, 43-52.

Locke, E.A., & Latham, G.P. (1990). *A theory of motivation and task performance.* Englewood Cliffs, N.J: Prentice Hall.

Loehr, J.E. (1982). *Athletic Excellence: Mental toughness training for Sport.* Forum Publishing Company, 58-70.

Loehr, J.E. (1986). *Mental toughness training for sports: achieving athletic excellence.* Lexington, MA: Stephen Greene Press.

Loehr, J.E. (1995). *The New Toughness Training for Sports,* New York: Plume Publishers.

Looney, D.S. (1998). Mental Toughness Wins Out. *Christian Science Monitor.* 90 (173) p81.

Lorge, I., & Thorndike, E.L. (1935). The influence of delay in the after effect of a connection. *Journal of Experimental Psychology,* 18, 186-194.

Luchins, A.S. (1942). Mechanizations in problem solving: the effect of Einsteelung. *Psychological Monographs,* 54 (whole No. 248).

Luszki, W.A. (1982). *Winning tennis through mental toughness.* New York: Everest House.

Luthar, S.S., & Cicchetti, D. (2000). The Construct Of Resilience: Implications For I nterventions And Social Policies. *Development and Psychopathology.* 12 (1) p857-885.

Lyles, D.J. (1989) The motivation of top-level swimmers. *The Swimming Times.* February (1991) pp. 19-22.

Lynch, J.J. (1977). *The Broken Heart: The Medical Consequences of Loneliness.* New York: Basic Books.

Maccoby, E., & Jacklin, C. (1974). *Psychology of Sex Differences.* Palo Alto: Stanford University Press.

Mace, R. (1990). Cognitive behavioural interventions in sport. *In G. Jones& L. Hardy (Eds.), Stress and performance in sport.* Chichester, UK: Wiley. Pp. 203-231.

MacPherson, S.J., Dees, V., & Grindley, G.C. (1948-49). The effects of knowledge of results on learning and performance: II. Some characteristics of very simple skills. *Quarterly Journal of Experimental Psychology,* 1, 68-78.

Maddi, S.R. (1991). *The personality construct of hardiness.* Unpublished manuscript. University of California, Irvine.

Maddi, S.R., Hoover, M., & Kobasa, S.C. (1982). Alienation and exploratory behavior. *Journal of Personality and Social Psychology.* May, Vol. 42(5), pp: 884-890.

Maddi, S.R., & Hess, M.J. (1992). Personality hardiness and success in basketball. International. *Journal of Sport Psychology,* 23: 360-368.

Maddi, S.R.., Kahn, S., and Maddi, K.L. (1998). The effectiveness of hardiness training. *Consulting Psychology Journal: Practice and Research,* 50, 78-86.

Maddi, S.R., & Khoshaba, D.M. (2001). *Personal views survey (3rd ed., Rev.).* Newport Beach, CA: The Hardiness Institute.

Mahoney, M.J., Gabriel, T.J., & Perkins, T.S. (1987). Psychological skills and exceptional athletic performance. *The Sport Psychologist,* 1, 181-199.

Mallozzi, V.M. (2004). Expert In Scouting Doesn't See Athletes Play. *New York Times.* 153 (52830) p8.

Manolis, M.B., & Milich, R. (1993). Gender differences in social persistence. *Journal of Social and Clinical Psychology,* 12 (4), 385-405.

Martens, R., & Landers, D.M.. (1970). Motor performance under stress: A test of the inverted-U hypothesis. *Journal of Personality and Social Research*(16): 29-37.

Martens, R. (1987). Science, knowledge and sport psychology. *Sport Psychologist*(1): 29-55.

Martens, R., Vealey, R.S., & Burton, D. (Eds.) (1990). *Competitive anxiety in sport.* Champaign, IL, Human Kinetics.

Martinsen, E.W. (1993). Therapeutic implications of exercise for clinically anxious and depressed patients. *International Journal of Sport Psychology,* 24, 182-199.

Maule, J.A., & Svenson, O. (1993). Judgement and decision making under time pressure: Studies and findings. *In O. Svenson & J.A. Maule (Eds.).Time pressure and stress in human judgement and decision making.* Amsterdam: North Holland

Maule, M.J., & Mackie, P. (1990). A componential investigation of the effects of deadlines on individual decision making. *In K.Borchering, O.I. Larichev, & D.M. Messick (Eds.). Contemporary Issues in Decision Masking.* Amsterdam: North Holland.

McClelland, D.C. (1961). *The achieving society*. Princeton, NJ: Van Nostrand

McCrae, R.R. (1982). Age differences in the use of coping mechanisms. *Journal of Gerontology,* 37, 454-460.

McCrae, R.R. & Costa, P.T. (1986). Personality, coping and coping effectiveness in an adult sample. *Journal of Personality,* 54, 385-405.

McCrae, R.R. & Costa, P.T. (1990). *Personality in Adulthood.* London: Guildford Press.

McCubbin M.A., McCubbin H.I. (1996). Resiliency in families: a conceptual model of family adjustment and adaptation in response to stress and crises. *In Family Assessment: Resiliency, Coping and Adaptation, Inventories for Research and Practice (McCubbin H.I., Thompson A.I. & McCubbin M.A., eds).* Madison: University of Wisconsin Press.

McGrath, J. E. (1970). Major methodological issues. *In J.E. McGrath (Ed.), Social and psychological factors in stress* (pp.19-49). New York, Holt, Rinehart, & Winston.

McMorris, R., & Graydon, J. (1997). The effect of exercise on cognitive performance in soccer-specific tests. *Journal of sport sciences,* 15, 459-468.

Megaw, E. (1992). The Visual Environment. *In A.P. Smith & D.M. Jones (Eds.) Handbook of Human Performance. Vol. 1: The physical environment.* London: Academic Press

Meyers, C., Zimmerli, W., Farr, S., & Baschnagel, N. (1969). Effects of strenuous physical activity on reaction time. *Research Quarterly,* 40(333-337).

Middleton, S.C., Marsh, H.W., Martin,A.J. , Richards, G.E., Savis, J., Perry, C. and Brown, R.(2004). The Psychological Performance Inventory: Is the mental toughness test tough enough? *International Journal of Sport Psychology,* 35: 91-108.

Middleton, S.C., Marsh, H.W., Martin,A.J. , Richards, G.E., Savis, J., and Perry, C.(2004). *Discovering mental toughness: A qualitative approach of mental toughness in elite athletes.* Self Research Centre Biannual Conference, Berlin.

Middleton, S.C., Marsh, H.W., Martin,A.J. , Richards, G.E., Savis, J., and Perry, C. *Developing a test for mental toughness: The Mental Toughness Inventory (MTI).* In press.

Moran, A.P. (1996). *The Psychology of Concentration in Sport Performers: A Cognitive Analysis.* East Sussex: Psychology Press.

Morgan, W.P. (1980). The trait psychology controversy. *Research Quarterly for Exercise and Sport, 51,* 50-76.

Morgan, W.P. (1997). *Physical activity and mental health (Vol. xv).* Philadelphia, PA, US: Taylor and Francis.

Moss, G.E. (1973). *Illness, immunity, and social interaction.* New York, Wiley.

Moulton, R.W. (1965). Effects of success and failure on a level of aspiration as related to achievement motives. *Journal of Personality and Social,* 1(5), 399-406.

Murphy, H.J., Kelleher, W.E., Doucette, P.A., & Young, J.D. (1998). Test-retest reliability and construct validity of the cognitive style index for business undergraduates. *Psychological Reports,* 82, 595-600.

Murphy, S.M. and Martin, K.A. (2002). The use of imagery in sport. *In: T.Horn (Ed) Advances in Sport Psychology. (2nd Edition)* Illinois, USA: Human Kinetics.

Murphy, S., & Tammen, V. (1988). In search of psychological skills. *In J.Duda (Ed.), Advances in sport and exercise psychology measurement.* (pp.195-209). Morgantown, WV: Fitness Information Technology.

Nemeth, E. (1999). Gender differences in relation to public achievement feedback. *Educational Studies,* 25 (3), 297-310.

Norris, E.K. (1999). *Epistemologies of champions: A discursive analysis of champions' retrospective attributions; Looking back and looking within.* Michigan University Microfilms International.

Nunnally, J. (1978). *Psychometric Theory.* New York: McGraw-Hill

Oborne, D.J. (1987). *Ergomics at work. 2nd edition.* Wiley: New York.

Ogilvie, B.C. (1976). Psychological consistencies within the personality of high-level competitors. *In A.C. Fisher (Ed.), Psychology of sport*. Palo Alto, CA: Mayfield Publishing Company.

Pankey, B. (1993). Presence of mind: Five ways to lower your class drop-out rate with mental toughness. *American Fitness,* 11, 18-19.

Parkes, K.R. (1994). Personality and coping as moderators of work stress processes: Models, methods and measures: *Work and Stress,* 8, 110-129.

Patton, M.Q. (1990). *Qualitative evaluation methods (2nd ed.)* Beverly Hills. CA: Sage.

Penley, J.A. Tomaka, J. Wiebe, J.S. (2002). The Association of Coping To Physical and Psychological Health Outcomes: A Meta Analytic Review. *Journal of Behavioural Medicine* 25 (6) p.551-603.

Petruzzello, S.J., Landers, D.M., Hatfield, B.D., Kubitz, K.A., & Salazar, W. (1991). A meta-analysis on the anxiety reducing aspects of acute and chronic exercise: outcomes and mechanisms. *Sports Medicine,* 11, 42-182.

Poczwardowski, A., & Conroy, D.E. (2002). Coping Responses to Failure and Success Among Elite Athletes and Performing Artists. *Journal of Applied Sport Psychology.* 14 (1) p313-329.

Prapavessis, H., & Grove, J.R. (1991). Precompetitive emotions and shooting performance: The mental health and zone of optimal function models. *The Sport Psychologist,* 5, 223-234.

Psychountaki, M., & Zervas, Y. (2000). Competitive worries, sport confidence, and performance ratings for young swimmers. *Perceptual and Motor Skills.* 91 pp. 87-94.

Rabbit, P.A. (1981). Sequential Reactions. *In D.H. Holding (Ed.), Human Skills.* Chicester; John Wiley & Sons.

Raglin, J.S., & Hanin, Y.L. (2000). Competitive anxiety. *In: Y.L. Hanin (Ed) Emotions in Sport.* Illinois, USA: Human Kinetics. pp. 93-112.

Ramsey, J.D., (1983). Heat and cold. *In G.R.J. Hockey (Ed.) Stress and fatigue in human performance.* Chichester: Wiley.

Rauste-von Wright, M., von-Wright, J., & Frankenhaeuser, M. (1981). Relationships between sex-related psychological characteristics during adolescence and catecholamine excretion during achievement stress. *Psychophysiology,* 18, 362-370.

Ravizza, K. (2001). Increasing awareness for sport performance. *In: J.M. Williams (Ed), Applied Sport Psychology: Personal Growth to Peak Performance. (4th Edition)* California: Mayfield Publishing Company. pp. 179-187.

Reid, G., & Nygren, T. (1988). The subjective workload assessment technique: a scaling procedure for measuring mental workload. *In N. Meshkati & P. Hancock (Ed.), Human Mental Workload* (pp. 185-218). Amsterdam: Elsevier.

Rhodewalt, F., & Aguostsdottir, S. (1984). On the relationship of hardiness to the Type A behavior pattern: Perception of life events versus coping with life events. *Journal of Research in Personality,* 18, 212-223.

Roberts, T. (1991). Gender and the influences of evaluation on self-assessment in achievement settings. *Psychological Bulletin,* 109, 297-308.

Rosenberg, Morris. 1989. *Society and the Adolescent Self-Image.* Revised edition. Middletown, CT: Wesleyan University Press.

Rothstein, H.G. (1986). The effects of time pressure on judgement in multiple cue probability learning. *Organisational Behaviour and Human Decision Processes,* 37, 83-92.

Rush, M.C., Schoel, W.A. & Barnard, S.M. (1995). Psychological resiliency in the public sector: hardiness and pressure for change. *Journal of Vocational Behavior,* 46, 17-39.

Rutter, M. (1985). Resilience In The Face Of Adversity: Protective Factors And Resistance In Psychiatric Disorder. *British Journal of Psychiatry.* 147 (1) p598-611.

Salguero, A., Gonzalez-Boto, R., Tuero, C., & Marquez, S. (2004). Relationship between perceived physical ability and sport participation motives in young competitive swimmers. *Journal of Sports Medicine and Physical Fitness.* 44(3) pp. 294-299.

Salmoni, A.W., Schmidt, R.A., & Walter, C.B. (1984). Knowledge of results and motor learning: A review and critical appraisal. *Psychological Bulletin,* 95, 355-386.

Sauter, S.L., Murphy, L.R., & Hurrell, J.R. (1991). Prevention of work-related psychological disorders. *American Psychologist,* 45(10), 1146-1158.

Scanlan, T. K., Stein, G.L., & Ravizza, K. (1991). An in-depth study of former elite figure skaters-Part 3. Sources of Stress. *Journal of Sport Exercise Psychology* 13(2): 103-120.

Scanlon, T. K. (1986). Competitive stress in children. *In M.R. Weiss & D. Gould (Eds.), Sport for children and youths* (pp. 113-118). Champaign, IL, Human Kinetics.

Scheier, M.F., & Carver, C.S. (1992). Effects of optimism on psychological well-being: Theoretical overview and empirical support. *Cognitive Therapy and Research,* 16, 201-228.

Schilling, G., & Gubelmann, |H. (1995). Enhancing performance with mental training. *In S.J.H. Biddle (Ed.)European Perspectives on Exercise and Sport Psychology,* Leeds: Human Kinetics.

Schneider, M. (1986). The boss and organizational stress. Unpublished Ph.D Dissertation, University of Chicago.

Schneider, S.L. (2001). In search of realistic optimism. *American Psychologist,* 56(3), 250-263.

Schrauger, S.J., & Rosenberg, S.E. (1970). Self esteem and the effects of success and failure feedback on performance. *Journal of Personality,* 38, 404-417.

Schuler, R.S. (1980). Definition and conceptualisation of stress in organization. *Organizational Behaviour and Human Performance,* 25, 184-215.

Schwab, R.S. (1953). Motivation in measurements of fatigue. In A.T. Welford (Ed.), *Fatigue* (pp. 143-148). London: H.K.Lewis & Co. Ltd.

Schwarz, R.S. (1975). Another look at immunologic surveillance. *New England Journal of Medicine,* 293, pp: 181-184.

Seligman, M.E.P. (1975). *Helplessness,* San Francisco: Freeman.

Sewell, D.F. (1996). Attention-focusing instructions and training times in competitive youth swimmers. *Perceptual and Motor Skills.* 83 pp. 915-920.

Selye, H. (1936). A syndrome produced by diverse nocous agents. *Nature* 138(32).

Selye, H. (1950). *Stress.* Montreal, Acta.

Selye, H. (1956). *The stress of life.* New York, McGraw-Hill.

Selye, H. (1976). *The stress of life (2nd ed).* New York: McGraw-Hill.

Selye, H. (1983). The stress concept: Past, present, and future. *In C.L. Cooper (Ed.), Stress research* (pp. 1-20). New York, John Wiley & Sons.

Sjoberg, H. (1980). Physical fitness and mental performance during and after work. *Ergonomics,* 23, 977-995.

Smith, J.F., Mitchell, T.R., & Beach, L.R. (1982). A cost-benefit mechanism for selectingprobel-solving strategies: Some extensions and empirical tests. *Organisational Behaviour and Human Performance,* 29, 370-396.

Sonstroem, R. J., & Bernardo, P. (1982). Intraindividual pregame state anxiety and basketball performance: A re-examination of the inverted-U curve. *Journal of Sport Psychology*(4): 235-245.

Sothmann, M. S., J., Buckworth, R.P. Claytor, R.H. Cox, J.E. White-Welkley, and R.K.Dishman. (1996). Exercise training and the cross-stressor adaptation hypothesis. *Exercise and Sport Sciences Reviews* 24: 267-287.

Spence, J. T., & Spence,K.W. (1966). The motivational components of manifest anxiety: Drive and drive stimuli. *In C.D. Spielberger (Ed.), Anxiety and behaviour.* New York, Academic Press.

Spielberger, C.D. (1983). *Manual for the state trait anxiety inventory.* Palo Alto: Consulting Psychologists Press, Inc.

Stennet, R. C. (1957). The relationship of performance level to level of arousal. *Journal of Experimental Psychology*(54): 158-173.

Svavarsdottir E.K., Rayens M.K. (2005). Hardiness in families of young children with asthma. *Journal of Advanced Nursing.* 50(4), 381–390.

Svenson, O., & Edland, A. (1987). Change of preferences under time pressure: Choices and judgements. *Scandinavian Journal of Psychology,* 29 (4), 322-330.

Svenson, O., & Benson, L. (1993). Framing and time pressure in decision making. *In O. Svenson & J.A. Maule. Time pressure and stress in human judgement and decision making.* New York: Plenum Press.

Svenson, O., & Edland, A., & Slovic, P. (1990). Choices between incompletely described alternatives under time stress. *Acta Psychologica,* 75 (2), 153-169.

Taylor, J. (1989). Mental toughness (Part 2): A simple reminder may be all you need. *Sport Talk,* 18, 2-3.

Taylor, A.H., & May, S. (1996). Threat and coping appraisal as determinants of compliance with sports injury rehabilitation: an application of protection motivation theory. *Journal of Sports Science,*14:472-482.

Teichner, W.H. (1968). Interaction of behavioural and physiological stress reactions. *Psychological Review,* 75, 51-80.

Tenenbaum, G. (1984). A note on the measurement and relationships of physiological and psychological components of anxiety. *International Journal of Sport Psychology,* 15, 88-97.

Thelwell, R.T., Weston, N., and Greenlees, I. (2005). Defining and understanding mental toughness within soccer. *Journal of Applied Sport Psychology.* [Internet] 17 pp. 326-332. Available from www.tandf.co.uk [Accessed March 1st 2006].

Thomas, P.R., Schlinker, P.J., and Over, R. (1996). Psychological and psychomotor skills associated with prowess at ten-pin bowling. *Journal of Sports Sciences.* 14 pp. 255-268.

Thomson, W.C., & Wendt, J.C. (1995). Contribution of hardiness and school climate to alienation experienced by student teachers. *Journal of Educational Research,* 88, 269-274.

Tomporowski, P.D., & Ellis, N.R. (1986). Effects of exercise on cognitive processes. A review. *Psychological Bulletin,* 99(3). 338-346.

Tomporowski, P.D., Ellis, N.R., & Stevens, R. (1987). The immediate effects of strenuous exercise on free-recall memory. *Ergonomics,* 30(1), 121-129.

Topf, M. (1989). Personality hardiness, occupational stress, and burnout in critical care nurses. *Research in Nursing and Health,* 12, 179-186.

Tunney, J. (1987). Thoughts on the line. Mental toughness: Biceps for the mind. *Soccer Journal,* 32, 49-50.

Turner, P.E., & Raglin, J.S. (1996). Variability in precompetition anxiety and performance in college track and field athletes. *Medicine and Science in Sports and Exercise,* 28, 378-385.

Tutko, T.A., & Richards, J.W. (1976). *Psychology of coaching.* Boston: Allyn and Bacon.

Vansell, M., Brief, A.P., and Schuler, R.S. (1981). Role conflict and Role ambiguity: Integration of the literature and directions for future research. *Journal of Human Relations,* Vol. 34, No. 1, pp. 43-66.

Vealey, R.S. (1994). Current status and prominent issues in sport psychology interventions. *Medicine and Science in Sports and Exercise,* 26, 496=5-502.

Vroom, V.H. (1964). *Work and Motivation.* New York: Wiley.

Wanlin, C.M., Hrycaiko, D.W., Martin, G.L., and Mahon, M. (1997). The effects of a goal setting package on the performance of speed skaters. *Journal of Applied Sport Psychology.* 9 pp. 212-228.

Weinberg, R.S. (1994). Goal setting and performance in sport and exercise setting: a synthesis and critique. *Medicine and Science in Sports and Exercise,* 26, 469-477.

Weinberg, R., & Gould, D. (1995). *Foundations of Sport and Exercise Psychology (2nd edition).* Champaign: Human Kinetics.

Weingarten, G., & Alexander, J.F. (1970). Effects of physical exertion on mental performance of college males of different physical fitness levels. *Perceptual and Motor Skills,* 31, 371-378.

Weinstein, N.D. (1980). Unrealistic Optimism About Future Life Events. *Journal of Personality & Social Psychology.* 39 (5) p.806-820.

Weiss, J.M., Glazer, H.I., Pohorecky, L.A., Brick, J., & Miller, N. B. (1975). Effects of chronic exposure to stressors on avoidance-escape behavior and on brain norepinephrine. *Psychosomatic Medicine,* 37, 153-160.

Welford, A. T. (1962). Arousal, channel-capacity, and decision. *Nature* (194): 365-366.

Welford, A. T. (1973). Stress and Performance. (16): 567-580.

Westman, M. (1990). The relationship between stress and performance: The moderating effect of hardiness. *Human Performance,* 3, 141-155.

Wickens, C.D. (1986). The effects of control dynamics on performance. *In K.R. Boff, L. Kaufman, & J.P. Thomas (Eds.), Handbook of perception and performance.* (Vol.II, pp.39-1/39-60). New York: Wiley & Sons.

Wickens, C.D. (1992). Processing resources in attention. *In R. Parasuraman & D.R. Davies (Ed.), Varieties of attention (pp. 63-102).* New York: Wiley.

Wiebe, D.J. (1991). Hardiness and stress moderation: a test of proposed mechanisms. *Journal of Personality and Social Psychology.* 60(1) pp.89-99.

Wilkinson, S. (2004). Focus Group Research. *In: D. Silverman (Ed) Qualitative Research: Theory, Method, and Practice.* London: Sage Publications. pp. 177-199.

Williams. J.M. and Harris, D.V. (2001). Relaxation and energising techniques for regulation of arousal. *In: J.M. Williams (Ed), Applied Sport Psychology: Personal Growth to Peak Performance. (4th Edition)* Califomia: Mayfield Publishing Company. pp. 229-246.

Williams, R.M. (1988). The U.S. open character test: Good strokes help. But the most individualistic of sports is ultimately a mental game. *Psychology Today,* 22, 60-62.

Williams, J.M. and Krane, V. (1993). Psychological characteristics of peak performance. *In Applied Sport Psychology (edited by J.M. Williams), 2nd edn,* pp. 137-147. Palo Alto, CA: Mayfield.

Willis, J. D., & Campbell, L.F. (1992). *Exercise psychology.* Champaign, IL, Human Kinetics.

Woods, R., Hocton, M. and Desmond, R. (1995). *Coaching tennis successfully.* Human Kinetics, Champaign, IL.

Wright, P. (1974). The harassed decision maker: Time pressure, distractions, and the use of evidence. *Journal of Applied Psychology,* 59 (4), 555-561.

Yerkes, R. M., & Dodson, J.D. (1908). The relationship of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology and Psychology*(18): 459-482.

Younkin, S.L. & Betz, N.E. (1994). Psychological hardiness: Reconceptualization and measurement. *In T.W. Miller (ed.) Stressful Life Events 2nd Edition.* Springer Netherlands.

Zaccaro, S.J., & Riley, A.W. (1987). *Occupational Stress and Organisational Effectiveness.* Praeger, New York.

Zakay, D. (1993). The impact of time perception processes on decision making under stress. *In O. Svenson & J.A. Maule (1993). Time pressure and stress in human judgement and decision making.* New York: Plenum Press.

Zinsser, N., Bunker, L., & Williams, J.M. (2001). Cognitive techniques for building confidence and enhancing performance. *In: J.M. Williams (Ed), Applied Sport Psychology: Personal Growth to Peak Performance. (4th Edition)* California: Mayfield Publishing Company. pp. 284-311.

Appendices

Appendix 2.1

Mental Toughness Questionnaire

Name:	**Age:**
Job Title:	**M/F:**

Please indicate your response to the following items by **circling one** of the numbers, which have the following meaning;

1 = strongly disagree; **2** = disagree; **3** = neither agree nor disagree; **4** = agree; **5** = strongly agree

Please answer these items carefully, **thinking about how you are generally**. Do not spend too much time on any one item.

	«Disagree				Agree»
1) I usually find something to motivate me	1	2	3	4	5
2) I generally feel in control	1	2	3	4	5
3) I generally feel that I am a worthwhile person	1	2	3	4	5
4) Challenges usually bring out the best in me	1	2	3	4	5
5) When working with other people I am usually quite influential	1	2	3	4	5
6) Unexpected changes to my schedule generally throw me	1	2	3	4	5
7) I don't usually give up under pressure	1	2	3	4	5
8) I am generally confident in my own abilities	1	2	3	4	5
9) I usually find myself just going through the motions	1	2	3	4	5
10) At times I expect things to go wrong	1	2	3	4	5
11) "I just don't know where to begin" is a feeling I usually have when presented with several things to do at once	1	2	3	4	5
12) I generally feel that I am in control of what happens in my life	1	2	3	4	5
13) However bad things are, I usually feel they will work out positively in the end	1	2	3	4	5
14) I often wish my life was more predictable	1	2	3	4	5
15) Whenever I try to plan something, unforeseen factors usually seem to wreck it	1	2	3	4	5
16) I generally look on the bright side of life	1	2	3	4	5
17) I usually speak my mind when I have something to say	1	2	3	4	5
18) At times I feel completely useless	1	2	3	4	5
19) I can generally be relied upon to complete the tasks I am given	1	2	3	4	5
20) I usually take charge of a situation when I feel it is appropriate	1	2	3	4	5

	«Disagree				Agree»
21) I generally find it hard to relax	1	2	3	4	5
22) I am easily distracted from tasks that I am involved with	1	2	3	4	5
23) I generally cope well with any problems that occur	1	2	3	4	5
24) I do not usually criticise myself even when things go wrong	1	2	3	4	5
25) I generally try to give 100%	1	2	3	4	5
26) When I am upset or annoyed I usually let others know	1	2	3	4	5
27) I tend to worry about things well before they actually happen	1	2	3	4	5
28) I often feel intimidated in social gatherings	1	2	3	4	5
29) When faced with difficulties I usually give up	1	2	3	4	5
30) I am generally able to react quickly when something unexpected happens	1	2	3	4	5
31) Even when under considerable pressure I usually remain calm	1	2	3	4	5
32) If something can go wrong, it usually will	1	2	3	4	5
33) Things just usually happen to me	1	2	3	4	5
34) I generally hide my emotion from others	1	2	3	4	5

	«Disagree				Agree»
35) I usually find it difficult to make a mental effort when I am tired	1	2	3	4	5
36) When I make mistakes I usually let it worry me for days after	1	2	3	4	5
37) When I am feeling tired I find it difficult to get going	1	2	3	4	5
38) I am comfortable telling people what to do	1	2	3	4	5
39) I can normally sustain high levels of mental effort for long periods	1	2	3	4	5
40) I usually look forward to changes in my routine	1	2	3	4	5
41) I feel that what I do tends to make no difference	1	2	3	4	5
42) I usually find it hard to summon enthusiasm for the tasks I have to do	1	2	3	4	5
43) If I feel somebody is wrong, I am not afraid to argue with them	1	2	3	4	5
44) I usually enjoy a challenge	1	2	3	4	5
45) I can usually control my nervousness	1	2	3	4	5
46) In discussions, I tend to back-down even when I feel strongly about something	1	2	3	4	5
47) When I face setbacks I am often unable to persist with my goal	1	2	3	4	5
48) I can usually adapt myself to challenges that come my way	1	2	3	4	5

MENTAL TOUGHNESS QUESTIONNAIRE

SCORING KEY

CHALLENGE	COMMITMENT	CONTROL		CONFIDENCE	
		Emotion	Life	Abilities	Interpers-onal
4	1	21 **R**	2	3	17
6 **R**	7	26 **R**	5	8	20
14 **R**	11 **R**	27 **R**	9 **R**	10 **R**	28 **R**
23	19	31	12	13	38
30	22 **R**	34	15 **R**	16	43
40	25	37 **R**	33 **R**	18 **R**	46 **R**
44	29 **R**	45	41 **R**	24	
48	35 **R**			32 **R**	
	39			36 **R**	
	42 **R**				
	47 **R**				

R – Reverse score

	Indepen-dent	Competi-tive	Assertive	**Conscie-ntious**	Convent-ional	Organis-ed	**Extrovert**	Group Orientated	Outgoing	**Stable**	Poised	Relaxed	Social Desirabil.
Overall MT	**0.30****	0.11	0.34**	**-0.09***	-0.16	0.01	**0.33****	0.14	0.36**	**0.43****	0.44**	0.34**	0.18*
Challenge	**0.38****	0.26**	0.33**	**-0.33**	-0.32**	-0.19	**0.30****	0.14	0.37**	**0.22***	0.26**	0.09	0.08
Commitment	**0.20***	0.11	0.22*	**0.17**	0.04	0.22*	**0.22****	0.10	0.25**	**0.16**	0.21*	0.11	0.17
Control	**0.03**	-0.03	0.06	**-0.06**	-0.15	0.01	**0.08**	-0.04	0.09	**0.49****	0.46**	0.40**	0.02
Control: Life	**0.11**	-0.11	0.21*	**-0.05**	-0.18*	0.06	**0.15**	0.03	0.20*	**0.44****	0.39**	0.38**	-0.03
Control: Emotions	**-0.06**	-0.08	-0.05	**-0.09**	-0.07	-0.10	**0.15**	0.05	0.11	**0.33***	0.35**	0.25**	0.08
Confidence	**0.39****	0.12	0.51**	**-0.06**	-0.17	0.03	**0.41****	0.21*	0.46**	**0.39****	0.35**	0.36**	0.21*
Confidence: In Abilities	**0.15**	0.05	0.19*	**-0.03**	-0.09	0.03	**0.27****	0.19*	0.23*	**0.55****	0.51**	0.46**	0.21*
Confidence: Interpersonal	**0.46****	0.23*	0.50**	**-0.16**	-0.20*	-0.08	**0.28****	0.09	0.36**	**0.30****	0.32**	0.25**	0.09

Table 2.7 Correlations table for MTQ48 and Prevue Personality Instrument.

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Correlations in bold signify the major scales of Prevue

Appendix 2.2

Appendix 4.1

Instructions for gun task

This is the first task I want you to try. It involves shooting this laser gun at the targets through this window here. I will demonstrate how to use the gun, I am aiming at target 3, I have been practicing for a while now so it should be easier for me.

You will be told by me which target to aim for. Then a bulb above the appropriate target will light up for 5 (or 10) seconds and within those 5 seconds this is when you aim and fire the gun. The gun is only set for 30 shots, so please do not fire the gun at any times other than when aiming at the target. Each time, I will re-set the targets and I will tell you which target to aim for. This will last for 30 trials, and at the end you will be told your final score.

This gun task should last around 5 – 10 minutes. Are there any questions?

How many targets do you think you will get out of 30?

(Then session begins)

Appendix 4.2

Feedback statements for gun task

Negative evaluative information (failure)

Right, from your performance on this task I can tell you that you hit less targets than you anticipated with a score of ___ out of 30 shots, that's ___ lower than your initial estimate.

Right, let's move onto the second task, follow me.

Positive evaluative information (no failure)

Right, from your performance on this task I can tell you that you have hit 1 more target than you anticipated with a score of ___ out of 30 shots, that's 1 higher than your initial estimate.

Right, let's move onto the second task, follow me.

Appendix 4.3: Conversion table for gun task scores

Estimated	Actual
30	24
29	23
28	22
27	21
26	20
25	20
24	19
23	18
22	17
21	16
20	16
19	15
18	14
17	13
16	12
15	12
14	11
13	10
12	9
11	8
10	8
9	7
8	6
7	5
6	4
5	4
4	3
3	2
2	1
1	0
0	0

Appendix 4.4

Snooker practice instructions

In this task I will firstly give you 5 straightforward practice shots and then give you a further 5 shots, measuring your performance and how well you think you will do.

Firstly on a scale of 0 – 10 with 0 being extremely poor and 10 being extremely good, how would you rate your ability at snooker? (Fill in your score on chart)

Now you will carry out the 5 practice shots. I will explain each one as we go through.

That is the end of the practice session

Appendix 4.5

Snooker task instructions

SNOOKER TASK: 1 - 5

Let's move on to the actual tasks. I will be measuring your performance for later analysis, so you will only receive general feedback at the end of this task.

That is the end of this task.

Appendix 4.6

Planning task instructions

Thank you for completing these tasks.

We now have the final part, which is a planning exercise.

(take to other room)

I will read through the instructions with you.

(Timed: say you have 20 minutes to complete the exercise; no time pressure: say no set amount of time, but should last no more than an hour and can leave anytime after 20 minutes).

Also ask participants how confident they are at completing the task based on own beliefs of past experiences at this type of planning task.

(After exercise finished)

Please put down your pens.

This is the end of all 3 tasks.

Thank you for your co-operation and time.

Either:

Please fill in your bank details and home address so your £15 can be sent through.

A feedback newsletter will also be sent to your home giving full details of the study that you have carried out.

Thank you again for your participation.

Appendix 4.7

Positive feedback on snooker task (task 2)

After looking at your overall performance on this task I can tell you that you have done very well.

Your performance on these shots has been better than most other people who have carried out this task.

You have also done better that you estimated for most of the 5 shots.

Negative feedback on snooker task (task 2)

After looking at your overall performance on this task I can tell you that you haven't done as well as you thought you would have/you haven't achieved any higher than the low estimate that you set for yourself.

Your performance on these shots was not as good as most other people who carried out this task.

Appendix 4.8

ANSWER SHEET

NAME: _____

CONDITION: _____

SHOOTING TASK

How many shots out of 30? _____

How many actually got? _____

SNOOKER TASK

Rating of performance? (0-10) _____

Practice shots:

SHOT	SCORE				COMMENT
1	0	1	2	3	
2	0	1	2	3	
3	0	1	2	3	
4	0	1	2	3	
5	0	1	2	3	

KEY FOR SCORES

3 = POTTED

2 = HIT JAWS

1 = JUST MISS (WITHIN 6 INCHES)

0 = COMPLETE MISS (MORE THAN 6 INCHES)

ACTUAL TASKS

SHOT	ESTIMATE (0-10)	DISTANCE OFF TARGET (DIST, OR WIDE, INCHES)	COMMENT
1		Distance = Wide =	
2		Distance = Wide =	
3		Distance = Wide =	
4		Distance = Wide =	
5		Distance = Wide =	

(Distance and width to be measured where appropriate)

Snooker task

1 = Shot within 20-30 inches of target position or above.

2 = Shot within 10-20 inches of target position.

3 = Shot within 0-10 inches of target position.

Planning exercise

Notes taken during task (if necessary)

1 = All areas incorrect or incomplete, no information eliminated.

2 = Mostly correct, either all participants or all tutors correct and days eliminated.

3 = All complete and correct, either on rough sheet or final answer.

Appendix 6.1

Mental Toughness Training Guide:

Remember: One of the best ways to develop your mental toughness is to practise regularly, and practise under simulated pressure situations in training.

Mentally tough athletes restructure competitive events to be opportunities to display their talents (challenge response) rather than as potential sources of failure (fear response).

GOAL SETTING TIPS:

1. Remember the SMART principle when setting goals.

S pecific

M easurable

A ction-oriented

R ealistic

T imely.

2. Use the performance profile circle to set and assess your goals and your progress regularly.

3. Make sure you incorporate your goals into training, and make use of sub-goals.
4. Ensure you check progress often and make necessary modifications.
5. Remember – goal setting needs to be an ACTIVE process and not simply a case of thinking and setting goals.

TIPS FOR EFFECTIVE RELAXATION:

1. The aim is to become practised at relaxation and familiar with the feeling. As you practise you will get better at deliberately relaxing and will be able to relax more selectively and more quickly in competition and stress situations.
2. Practise makes permanent!!!!!!
3. Use the script until you can relax deliberately without it. You may want to record the script onto tape so you can continue practising or get someone to read it to you the first few times.
4. Try to practise 2-3 times a week.
5. Remember at the end of relaxation to give yourself time to wake up before standing up and not to stand up too quickly.

The PMR Script:

Start sitting comfortably, ease into regular, even breathing.

Notice the feel of the seat supporting your body…., feel the weight of your feet against the floor…., your arms resting on support (lap or chair arms)…., the light, comfortable, balance of your head on your spine…., the gentle rise of your shoulders as you breathe in …., and ……, out.

(1min) Now focus on your face, as you breathe in frown slightly, feel your forehead contract……, and now as you breathe out, let go of the tension, breathe in again…., and out again letting the tension flow away.

(1min30) Breathe in and gently close your jaw, feel your teeth connect, notice the feel of the muscles at the side of your face…., now breathe the tension away…., breathe in…., and again breathe the tension out…., feel your face relax.

(2mins30) Move to your shoulders now….., breathe in and hold your shoulders back…., as you breathe out let your shoulders relax….., breathe out again…., and relax.

Now let your upper arms take on a little of the weight of your forearms, as you breathe out let your arms' weight subside onto their supports…., breathe in and out again…, feeling the weight being taken by the supports.

(3mins30) Now clench your fists and breathe in….., as you breathe out unclench and again let go, feel the deep relaxation in your upper body and arms.

(4mins30) Moving down to your bottom, add slight tension as you inhale, and now as you exhale breathe the tension out and away……, and now as you

exhale again....feel the tension flow away.

Move attention gently to your thighs now....., tense the muscles as you breathe in....., relax as you exhale...., and relax again as you exhale the next breath....., feel the relaxation deepen.

(6mins) Gently press your toes into the floor and breathe in...., exhale and ease off...., now breathe in and out again...., easing the tension away.

(7mins) Feel deep relaxation through your body as you continue breathing in....., and out....., in....., and out.

(8mins) Move your attention back to your face, as you breathe out let the last traces of tension slide away....., and again.....

Down to your shoulders and arms now, feel the tension flow away as you breathe evenly.

(8mins30) So down to your legs, feel the relaxation deepen with your regular in an exhalations.

(9mins30) Gently move your attention outwards now....., to sounds and sights around you....., gently ease your arms into motion, stretch, and begin to sit up...., gently sit up, stretch and "wake up" your feet and hands, arms and legs.....

Make sure you take time to stretch and return circulation to normal before you stand up, and don't stand up too quickly.

YOUR IMAGERY:

Helping create and recreate success!

"I try to visualise my race before I swim. I'll relax, totally relax, and just think how I'm going to swim my race. How I'm going to get into and out of turns, how my stroke is going to be. I go through my entire race."

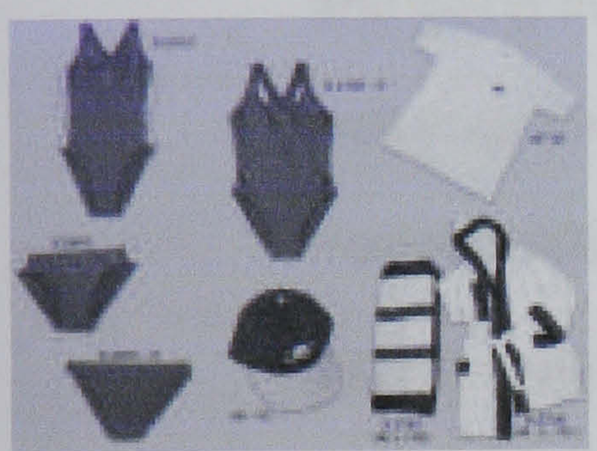
(National Team Swimmer)

Remember you can use imagery to see success, improve your confidence, motivate, and prepare for competition.

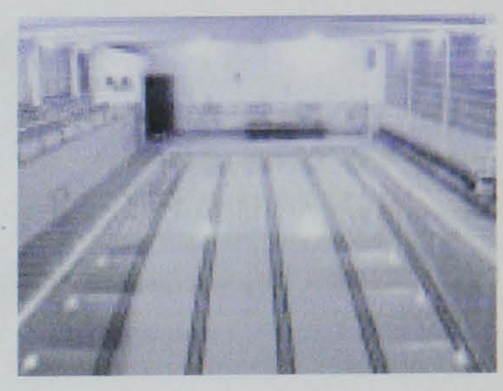
Tips to best learn and use imagery:

1. Be calm and relaxed.
2. You can use imagery from internal or external views.
3. Include all your senses.
4. Control your images.
5. Integrate into training.

You need to practise imagery regularly. Continue to use the exercises you were taught in the training session. To begin with use exercises 1-4 in your first few practises, when you become comfortable with your imagery and are able to control your images, move onto using exercise 5 the race simulation.



Exercise 1: Objects.



Exercise 2: The Pool.

Exercise 3: Swimming.

Exercise 4: Dives, turns, finishes.

Exercise 5:

Race Simulation:

As you enter the pool you immediately recognise the smell of chlorine, the lighting and warmth of the pool. Looking around you see the pool layout, the crowd in the stands, you notice sounds of the announcer, music, swimmers talking, water splashing, and the beeps of electronic timing.

Imagine yourself getting ready for your event, getting changed, stretching, and going over last details in your mind. This is your best event, you are well prepared, and feeling mentally strong.

You are called up to the waiting area, this maybe a perfect time to relax yourself using controlled breathing and shortened PMR techniques.

The official calls you to the blocks, imagine the starter, the whistles, you bend down ready to dive in, the beep sounds and with a strong, powerful dive, you enter the water and start your race.

From your streamlined position you kick powerfully to the surface, you begin strong strokes, feel the water slipping off your skin and the sound of water moving past.

With each stroke you fell stronger and stronger, moving through the water faster and faster. You notice another swimmer nearby, put them out of your mind and focus on your own race. Concentrate even more on each stroke as you approach the turn, come to the wall quickly, turn, and push off hard into streamline, powerful kicks to the surface again, and you attack the second half of your race.

You are still feeling very strong as you approach the end of the race,

focusing on your stroke, you are completely focused, positioning, arms, legs, breathing, everything is as it should be. You dig in more now with every stroke, pushing beyond expectations, surging forward you put your head down and lunge towards the wall.

Your hands finish hard on the electronic pad, you immediately look up at the scoreboard, a PB and great position. Slowly you regain awareness of your surroundings, the cheers from the crowd, and you realise what you have achieved. You are instructed to leave the pool, you grab your towel and clothes, and return to

your team. Feelings of excitement and accomplishment build inside, you have succeeded, and you are a great swimmer. Imagine now being congratulated by your teammates, well done!

Remember:

Practice as often as you can.

Practice the exercises during normal training.

Have a good time!

Appendix 6.2

Questionnaire Responses:

How many times did you attend training each week during the weeks of testing?

Participant 1 – Four

Participants 5, 7, 8, 12, and 18 – Three

Participants 11, 21, and 22 – Two

Participants 9, 13, 17 – One

How effective did you find the mental toughness training session?

1 – "Very effective."

5 – " Relaxation techniques fairly effective, helped concentration."

7 – " Helpful."

8 – " Information was clear and understandable whilst being specific to give ideas on how to use the techniques."

9 – " A little."

11 – "Highly effective."

12 – "Very effective, taught new relaxation techniques."

13 – "Helped understand what to do."

17 – " Helpful."

18 – "Very effective."

21 – "Quite effective, had never heard of the techniques before."

22 – "Very useful, to a degree."

How effective did you find the booklet provided?

1 – "Fairly effective."

5 – "Helped to learn the techniques."

7 – "Very helpful, learnt the pre-race visualisation."

8 – "Clear and specific with some good ideas."

9 – " Only the relaxation techniques."

11 – "Useful to refresh knowledge from session."

12 – "Fairly helpful, especially imagery exercise."

13 – "Good."

17 – "Effective in showing what mental toughness is."

18 – "Very helpful, especially when was nervous the night before – provided good guidance."

21 – "Effective – gave a reminder of techniques learnt in session."

22 – "Very effective and simple to understand."

Positives/Negatives of the training and booklet provided?

1 – "Quite a bit to read through."

5 – "Insight into difference techniques for relaxation and concentration."

7 – "Clear and self-explanatory."

8 – "Variety of methods and clearly presented. Possibly time consuming."

9 – "Race simulation – positive, race simulation – negative."

12 – "Good relaxation guide."

13 – "Helped to be more positive towards performances."

17 – "Very detailed, and gave detailed explanations of what things could do."

18 – "None negative – very helpful."

21 – "Was informative."
22 – "Simple to understand, no complicated jargon."

How many times did you practise the mental toughness skills during the weeks of testing?

1 and 12 - One to three times each week.

5 and 17 - Once a week.

7, 8, 13, and 22 - Twice a week.

9 - Before each session.

11 and 21 - Four times a week.

18 - Night before time trial and immediately before time trial.

How did you practise the mental toughness skills?

1 – "At home and at training, used relaxation technique – tensing body then releasing."

5 – "Set goals to achieve at training, used the scripts from booklet."

7 – "Read through race simulation, focused on stroke technique."

8 – "Formed ideas when resting at home, took these ideas to the pool."

9 – "Imagery and relaxation at side of pool with eyes closed."

11 – "As shown in training session."

12 – "Mainly in hour before training or time trial, shortened techniques in changing room and immediately before swimming."

13 – "Read through and visualised."

17 – "Thought techniques through, occasionally used clenching fists exercise."

18 – "Got away from people, learnt on own and used book for guidance."

21 – "Before training."

22 – "Before changing and immediately before racing."

How did you use the mental toughness skills?

1 – "For competitions."

5 – " To help relax so could swim faster and with fewer nerves."

7 – "To focus on stroke elements."

8 – "To relax, try and focus on swimming as fast as could, focused on muscles would be using."

9 – "Not sure I did."

11 – "To prepare for competitions."

12 – "Used imagery when training to try and improve stroke and relax when swimming."

13 – "To prepare."

17 – "To prepare for timed swim."

18 – "In races."

21 – "To relax and increase confidence."

22 – "To relax and focus on job at hand."

Have the skills helped you in anyway? With what? How?

1 – "Helped body relax slightly before competing."

5 – "Only with swimming."

7 – "Starts are not as delayed, turns are also quicker."

8 – "Helped visualise performance, and allowed to focus on specific areas to best improve performances."

9 – "Don't think did."

11 – "PMR relaxation technique helped with stress and anxiety relief."

12 – "Helped relax when stressed, improved swimming stroke."

13 – "Competition preparation."

17 – "No."

18 – "Less nervous for races, visualised self improving."

21 – "Helped relax, didn't improve swimming time."

22 – "Helped focus and block out surroundings."

Did you attend any competitions during the weeks of testing? If yes, how many?

1 and 7 - One

5, 9, 12, 17, 21, and 22 - No

8, 11, 13, and 18 - Two

Do you have a pre-competition routine? Please describe...
1 – "Used to use imagery."
7 – "Strict warm-up routine."
8 – "Try to relax and not think about race too much, check equipment, and deep breaths."
11 – "Stretching and general warm-up."
13- "Check goggles."
18 – No previous routines, just nervous."

Has this routine changed since the mental toughness training? How?
1 – "Now incorporate relaxation."
8 – "Changed slightly as now focus on specific muscles."
11 – "Now involves relaxation and imagery techniques."
13 – "Still nervously check goggles."
18 – Now use routine outlined in booklet."

How did you use the skills and practises at competitions?

1 – "Used the skills all through the day, more so within the hour before race."

7 – "Imagined how event was going to pan out."

8 – "Same as used in training: To relax, try and focus on swimming as fast as could, focused on muscles would be using."

11 – "To prepare self for races."

13 – "Mentally prepare for race."

Did the skills/practises help you at competitions? In what ways?

1 – "Stopped being quite so nervous, first time used skills at competition performed a lot better."

7 – "Did PB's in all events."

8 – Helped become relaxed and ready – times improved."

11 – "Seemed to reduce anxiety and increase focus."

18 – "Achieved PB's."

Appendix 6.3

Focus Group Responses

Participant 1, female, experienced competitive swimmer; attended 1 competition over course of study:

- Practised relaxation times as and when had time.
- No set pattern or routine for mental toughness practice.
- Used full body relaxation techniques twice during the course of the study.
- Most weeks used the relaxation technique for just the arms and fists, at home and prior to performance measures or competitions.
- Felt the techniques to be mainly effective in reducing cognitive and somatic anxiety at competitions.
- Didn't feel any effect at weekly performance measures.
- Has used imagery in past and continues to do so but finds it causes nervousness due to thinking about race.

Participant 13, female, experienced competitive swimmer; attended two competitions over course of the study:

- Practised imagery prior to performance measure, mainly visualising lane.
- Used imagery at competitions but had always done so.
- Helped with calming of cognitive anxiety at competitions only.
- Little practise done other than directly before performance measures.

Participant 17, female, low experienced social swimmer; didn't attend competitions over course of study:

- Usually practised "clench fists" relaxation immediately prior to performance measure.
- Didn't feel any effect.

Participant 7, male, experienced competitive swimmer, attended 1 competition over course of the study:

- Practised imagery when had time.
- Read race simulation script, planned race in head, each week worked on a different technique aspect for example, improving turns.
- Didn't feel much benefit at weekly performance measures.
- Felt the techniques helped at competitions to increase focus by planning race using imagery.

Participant 8, male, experienced competitive swimmer; attended 2 competitions over the course of the study:

- Regularly used imagery and relaxation techniques.
- Little time to practise at home but each week during warm-up prior to performance measure would imagine how turns would be, executing dive into the water, and the streamline, butterfly, and front crawl kick sequence after entering water.
- Before performance measure would visualise the full swim and immediately prior to performance measure-starting instructions would take many deep breaths.
- During the first performance measures, just swam, progressively used mental toughness skills more as knew the times that had been achieved in previous weeks and wanted to perform better.
- Felt the skills helped with reaction times to starting instructions during some of the weekly performance measures.
- After each performance measure used imagery to think about improvements that could be made.
- Used relaxation for a longer duration before the fifth swim test and felt this was helpful.
- Relaxation was of great help at competitions in keeping self relaxed, especially in event of event being postponed.

Participant 18, male, medium experience; attended two competitions over the

course of the study:

- Used imagery to improve starts and execution of dives. Visualised incorrectly performed dives, visualised corrections, then visualised self performing dives correctly.
- Practised this imagery at home in evenings at least once a week.
- Also used imagery in warm-up and immediately prior to performance measure.
- Didn't help initially but progressively helped in feeling relaxed.
- Helped much more at competitions – felt less daunted.