SPORT-RELATED INJURY: PREDICTION, PREVENTION, AND REHABILITATION - A PSYCHOLOGICAL APPROACH

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Abstract

Two interrelated studies were performed to examine the role of psychological factors in the prediction and prevention of sport-related injury. As far as injury prediction is concerned, Study 1 tested the Williams and Andersen (1998) revised stress-injury model. It was hypothesised through the model that athletes with a history of stressors, a shortage of coping resources, and personality dispositions that augment the stress response, would be the most vulnerable to injury. Four-hundred and seventy-rugby players from 37-teams participated in the study and completed measures corresponding to variables in the Williams and Andersen stress-injury model at the beginning of the playing season. The number of injuries sustained and the amount of time loss due to injury were recorded throughout the season. Data were analysed using product moment correlations between life-stress and injury for groups of participants who fell in the upper and lower third of the moderator variables (i.e., coping resources—type of coping and social support, history of stressor—previous injury, and personality—competitive anxiety) distributions. As expected, a mild positive relationship was found between life-stress and injury time loss ($r = .09$, $p < .05$) and number of injuries sustained ($r = .11$, $p < .05$). Results also showed that previous injury, the type of coping, social support, and competitive anxiety interacted in a conjunctive fashion to produce a maximum moderator effect (explaining up to 29% of the injury variance).

A second study (Study 2) was performed to determine whether a stress management intervention programme could effectively reduce injury among athletes identified from Study 1 to be most vulnerable to injury. A second purpose was to examine what might explain a positive result by exploring psychological (i.e., coping and anxiety) and stress response (i.e., reaction time and perceptual sensitivity) variables.

Fifty-one rugby players from Study 1 who were found to be most vulnerable to injury (i.e., a rugby player with many recent life-stresses, high competition anxiety, inappropriate coping skills, and a history of previous injury) were recruited and randomly assigned to either an intervention (stress management programme) or a control condition. Participants completed psychological inventories at the beginning (Time 1) and end (Time 2) of the 2002 rugby season. Prospective and objective injury data were obtained for both number of injuries and time loss. In addition, a purpose built apparatus was used to assess stress response variables at the beginning (Time 1) and end (Time 2) of the 2002 rugby season.

Prior to the start of the 2002 rugby season participants in the intervention group started a 6-session stress management programme that lasted 4-consecutive weeks. Emphasis was placed on how athletes could modify their reaction to stress. Participants were contacted monthly to reinforce the intervention, discuss implementation of the skills, and any relevant issues.

ANCOVA results showed a significant condition (control versus intervention) effect for total time missed, but not for number of injuries sustained. Participants in the stress management intervention reported missing less time due to injury at the end of the 2002 season compared to their non-intervention counterparts. Furthermore, the intervention group appeared to only marginally increase the amount of time missed in 2002 compared to 2001, whereas the control group missed significantly more time due to injury.

ANCOVA results provided some insight into the potential reasons for injury reduction. For the psychological variables, a significant condition effect was found for total coping resources. The intervention group showed an increase in the amount of coping resources at Time 2 compared to Time 1, and showed greater coping resources than did the control group

at Time 2. The intervention group also showed a decrease in worry at Time 2 compared to Time 1 and less worry than the control group at Time 2. The condition effect for concentration disruption (CD) approached statistical significance, with the intervention group showing less CD at Time 2 compared to the control group at Time 2. For the stress response variables no significant condition effects were found for reaction times or perceptual sensitivity (d').

Overall, results support the recommendation that a stress management programme is effective in preventing further time loss due to injury for athletes with an "at-risk" injury profile. This result in part, is due to these athletes increasing their coping skills, and decreasing their worry and concentration disruption cognitions.

In an extension of the prediction and prevention studies, a third study was conducted to examine the effectiveness of a psychological intervention (modelling) in affecting rehabilitation outcomes. Specifically the purpose of Study 3 was to investigate whether a coping modelling intervention could decrease pre-operative anxiety and perceptions of expected pain, as well as increasing rehabilitation self-efficacy and motivation associated with surgical reconstruction of the anterior cruciate ligament (ACLR). A second purpose was to determine whether the modelling intervention would be associated with improved functional outcomes in the early post-operative period (6-weeks) following ACLR.

Sixty-four patients undergoing arthroscopic ACLR were randomised to receive a coping modelling intervention or to act as a control. Participants completed psychological inventories at different time periods during a 6-week period. In addition, the following functional outcomes were assessed, days walking with crutches, range of motion (ROM), and International Knee Documentation Committee assessment (IKDC). ANCOVA results revealed a significant condition effect for perceptions of expected pain, but not for state anxiety. Significant group differences were found for crutch self-efficacy, with the

intervention group reporting greater self-efficacy than the control group. Repeated measure ANOVA results revealed significant time x condition effects for walking self-efficacy and exercise self-efficacy. No condition effect was found for jogging self-efficacy, nor were there any condition effects found for the motivation variables. ANCOVA results showed a significant condition effect (modelling) for functional outcome improvements (IKDC scores and crutch use) with the intervention group reporting superior IKDC scores and fewer days walking with crutches. No effects were found for ROM.

Collective findings from the three studies highlight the importance of psychological factors in the prediction, prevention, and rehabilitation of athletic-related injury. Moreover, studies 2 & 3 support the use of psychological based interventions for reducing injury and augmenting traditional rehabilitation outcomes. Opportunities for future research are discussed.

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Chapter 1
Introduction

Statement of the Problem

Athletic injury is a common occurrence and concern for those that participate in sport and recreational activities, (Uitenbroek, 1996). In the United States of America (U.S.) high injury rates have been reported as a consequence of participation in recreation activities (Booth, 1987; Kraus & Conroy, 1984). Similarly, in New Zealand a country with a population of 4 million, sport and recreational activities represented 16% of all new claims to the national no-fault injury compensation scheme (Accident Rehabilitation Compensation and Insurance Corporation) in 2002 (ACC, 2002). Of those claims, rugby had the highest rate of injury, and represented 4% of all new claims in 2002.

Information regarding the incidence and nature of rugby union and league injuries support the notion that injury is multi-factorial, but more often than not involves contact due to tackling (Alsop et al., 2000; Durie & Munroe, 2000; Wilson, Quarrie, Milburn, & Chalmers, 1999). This is consistent with the medical literature that has focused typically on physical aspects of sport injury and largely ignored the importance of psychosocial factors. However, during the past 15 years a substantial body of literature has developed to confirm that psychosocial factors have a significant role to play in understanding the occurrence, response, and prevention of sport injury (Williams, 2001). The Andersen and Williams (1988) (Figure 1), and the revised Williams and Andersen (1998) stress injury models (Figure 2) have driven much of the research conducted in this area. As can be seen in Figures 1 and 2 the proposed mechanism for a stress response leading to injury is the presence of: (a) greater generalized muscle tension; (b) increased distractibility; and (c) narrowing of the visual field. These variables may increase the risk of injury by disrupting co-ordination and flexibility as well as interfering with the detection of important environmental cues. It is hypothesised through the model that athletes with a history of stressors, a shortage of coping resources, and personality dispositions that augment the stress response will when placed in a stressful situation demonstrate a greater stress response (i.e., disruption in physiological and attentional processes) and be more vulnerable to injury (see Andersen & Williams, 1988, & Williams and Andersen 1998 for a complete review).

Although it is impossible to directly measure the proposed stress response mechanisms during competition, general support for a life-stress-injury relationship has been shown by a number of researchers (e.g., Kontos, 2001). Two recent reviews have reported that athletes with high life-stress are two to five times more likely to sustain injury compared to athletes with low life-stress (Williams, 2001; Williams & Roepke, 1993).

A number of studies have also examined whether certain variables in the Williams and Anderson model (e.g., social support and/or coping resources) moderate the life-stress injury relationship. A moderator variable is a qualitative or quantitative variable that affects the nature, the direction, or the strength of a relation between an independent and criterion variables (Arnold, 1982; Baron & Kenny, 1986). For example, Petrie (1992) showed that among gymnasts with low social support (lower third distribution of social support scores) negative life-events accounted for 6-12% of the injury variance outcome. Petrie suggested that low social support increased vulnerability to injury whereas high social support seemed to provide injury protection. Similar results have been reported by Patterson, Smith, Everett, and Ptacek (1998) in a sample of ballet dancers. Andersen and Williams (1999) reported that athletes with high life-stress, low social support, and greater peripheral narrowing during a stressful laboratory condition were more likely to be injured than those with the opposite profile.

In their seminal paper, Smith, Smoll, and Ptacek (1990) found that negative-life-events accounted for 22-30% of the injury time loss variance for athletes low in both social support and coping skills. Since this paper was published I am unaware of any study that has tested how coping and social support might interact with other moderator components of the Williams and Anderson model (i.e., history of stressors and personality) to influence the life-stress injury relationship. The aim of the first study is to utilise the revised Williams and Andersen (1998) stress and injury model as a framework to predict athletic injury.

The Williams and Andersen revised stress injury model (1998, Figure 2) also proposes a two-pronged intervention approach to prevent injuries from increased stress reactivity among at-risk individuals. This approach should focus on: (1) the alteration of the cognitive appraisal of potentially stressful events; and (2) modifying the physiological and attentional aspects of the stress response. It is also proposed that these interventions (and others) may be used to directly influence the moderator variables under coping resources and personality factors.

The implementation and assessment of psychological interventions that are proposed to diminish the stress response and reduce injury vulnerability is the least researched area of the Williams and Andersen model (Williams & Andersen, 1998). However, a few studies have provided evidence that a psychological intervention can reduce injuries (Davis, 1991; Kerr & Goss, 1996; May, Veach, & Reed, 1985; Perna, Antoni, Baum, Cordon, & Schneiderman, 2003; Schomer, 1990). Of these, only Kerr and Goss (1996) and Perna et al. (2003) offer experimental support for a reduction in life-stress and injury, with both using cognitive behavioural stress management interventions (CBSM).

Kerr and Goss (1996) examined the effectiveness of a CBSM intervention in the reduction of life-stress and injury. Although a significant treatment effect occurred for decreased life-stress, a non-significant effect was found for injury reduction. Kerr and Goss's (1996) explanation for the non-significant findings related to the late introduction (half-way) of relaxation and distraction control skills into the programme. Recently Perna et al. (2003)

provided evidence supporting the effectiveness of a CBSM intervention in reducing injury and illness among collegiate athletes. In addition, the CBSM intervention was related to decreased cortisol and negative affect (indices of exercise training maladaption).

Although results from both these studies are encouraging, neither study tested their intervention using athletes with an "at-risk" psychological profile to injury, nor tested whether their intervention had any effect on the moderator variables (e.g., coping resources) or the stress response as advanced through the Williams and Andersen (1998) model. The purpose of Study 2 is to examine the effectiveness of a cognitive behavioural stress management intervention (CBSM) in reducing injury vulnerability among athletes previously identified with an "at-risk' psychological profile to injury from Study 1. A second purpose is to examine what might explain a positive effect.

The occurrence of injury has been shown to be associated with numerous physical social and psychological consequences. Sport medicine has traditionally focussed on the physical factors that influence injury rehabilitation and outcome factors, whereas the role of psychology in the rehabilitation setting has only emerged during the past 3 decades (Brewer, 2001).

With respect to post-injury research three major areas of interest have been examined. The first relates to the emotional and psychological response to injury (for example, mood changes, and self-esteem etc., Smith, 1996). The second relates to psychological factors involved in adherence to prescribed rehabilitation regimens (cf., Brewer 2001). The third approach has focussed on the effectiveness of psychological interventions to improve psychological and functional outcomes following sport-injury rehabilitation (e.g., Cupal & Brewer, 2001; Flint, 1991; Ross & Berger, 1996). Previous recovery studies have investigated imagery (Ievela & Orlick, 1991), guided imagery and relaxation (Cupal & Brewer, 2001), goal setting (Theodorakis, Beneca, Malliou, & Goudas, 1997; Theodorakis, Malliou, Papaioannou, Beneca, & Filactakidou, 1996) and biofeedback (Dalley, Laing, & McCartin, 1992; Draper, 1990; Draper & Ballard, 1991) for influencing psychological and functional outcomes. Only one study by Flint (1991) has examined the effectiveness of a coping modelling intervention in improving psychological and functional outcomes in an athletic injury rehabilitation setting, post anterior cruciate ligament reconstruction (ACLR). Flint's findings offered some support for a coping modelling video increasing self-efficacy and showing some improvements in functional outcomes. Unfortunately Flint's study had a modest sample size, which did not permit sufficient statistical power. Also the intervention was introduced post-operatively and did not investigate possible pre-operative effects. Following ACLR the key goals in the post-operative period are to reduce swelling, increase range of motion (ROM), and to begin strengthening exercises. As the person continues to progresses in their rehabilitation, variation in management and physiotherapy practices increase. No study has examined the effect of modelling on psychological and functional outcomes in this early post-operative period (6-weeks). The purpose of the third study was to extend the work of Flint by investigating whether a coping modelling intervention could decrease pre-operative perceptions of expected pain and pre-operative anxiety, and increase rehabilitation self-efficacy and motivation following ACLR. A second purpose was to determine whether the modelling intervention would improve functional outcomes in the early post-operative period (6-weeks) following ACLR.

Figure 1 The Andersen and Williams Stress-Injury Model (1988).

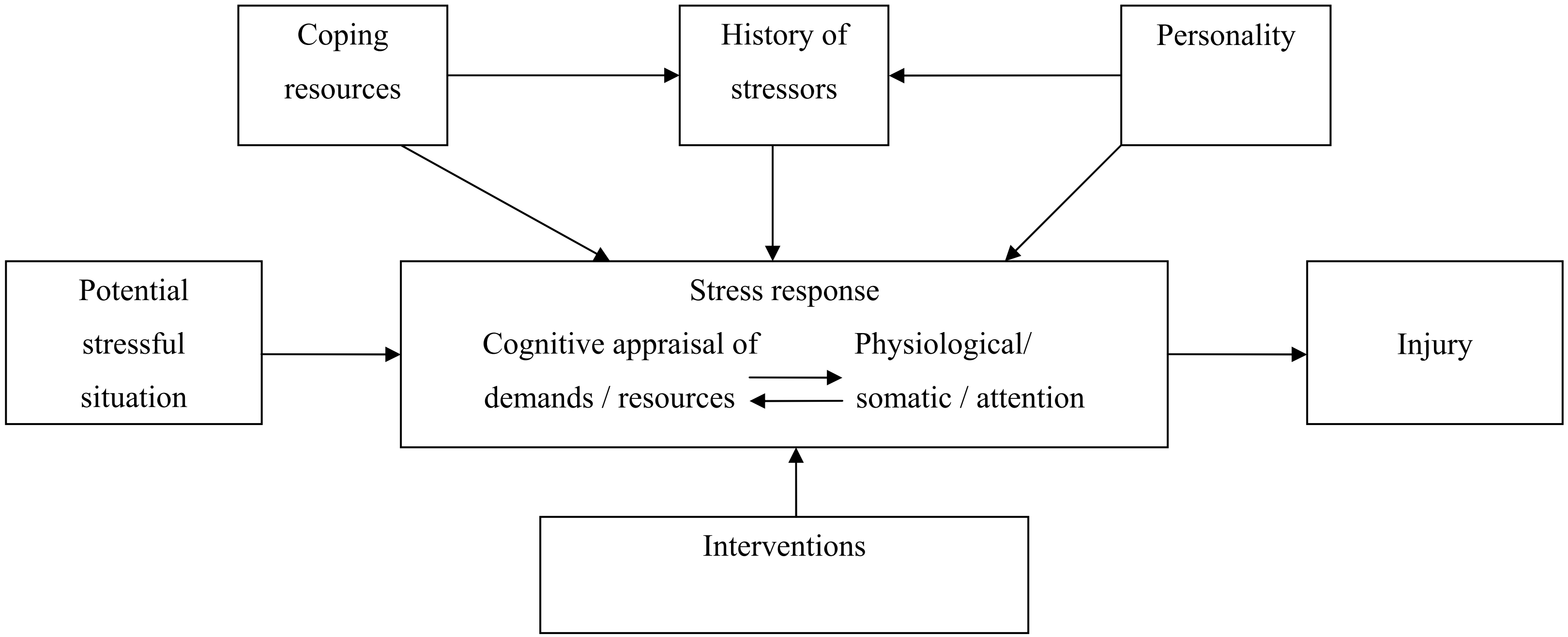
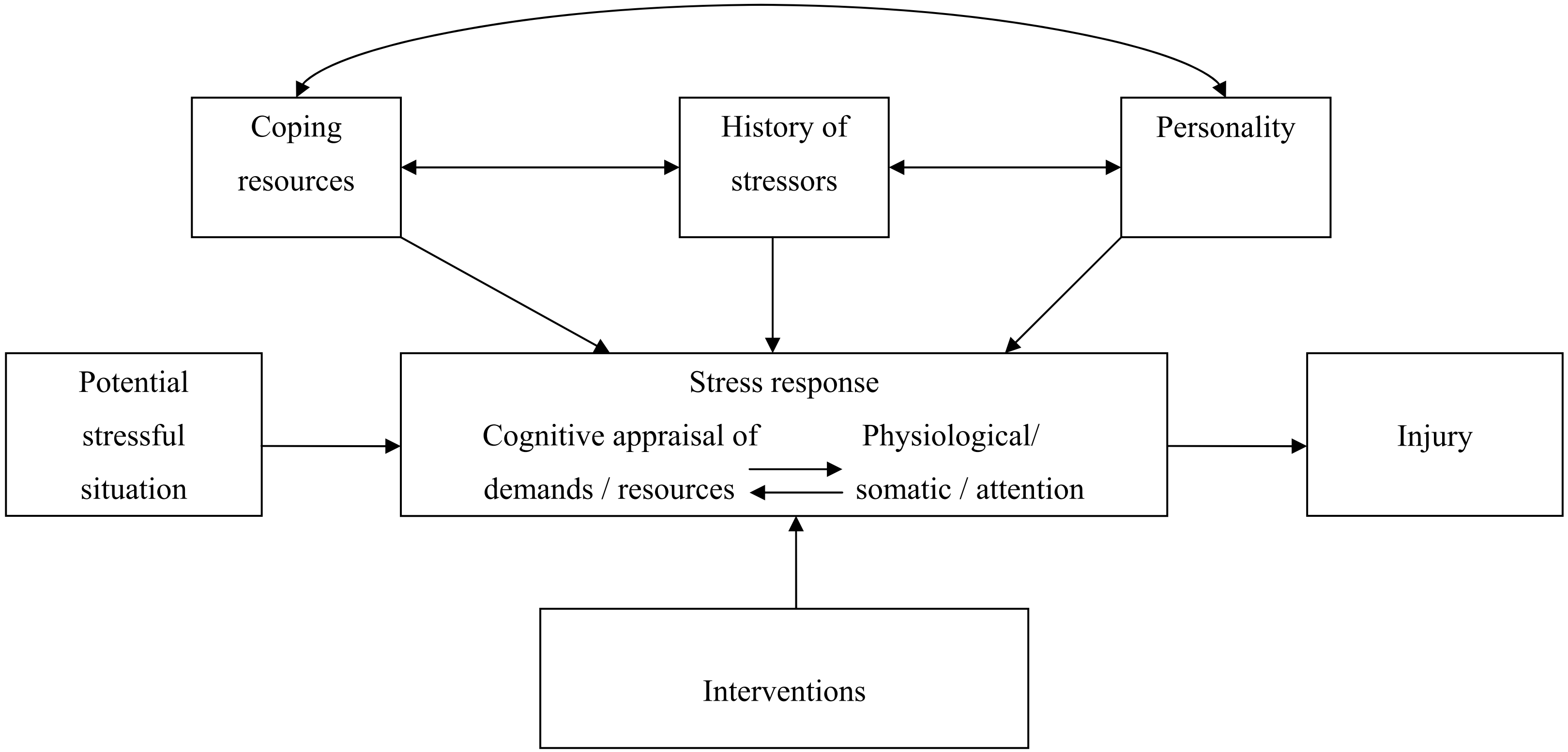


Figure 2 The Williams and Andersen Revises Stress-Injury Model (1998).



Chapter 2
Review of Literature – Study 1

Despite the documented health-related benefits of participating in both sport and exercise it has been shown that injury is an inevitable consequence of such participation (Bijur, Trumble, Harel, Overpeck, Jones, & Scheidt, 1995, Uitenbroek, 1996). In fact, a population survey revealed that sport/exercise was the leading source of physical injury experienced by respondents, which accounted for approximately one third of all injuries sustained (Uitenbroek, 1996). In the United States of America (U.S.) high injury rates have been reported as a consequence of participation in recreation activities (Booth, 1987; Kraus & Conroy, 1984). Similarly, in New Zealand (NZ) a country with a population of 4-million the national no-fault injury compensation—Accident Rehabilitation Compensation and Insurance Corporation (ACC, 2002) had over 12 000 claims for sporting injuries from July 2001-June 2002 at a cost of almost NZ$47 million dollars representing 16% of all new claims, whilst rugby had the highest rate of injury, and represented 4% of all new claims in 2002.

Information regarding the incidence and nature of rugby union and league injuries has been well documented among the rugby playing nations including, Argentina (Bottini, Poggi, Luzuriaga, & Secin, 2000), Australia (Davidson, 1987; Gabbett, 2000; Gissane, Jennings, Cumine, Stephenson, & White, 1997; Hughes & Fricker, 1994; Seward, Orchard, Hazard, & Collinson, 1983), England (Stephenson, Gissane, & Jennings, 1996), New Zealand (Alsop et al., 2000; Dalley et al., 1992; Dalley, Laing, Rowberry, & Caird, 1982; Durie & Munroe, 2000; Holmes & Rahe, 1967; Norton & Wilson, 1995; Wilson et al., 1999), Scotland (Clark, Roux & Noakes, 1990; Garraway & McLeod, 1995), and Wales (Lewis, 1994). Generally, results from these studies support the notion that rugby-related injury is multi-factorial and more often than not involves tackling or physical aspects of injury.

This is consistent with the medical literature that has focused typically on the physical aspects of sport injury and largely ignored the importance of psychosocial factors. However, during the past 15-years a substantial body of literature has developed to confirm that psychological factors have a significant part to play in understanding the occurrence, reaction, and prevention of sport injury (Bond, Miller, & Chrisfield, 1988; Bramwell, Masuda, Wagner, & Holmes, 1975; Coddington & Troxell, 1980; Crossman, 1985; Ford, Eklund, & Grove, 2000; Hanson, McCullagh, & Tonymon, 1992; Hardy, Richman, & Rosenfeld, 1991; Hardy & Riehl, 1988; Hardy, 1992; Junge, 2000; Kelley, 1990; Kerr & Fowler, 1988; Kerr & Minden, 1988; Passer & Seese, 1983; Petrie, 1992; Smith, Ptacek, & Smoll, 1992; Willlams, Tonymon, & Wadsworth, 1986). The Andersen and Williams (1988) (Figure 1) and the revised Williams and Andersen (1998) stress injury models (Figure 2) have driven much of the research conducted in this area.

The original and the revised models: (1) posit three categories of psychological variables that may influence athletic injury outcome; (2) proposes possible mechanisms underlying their relationship to injury; and (3) suggests specific interventions for reducing the risk of athletic injury (Williams & Andersen, 1997). As can be seen in Figures 1 and 2 the core of the model is the stress response. It is suggested through the model that athletes experience a myriad of stressful events associated with sporting situations. The cognitive appraisal of potentially stressful situations (i.e., competition) is posited to affect the stress response (Andersen & Williams, 1988). If the athlete perceives the situation as stressful, but believes they have the resources/capabilities to meet the demands of the event then, the stress response to the situation may be minimal. However, an athlete who experiences a potentially stressful situation and perceives the demands of this situation to exceed their current resources, then the stress response may be pronounced. Furthermore, appraisal of the consequences of the event may also influence the stress response. If the consequences, whether actual or perceived are crucial to the athlete's career or self-esteem, then the stress response may be extreme (Andersen & Williams, 1988).

The proposed mechanism for a strong response leading to injury is the presence of: (a) greater generalised muscle tension; (b) increased distractibility; and (c) narrowing of the visual field. These variables may increase the risk of injury by disrupting co-ordination and flexibility as well as interfering with the detection of important environmental cues.

Above the core of the model (i.e., stress response) three major areas, personality, history of stressors, and coping resources may operate alone or in combination to affect the stress response, and in turn injury occurrence and severity. In the revised model (Figure 2) Williams and Andersen (1998) added bi-directional arrows between personality and history of stressors, and between coping resources and history of stressors, and between personality and coping resources, whereas the original model had only unidirectional arrows from personality to history of stressors and from coping resources to history of stressors (Figure 1). Interventions is the final component of the model and it is suggested that in order to prevent injuries caused by stress, the intervention should focus on: (1) the alteration of the cognitive appraisal of potentially stressful events; and (2) modifying the physiological and attentional aspects of the stress response. In addition, these interventions (and others) may be used to directly, as well as indirectly influence the moderator variables under coping resources and personality factors.

In short, it is hypothesised through the model that athletes with many life-stressors, few coping resources, and personality dispositions, will when placed in a stressful situation, demonstrate a greater stress response (i.e., disruption in physiological and attentional processes) and be more at risk of injury. Athletes with this high-risk profile will more likely to sustain injury compared to athletes with the opposite profile (Williams & Andersen, 1998). Whilst it is acknowledged that an existing body of knowledge exists for the stress response mechanisms proposed in the model and for the effectiveness of interventions to reduce injury vulnerability, the literature review for Study 1 will address the extant literature under the headings of History of Stressors, Coping, and Personality. The review for Study 2 (injury prevention) will address the intervention and stress-response literature.

Insofar as the occurrence of injury is concerned, researchers have been primarily interested in determining whether certain psychological variables can predict vulnerability and resiliency to sport injury. Although it is impossible to directly measure the proposed stress response mechanisms during competition, much of the research has examined the relationship between life-events (or life-stress) and injury. It must be recognised at this point that life-events have been examined both as a moderating variable under the heading of history of stressor, as well as having a direct relationship with injury.

History of Stressors

The first of the categories in the model—history of stressor includes, major life-events, daily hassles, and history of previous injury. Of these, major life-events has received the most research attention. Systematic research on distressing life-events has been performed since the 1950's (Theorell, 1992). Interest in this area increased significantly when Holmes and Rahe published their schedule of recent experiences called the Social Readjustment Rating Scale (SRRS) (Holmes & Rahe, 1967). The SRRS was developed in an effort to produce weightings associated with different life-events experienced by the average person in the population. The literature describing associations between life-events and illness is substantial and for a comprehensive review of literature in this area the reader is referred to Theorell (1992), Rahe (1974), Brown and Harris (1978), Dohrenwend and Dohrenwend (1974), and de Faire and Theorell (1984).

With respect to athletic injury, Holmes and Rahe (1970) performed a pilot study using the SSRS in 100 American football players. They showed that 50% of the players who experienced life-events during the preceding season suffered an injury that required missing at least three days of practice and one game. This is compared to the 9% and 25% of athletes with low or moderate life-stress respectively who suffered equivalent injuries.

A follow up study by Bramwell, Masuda, Wagner, and Holmes, (1975) saw a modification to the Social Readjustment Scale to increase its appropriateness to collegiate athletes. The modified Social Athletic Readjustment Rating Scale (SARRS) was then examined to determine the relationship between life-change events and injury among University football players (Bramwell, Masuda, Wagner, & Holmes, 1975). Results showed that injured players had higher change scores, whereas the majority of low-risk players did not. Cryan and Alles (1983) attempted to replicate and extend the football injury study of Holmes and Rahe by assessing not only the incidence, but also the severity of injury. The National Athletic Injury Reporting System (NAIRS) (an established injury surveillance system) was used as the injury assessment tool. Using the NAIRIS, injuries were classified as: (a) minor (injured athlete returns to sport within seven days); (b) moderate (injured athlete returns to action between 8-21 days); or (c) major (injured athlete returns to sport after 21-days) for injury severity. Cryan and Alles showed that higher levels of life-change was associated with greater risk of injury and for sustaining multiple injuries, but that it did not differentiate injury vulnerability based on severity.

Petrie and Falkstein (1998) argued that the SARRS is based upon a stimulus perspective of stress, and is limited "because it assumes that the stress associated with the event resides in the event itself and not in the interaction between the person and the event. In other words, the SARRS does not account for the fact that individuals may experience life-events differently. A transactional approach to measuring life-stress, on the other hand, allows for individual variability by having each person rate the impact of each life event they experience" (p. 32).

In other work, Coddington and Troxell (1980) developed a life-event measure more applicable to adolescents (Life Event Scale for Adolescents LES-A). The LES-A is composed of 50 events—17 family events over which the adolescent has no control, 18 extrafamilial events, generally considered desirable, and a further 15 undesirable and extrafamilial events. In a pilot study of adolescent football players, findings indicated that risk of injury was significantly greater for those with greater object loss (family instability, particularly death of parent, divorces and separation) rather than life change.

Passer and Sesse (1983) suggested that the above findings offered some support, in part for injury being related to negative rather than positive life-events. This coupled with evidence suggesting that intrapersonal and situational variables might moderate the life-stress relationship (e.g., Cooley & Keesey, 1981) led Passer and Sesse (1983) to further improve life-stress research methodology. Earlier life-stress measures simply included a computation of an overall life-change score, whereas Passer and Sesse modified the Life Experiences Survey (Sarason, Johnson, & Siegel, 1978) to distinguish between negative and positive life-events. This new scale, the Athletic Life Experiences Survey, (ALES) now permitted the computation of separate unit scores for desirable (positive) and undesirable (negative) events, thus allowing both an assessment of event desirability and impactability. Using the ALES, Passer and Sesse found that Division II American football players with higher levels of negative life-events were at greatest risk of injury, however similar results were not found among Division 1 players. Up to this point most of the life-stress studies had primarily examined male American Football Players. However, Hardy and Riehl (1988) (also using the ALES) examined the role of life-stress and object loss among a mixed gender population of collegiate athletes. In line with previous studies injured athletes had greater negative life-stress compared to non-injured athletes. In addition, negative life-events was the most salient predictor of injury frequency.

Williams, Tonymon, and Wadsworth (1986) provided a direct comparison of the SARRS with the ALES using a sample of collegiate volleyball players. Unfortunately, because no life-stress injury relations were found the relative merits of each life-stress measure were not examined. In a review of the life-stress literature Andersen and Williams (1988) suggested that life-event inventories such as the SARRS and ALES were inadequate and required refinement. Criticisms of the SARRS and ALES included that they are merely modifications to previous instruments with limited reliability and validity data associated with them. Due to these methodological concerns, Petrie (1992) developed an athlete-specific life-event measure—the Life Events Survey for Collegiate Athletes (LESCA). In his paper Petrie (1992) demonstrated good construct validity for the LESCA and also showed it to be better than the SARRS for predicting athletic injury.

Overall, using the LESCA and other life-event measures, research findings have provided general support for the life-stress injury relationship (Andersen & Williams, 1999; Bramwell et al., 1975; Cryan & Alles, 1983; Ford et al., 2000; Hardy & Riehl, 1988; Hardy, 1992; Passer & Seese, 1983; Petrie, 1992; Sarason et al., 1978; Smith, et al., 1990; Willlams et al., 1986). Two recent reviews have been performed, which also emphasise the life-stress injury relationship. The first review of 20 studies by Williams and Roepke (1993) reported that athletes with high life-stress were two- to five-times more likely to sustain injury compared to athletes with low life-stress. The second by Williams (2001) suggested that of the further 15 stress studies identified since the earlier 1993 review, 12 provided results that concurred with previous research (Andersen & Williams, 1999; Byrd, 1993; Fawkner, 1995; Kolt & Kirkby, 1996; Meyer, 1995; Patterson et al., 1998; Perna & McDowell, 1993; Petrie, 1993a, 1993b; Thompson & Morris, 1994; Van Mechelen et al., 1996; Williams & Andersen, 1997). Results from the remaining three studies (Lavelle & Flint, 1996; Petrie & Stoever, 1995; Rider & Hicks, 1995) found no relations between life-stress and injury. Ongoing research in this area continues to support the relationship between life-stress and injury (e.g., Gunnoe, Horodyski, Tennant, & Murphey, 2001).

Evidence to support the role of negative life-stress, positive life-stress, or total life-stress being the culprit is varied. For instance, many of the studies that distinguish between life-stress provided evidence that only negative life-stress increased injury vulnerability (Byrd, 1993; Meyer, 1995; Passer & Seese, 1983; Patterson et al., 1998; Petrie, 1992; Petrie, 1993b; Smith, Smoll, & Schutz, 1990; Smith et al., 1992). Others support the role of positive and total life-events (Blackwell & McCullagh, 1990; Hanson et al., 1992; Petrie, 1993a). However, Kontos (2001) using a meta-analytical approach reported the following correlations between life-stress and injury: (a) total life-stress, $r = .13$; (b) negative life-stress, $r = .14$; and (c) positive life-stress, $r = -.02$. These finding suggest that negative and total life-stress are important factors when considering injury risk or vulnerability.

The next category under the heading of history of stressors is daily hassles, which refers to the minor daily problems or irritations that occur in life. As highlighted by Andersen and Williams (1988) a weakness of earlier stress-injury studies is that they only examined stress within the framework of life-events—assessing only major life-stresses. Some researchers (e.g., Coyne, Kanner, & Hulley, 1979; Kanner, Coyne, Schaefer, & Lazarus, 1981) have suggested this major life-events approach to stress measurement places too much emphasis on the role of change, whilst neglecting the subjective significance of different events and the importance of differences between individuals' coping skills and resources. The role for examining the more frequent minor stresses associated with daily living ("hassles") has been argued for (Coyne, et al., 1979; Kanner, et al., 1981). The major traumatic but infrequent life-event changes to one's life are likely to produce stress which is of less significance for affective outcomes such as morale, psychological symptoms, and somatic health, compared to the more frequent minor stresses associated with everyday living (termed “hassles”). This argument is based around the substantial cumulative adaptational significance of these relatively minor stresses (Kanner et al., 1981). Kanner and colleagues (1981) developed the Daily Hassles Scale (DHS) to measure minor chronic stressors or “hassles” rather than major life-events. Results from this work showed that hassles were a considerably better predictor of psychological symptoms than major life-events. Other research has shown that the frequency and intensity of hassles are better able to explain psychological symptoms and somatic health than life-event measures (DeLongis, Coyne, Dakof, Folkman, & Lazarus, 1982). More recently, Savery and Wooden, (1994) examined the relative influence of major life-events and daily hassles on work-related injuries. Results from this study showed that life-events appeared to increase the probability of being injured by about 10%. However, when the measure of hassles frequency was examined it proved to be the best predictor of injury occurrence (up to 20% of cases).

With respect to sport there remains a dearth of literature that has examined the nature of “hassles” and athletic injury. Blackwell and McCullagh (1990) examined the relationship between life-change, competitive anxiety, and athletic injury. Two measures of life-stress were administered, first the Athletic Life Experiences Scale (ALES) at pre-season and then the Daily Hassles Scale (DHS) at the end of the season. Results showed that the ALES total score significantly differentiated injured versus non-injured athletes, however daily hassles scores did not. These non-significant findings for daily hassles may have been related to the DHS being administered at the end of season.

Another study by Hanson, McCullagh, and Tonymon, (1992) examined the relationship between life-events, coping resources, and athletic injury using a measure of minor life-events. Again, no relationship between minor life-events and injury was seen. In this study the minor life-events was only measured once and could have contributed to the non-significant findings. In support of minor life-events, a retrospective study by Luo (1994) found a relationship between minor life-events and athletic injury.

The exact mechanism of minor events or hassles is unknown. Kanner et al. (1981) commented that, "ultimately we need to know whether the impact of a hassle depends merely on its cumulative impact or on its content and meaning in the person's life" (p. 5). Single or retrospective assessments of minor life-events (hassles) do not seem appropriate to fully understand this relationship. Rather multiple assessments during a competitive season might truly reflect the ever-changing nature of minor life-events (hassles).

In an attempt to address these concerns, Fawkner, McMurray, and Summers (1999) examined the hassles-injury relationship by recording changes in weekly hassles throughout a competitive season. Results revealed differences in the profile of weekly hassle scores for injured and non-injured athletes. Injured athletes reported a significant increase in mean intensity of hassles scores in the week prior to injury. Also a decrease in hassles intensity was seen from injury occurrence to 2-weeks post injury. Minimal fluctuations were seen in the intensity of weekly hassles for non-injured athletes.

The Daily Hassles Scale (Kanner et al., 1981) has been used to assess "hassles" in all the previous studies. No one has attempted to develop a sport specific hassles measure, which may continue to hinder research in this area. The generalisability of the DHS (Kanner et al., 1981) to athletes is questionable. Until a sport-specific scale is developed then the relationship between daily hassles and injury may not truly be elucidated (Williams, 2001).

Highlighting the issue of specificity, Dunn, Smith, and Smoll (2000) provided evidence that sport specific stressors predicted time loss due to injury over and above general life-stress among female high school athletes. However, their study did not show similar effects for male athletes. Overall results from this study showed that differences in the two classes of stressors accounted for 3%, and 7% of the injury variance in males and females respectively. As this is the only study of its kind, further work is required to replicate these results and to generalise these findings.

The third component to the history of stressors category is previous injury. A number of reasons for including previous injury in the stress-injury model are offered by Williams (2001). The first suggests that an athlete returning to sport when they are not fully recovered is at greater risk of re-injury. Second, the athlete that is physically but not psychologically prepared for return to sport participation risks re-injury because of potential negative cognitive appraisal and anxiety. To emphasise this point, Andersen and Williams (1988) posited that fears or concerns of re-injury may evoke the stress response, increasing the likelihood of subsequent injury. This relationship between previous injury and vulnerability to subsequent injury has received little empirical investigation. However, Hanson et al. (1992) reported that time from injury recovery was unrelated to subsequent injury frequency, or severity. In contrast, Williams, Hogan, and Andersen (1993) showed a positive relationship between previous injury and subsequent injury, whilst Lysens, Van den Auweele, and Ostyn, (1986) reported higher risk of re-injury among those with previous injury. Van Mechelen, et al. (1996) observed that previous injury was a better predictor of injury than psychological, psychosocial, physiological, and anthropometric factors. An important methodological point was made by Williams (2001) stating that previous studies have not distinguished between the recurrence of an old injury, or the occurrence of a new injury at a new site.

Personality

Personality is the next heading in the Andersen and Williams (1988) and the revised Williams and Andersen (1998) models. Within the stress-illness literature numerous personality variables have been identified for their role in moderating the stress-illness relationship. Within the stress-injury model (Andersen & Williams, 1988; Williams &

Andersen, 1998) it is suggested that certain personality characteristics could allow some individuals to perceive fewer situations and events as stressful, or they could permit individuals to be less vulnerable to the effects of stressors such as major and minor life-events (Williams, 2001). In their initial stress-injury model Andersen and Williams (1988) presented five possible personality variables that had either moderated the stress-illness relationship or were examined in the sport injury literature (i.e., hardiness, locus of control, sense of coherence, competitive anxiety and achievement motivation. These five-variables were never considered to be an exhaustive account of all personality factors, rather they served as suggestions for future research in identifying those most vulnerable to injury.

In the 16-years that has elapsed since Andersen and William proposed the five personality variables in the stress-injury model, no sport injury researchers have assessed hardiness or sense of coherence. Despite this, evidence does exist in non-athletic settings for the relationship between hardiness and illness. Kobasa (1982, p. 250) defines hardiness as a "personality style or set of general attitudes toward self and world that express: (a) *commitment* to self, work, family and other areas of involvement; (b) *control* or belief in ability to influence what occurs in one's life space; and (c) *challenge* or an interest in change and new experiences". Having developed a hardiness scale, Kobasa and colleagues (Kobasa, 1979; Kobasa, Maddi, & Kahn, 1982) found that after controlling for prior levels of physical illness, hardness was a significant predictor of subsequent illness one year later. Kobasa et al. (1982) went on to conclude that the personality constellation assessed by the hardiness construct serves as a protective buffer against physical illness.

Despite this, Swindle, Jr, Heller, and Lakey (1987) suggest that this type of research shares a number of problems common to the studies of personality and stress. They highlight a number of concerns when examining the role of personality and stressful life-events. The first being, that the major variance in hardiness may be a simple reflection of prior levels of psychological symptomatology. In a principal-component factor analysis performed on the six-scales used in forming the composite hardiness score, the scales with the highest loadings on the General Hardiness factor were concerned with “Powerlessness”, “Alientaion from Work”, and “Alienation from Self”. Swindle et al. argued that items from these subscales could be tapping depressive symptomatology, and if so the Kobasa et al. (1982) findings could be re-interpreted as indicating that depressive individuals with self-concepts that include alienation and powerlessness are candidates for future illness when controlling for prior levels of physical symptoms.

Swindle, Jr. et al. (1987) also suggests that, with the hardiness concept there is an expectation engendered that hardiness characteristics apply equally to all situations and circumstances. They argue that the search for resistance resources should lie in understanding the necessary coping for particular situations rather than identifying hardiness traits or “invulnerable persons”. It is clear that more research is necessary to understand the role of hardiness as a factor in the stress-injury relationship.

Only one study has examined the role of achievement motivation in a sport injury setting (Van Mechelen et al., 1996). Findings did not support a relationship between achievement motivation and the incidence of injury. With respect to locus of control and anxiety, a number of studies have been performed producing equivocal results. First, for locus of control, Pargman and Lunt (1989) reported a positive association between external locus of control and injury severity (greater time loss due to injury) among freshman football players. Kolt and Kirkby (1996) found no relationship between locus of control and injury among non-elite gymnasts. However, among elite gymnasts a more internal locus of control was predictive of injury. Tyler (1986) showed that locus of control interacted with negative life-events to predict injury/illness among collegiate field hockey players. A number of researchers (Blackwell & McCullagh, 1990; Hanson et al., 1992; Kerr & Minden, 1988;

McLeod & Kirkby, 1995; Tyler, 1986) have used non-sport measures to assess locus of control and found no relationship with injury incidence.

Insofar as trait anxiety is concerned, Kolt and Kirkby (1994) found a significant relation with injury. Athletes with four or more injuries could be distinguished from those with no injuries by higher scores on the anxiety measures. In addition, gymnasts with more injuries had higher CSAI-2 Cognitive Anxiety scores. Using general measures of trait anxiety researchers have reported no support for relations between anxiety and injury. For example, Kerr and Minden (1988) found no relations between trait anxiety and injury among gymnasts. Similarly, Passer and Seese (1983) found no relations between injury and anxiety in American football players. However, using sport-based tools to assess competitive trait anxiety and having divided their samples based on injury status (injured vs. non-injured) a number of investigators have found that greater number (or severity) of injuries was related to higher competitive anxiety scores (e.g., Blackwell & McCullagh, 1990; Hanson et al., 1992; Lavelle & Flint, 1996).

In a different approach Petrie (1993a) showed that competitive trait anxiety had a direct and an indirect effect on injury. For the direct effect Petrie found that increases in trait anxiety were positively associated with injury rate for collegiate football 'starters', but not so for 'non-starters'. With respect to the indirect effect, Petrie showed that competitive trait anxiety moderated the effects of positive life-stress, in that greater time lost due to injury was associated with higher levels of anxiety and stress. This combination of having high life-stress and competitive trait anxiety "may have negatively influenced" these athletes' appraisals such that they either viewed practices and competitions as threatening / uncontrollable, or believed they did not have the resources to cope. Such appraisals may have corresponded with "attentional and physiological disruptions that would have increased the starters "vulnerability to injury" (p. 272). Further work is therefore required to fully understand the relationship between locus of control, anxiety, and injury vulnerability.

As highlighted in her review, Williams (2001) stated, "except for Petrie (1993a) none of the preceding studies employed designs that permitted testing whether their personality variables interacted with history of stressors or with other personality and coping variables in influencing injury risk. Such limited designs will not elucidate the potential complexity of the relationship of personality factors to injury vulnerability and resiliency" (p. 772).

Although general anxiety in the sense of a personality trait, appears to have no clear effect on sports injuries competitive anxiety clearly does, however research needs to include sport-based instruments rather than general ones (Junge, 2000). Moreover, Williams (2001) noted that injury researchers should consider using a multi-dimensional assessment of anxiety such as the Sport Anxiety Scale (SAS, Smith, Smoll, & Schutz, 1990), which differentiates cognitive and somatic anxiety, compared to the Sport Competition Anxiety Test (SCAT), which utilises a uni-dimensional approach to anxiety. It is suggested that the different subtypes of anxiety highlighted in the SAS could, at various levels differentially influence an athlete's cognitive appraisal and attentional / physiological disruptions when faced with a stressful situation (competition / practice). Another important aspect highlighted is the inclusion of some assessment of whether athletes interpret their anxiety symptoms as being facilitative or debilitative to performance (referred to as direction of anxiety) (Jones, 1995). Athletes most vulnerable to injury may be ones that not only have high competitive anxiety, but also interpret their anxiety as being detrimental to their performance. Jones (1995) and Leffingwell and Williams (1996, cited in Williams, 2001) present a comprehensive discussion of the conceptual distinctions between intensity and direction of anxiety, and offer suggestions to modify current anxiety tools.

Since the original five possible personality factors were proposed by Andersen and Williams (1988), a number of other factors have been subsequently studied, suggesting that some types of aggression, anger, or dominance measures may be related to injury. For example, Jackson et al. (1978) examined injury prone football players and found two bi-polar psychological traits—reserved vs., outgoing and tough mined vs., tender-mined differentiated injured versus non-injured players. In support of these findings, Valliant (1981) also reported differences between injured and non-injured runners such that injured runners were less tough-minded and less forthright. Later work by Fields, Delaney, and Hinkle (1990) revealed opposite findings. They showed that Type-A personality variables (i.e., aggression and hard driving) were positively associated with injury incidence compared to athletes with lower scores. Thompson and Morris (1994) found that high anger directed outward, but not inward, increased injury vulnerability. Tough mindedness has been found to predict injury severity (but not occurrence) (Wittig & Schurr, 1994). From their findings Wittig and Schurr proposed that athletes with this type of personality profile might undertake greater risk-taking and therefore incur more severe injuries. Gill, Henderson, and Pargman (1995) found no differences in the number of injuries and time missed between Type-A or Type-B runners (Type-B being more relaxed, unhurried, and less anxious in response to challenge compared to Type-A).

In a different approach, a number of researchers have examined the link between mood states and injury (Fawkner, 1995; Lavelle & Flint, 1996; Van Mechelen et al., 1996; Williams et al., 1993). The Positive States of Mind (PSOM) scale (Horowitz, Adler, & Kegeles, 1988) assesses participant’s ability to enter desirable states of mind such as keeping focussed, staying relaxed and sharing with others. In the first examination of relations between injury and the PSOM, Williams et al. (1993) found that for athletes who experienced positive states of mind early in the season sustained significantly fewer injuries during the subsequent season, compared to those with less positive states of mind. By assessing mood states at various time periods through the athletic season, Fawkner (1995) found that negative mood states increased significantly prior to injury, supporting the notion that positive states of mind might buffer the effects of potentially stressful sport situations, thus creating less stress and fewer injuries. Using the Profile of Mood States (POMS) inventory (McNair, Lorr, & Droppleman, 1971), Lavelle and Flint (1996) reported a positive association between negative mood (tension/anxiety) and injury rate. Also severity of injury was positively associated to negative mood states (anger/hostility) and total mood state. In another study, Fritts (1992) found that linear trend analyses revealed a great deal of fluctuation in the mood states of gymnasts over a competitive season. It was argued that because of these large fluctuations and modest sample size ($n = 10$), relations between mood states and injury could not be determined. However, this approach of repeated assessments is consistent with that of Fawkner (1995) and supports the need for further examination of this issue. It is possible that negative mood states predispose an athlete to injury, but may also be a consequence of injury occurrence, or time missed due to injury. Subsequent work might consider some form of cross-lagged path analyses to examine the issue of causality (e.g., Granberg & King, 1980).

Sensation seeking behaviour has also been highlighted under the personality heading to have a directly or an indirect affect to injury. Theoretical support for the influence of risk taking tendency was found in the concept of risk homeostasis and sensation seeking. With risk homeostasis (Wilde, 1982) the central idea is that everyone has a target level of acceptable risk. A feedback mechanism is postulated in which the individual ensures that the target level of risk is realised, taking into account all internal (e.g., physical condition and ability) and external (e.g., difficulty of task and weather) circumstances. The target level of risk is supposed to be a function of expected outcome (i.e., advantages or disadvantages) of risky and cautious behaviour alternatives. Individual differences in optimal arousal, and thus in risk taking tendency (target level) can be partly operationalised with the personality trait sensation seeking (SS; Wilde, Claxton-Oldfield, & Platenius, 1985). This trait has been defined as "the need for varied, novel, and complex sensations and experiences and willingness to take social risks for the sake of such experience" (Zuckerman, 1979, p. 10).

In a study of sensation seeking behaviour and injury risk in downhill skiing, Bouter, Knipshild, Feij, and Volovics (1988) reported that high sensation seeking was associated with lower risk of injury for skiers that made medical related claims compared to a control condition (i.e., skiers that made non-medical claims). These results were contrary to the work of Conolly (1981) who reported greater sensation seeking among skiers who reported an injury in the past compared to skiers who had never been injured. Both of these studies however should be viewed with some caution due to their retrospective designs. In a more recent study, again examining a snow-skiing cohort, Cherpitel, Myers, and Perrine, (1998) reported being female and low sensation seeking was predictive of injury. Also the authors reported that drinking alcohol 12-hours prior to skiing was the better predictor of injury.

Only one study has examined the role sensation seeking as a potential moderator of the stress-injury relationship (Smith, Ptacek, & Smoll, 1992). Smith et al. found that only athletes who scored low in sensation seeking had a significant positive relationship between major negative sport-specific life-events and subsequent injury (time-loss). Although Smith, et al. found greater scores for the four-coping subscales (freedom of worry, concentration, stress management, and peaking under pressure) for those with high sensation seeking behaviour compared to low sensation seekers, they found no support that coping served to mediate injury vulnerability differences. These results suggested that the high sensation seeking (e.g., more risk-taking behaviours) did not represent an injury-vulnerability factor. Further research is needed to examine the role of sensation seeking as a buffer to injury vulnerability by examining those who score high on sensation seeking and to determine their response to some form of laboratory-induced stress. If individual differences in the ability to tolerate emotional arousal produced by stressful life-events exist, then high sensation seekers may be more likely to exhibit a muted stress response than low sensation seekers (Smith et al., 1992).

A number of other personality moderator variables from the Williams and Andersen model (1998) have been examined including, sensation seeking behaviour (Smith et al., 1992), dispositional optimism and hardiness (Ford et al., 2000). Original variables from the Andersen and Williams (1988) such as hardiness and sense of coherence merit research attention, as do other personality variables. The assessment of these variables as potential moderators or the life-stress injury relationship is warranted.

Coping Resources

Coping is the third heading in the Andersen and Williams (1988) and revised Williams and Andersen (1998) models, and from the broadest perspective refers to those actions or thoughts that enable individuals to handle difficult situations (Stone, Helder, & Schneider, 1987). Coping resources represents a broad set of behaviours and social networks that assist an individual to deal with various life-stressors. Coping resources may be extrinsic, such as social support networks, or intrinsic (e.g., personal coping capabilities). Coping may have a direct effect in inoculating an individual against injury, or it may have an indirect effect by moderating or mediating the stress response (Stone, Helder, & Schneider, 1987).

In their original stress-injury model, Andersen and Williams (1988) included general coping behaviours, social support systems, stress management techniques, and various mental skills, as well as medication (prescribed or self-administered) under the heading of coping resources. Under the general coping behaviour category, behaviours such as sleep patterns, nutritional habits, and taking time for oneself were included. Social support has been viewed as both a mode of coping with stressful situations and as a mediator of the stress response

(Stone, Helder & Schneider, 1987). Social support coping can be divided into problem and non-problem directed. Problem-directed support can be defined as seeking assistance from social networks (i.e., friends and family), whereas non-problem-directed support is simply expressing one's feelings to and receiving empathy from another person without necessarily seeking advice, and is often termed emotional support (Stone, Helder, & Schneider, 1987). Social support typically refers to the presence of others whom we know value and care for us, and on whom we can rely (Sarason, Levin, Basham, & Sarason, 1983).

The stress management techniques and mental skills component of coping are often referred to as psychological coping skills. These refer to the various techniques an individual has at his or her disposal to deal with potential stressors and include skills such as arousal control and dealing with concentration disruption. The final coping resource highlighted in the model refers to the use of medication (prescribed or self-administered). Drug use is prevalent in today's society, with many of the substances influencing cognitive perception and physiology, which in turn could affect the stress response, thereby increasing injury vulnerability. Despite this, assessment of drug use is difficult, if not impossible, due to the often subversive nature of' drug use (Williams, 2001). Numerous problems exist to allow researchers to truly understand the nature of drug use and its relation to injury vulnerability (e.g., truthful reporting, Williams, 2001). Due to these problems, Williams and Andersen (1998) in a critique of the original model suggested that medication should be removed from the model. Despite the removal of medication from their model, injury researchers might consider examining the role of drug taking and injury vulnerability. For example, athletes taking anabolic steroids may have increased aggression or tension which in turn contributes to injury. Alternatively, prolonged stimulant use may contribute to chronic fatigue and therefore injury vulnerability.

With respect to coping resources, it is plausible that low coping may lead to greater amounts of stress thereby increasing injury vulnerability. Conversely, individuals who feel better equipped to cope with the demands of stressful competitive situations may be less vulnerable to injury. There is considerable evidence supporting both a direct and an indirect effect to injury. Some have shown coping resources (or lack of) to either predict injury (Williams, Tonymon, & Wadsworth, 1986) or discriminate injured from non-injured athletes (Hanson, McCullagh, & Tonymon, 1992; Williams et al., 1986). However, others have been unable to provide support for coping measures as a predictor of injury (Blackwell & McCullagh, 1990). Social support on its own has also been shown to influence injury in athletes, such that athletes with low levels of support were more likely to be injured, whereas athletes with high levels of social support had fewer injuries (Byrd, 1993; Hardy, Connor, & Geisler, 1990). Other researchers have found no relationship between social support and injury (Lavelle & Flint, 1996; Rider & Hicks, 1995).

With respect to an indirect response between coping and injury, some researchers have examined whether social support and/or coping resources might moderate the life-stress injury relationship. A moderator variable is a qualitative or quantitative variable that affects the nature, the direction, or the strength of a relation between an independent or predictor variable (Arnold, 1982; Baron & Kenny, 1986). Smith, Smoll, and Ptacek (1990) suggested that more information is needed to understand how different moderating variables might function in combination with one another. In doing so research can "identify patterns of moderator variables that can: (a) increase the amount of outcome measure variance accounted for by life-event measures; and (b) serve as a basis for identifying highly vulnerable individuals" (Smith et al., 1990, p. 361). It is proposed that multiple moderator variables may function in a number of ways to influence the life-stress-injury relationship. In some cases they might affect the relationship independently, whilst in others, they may act interactively.

Smith et al. (1990) in their seminal paper make the distinction between two types of moderating conditions, called disjunctive and conjunctive moderation (Smith, et al., 1990). Disjunctive moderators act in an all or none manner, that is, the relevant moderating variable must exist in a high or low manner to affect the base relationship. For example, the life-stress injury relationship would be strengthened, when either, low social support, low coping skills, or high history of stressor was present. If these variables existed at a specific magnitude the moderator effect occurs and the contribution of other variables will not have a notable incremental effect on the predictor-criterion relation. Conjunctive moderating variables however, act in a particular combination to produce an optimal effect. For example, the life-stress injury relationship would be strengthened under the following condition, low social support, low coping skills, and high history or stressor. "Such is the effect of multiple moderators that a certain pattern is necessary, but not individually sufficient to produce the maximum moderator effect" (Smith et al., 1990, p. 361). Moreover, Smith et al. stated that, "conceptually, conjunctive patterns involve two levels of interaction effects: (a) an interaction between two or more moderator variables; and (b) an interaction of pattern "a" with the predictor variable. In the simplest instance involving a predictor variable and two moderator variables, we would be concerned with a three-way interaction involving moderator_1, moderator_2 and the predictor (e.g., life-stress)"(Smith et al., 1990, p. 361). Results from the Smith et al. (1990) study showed that the relationship between life-stress and injury was maximised only for athletes that were low in both coping skills and social support. Furthermore, negative-life-events accounted for 22-30% of the injury time loss variance for athletes low in both social support and coping skills.

Since this paper was published a number of studies have examined the moderating effect of social support and coping skills. For example, Petrie (1992) showed that among gymnasts with low social support (lower third distribution of social support scores) negative life-events accounted for 6-12% of the injury variance outcome. Petrie suggested that low social support increased vulnerability to injury, whereas high social support seemed to provide injury protection. Patterson, Smith, Everett, and Ptacek (1998) found that among ballet-dancers life-events was not related to injury, however for those with low social support, life-events accounted for nearly 50% of the injury variance. Andersen and Williams (1999) reported that athletes with high life-stress, low social support, and greater peripheral narrowing during a stressful laboratory condition were more likely to be injured than those with the opposite profile.

Gender has been highlighted as an important consideration when attempting to understand the direction of the effect that moderating variables may have on a base-relation. For example Hardy et al. (1990) found that for females low in social support (number of people and satisfaction) the life-event measures score (total life-events—TLE, negative life-events—NLE or object loss—OL) accounted for 69% to 92% of the injury variance. The amount of injury variance seen also depended on whether TLE, NLE, or OL scores were examined. When females who scored high in social support (number of providers) were examined, TLE and OL scores now accounted for 50% and 55% of the injury variance respectively. In a later study, Hardy et al. (1991) reported that high social support, combined with high OL or PLE had a negative rather than a positive effect on the well being of male athletes. For male athletes with high negative life-events and high social support the injury rate decreased.

Overall, research has shown that social support has a role to play in, either directly influencing injury or as a moderator of the life-stress injury relationship. Coping resources also appear to have a moderator effect, yet their direct relationship to injury is less clear. A limitation of past research is the failure to test how all the moderating components of the model (i.e., history of stressors, personality, and coping) might interact together to influence the life-stress injury relationship. Also, “no studies have used the Smith et al. (1990) paper as a prototype for future injury research” (Williams, 2001, p. 776), in that similar design and statistics have not been used. Specifically, Smith and colleagues (1990) make a coherent argument for the use of correlation versus regression analysis when examining the roles of moderating variables, therefore the aim of the present study is to use the revised Williams and Andersen (1998) stress and injury model (Figure 2) as a framework to predict the occurrence of sport injury in New Zealand rugby players. A secondary aim is to use the Smith, et al. study as a prototype from which to base statistical procedures and analyses to determine the extent to which individual differences in athletes’ coping resources, history of stressor, and personality scores, both separately and in combination, affect the magnitude of the correlation between life-stress and sport injury. Insofar as predicting sport injury is concerned, the following hypotheses are generated. A mild-to-moderate positive relationship will be found between life-stress and sport injury. Personality, history of stressors, and coping resources will moderate relations between life-stress and injury. These variables will act in a conjunctive fashion (multiple moderators co-occur in a specific combination or pattern) to maximise relations between life-stress and sport injury.

Chapter 3
Methods – Study 1

Participants and General Recruitment Procedure

Six-hundred male rugby (union & league) players from 37-separate teams were recruited for the study. Four hundred and seventy participants provided complete injury and questionnaire data and were included in the final analysis. Participants ranged in age from 16 – 34 years (M = 20.69, SD = 4.18) and were from a variety of ethnic groups (NZ European, 50%; NZ Maori, 17%; Pacific Islanders 28%; other 5%). All played at a competitive school or club level.

Approval was obtained from the University Ethics Committee. At the beginning of the 2001 season rugby union and rugby league clubs were contacted to elicit the desire to participate in the present study. Team managers and coaches were contacted to gain access to team players. Players received verbal and written information before signing consent forms (Appendices, A & B). Players were also given a battery of measures to complete prior to a team practice, which were collected by the investigator on completion. The measures included a demographic sheet, assessments of social desirability, life-stress, social support, competitive anxiety, and coping. A question was also asked to ascertain history of injury within the previous 12-month period. Injury data (dependant variable) were collected throughout the season.

Psychological Measures

Demographic information. All participants provided the following demographic information, age, ethnic affiliation, height, weight, grade, and playing position.

Life-stress. The Life Events Survey for Collegiate Athletes (LESCA; Petrie, 1992) was used to assess life-stress (Appendix C). The LESCA is a 69-item questionnaire used to measure positive and negative life change. Participants were asked to report each of the events that they had experienced in the previous 12-months. For each life event experienced the athlete had to indicate the event's impact on an eight point Likert-type scale (from – 4 extremely negative to + 4 extremely positive). By summing the respective life-events values, two life-event scores can be derived (negative [NLE] and positive [PLE]). Adequate scale reliability and validity results have been reported, with test retest reliabilities ranging from .76 to .84 (Petrie, 1992). In the present study the following modifications were made to the LESCA to increase its appropriateness to the all male sample and to ensure its applicability to non-collegiate athletes: (1) all items were keyed to male respondents (e.g., breaking up with boyfriend / girlfriend was changed to breaking up with girlfriend); (2) three of the female items were deleted (e.g., female: menstrual period / PMS); and (3) items that only represented collegiate athletes were changed to incorporate other non-collegiate athletes (e.g., being dismissed from college residence) was changed to (being dismissed from school or home residence). In the present study only the NLE scale was used, because of it is consistent relationship to injury (cf., Kontos 2001). Reliability for the NLE measure was good (Cronbach alpha, $\alpha = .82$).

Coping resources. The modified version of the Ways of Coping Scale (M-WCS; Grove, Eklund, & Heard, 1997) was used to measure the frequency specific strategies are used to cope with competition stress (Appendix D). The M-WCS is a 26-item multidimensional scale that measures five separate coping components; social support, denial, avoidance, wishful thinking, emotional control, and effort resolve. Cronbach's alpha values for the separate scales were denial, .62; social support, .82; effort, .76; wishful thinking, .78; and emotional control, .46. Because of the poor reliability, emotional control was removed from subsequent analysis. Coping consists of a combination of cognitive and behavioural strategies used to manage stress, and according to Folkman and Lazarus (1985) takes two basic forms. The first general form has been termed as problem focused coping, and refers to attempting, altering or removing the stressor. The second form is termed emotion focused coping, and involves an attempt to regulate the emotions or distress created by the stressor. Avoidance coping has also been proposed by Endler and Parker (1990) and may serve instrumental and person oriented benefits by providing a break from the stressful situation (Grove et al., 1997). Consistent with theoretical underpinnings of coping, and to reduce the number of variables for analyses, a problem focused scale was derived by summing values from effort and seeking social support (α = .84). An avoidance-coping scale was also derived by summing values from denial/avoidance and wishful thinking (α = .75). Possible scores for both scales was 0-30.

Social support. The Social Support Questionnaire (Cauce, Felner, & Primavera, 1982) adapted by Smith, Smoll, and Ptacek, (1990) was used to assess the amount of social support available to the individual (Appendix E). On separate scales participants indicated the extent to which each individual and group could be counted on to provide them with: (a) emotional support and caring; and (b) help and guidance on a scale ranging from ‘not all helpful’ (1) to ‘very helpful’ (5). Scores were summed to provide overall measures of social support. Smith, Smoll, and Ptacek reported 1-week test-retest reliability of .87 for emotional support and .88 for help and guidance. Due to the high correlations between these two measures only social support was used in the present study. Cronbach’s alpha value for social support was .85. The social support measure used in the present study differs from the subcomponent of the M-WCS—whereas the social support questionnaire assesses those parties available to participants to provide support and how helpful these were in providing emotional support, the M-WCS assesses the seeking of social support (e.g., “I look for help”). These two measures were mildly correlated (r = .26) and were considered to be sufficiently different to be tapping separate constructs.

Personality-competitive anxiety. The Sport Anxiety Scale (SAS; Smith et al., 1990) was used to measure sport specific competitive anxiety. Smith, Smoll, and Schutz (1990) have presented factor analyses, reliability and validity results for the SAS. Recently Dunn, Causgrove-Dunn, Wilson, and Syrotuik (2000) re-examined the factor structure and factor composition of the SAS using male intercollegiate and high school athletes. Overall, they found that their data supported the tenability of the original three-factor model proposed by Smith et al. (1990). However, two of the items (i.e., 14 and 20) originally designed to measure Concentration Disruption loaded on the Worry factor. The reconstituted scale was used in the present study, with possible scores as follows; somatic anxiety, 8-32 (α = .84), worry, 9-36 (α = .84) and concentration disruption, 3-12 (α = .80).

Social desirability. The Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960) is a 33-item scale that assesses impression management and self-deception aspects of social desirability. In the present study, the short version (13-item) of the scale was used (Appendix G). This version correlates (r = .93) with the standard form (Reynolds, 1982). Participants were asked to indicate whether each statement was true or false as it related to them (e.g., no matter who I am talking to, I'm always a good listener). Scores range from 0-13 with the higher score indicating greater deception. For the present sample the Cronbach alpha value was .67. Social desirability scores only had a mild correlation with the psychological measures (problem focussed coping, r = .12, avoidance based coping, r = -.19, concentration disruption, r = -.21, worry, r = -.19, somatic anxiety, r = -.11, and previous injury, r = -.08).

History of stressor. Within the Williams and Andersen model (1998) the history of stressor category includes, previous injury, major life-events, and daily hassles (Williams, 2001). In the present study history of stressor (previous injury history) was assessed by asking athletes to record the number of injuries sustained during the previous rugby season and also the time missed in weeks due to the injury. A composite score was then calculated by multiplying number of injuries by time lost. Hence, sustaining one major injury resulting in 4-weeks missed is equivalent to someone sustaining 4-minor injuries with a total of 1-week lost. However in reality most athletes recalled only one or two injuries (M = 1.34) with an average of 7-weeks missed, suggesting that the measure 'previous injury' reflected serious injuries and did not over represent minor ones.

Injury Assessment

Previous studies have generally classified injuries as those requiring medical treatment with the athlete missing at least one day of play or training. Andersen and Williams (1999) suggested a need to collect injury data that reflects minor as well as major injuries, including injury that requires modification to play (such as wearing protective head gear and strapping etc.). They argued that collecting this type of injury data is more in line with the prediction of their model—psychological factors are related to the number of injuries (irrespective of severity) that occur throughout the season.

Although we acknowledge the recommendation of Andersen and Williams with respect to injury occurrence their assessment of injury is not the only one endorsed in the literature. For instance, Hodgson-Phillips (2000) recommended all injuries be recorded, including transient injury—that is injuries requiring treatment but did not necessarily result in time missed. Furthermore, Hodgson-Phillips suggested that time lost from participation must be recorded accurately, using both training and game/competitive participation data. She suggested that failure to do so would see the loss of valuable data and the failure to portray the true injury picture of the sport. Because injury occurrence and time missed are inexorably linked, two approaches were taken to assess the dependant variable (injury). The first approach assessed time missed due injury, which reflected total time missed (in hours) as a results of injury occurrence (during either game or training). It was calculated using the following formula.

$$\frac{\text{Total time missed due to injury}}{\text{Number of players x Total time played and trained x 1000 hrs}}$$

The second approach included an assessment of injury number, which included all injuries resulting in an athlete having to modify at least one game or practice or receiving treatment pre and post practice, but did not necessarily result in time loss.

$$\frac{\text{Total number of injuries sustained}}{\text{Number of player x Total time played and trained x1000 hrs}}$$

As players and teams varied in the amount of time played and trained all data were corrected for exposure to injury. The data were expressed as time missed per 1000 contact hours. The benefit of this approach is that it permits comparison across sports (Hodgson-Phillips, 2000).

To obtain a prospective and an objective assessment of injury the team's coaches or managers were paid and trained to record injuries on a weekly basis. Each week, coaches or mangers completed injury data sheets that indicated whether a player played a game and the number of minutes played, whether an injury occurred during the game, whether the player missed any time due to that injury—identical data was collected for training time. Research assistants were responsible for collecting the injury sheets each week and returning these for data entry.

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Chapter 4
Results – Study 1

Overview of Data Analysis

Moderating Variables

As mentioned earlier, a moderator variable is a qualitative or quantitative variable that affects the nature, the direction, or the strength of a relation between an independent or predictor variable (Arnold, 1982; Baron & Kenny, 1986). A number of statistical approaches have been used to assess the presence of moderating variables. Two key approaches for assessing the presence of moderator variables are the correlation approach and the conventional moderated regression strategy. However, there has been some disagreement about the statistical procedures that should be used in the detection of such a variable (e.g., Arnold, 1982; Cohen & Cohen, 1983; Stone & Hollenbeck, 1989). Specifically, Arnold (1982) has raised questions regarding the use of the conventional moderated regression strategy for detecting moderating effects. Arnold argued that a distinction needs to be made between the *form*, and the *degree* types of moderator variable analyses. Second, he suggested that conventional moderated regression strategy is only appropriate in instances in which the researcher's interests are in detecting moderating effects of the *form* variety. These are characterised as being cases for which the slope of the regression line differs across the various levels of a moderator variable. Third, Arnold stated that in cases where the researcher is interested in degree-type moderating effects, zero-order correlations coefficients should be computed for two or more subgroups formed on the basis of the hypothesised moderator variables, and the consequent correlating coefficients should be tested for equality. This latter technique will be subsequently referred to as the subgrouping method. The correlation analytical approach is the most direct approach for assessing the amount of variance in an outcome variable accounted for by a predictor within specific subgroups defined by the moderator variables.

Stone and Hollenbeck (1984; 1989) have refuted Arnold's claims and argue for the perseverance of the moderated regression approach stating that the form or degree distinction is a product of an overly restrictive operational definition of the degree of relationship concept, that is restricting it to the correlation coefficient.

With these arguments in mind and in accordance with Smith et al. (1990), the analytical strategy employed in the present study focussed on determining the extent to which individual differences in athlete's social support, coping skills, personality, and history of stressors, singly and in combination affected the magnitude of the correlations between life-event and injury variables. In line with Smith et al's (1990) assessment of potential moderator effects, correlations were computed between the life-stress measure (NLE) and injuries for participants in the upper and lower thirds of the social support, coping resources, history of stressor, and personality distribution scores. This straight forward approach is appropriate on statistical grounds provided that restriction in range and variance in the predictor and dependent variable are not present in the subgroups defined by the moderator variable(s) (Arnold, 1982; Cohen & Cohen, 1983). In addition, regression of the injury measures on negative life-events separately for each of the moderating conditions should produce similar Y (injury) intercepts. Fundamental differences in intercepts could present difficulties in suggesting vulnerability or resiliency effects, even if the correlation coefficients differ (Cohen & Edwards, 1989). Finally, clarity in demonstrating conjunctive moderator patterns requires that the moderator variables of interest are not highly correlated with one another (Baron & Kenny, 1986). The distribution of the injury data were positively skewed and were subjected to a logarithmic transformation to reduce a potential spurious influence of extreme scores (Tabachnick & Fidell, 2001).

Descriptive Data

Descriptive data for the psychological and injury variables are presented in Table 1. Forty-six percent of players suffered at least one injury throughout the playing season. Bivariate correlations for all the variables of interest are presented in Table 2. Negative life-events were mildly correlated with both injury time loss ($r = .09$, $p < .05$) and number of injuries ($r = .11$, $p < .05$). Social support, coping skills (avoidance/problem focused), and personality (somatic anxiety, worry and concentration disruption) were not correlated to either injury measure. The history of stressor measure was mildly correlated with both injury time missed and number ($r = .17$, $p < .01$). Of the moderator variables used in the present study, only worry and avoidance coping were moderately correlated ($r = .39$, $p < .01$).

Testing for Moderation

For disjunctive (single) moderator effects, negative life-event (NLE)-injury (time missed) correlations increased for those either, low in social support, high avoidance coping, or high problem focused coping. NLE-injury (number of injuries) correlations also increased for those in the high avoidance coping or high concentration disruption subgroups (Table 3). In-line with Smith et al. (1990) the next logical step was to assess possible conjunctive (multiple) moderator effects of social support and coping resources by examining subgroups of rugby players who fell in the upper and lower thirds of the distributions on both measures. Descriptive and correlation data are presented in Table 4, for the four groups of athletes on the life-events measures and for the transformed injury variables. As can be seen in Table 4 increased correlation coefficients for NLE and injury (both time missed and injury number) were seen in the low social support and high avoidance coping, as well as the low social support and high problem coping subgroups (time missed only). Statistical tests for differences among three or more correlation coefficients (Edwards, 1984, p, 74) were applied and revealed that differences between the coefficients were not significantly different ($\chi2 = 4.16$, $p = .10$, $df = 3$).

Next, possible conjunctive moderator effects of social support and coping resources with the addition of personality or previous injury were assessed by selecting rugby players who fell in the upper and lower third distributions on all three measures (e.g., social support, coping, and personality or social support, coping, and previous injury). Descriptive data for the 8-subgroups for three moderating variables are presented in Table 5. As can be seen in Table 5, a further increase in the NLE-injury (time missed) relationship was seen for athletes in the following subgroups: (a) low social support, high avoidance coping, and low somatic anxiety; (b) high social support, low avoidance coping skills, and high somatic anxiety; (c) low social support, high avoidance coping, and low worry; (d) low social support, high avoidance coping, and high in previous injury; and (e) low social support, high avoidance coping, and high concentration disruption. In addition, a further increase in NLE and injury (number of injuries) relations was seen for athletes in the following subgroups: (a) low social support, high avoidance coping, and low somatic; (b) low social support, high avoidance coping, and low worry; (c) high social support, high avoidance coping, and high worry; and (d) low social support, high avoidance coping, and high concentration disruption (Table 5). Statistical test for differences among three or more correlation coefficients (Edwards, 1984, p. 74) were applied and revealed that the coefficients were not significantly different ($\chi2 < 14.06$, $p > .05$, $df = 7$). No statistically significant conjunctive relations using three moderator variables were found replacing avoidance focussed coping with problem focussed coping.

Moderated Regression Analysis

Although it has been highlighted that the correlation approach is an appropriate statistical approach for assessing moderator variables, an alternative and frequently used approach is moderated regression analysis involving a predictor variable, a moderator variable and a product term (Baron & Kenny, 1986). A hierarchical regression is performed in order to assess the unique increment in variance accounted for by the predictor and the moderating variables (Cohen & Cohen, 1983). This approach assesses how the moderator variables affect the form of the life-stress relations. To further explore the non-significant differences among the correlation coefficients a hierarchical regression approach using dummy variable moderators was conducted, as recommended by Smith (Personal communication, 2003) and based on an amendment to their 1990 published work. Adopting this approach, one group is selected as the reference group, and each of the un-standardised regression coefficients is the difference between the mean of one of the groups and the mean of the reference group (see Cohen, Cohen, West, & Aiken, 2003). To do this each of the eight social support / coping / personality / history of stressor subgroups served as dummy variables, then entering NLE, the dummy coded groups, and the NLE X dummy variable product score in that order.

A product-term interaction, R^2 change = .06, *F* Change (1, 123) = 8.89, $p < .01$ was found at step 3. For those low social support, high avoidance coping, and high previous injury, negative life-events explained a significant amount of the injury variance (*Beta* = .26). Similar results were seen for number of injuries sustained R^2 change at step 3 = .09, *F* Change (6, 119) = 2.11, $p = .05$. Negative life-events explained a significant amount of injury variance (*Beta* = .20) for those low in social support, high avoidance focused coping, and with high previous injury. No other moderating effects were found.

Table 1. Study 1 Descriptive Data for Psychological and Injury Variables.

Variable	*n*	*M*	*SD*	Range
Negative life-events	469	9.28	4.18	0-72
Somatic anxiety	468	16.18	4.65	8-32
Worry	470	17.05	4.75	9-36
Concentration disruption	469	4.73	1.76	3-12
Avoidance focused coping	456	11.19	5.73	1-29
Problem focused coping	459	14.82	5.75	1-30
Previous injury	469	17.36	33.42	0-234
Total time missed due to injury (per 1000 hrs)[a]	470	3.30	7.42	0-67
Total number of injuries (per 1000 hrs)[a]	470	0.95	1.37	0-8.9

a Represents the exposure corrected injury time loss and injury number data.

Table 2. Study 1 Bivariate Correlations of all Variables of Interest.

Variable	1	2	3	4	5	6	7	8	9	10
1. Negative life-events	1.00	-.12**	-.23**	-.09*	-.13**	-.24**	-.23**	-.22**	.09*	.11*
2. Social support		1.00	.15**	.25**	.07	.07	-.01	.01*	.06	.07
3. Avoidance coping			1.00	.34**	.18**	.39**	.25**	.14**	.01	-.01
4. Problem coping				1.00	.16**	.13**	-.03	.07	.06	.12**
5. Somatic anxiety					1.00	.47**	.21**	.07	.04	-.07
6. Worry						1.00	.35**	.15**	.01	-.02
7. Concentration disruption							1.00	.17**	.06	.02
8. Previous injury								1.00	.17**	.17**
9. Injury time loss									1.00	.69**
10. Number of injuries										1.00

n = 470 *$p < .05$, ** $p < .01$.

Table 3. Study 1 Correlations Between Negative Life-events and Injury for Single Moderator Variables.

	Negative life-events			Injury time missed			Number of injuries		
Moderator variables	*n*	*M*	*SD*	*M*	*SD*	*r*	*M*	*SD*	*r*
Low social support	162	7.78	9.79	.30	.43	.16*	.37	.42	.04
High social support	162	10.21	9.94	.37	.46	.05	.42	.43	.14
Low avoidance focused coping	157	7.47	9.57	.33	.44	.11	.39	.43	.08
High avoidance focused coping	178	11.29	12.11	.32	.44	.17*	.35	.42	.23**
Low problem focused coping	167	7.80	9.29	.32	.46	.09	.32	.41	.09
High problem focused coping	178	11.29	12.12	.33	.44	.17*	.42	.43	.13

Note. High and low = upper and lower thirds of the distributions.

* $p < .05$ ** $p < .01$.

Range restriction violations were not present in any of the subgroups

y intercepts, were similar with the greatest difference less than .3 SE of the constant (intercept).

Table 4. Study 1 Correlations Between Negative Life-events and Injury for Two Moderator Variables.

Moderator variables	Negative life-events			Injury time missed			Number of injuries		
	n	*M*	*SD*	*M*	*SD*	*r*	*M*	*SD*	*r*
Social support / avoidance coping									
Low-low	66	6.5	9.75	.33	.43	.12	.43	.42	.02
Low-high	53	9.92	10.60	.30	.42	.39**	.32	.41	.32*
High-low	49	7.63	7.02	.35	.43	.04	.41	.43	.21
High-High	64	12.43	11.62	.38	.46	.07	.41	.42	.12
Social support / problem coping									
Low-low	80	7.36	7.55	.30	.48	.11	.28	.41	.09
Low-high	48	9.18	13.15	.31	.38	.38**	.47	.44	.06
High-low	38	8.44	7.37	.38	.45	.02	.40	.41	.02
High-High	84	11.11	11.02	.41	.49	.06	.43	.43	.15

Note. High and low = upper and lower thirds of the distributions.

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

Table 5. Study 1 Correlations Between Negative Life-events and Injury for Three Moderator Variables.

	Negative life-events			Injury time missed			Number of injuries		
Moderator variables	*n*	*M*	*SD*	*M*	*SD*	*r*	*M*	*SD*	*r*
Social support / avoidance coping / somatic									
Low-low-low	27	5.67	10.27	.26	.43	.17	.37	.41	.02
Low-high-low	17	7.53	8.48	.20	.32	.49*	.31	.43	.47*
Low-high-high	17	11.47	14.28	.47	.50	.35	.38	.44	.28
Low-low-high	17	9.64	12.99	.35	.46	.07	.42	.39	.08
High-high-high	52	13.08	11.72	.43	.49	.08	.42	.41	.23
High-high-low	11	8.09	10.26	.16	.25	.35	.36	.51	.46
High-low-low	18	10.77	8.42	.39	.42	.32	.55	.43	.12
High-low-high	14	4.78	5.36	.32	.49	.54*	.19	.35	.45
Social support / avoidance coping /worry									
Low-low-low	35	3.48	3.34	.27	.41	.29	.36	.43	.22
Low-high-low	16	9.31	11.13	.49	.46	.49*	.47	.46	.48*
Low-high-high	26	11.34	11.26	.27	.43	.33	.26	.38	.26
Low-low-high	9	17.11	21.50	.44	.51	.05	.37	.40	.09
High-high-high	31	17.71	11.35	.32	.47	.23	.35	.44	.40*
High-high-low	16	6.06	5.81	.54	.47	.25	.56	.41	.37
High-low-low	28	8.71	6.74	.32	.44	.01	.39	.39	.04
High-low-high	13	5.15	5.01	.34	.42	.44	.28	.40	.36

Note. High and low = upper and lower thirds of the distributions.

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

Table 5 continued.

	Negative life-events			Injury time missed			Number of injuries		
Moderator variables	*n*	*M*	*SD*	*M*	*SD*	*r*	*M*	*SD*	*r*
Social support / avoidance coping / concentration disruption									
Low-low-low	31	4.22	4.91	.27	.34	.26	.45	.44	.34
Low-high-low	9	6.77	9.95	.15	.38	.27	.18	.38	.33
Low-high-high	32	10.62	11.04	.35	.44	.40*	.36	.42	.38*
Low-low-high	23	9.95	14.63	.42	.55	.05	.43	.41	.16
High-high-high	35	14.57	12.99	.39	.44	.13	.41	.41	.26
High-high-low	15	7.93	6.70	.54	.59	.18	.48	.46	.16
High-low-low	27	6.74	5.04	.40	.48	.29	.42	.47	.09
High-low-high	16	8.75	9.03	.26	.38	.32	.37	.42	.34
Social support / avoidance coping / previous injury									
Low-low-low	35	5.42	9.03	.16	.27	.05	.71	.37	.06
Low-high-low	22	4.68	4.78	.25	.40	.08	.26	.37	.05
Low-high-high	20	13.40	8.98	.36	.44	.49*	.35	.46	.31
Low-low-high	19	9.46	14.00	.76	.54	.23	.71	.37	.06
High-high-high	25	16.6	12.95	.51	.52	.21	.56	.42	.33
High-high-low	21	8.71	10.50	.24	.33	.27	.30	.37	.28
High-low-low	13	10.00	5.64	.34	.47	.25	.39	.46	.21
High-low-high	18	8.5	8.78	.40	.41	.04	.55	.42	.35

Note. High and low = upper and lower thirds of the distributions.

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

Table 5 continued.

	Negative life-events			Injury time loss			Number of injuries		
Moderator variables	*n*	*M*	*SD*	*M*	*SD*	*r*	*M*	*SD*	*r*
Social support / problem coping / somatic									
Low-low-low	31	5.81	7.35	.24	.43	.14	.31	.44	.21
Low-high-low	16	7.94	12.64	.34	.35	.37	.56	.46	-.01
Low-high-high	20	12.00	15.61	.31	.43	.33	.40	.39	.01
Low-low-high	22	9.36	8.26	.29	.47	.05	.27	.38	.07
High-high-high	27	9.85	8.74	.46	.53	.08	.43	.43	.26
High-high-low	25	9.00	11.73	.35	.46	.04	.46	.46	.04
High-low-low	11	12.73	9.78	.25	.35	-.49	.39	.37	-.35
High-low-high	16	6.43	6.18	.47	.53	.43	.37	.44	.32
Social support / problem coping / worry									
Low-low-low	41	5.41	6.35	.32	.46	.21	.34	.45	.26
Low-high-low	7	4.7	6.26	.28	.38	.69	.44	.59	-.48
Low-high-high	13	17.69	21.04	.36	.47	.36	.36	.36	.18
Low-low-high	26	10.42	9.37	.21	.44	.07	.13	.28	.22
High-high-high	30	14.90	11.75	.31	.44	.20	.42	.43	.22
High-high-low	30	7.86	8.04	.42	.55	.31	.35	.42	.06
High-low-low	18	8.61	6.01	.36	.41	-.23	.49	.38	-.11
High-low-high	14	7.50	5.74	.54	.55	.36	.36	.43	.26

Note. High and low = upper and lower thirds of the distributions.

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

Table 5 continued.

	Negative life-events			Injury time loss			Number of injuries		
Moderator variable	*n*	*M*	*SD*	*M*	*SD*	*r*	*M*	*SD*	*r*
Social support / problem coping / concentration disruption									
Low-low-low	23	6.91	9.61	.20	.35	.19	.28	.39	.23
Low-high-low	23	5.13	5.28	.22	.30	.39	.47	.49	.22
Low-high-high	18	15.94	18.81	.44	.46	.28	.42	.37	.09
Low-low-high	41	7.70	6.63	.35	.52	.19	.33	.44	.25
High-high-high	39	13.92	12.83	.38	.44	.13	.46	.42	.23
High-high-low	28	6.89	7.01	.60	.60	.16	.47	.46	-.04
High-low-low	14	8.36	6.09	.33	.46	.26	.34	.42	.04
High-low-high	20	8.75	8.89	.44	.49	-.14	.44	.41	-.01
Social support / problem coping / previous injury									
Low-low-low	41	5.29	6.70	.13	.26	.10	.19	.37	.14
Low-high-low	23	6.47	11.05	.26	.34	-.02	.46	.46	-.13
Low-high-high	15	11.66	13.53	.39	.422	.43	.45	.43	.08
Low-low-high	18	12.55	8.75	.66	.64	-.01	.38	.41	.28
High-high-high	28	16.21	12.67	.58	.52	-.03	.62	.36	.25
High-high-low	30	8.66	9.70	.31	.47	.04	.36	.44	.04
High-low-low	11	8.81	5.84	.29	.35	.03	.39	.37	-.08
High-low-high	19	11.32	9.80	.39	.45	.05	.49	.42	.17

Note. High and low = upper and lower thirds of the distributions.

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

Chapter 5

Discussion – Study 1

This study sought to examine the utility of the revised Williams and Andersen stress and injury model (1998) as a framework to predict injury among New Zealand rugby players and to examine the moderator effects of variables presented in the model. Results provide general support for the model in predicting injury among New Zealand rugby players. Over and above this general observation, specific results need to be highlighted.

First, evidence for a conjunctive moderation effect on the life-stress injury relation is provided. With respect to social support and coping resources results suggest that when considered separately, no considerable increase in injury variance accounted for by negative life-events was evident (the greatest explanation of injury variance—5% was seen in the high avoidance focusing coping subgroup, Table 3). Further increases in the correlation coefficients between negative life-events and injury (time missed and injury number) were evident for those both low in social support and high in avoidance focused coping, as well as for those low in social support and high in problem focussed coping resources, now accounting for between 10% and 15% of the injury variance (Table 4). These results (albeit slightly less) mirror those reported by Smith et al. (1990).

The conjunctive relation between, high avoidance focused coping and low social support, is intuitively appealing when one considers that avoidance coping was a product of the factors denial and wishful thinking. This suggests that individuals with insufficient social networks who also use more disengagement, passivity, and/or fantasy coping strategies (e.g., denial and wishful thinking) are less likely to deal with potential stressors, and as a result are more vulnerable to injury. The role of problem focused coping (a product of the factors, seeking social support and effort/resolve) is less intuitively appealing, suggesting that those in the high subgroup, made inappropriate attempts to seek support or tried "too" hard with respect to effort. These inappropriate attempts combined with low social support were associated with increased injury vulnerability. The joint influence of coping resources and social support in increasing injury vulnerability echo those of Smith et al. (1990) and highlights their importance when trying to understand life-stress injury relations.

Second, this study extends the findings of Smith et al. (1990), by adding a third moderating variable (personality or history of stressor) with social support and coping to maximise life-stress-injury relations. Specifically, when participants in the following conditions (low social support / high avoidance focused coping / low somatic anxiety, or low social support / high avoidance coping / low worry, or high social support / high avoidance focused coping / high worry, or low social support / high avoidance focused coping / high previous injury) were considered, negative life-events now accounted for between 14% and 29% of the injury variance (Table 5). This is notable when one considers the amount of injury variance explained by physical, environmental and biomechanical factors, leaving less to be accounted for by psychological factors. Statistical tests for differences between more than three correlations however showed that the correlations were not significant. These non-significant findings are consistent with those of Smith et al. (1990) and can most likely be attributed to sample size. As Arnold (1982) suggested, the subgroup correlation analyses require large sample sizes to provide sufficient power. For the four sub-group analyses increases in each group to 80-participants would have revealed significant differences. Whilst the differences in the present study were not statistically significant they remain theoretically and conceptually coherent.

Statistical evidence for a three moderator conjunctive effect was, however found using a hierarchical regression approach with dummy moderator variables. Smith, et al. (1990)

reported similar findings in an amendment to their paper (personal communication 2003). Considered together, these findings extend the extant literature by showing that history of stressor (previous injury) also acts with social support and coping in a conjunctive pattern to produce a maximum moderator effect. These suggest that those with low social support, high avoidance coping, and a history of high previous injury were more likely to miss more time due to injury compared to those with the opposite profile. Research in this area has generally provided support that previous injury is related to subsequent injury risk (Lysens et al., 1984; Van Mechelen et al., 1996; Williams et al., 1993). Previous injury may be important for a number of reasons; first the athlete may not be prepared physically or psychologically to return to sport, increasing the likelihood of negative cognitive appraisals (i.e., anxiety and fear of reinjury), second, injury may alter one's efficacy to perform the task required at the level required, or thirdly they may experience attentional disruption due to worry or concern over their injury (Williams, 2001). Certainly, results from this study add support that previous injury is an important variable to consider with future life-stress research. A limitation of this study is that the assessment of injury did not differentiate between new injury or the recurrence of a previous injury. Future studies may well choose to examine this.

When conjunctive moderators were examined with social support / problem coping and either personality or previous injury some interesting relations are worth noting. Although, statistically non-significant, NLE-injury time missed relations were maximised for those with either, low social support / high problem coping / low worry (p = .08), or low social support / high problem coping / low concentration disruption (p = .06), or high social support / low problem coping / high somatic anxiety (p = .09). Non-significant relations may be related to the small sample size in the respective subgroups. Interestingly, these relations were all significant when game time missed was examined rather than total time missed. Future research is needed to further explore these trends.

Third, the evidence for the personality variables (competitive anxiety) is not quite so strong. The correlation approach does however offer some preliminary support for the role of somatic anxiety, worry, and concentration disruption as moderator variables. With respect to somatic anxiety, two patterns emerged – the first was low somatic anxiety in combination with low social support and high avoidance focussed coping, with the second being the exact opposite profile (high social support / low avoidance focussed coping / high somatic anxiety). The model posits two potential mechanisms for injury—one cognitive and the other somatic. With respect to somatic, it is suggested that stress produces physiological arousal that increases muscle tension, reduces motor coordination and fluidity of motion, thus increasing the likelihood of injury. Our results suggest that the role somatic anxiety has in affecting injury vulnerability may not be quite so clear-cut. Rather, it may be the context in which the individual experiences somatic anxiety that is important. A cautionary note with respect to the somatic anxiety results must also be observed. The combination of high social support / low avoidance focussed coping / high somatic anxiety showed the greatest, correlation coefficient between negative life-events and injury time loss (r = .54).

The personality variable—concentration disruption provided additional injury variance when combined with low social support and high avoidance focussed strategies, for both time loss and number of injuries. In addition, these results provide indirect evidence for the second mechanism purported in the model, suggesting that attentional disruption is produced by preoccupation with stressful life-events. In a recent paper, Janelle (2002) commented that with increases in anxiety, peripheral visual fields are narrowed. There is also a reduction in the "discriminative capabilities of anxious performers, leading to an increased propensity to be distracted by irrelevant cues. Similarly, an increase in distractibility not only warrants more processing time to identify cue relevance, but also increases the likelihood that anxious individuals will misidentify peripheral stimuli, potentially leading to errors" (p. 247). The role of personality variables as moderators warrants further attention. I concur with Smith et al's (1990) sentiments that opportunities exist to study the "interactions among personality variables……to the extent that moderator variables are selected on the basis of sound theory and previous research, this approach need not be a 'fishing expedition' that capitalises on chance findings" (1990, p. 368).

Fourth, I was unable to examine all possible multiple moderator effects using the correlation approach due to insufficient sample. Larger studies are warranted to examine more than three variables from the various components of the model (i.e., personality—locus of control or history of stressor—daily hassles).

Fifth, a number of analytical issues are worthy of discussion. Continued examination of moderator variables is necessary if we are truly going to understand the complex nature of the stress-injury relationship. However, sufficiently powerful statistical procedures are required to identify moderating effects. The correlation approach appears useful in identifying the existence of theoretical and conceptually sound subgroups vulnerable to injury, but requires large sample sizes to provide sufficient power (Arnold, 1982). Next, although the regression approach is the most commonly used method for examining moderator effects, this approach often lacks sufficient power in revealing significant effects, even with large sample sizes, (Bobko, 1986; Cronbach, 1987; Dunlap & Kemery, 1987; Hedges, 1987). Creating dummy variables for each of the subgroups in a hierarchical regression provides a more powerful approach to examine this issue. The present data provide some support for the dummy variable approach. Further work is needed to examine the dummy variable approach as well as alternative and more powerful statistical techniques to fully explore moderator effects. For example, Petrie and Falkstein (1998) suggested the use of structural equation modelling because all model paths can be specified and easily analysed and multiple indicators can be used to represent the latent variables. "This is particularly salient when, in a model like that of Andersen and Williams (1988), multiple variables are suggested to represent the constructs of interest" (p. 40).

Sixth and finally, the assessment of injury requires some discussion. It is acknowledged that the original Andersen and Williams (1988) and the revised Williams and Andersen (1998) models propose a relationship between the stress response and injury occurrence, but does not specifically refer to time missed as an injury outcome. Despite this, time missed has frequently been used as an injury variable (e.g., Smith et al., 1990; Petrie, 1992). For example, the National Athletic Injury Reporting System (Coddington & Troxell, 1980) uses number of days missed from athletic participation as an indication of injury severity. Collection of both types of information (time missed and number of injuries) is important if we are to fully understand the complex relationship between psychological factors and injury. Another issue is that injury data will always be skewed because some scores will equal zero (no-injury). Despite transformation techniques, skewed data will still exist. This issue remains a methodological problem with injury data. In the present study, total time missed and total injury number (game and training) was recorded, however the strength of the correlations between life-stress and injury were in some instances stronger when only game time data were examined. Although total time and game time were correlated, most of the injuries occurred during games, thus collapsing training and game time into a total time measure may dilute this relationship, and needs to be considered in future research. Finally the approach used in the present study for assessing injury was in line with that of Hodgson-Phillips (2000) that allowed for calculating an exposure factor based on time played and number of players in the team and was expressed per 1000 playing hours. This technique is allows for comparison across time and sports.

To summarise, the present study provided evidence for the utility of the revised Williams and Andersen model (1998) in predicting injury among NZ rugby players. Athletes with an "at-risk" psychological profile (e.g., low social support / high avoidance coping / high previous injury) were the most vulnerable to injury. A logical extension of the present study is to examine whether a psychological intervention would be of benefit to those athletes, identified "at-risk" of injury—this is the focus of Study 2.

Chapter 6
Review of Literature – Study 2

The least researched area of the Andersen and Williams (1988) and the revised Williams and Andersen models (1998) is the implementation and assessment of psychological interventions that are proposed to diminish the stress response and reduce injury vulnerability. It is suggested through their model that in order to prevent injuries caused by stress, the intervention should focus on: (1) the alteration of the cognitive appraisal of potentially stressful events; and (2) modifying the physiological and attentional aspects of the stress response. In addition, these interventions and others may be used to directly influence the moderator variables under coping resources and personality factors.

Psychological Interventions

A number of researchers have provided evidence for the effectiveness of psychological interventions in altering the stress response, concentration, and/or reducing injury. These interventions include the use of biofeedback (DeWitt, 1980), imagery, (Davis, 1991), relaxation (Davis, 1991), autogenics (Williams & Harris, 1998), various concentration techniques (Schmid & Peper, 1998; Schomer, 1990), and cognitive behavioural stress management training (e.g., stress inoculation training) (Kerr & Goss, 1996; Mace & Carroll, 1985, 1989; Perna et al., 2003).

Various interventions have been proposed to reduce the stress response. For example, a number of authors have provided detailed description of various relaxation techniques (progressive relaxation, meditation, autogenics, and breathing exercises) to decrease physiological arousal (e.g., Sherman & Poczwardowski, 2000; Williams & Harris, 1998; Zinsser, Bunker, & Williams, 2001). Schmid and Peper (1998) also provide a description of various concentration-training strategies to increase focus and decrease distractibility. Stress inoculation training (SIT, Meichenbaum, 1985), a set of techniques originally developed in clinical psychology for ameliorating the stress response has also been found to be effective within the sporting context. Stress inoculation training involves three overlapping stages, conceptualisation, skills acquisition and rehearsal, and skill application. Mace and Carroll (1985) and Mace, Carroll, and Eastman (1986) found that participants given stress inoculation training had significantly lower psychological stress and anxiety levels before abseiling compared to a control condition receiving no such intervention. In a later study, Mace and Carroll (1989) also found that novice females exposed to stress inoculation techniques reported significantly less stress and performed better than a control group during a gymnastic test. Using a similar technique—cognitive-affective stress management training (SMT), Crocker, Alderman, Murray, and Smith (1988) found that the SMT intervention group reported significantly less negative thoughts in response to videotaped stressors and superior performance compared to the non SMT control condition. However, no group differences were found for state or trait anxiety.

Evidence for the intervention component of the model affecting the stress response and in turn injury has also been offered. In an early study, DeWitt (1980) found that basketball and football players reported a notable decrease in minor injuries as a result of participating in cognitive and biofeedback training. Unfortunately, no objective assessment of injury was recorded. At the 1987 Olympic festival, Murphy (1988) provided relaxation sessions after every workout for 12-athletes, seven of which were inured (2 seriously). In addition, pain control techniques were introduced for some individuals. The result of this involvement allowed all 12-athletes to compete at the festival.

Davis (1991) introduced relaxation and guided imagery of sport skills to two-cohorts, one with swimmers and the other with football players. Comparing injury rates after the intervention with previous archival data, Davis found a 52% reduction in injury rates in the swimmers and a 33% reduction in serious injuries for football players.

May and Brown, (1989) conducted an intervention study and delivered a number of techniques such as attention control, imagery, and other mental skills to individuals, pairs and groups of U.S. alpine skiers at the Calgary Olympics. Skiers were also exposed to team building, relationship orientations, communication, and crisis interventions. The intervention was associated with a reduction in injuries, enhanced self-control, and an increase in self-confidence.

In a different approach, Schomer (1990) examined the role of associative versus dis-associative strategies among 10 marathon runners. The intervention involved shaping associative thought processes during a five-week training period using audiotapes of attentional strategies with a resulting convergence of increased associative thinking and perceptions of increased training effort. Athletes reported an ability to optimise training intensity without increasing injuries.

Despite the support provided by the preceding studies for the role of psychological interventions having an effect on injuries, methodological concerns exist. For example, none of the previous research utilised a randomised control design, nor was the assessment of injury prospective. Only Kerr and Goss (1996) and Perna et al. (2003) offer experimental sound support for a reduction in life-stress and injury—both using cognitive behavioural stress management interventions (CBSM).

Kerr and Goss (1996) examined the effect of a CBSM intervention based upon Meichenbaum's (1985) Stress Inoculation Training in the reduction of life-stress and injury among a group of national and international gymnasts. Participants were matched into pairs according to gender, age, and performance before being allocated to an intervention versus a control condition. Bimonthly sessions over an eight-month period addressed a plethora of psychological skills including, thought stoppage, cognitive restructuring, relaxation, and imagery. At the end of the study participants in the intervention group reported significantly less negative athletic stress, less total negative stress, and a trend to more positive athletic stress toward the end of the programme compared to the control group. Although, a significant treatment effect occurred for decreased life-stress, a non-significant (albeit robust *d* = .67) reduction was found for injury reduction. Kerr and Goss's (1996) explanation for the non-significant findings related to the late introduction (half-way) of relaxation and distraction control skills into the program. However, Andersen and Stoove (1998) argued that the small number of participants in each group and the resultant lack of power was the cause.

Recently Perna et al. (2003) provided evidence supporting the efficacy a CBSM intervention reducing injury and illness among collegiate athletes. Thirty-four competitive rowers were randomised to participate in the CBSM intervention using a stress-inoculation training (SIT) format. For most of the intervention, athletes met for 35-40-minutes, twice a week for 3-weeks. Compared to the control group, athletes in the CBSM condition experienced significant reductions in the number of injury and illness days. In addition, the intervention was related to decreased cortisol and negative affect (indices of exercise training maladaption),

Although results from both these studies are encouraging, neither study directly tested whether their intervention had any effect on the stress response purported by Andersen and Williams (1988)—the mechanism proposed to minimise the risk of injury, or whether their intervention had any effect on the moderator variables (e.g., coping resources). This is unfortunate, as evidence exists linking the stress response and moderator variables to injury.

The Stress Response

As highlighted earlier, the core of the Andersen and Williams (1988) and revised Williams and Andersen (1998) models is the stress response. To reiterate, it is posited that how an athlete cognitively appraises a potentially stressful situation (i.e., competition) affects the stress response (Andersen & Williams, 1988). For example, an athlete who perceives the situation as stressful, but believes he/she has the resources/capabilities to meet or exceed the demands of the event, will be likely to experience minimal stress reactivity. On the other hand, an athlete who experience a potentially stressful situation, and perceives the demands of this situation as exceeding their current resources, will most likely demonstrate a pronounced stress response. Appraisal of the consequences of the event may also influence the stress response. If the consequences, whether actual or perceived, are crucial to the athlete's career or self-esteem, the stress response may be extreme (Andersen & Williams, 1988).

The proposed mechanisms for a strong response leading to injury are the presence of: (a) greater generalised muscle tension; (b) increased distractibility; and (c) narrowing of the visual field. These variables may increase the risk of injury by disrupting co-ordination and flexibility as well as interfering with the detection of important environmental cues (Williams & Andersen, 1998). However due to the inherent difficulties with directly assessing the stress response, few researchers have attempted to explore the potential mechanisms proposed to explain how psychological factors influence injury vulnerability.

Easterbrook (1959) produced the seminal paper and popularised the concept of attentional narrowing. His work on cue-utilisation theory suggested that variation in arousal can produce a change in attentional processes. Specifically, increased arousal will result in the shift or narrowing of attention to those components of a task that are central to correct performance (Bursill, 1958; Tomporowski & Ellis, 1986). Janelle (2002) in a recent review suggests that sufficient evidence exists to support the tenet that attentional narrowing and hyperdistractability occur as a result of increased anxiety.

A common method for assessing changes in attention during increased arousal (stress) has been the dual-task paradigm (cf., Abernathy, 2001). Within the dual-task paradigm an individual faced with two tasks (e.g., one peripheral and one central) will when placed in a stressful condition, show decrements in the peripheral task. This dual-task paradigm has formed the basis for a number of studies. For example, Andersen, Williams, and colleagues (Andersen, 1988; Williams & Andersen, 1997; Williams, Tonymon, & Andersen, 1990, 1991) have used the Stroop-colour word test (Stroop, 1935). The Stroop-colour word test involves an individual responding to numerous words that denote the names of various colours written in an ink of a different colour from the colour of the word represented (e.g., the word green is written in red ink). An individual is required to respond to the ink colour, rather than the word. In the laboratory stress paradigm used by Andersen, Williams, and colleagues the Strop test is made more difficulty with the addition of distracting words and audible stimuli (white noise).

Adopting the dual-task paradigm for inducing the stress response, Andersen, Williams, et al. (Andersen, 1988; Williams & Andersen, 1997; Williams et al., 1990, 1991) have provided much of the research evidence for understanding potential injury vulnerability mechanisms. Andersen (1988) examined the link between psychosocial factors and muscle tension under high and low stress conditions. Results of this study supported the presence of increased muscle tension under the stress condition for the entire group. No evidence was found to support the model's hypothesis of even greater muscle tension for those at risk (i.e., high life-stress). Andersen's study is the only one that has made the link between stress and muscle tension.

Williams, Tonymon, and Andersen (1990) found that recreational athletes with high life-event stress experienced greater decrements in peripheral vision (assessed using a visual arc perimeter) when placed in a more stressful laboratory situation compared to individuals with low life-event stress. A second study by Williams, Tonymon, and Andersen (1991) again, found that athletes who were previously screened to be at-risk of injury (i.e., high negative life-event scores) had greater peripheral-vision narrowing and state anxiety during a stressful laboratory situation compared to those at low risk (i.e., with low negative life-evnet scores). This second study also sought to assess the effects of coping resources and daily hassles over and above the effects of life-change events. No direct support was found for differences in daily hassles and coping resources directly affecting peripheral vision. In addition, high levels of coping resources did not appear to buffer the adverse peripheral vision effects of high life-events and daily hassles. With respect to anxiety, Williams et al. (1991) did find higher state anxiety in athletes who had high daily hassles but low coping resources.

Extending on the above research, Williams and Andersen (1997) showed that athletes with high negative life-events (i.e., high risk) had greater peripheral vision narrowing, and slower central reaction times during a stressful laboratory situation compared to those with low negative life-events (i.e., low risk). In addition, males with high negative life-events, low social support, and low coping skills had the lowest perceptual sensitivity (i.e., detecting fewer targets and/or making more false positives). Males with low social support also missed twice as many targets as those with high social support. Whereas, females with high negative life-events and low coping skills missed twice as many targets as all other groups. In a later study, Andersen and Williams (1999) linked the proposed stress-mechanism with injury and found that athletes with greater negative life-stress and peripheral vision narrowing under stress sustained more injuries during the following season. Moreover, negative life-events and peripheral narrowing accounted for 26% of the injury variance. Also, athletes with high negative life-events, low social support, and greater peripheral narrowing sustained more injuries compared to athletes with the opposite profile.

Thompson and Morris (1994) have also examined the relationship between attention and injury. Despite using retrospective and archival injury data collection methods, they found a significant interaction between stressful life-events and vigilant attention, such that unless an athlete maintained a high level of vigilant attention their risk of injury was increased. In addition, a negative association was found between focussed attention and injury. In a recent and novel study Janelle, Singer, and Williams (1999) used a dual-task car-racing simulation to examine the effects of various levels of anxiety and arousal on attention. Participants assigned to the anxiety conditions were exposed to increasing levels of anxiety, whilst performing a driving task. Results suggested that participants' identification of peripheral lights became slower and less accurate, and significant performance decrements occurred centrally and peripherally when exposed to increasing levels of anxiety. Participants in the distraction anxiety group demonstrated the slowest response time in the competition session and misidentified more peripheral cues than did any other group under high levels of anxiety. Janelle et al. (1999) highlighted that these findings were consistent with the existing body of research that has found detrimental performance on peripheral tasks with increased levels of anxiety (Yoo, 1996).

Although not directly testing the stress response other studies have found support for long reaction time (RT) being related to musculoskeletal injury. For example, long reaction time (RT) was related to traumatic soccer injuries in a sample of 37-men (Taimela et al., 1990). In a cross sectional study of 123 young men, the subjects who had experienced a traumatic bone facture during the preceding 20-months had longer choice RT compared to the non-injured (Taimela, 1990), however, the longer reaction times may have been a result of being injured.

Findings concerning the effects of physical activity on mental functioning are contradictory. Tomporowksi and Ellis (1986) in a review reported equivocal findings suggesting that physical arousal has either a facilitating or a debilitating effect on mental functioning (including reaction time) shortly after exercise. The relationship between reaction time (during some form of physical or cognitive stress) and injury needs to be explored more fully. It is plausible that reaction times under stress may be less of a factor in understanding injury mechanisms.

Further studies are required to assess how stress-reactivity affects perceptual sensitivity (attention narrowing) and reaction times, and in turn how these factors are related to injury vulnerability. In addition, limited research is available that has examined this question in an ecologically valid test situation. It is likely that the context in which the athlete performs the dual-task may provide more insight into the stress response—injury vulnerability relationship. For example, it is common for athletes (such as rugby or ice hockey players) to be faced with dual or multi-task situations during competition (e.g., avoiding tackles, whilst running with the ball or shooting on goal in the midst of aggressive play). Examination of the mechanism related to injury vulnerability (i.e., perceptual sensitivity and muscle tension) during ecologically valid testing (i.e., running) may prove valuable. Finally, no research has examined the effectiveness of a psychological interventions in improving mechanism variables (perceptual sensitivity and reaction times) when placed under duress. Techniques introduced during stress inoculation training (i.e., relaxation, cognitive restructuring, and imagery) may be effective in ameliorating the stress response, thereby reducing injury vulnerability by minimising perceptual sensitivity deficits or reaction time changes.

The purpose of Study 2 is to extend on the above research by examining the efficacy of a cognitive behavioural stress management intervention (CBSM) in the reduction of injury vulnerability among athletes previously identified as “at-risk’ of injury from Study 1. A secondary purpose is to determine what might explain a positive result. With respect to the first purpose it is hypothesised that athletes “at-risk” of injury will have fewer injuries following the CBSM intervention than their control condition counterparts. For the second purpose it is predicted that athletes in the intervention condition will also report an increase in coping resources and decrease in competitive anxiety compared to athletes in the control condition. In addition, athletes who undertake a stress-management intervention will have less peripheral narrowing and better reaction times when placed under stress compared to those in a control condition.

Chapter 7
Methods – Study 2

Participants and General Recruitment Procedure

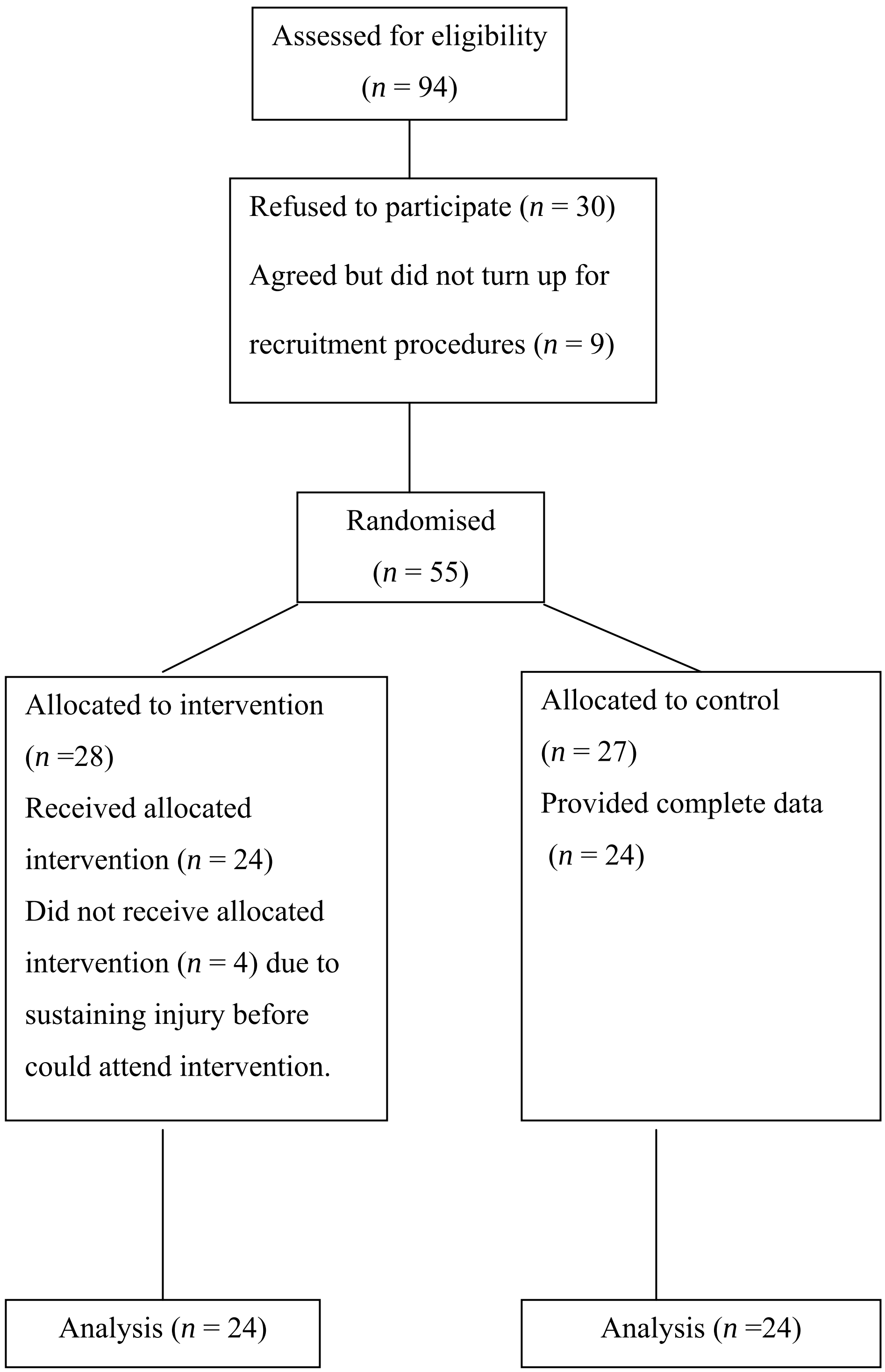
Players from Study 1 who were most vulnerable to injury (e.g., high life stress, low coping skills, and a history of previous injury) were contacted at the beginning of the 2002 to participate in the present study. Sixty-four players were initially recruited, however forty-eight of these provided complete data and were included in the final analyses (see Figure 3). Participants ranged in age from 17 – 33 years (M = 20.98, SD = 1.42) and were from a variety of ethnic groups (NZ Pakeha, 57%; NZ Maori, 6%; Pacific Islanders 33% other 4%). Approval was obtained from the University Ethics Committee.

All participants received verbal and written information before signing consent forms (Appendices I & J). Players provided demographic information (age, and ethnic affiliation) and completed psychological measures and stress response testing at the beginning (Time 1) and end (Time 2) of the 2002 season. The measures included assessments of competitive anxiety and coping. Injury data were collected throughout the season. Participants were randomly assigned to either an intervention (cognitive-behavioural stress management programme) or a control condition using Statistical Packages for Social Sciences (SPSS) 11.5 software. Comparison of baseline group means for age, injury and psychological variables revealed no differences, suggesting pre-treatment group equivalence on these variables.

Injury Variables

Assessment of injury in the present study (Study 2) was identical to that used in Study 1 and included injury time loss and number of injuries sustained. All participants were trained to record injuries on a weekly basis, to ensure a prospective and an objective assessment.

Figure 3. Participant Recruitment Flowchart for Study 2.



Possible Explanations (mechanisms) for Injury Reduction

Psychological Variables

Personality. As with Study 1, the Sport Anxiety Scale (SAS; Smith et al., 1990) was used to measure sport specific competitive anxiety (Appendix F). Cronbach alpha values for the subscales were as follows for Time 1 and Time 2 respectively, somatic, (.86 & .86); worry, (.80 & .82) and concentration disruption, (.80 & .82).

Coping. The Athletic Coping Skills Inventory-28 (ACSI-28; Smith, Schutz, Smoll, & Ptacek, 1995) was used to assess the frequency specific strategies are used to cope within a sporting context (Appendix K). The ACSI-28 is a 28-item multidimensional scale that assesses eight separate coping components; coping with adversity, coachability, concentration, confidence, and achievement motivation, goal setting and mental preparation, peaking under pressure, freedom from worry. The scale can also be summed to represent total personal coping resources. In the present study, the composite score (total personal coping resources) was used. Reliability for the coping scale was acceptable at the respective time points ($\alpha = .77$ at Time 1, and $\alpha = .82$ at Time 2).

Stress Response Variables

Apparatus. A purpose built stress reaction device (SRD) was constructed that presented the stimuli for the peripheral and central vision tasks (Figure 4). The device was based on a clinical perimeter (cf., Harrington, 1981) as used by Andersen and Williams (1999) but was adapted to create an ecologically valid test. The device presented 24-yellow 4-mm Light Emitting Diodes (LEDs) on a large curved screen. Four lights (equally-spaced) were presented on the horizontal plane and at 15^{o} of the horizontal in both upper and lower quadrants. The pattern was identical for left and right sides.

Figure 4. Stress Reaction Device Front and Rear.

A central red-coloured LED was used to focus the participant's gaze. Target lights could be presented statically on the screen surface up to 95^{O} left and right of centre. All LEDs in the present study were 4mm in diameter and of standard luminosity (Andersen & Williams, 1999; Harrington, 1981). The SRD could be adjusted both vertically and horizontally to suit each participant.

The SRD had a hand held reaction time switch that was depressed once the participant detected an LED target illuminate. A software programme was developed to dictate the sequencing and randomisation of each LED. The interval between each LED illumination was also randomised, with participants having a maximum of 1000 ms to respond to any given LED. Reaction times were recorded automatically as soon as the reaction time switch was depressed.

Two forms of response data were collected: (a) reaction time—time from LED illumination to a valid response by the participant in milliseconds, (ms); and (b) perceptual sensitivity (d'). Signal detection theory (SDT) offers a framework to assess perceptual sensitivity. The value of SDT methodology is that it separates response determinants related to the detection of a stimulus that involves a decision (Green & Swets, 1966; Heeger, 2003; McNicol, 1972). With signal detection theory the classic simple forced choice experiment involves a subject that must respond "yes" or "no" to indicate whether light stimuli were present during a random dispersion. Adopting this paradigm, one can assume that, performance during this task is determined by the number of photon absorptions during each trial (cf., Heeger, 2003). However, there are two types of noise factors that limit the subject's performance: internal noise (variations of the person e.g., scattering of the emitted photons on the cornea); and external noise (physical features of the signal, e.g., variation of light photons emitted). This noise creates some uncertainty as to whether the light stimulus was present or not. Either there was a stimulus (signal plus noise), or there was no stimulus (noise alone). Either the subject saw the stimulus (responded "yes") or they did not see the stimulus (responded "no"). This presents 4-possible outcomes: hit (signal present and acknowledged "yes"); miss (signal present, but not acknowledged "no"); false positive (signal absent, but acknowledged "yes"); and correct rejection (signal absent and acknowledged "no"). Hence SDT does not assess the *quality* of the stimulus, rather, it assesses *discrimination*—the ability to tell two or more stimuli apart. Discrimination is usually known as d-prime (d') and is equal to the distance between the mean of two-distributions (noise and signal plus noise).

The assessment of perceptual sensitivity or d-prime involves determining the probability of detecting a target if a target is indeed present and the probability of saying a target is present when no in fact the target is absent (false positive). In-line with Williams et al. (1997) all calculations of d' were derived from the Hochhaus (1972) table. The forced choice paradigm forms the basis for the present assessment of the stress response mechanism.

Procedure

Laboratory Testing Procedures

Participants presented for testing at the University of Auckland physiology laboratory with only one experimenter present. Ambient temperature was maintained between 20 and 22^{O}C. Stress response testing occurred at two separate times. The first (Time 1), took place early in the 2002 rugby season (February) and the second (Time 2), took place at the season end (August). Following explanation of the testing procedures, participants completed the SAS and ACSI-28. The experimenter adjusted all equipment so that, with the participant standing on a treadmill (Power Jog GX200) facing the SRD, their eyes were at 0^{o} latitude and distal targets were within the field of peripheral vision (95^{O}). Lights were dimmed prior to all stress response testing.

Baseline assessment. For the baseline (non-stressed) protocol the participant was asked to focus their vision on the central red light and to use their index finger of their dominant hand to depress the reaction time button when any yellow LED cues were detected. Two-practice trials were performed allowing participants to respond to a total of 24-LED illuminations presented in a randomised order. During the baseline assessment participants responded to each LED 4-times in a randomised sequence (i.e., total of 96 responses). Following the baseline assessment, participants completed a sub-maximal VO_2 test to ascertain treadmill speed corresponding to 75-80% effort.

Stress assessment. For the stressful condition participants were again asked to respond to LED illuminations whilst performing the combined tasks of, running on the treadmill at a speed associated with an effort of 75-80% of the athlete's VO_2 (10-13km/hr), listening to white noise through headphones, and counting the flash rate of the central red light (which flashed regularly at 1000 ms intervals). As a manipulation check for increased anxiety, the STAI (Spielberger, Gorsuch, & Lushene, 1970, Appendix L) was administered immediately after Trials 1 and 2. Identical procedures to Time 1 (early season) were followed at the Time 2 (end of season) assessment.

Intervention

The author developed a structured 6-session CSBM intervention based on Meichenbaum's Stress Inoculation Training (SIT, Meichenbaum, 1985). Content of the intervention was based around the work of Kerr and Goss (1996), however, the intervention was introduced early in the season. The intervention group met weekly for 90-120 minutes during a 4-week period in the early pre-season. In-line with the SIT format, sessions were structured to include, conceptualisation, practical skills acquisition, and application. Each session consisted of a mixture of instructive information with some form of practical experiential exercise. The whole programme was supported with written information, which encouraged the completion of a number of home-based exercises. In line with Meichenabum's suggestions the conceptualisation components addressed the rational for behaviour change by describing the physiological and behavioural sequel of life and competitive stress, as well as the possible implications for athletic performance and vulnerability to injury. Participants were also informed regarding the efficacy of cognitive behavioural interventions to relieve psychological distress and enhance athletic performance (session 1). With respect to skill acquisition, participants were trained in relaxation strategies (e.g., progressive muscle relaxation and autogenic techniques) during sessions 2 & 3 (Sherman & Poczwardowski, 2000; Williams & Harris, 1998), and cognitively based strategies (e.g., imagery and cognitive restructuring) (Vealey & Greenleaf, 2001; Zinsser et al., 2001) during sessions 4 and 5. The final session addressed additional strategies (e.g., goal-setting and event planning) (Gould, 2001), before finishing with a review to facilitate the ongoing use of CBSM techniques. Open discussion was encouraged during all group sessions. Finally, those in the intervention group were contacted monthly (via telephone) to discuss application of the strategies and to reinforce the use of the various CBSM techniques. Details of the intervention can be found in Appendix M.

Chapter 8
Results – Study 2

Overview of Data Analysis

The analysis plan involved conducting a 2-way (intervention vs. control) ANCOVA on each of the dependant measures (injury, moderating variables, and stress response variables). Pre-scores served as the covariate. Prior to conducting these analyses, the assumptions underlying the use of ANCOVA (i.e., reliability of covariates, linear relationship between the dependent variable and covariates, and homogeneity of regression slopes) were tested and satisfied (Tabachnick & Fidell, 2001). To ensure there was sufficient power of 80% (alpha = .05) and to detect a large effect size (i.e., Cohen's *d* .70) between conditions on the variables of interest (Cohen, 1992), it was estimated that approximately 38-participants would be required in each condition (stress vs. non-stress control). Skewed data were subjected to a logarithmic transformation to reduce a potential spurious influence of extreme scores (Tabachnick & Fidell, 2001).

Descriptive Data

Descriptive data for the injury, psychological, and stress response variables are presented in Table 7. As can be seen, injury variables showed an overall increase from 2001 to 2002. For the psychological variables, total coping generally increased, whilst worry decreased. Both anxiety and concentration disruption scores remained stable across time. With respect to the stress response data, reaction times generally decreased and perceptual sensitivity (d) decreased from Time 1 (pre-season) to Time 2 (end of season).

Injury

With respect to injury, ANCOVA results showed a significant condition (control versus intervention) effect for total time missed, F (1, 46) = 4.58, $p < .05$, Eta squared ($\acute{\eta}^2$) = .07 (Figure 5), but not for number of injuries sustained, F (1, 46) = 1.02, $p = .32$, $\acute{\eta}^2 = .03$ (Figure 6). As can be seen in Figure 5, participants in the stress management intervention reported missing less time due to injury at Time 2 (M = 5.19) compared to their non-intervention counterparts (M = 12.91). Furthermore, the intervention group appeared to only marginally increase the amount of time missed in 2002 compared to 2001, (M = 4.47) whereas the control group missed significantly more time due to injury (M = 8.31).

Psychological Variables

ANCOVA results for the psychological variables revealed a significant condition effect for total coping resources, F (1, 46) = 7.49, $p < .01$, $\acute{\eta}^2 = .09$, and for worry, F (1, 46) = 4.33, $p < .05$, $\acute{\eta}^2 = .14$. The condition effect for concentration disruption approached statistical significance, F (1, 46) = 2.97, $p = .09$, $\acute{\eta}^2 = .04$. ANCOVA results showed no significant effects for somatic anxiety, F (1, 46) = .06, $p > .05$, $\acute{\eta}^2 = .01$. Specifically, as can be seen in Figure 7 the intervention group reported an increase in total coping resources at Time 2 (M = 86.08) compared to Time 1 (M = 78.16) and had significantly greater coping resources than the control group (M = 80.70) at Time 2. As can be seen in Figure 8 the intervention group reported a decrease in worry at Time 2 (M = 14.04), compared to Time 1 (M = 16.16). Although results for concentration disruption were statistically non-significant they were in the same direction as worry, showing an overall decrease in concentration disruption (Time 1, *M* = 3.79, Time 2, *M* = 3.34) over time (Figure 9).

To further elucidate the relationships between the intervention, the psychological variables and injury, path analysis (Pedhazur, 1982) was conducted. Results showed that the intervention was related to worry, concentration disruption and coping (path coefficients ranged between .20 and .38), as well as with injury time missed (.30) but that worry, concentration disruption and coping were unrelated to injury (time missed; path coefficients ranged between .01 and .05). Therefore, the initial conditions of were not met (Baron & Kenny, 1986). When injury number was examined, similar patterns were found for coping and concentration disruption, but not for worry. Specifically, the indirect effect (.07) of the intervention through worry to injury was less than the direct effect of the intervention to injury number (.23). Hence, no support for mediation was found.

Stress Response Variables

Manipulation check. To provide some insight into whether the stress response condition evoked changes in anxiety, assessments of state anxiety were performed before each testing (baseline and stressed) at both time periods (pre-season – Time 1 and end of season – Time 2). From baseline to the stress conditions state anxiety did not increase (Time 1, $t = 1.06$, $p = .32$ and Time 2, $t = 1.66$, $p = .10$), however perceptual sensitivity decreased (Time 1, $t = 7.28$, $p < .01$ and Time 2, $t = 7.35$, $p < .01$) and reaction times increased (Time 1, $t = -10.86$, $p < .01$ and Time 2, $t = -5.94$, $p < .01$).

ANCOVA results showed no significant condition effects for peripheral, $F\ (1, 46) = .01$, $p = .92$, and central reaction times, $F\ (1, 46) = .44$, $p = .51$. Similarly, no condition effects were found for peripheral perceptual sensitivity, $F\ (1, 46) = 1.51$, $p = .23$, nor for central perceptual sensitivity, F (1, 46) = .32, p = .57. Bivariate correlations between reaction time and perceptual sensitivity change scores (i.e., stressed condition - baseline) and injury data (time missed and number of injuries) revealed a non-significant trend for relations between total perceptual sensitivity change scores and time missed due to injury (r = .27, p = .06). These results suggest that individuals with greatest perceptual change under stress were more likely to miss time due to injury. No other correlations were significant.

Table 6. Study 2 Descriptive Data of Injury and Psychological (Moderator) Variables.

Variable	*n*	*M*	*SD*	Range	Skewness
Injury time missed 2001	48	6.50	7.31	0-28.65	1.30
Injury time missed 2002	48	8.72	12.61	0-62.19	2.48
Injury number 2001	48	1.73	1.52	0-6.34	.70
Injury number 2002	48	3.16	1.79	0-9.4	.93
Total Coping Resources Time 1	48	78.12	8.43	62-96	8.43
Total Coping Resources Time 2	48	83.21	8.27	68-105	8.27
Worry Time 1	48	15.21	3.95	9-27	.64
Worry Time 2	48	14.45	3.96	8-23	.26
Concentration disruption Time 1	48	3.75	1.36	2-7	.32
Concentration disruption Time 2	48	3.75	1.44	2-8	1.09
Somatic anxiety Time 1	48	17.29	5.01	10-33	1.15
Somatic anxiety Time 2	48	17.43	5.45	9-33	.71

Injury measures represent the raw scores before log transformation.

Table 7. Study 2 Descriptive Data of all Perceptual and Reaction Time Variables.

Variable	*n*	*M*	*SD*	Range
Baseline d prime total Time 1	48	2.92	.29	1-4
Stressed d prime total Time 1	48	2.34	.56	3-5
Baseline d prime peripheral Time 1	48	3.02	.28	1-4
Stressed d prime peripheral Time 1	48	2.51	.32	2-3
Baseline d prime central Time 1	48	3.35	.18	1-4
Stressed d prime central Time 1	48	3.03	.32	1-4
Baseline d prime total Time 2	48	3.07	.25	1-4
Stressed d prime total Time 2	48	2.70	.36	2-3
Baseline d prime peripheral Time 2	48	3.15	.24	1-4
Stressed d prime peripheral Time 2	48	2.92	.27	1-4
Baseline d prime central Time 2	48	3.39	.16	1-4
Stressed d prime central Time 2	48	3.20	.28	1-4
Variable	*n*	*M* (ms)	*SD*	Range (ms)
Baseline reaction time total Time 1	48	480.03	47.28	402-575
Stressed reaction time total Time 1	48	549.66	52.94	458-681
Baseline reaction time peripheral Time 1	48	500.84	50.90	424-609
Stressed reaction time peripheral Time 1	48	569.85	59.27	472-724
Baseline reaction time central Time 1	48	459.23	45.73	378-563
Stressed reaction time central Time 1	48	529.47	50.79	440-638
Baseline reaction time total Time 2	48	470.84	52.74	369-660
Stressed reaction time total Time 2	48	512.65	54.72	409-713
Baseline reaction time peripheral Time 2	48	486.38	57.69	386-692
Stressed reaction time peripheral Time 2	48	525.40	59.08	423-700
Baseline reaction time central Time 2	48	455.31	49.07	353-628
Stressed reaction time central Time 2	48	499.92	53.11	395-686

Figure 5. Injury Time Missed Interaction Effect.

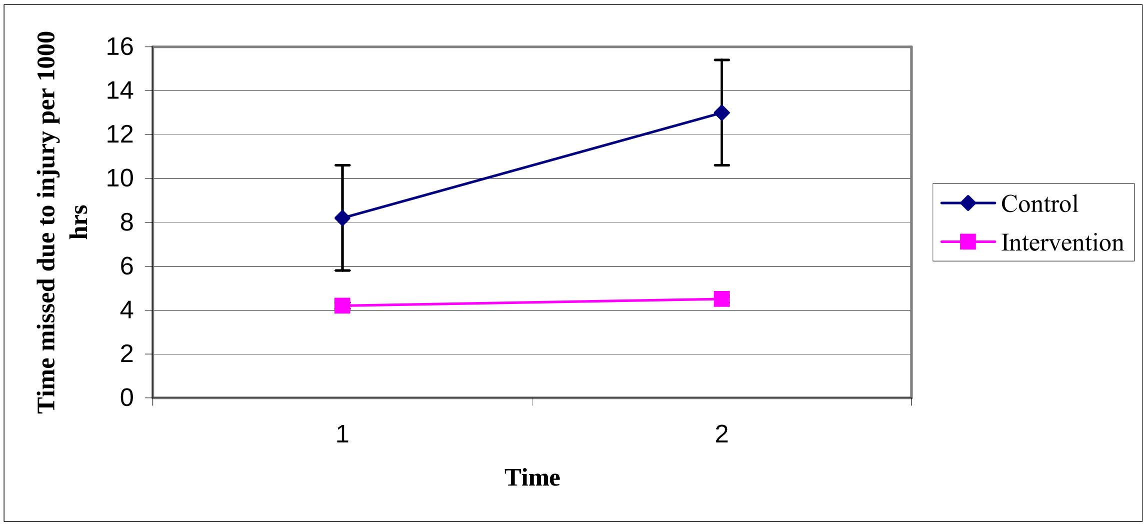


Figure 6. Injury Number Interaction Effect (ns).

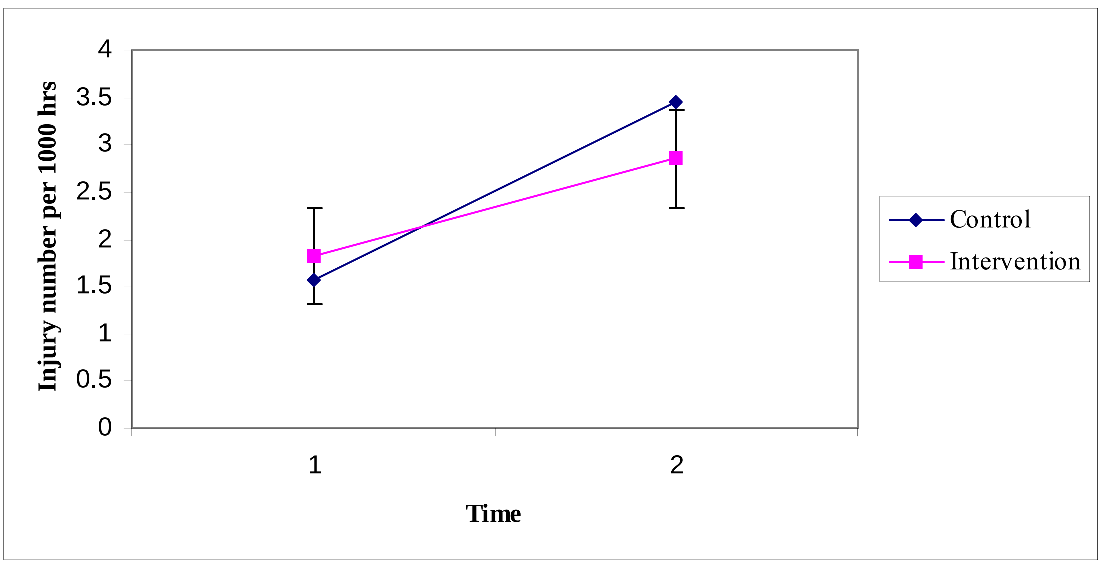


Figure 7. Total Coping Resources Interaction Effect.

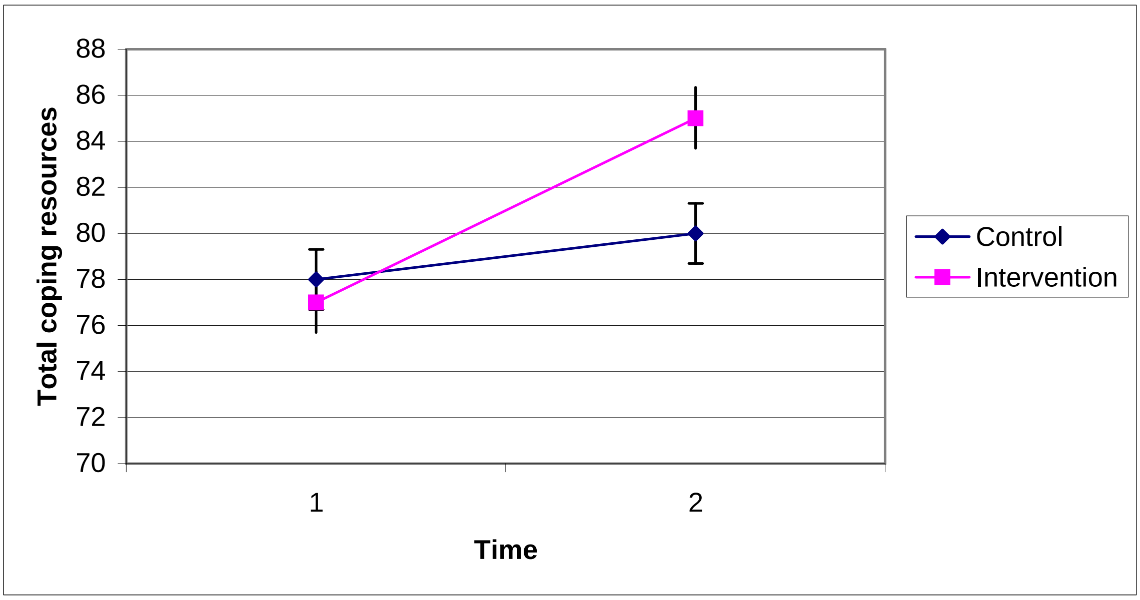


Figure 8. Worry Interaction Effect.

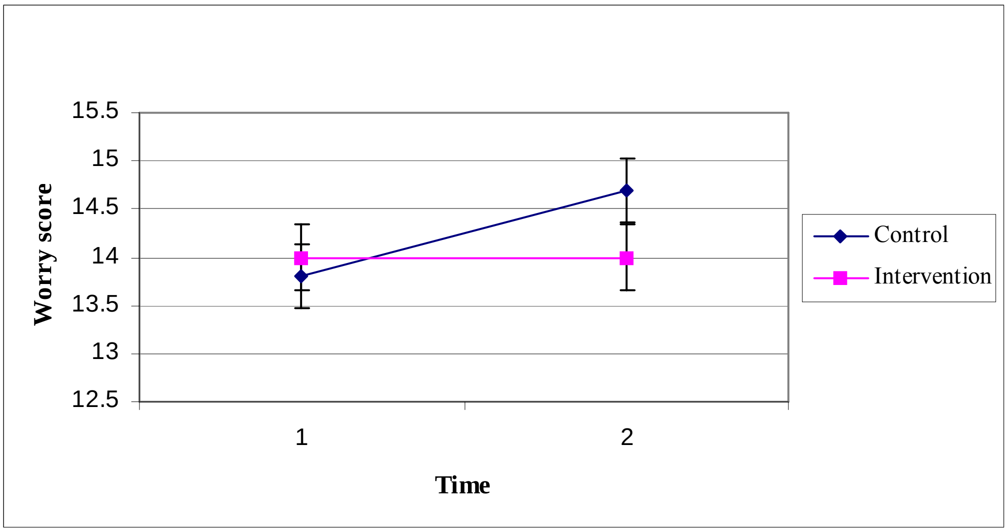


Figure 9. Concentration Disruption Interaction Effect (*p* =.09).

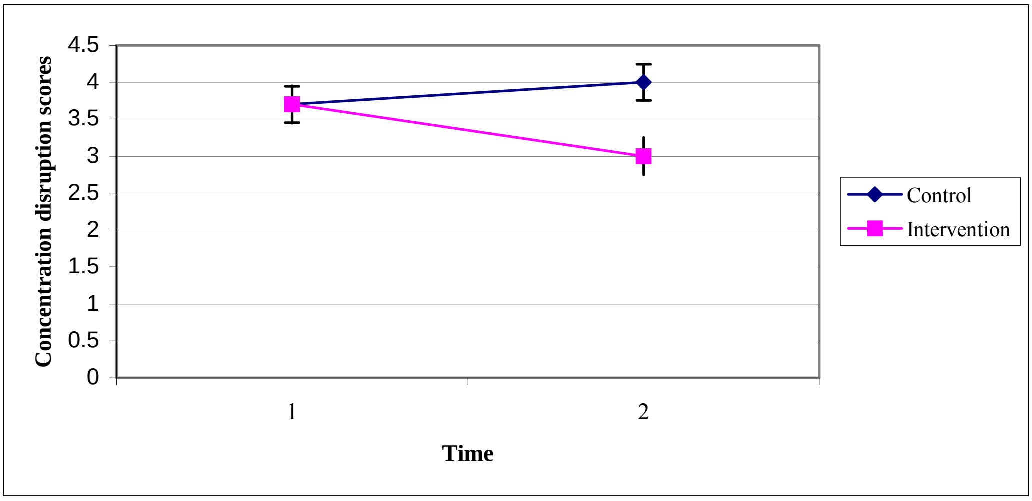


Figure 10. Somatic Anxiety Interaction Effect (ns).

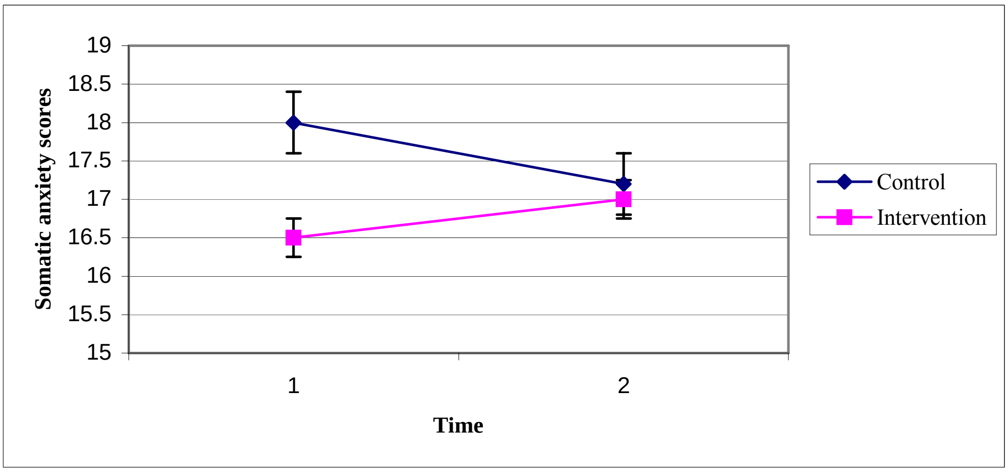


Figure 11. Reaction time condition effect (ns).

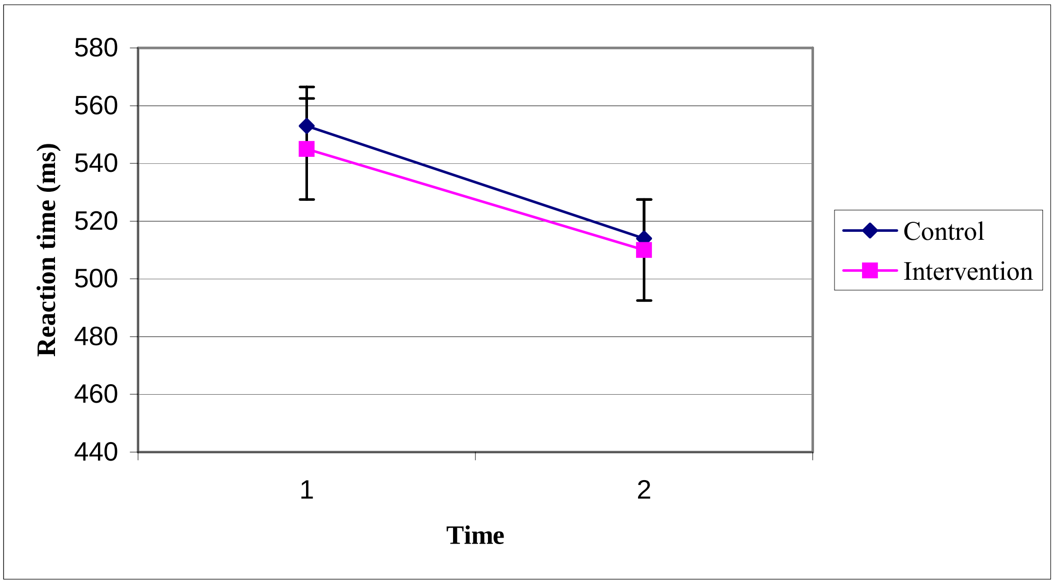
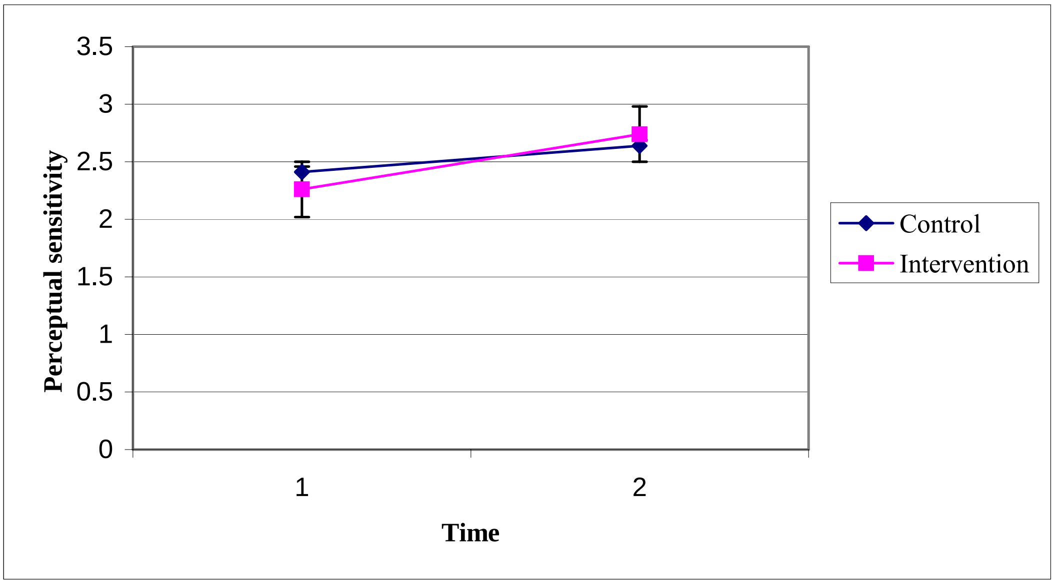


Figure 12. Perceptual sensitivity (d' prime) condition effect (ns).



Chapter 9
Discussion – Study 2

The primary aim of Study 2 was to investigate the effectiveness of a cognitive behavioural stress management programme in reducing injury among rugby players previously identified with an "at-risk" psychological profile to injury. A secondary aim was to investigate potential reasons for a positive effect. With respect to injury, results supported a reduction in injury vulnerability for those who completed a 6-session CBSM intervention. Specifically, the amount time missed as a consequence of injury was reduced in the intervention group compared to the control group (Figure 5). A similar pattern of results was shown for injury occurrence, although the effect was statistically non-significant (Figure 6). Taken together, these results echo those of Perna and colleagues as well as Kerr and Goss, and support the use of cognitive behavioral stress management interventions.

An examination of the psychological variables sheds some light on the injury findings. First, an increase in total coping resources was found in the intervention group but not in the control group. This suggests that the CBSM group felt they had sufficient coping resources to deal with numerous obstacles and potential stressors, which in turn may have reduced their risk of further injury. The lower levels of worry and concentration disruption experienced by the intervention group also may have impacted indirectly in injury time missed. Reducing the amount of time worrying or ruminating may have minimized physiological (i.e., muscle tension) and psychological (i.e., narrowing of visual field) stress response processes, while the lower levels of concentration disruption permitted more focused attention on tasks at hand. A less stressed and focused athlete is likely to increase injury resiliency because co-ordination and flexibility of movement is not impaired and important environmental cues are more easily detected.

No support was found for the intervention having an indirect (mediating) effect on injury through the psychological variables. These results differ somewhat from those of Perna et al. (2003) who found significant direct path coefficients from the intervention to post intervention affect (-.47), the coefficient from group to days out (-.41) and the coefficient from negative affect to days out (.43). Perna et al's results did however show that negative affect partially mediated the CBSM effect on subsequent time missed due to injury and illness.

Insofar as the stress response data are concerned, the CBSM intervention did not have an effect on either reaction time or perceptual sensitivity. These results were somewhat disappointing as the CBSM addressed various relaxation strategies and breathing techniques, which it was thought might impact on the stress response testing. Possible reasons for the apparent non-effect might be related to the lack of specificity of the CBSM intervention to the stress response task. However, results of the manipulation check (STAI scores) suggest that a situation of cognitive interference, rather than state anxiety was created during the 'stressed condition' of the stress response testing. This being the case, then the anxiolytic effects of the various CBSM techniques would not have been evident. Future ecologically valid stress response testing might consider including some form of performance evaluation to generate increases in state anxiety. Finally, there was an overall reduction in reaction time and increase in perceptual sensitivity from Time 1 (pre-season) to Time 2 (end of season). This could be attributed to a learning effect (despite practice trials of the stress response testing) or may be a general improvement or adaptation due to participation in competitive rugby.

Changes scores between stress and baseline assessment of perceptual sensitivity was mildly correlated to injury time missed but not to injury number. The direct relation (albeit small) between the stress response and injury is similar to the results of Andersen and Williams (1999) who found that both negative life-events and peripheral narrowing were related to injury (number of injuries). Although the present study examined the stress response in athletes "at-risk" of injury, negative life-events were not assessed. However, as highlighted by Andersen and Williams (1999) the stress mechanism (perceptual sensitivity) injury relationship may best be examined among those with high negative life-events.

Despite the positive effects of this intervention, the present study is not without limitations. The author developed the CBSM stress management programme, which may have influenced the results through expectancy bias. However, it is more likely that athletes missed less time due to injury as a result of increased coping skills etc., rather than through some Pygmalion response (Andersen & Stoove, 1998). Although an attention control condition was not used in this study, future researchers should consider addressing this limitation. I was also unable to clarify the individual contribution of the treatment components of this study (e.g., relaxation training, cognitive restructuring). This study sought to examine the efficacy of a stress management intervention on injury by incorporating the multi-component approach recommended in stress management training. Other researchers may wish to clearly delineate what specific sub-components of a CBSM intervention contribute the most to reduction in injury and illness (Perna et al., 2003). An important methodological point, recently highlighted by Williams (2001) is that that previous studies have not distinguished between the recurrence of an old injury, or the occurrence of a new injury at a new site. In the present study it was not possible to delineate whether injuries sustained in 2002 were new or had resulted from a previously sustained injury. Injury researchers should consider this important point in subsequent studies.

Finally, this study had less than the required group numbers to provide the optimal statistical power of 80% (observed power ranged between 40% and 80%). Stevens (1996) suggests that when small group sizes are involved, it may be necessary to adjust the alpha level to compensate (e.g., set a cut off of .10 or .15, rather than the traditional .05 level).

Adopting this approach, non-significant trend effects found in the present study (e.g., concentration disruption) would become statistically significant. Alternatively, increased sample size would have helped to optimise statistical power in the present study. The magnitude of the effects for the intervention on the injury variables ranged between 3% and 7%. Whilst the magnitude of these effects can be considered modest in size they are nevertheless clinically relevant. The minimal time and expense associated with this intervention should encourage coaches, athletes, and sports organizations to fund and participate in similar injury prevention programs. Perhaps had the intervention focused on providing the mental skills to players for a longer period the magnitude of the effect may have been greater (c.f., Kerr & Goss, 1996; Perna et al., 2003).

To summarise, this study tested the effectiveness of a cognitive behavioural stress management (CBSM) programme in reducing injury among athletes identified from Study 1 as “at-risk” of injury. A second purpose was to examine potential reasons to explain a positive result. Results showed that the CBSM intervention can help to reduce time loss due to injury. This result is due in part to these athletes increasing their coping skills and decreasing worry and concentration disruption cognitions.

If injury continues to result from sport and recreation participation, then the corollary is that treatment and rehabilitation of these injuries will remain a necessary and important modality. If this is the case, a logical extension of the preceding prediction and prevention studies is to examine the role that a psychological intervention has in the recovery and rehabilitation of sport-related injury—this was the focus of Study 3.

Chapter 10
Review of Literature – Study 3

When one considers the imposing financial burden sporting and recreation-related injuries place on society (Caine, Caine, & Lindner, 1986) (e.g., over 2-million hospital-based accident and emergency department visits in the U.S.; NEISS data highlights, 1998) and the plethora of physical, social and psychological implications for injured individuals (Smith, 1996; Wiese-Bjornstal, Smith, Shaffer, & Morrey, 1998 for a review) then understanding the contribution of psychological factors in the prediction, prevention, and rehabilitation of sport-related injury warrants serious consideration. Indeed, sports medicine has traditionally focussed on the physical factors that affect injury occurrence and rehabilitation, whilst the role psychological factors have in the prediction, prevention, and rehabilitation of sport-related injury has only emerged during the past 25-years (Brewer 2001). Indeed, the credibility of linking psychological-based interventions to augment traditional physical therapy injury rehabilitation programmes is an area that is gaining greater research attention (e.g., Cupal & Brewer, 2001, Ross & Berger, 1996).

With respect to post-injury research three major areas of interest have been examined. The first relates to the emotional and psychological response to injury (e.g., Quinn & Fallon, 1999; Smith, 1996; Udry, Gould, Bridges, & Tuffey, 1997; Weiss & Troxell, 1986; Wiese-Bjornstal, Smith, Shaffer, & Morrey, 1998). The second relates to psychological factors involved in adherence to prescribed rehabilitation regimens (cf., Brewer 2001). The third approach has focussed on the effectiveness of psychological-based interventions to improve psychological and functional outcomes following sport-injury rehabilitation (e.g., Cupal & Brewer, 2001; Flint, 1991; Ross & Berger, 1996). The review of literature that follows will focus primarily on this third area of research.

Within the rehabilitation domain, Brewer (2001) argued that a theoretical framework is required that merges medical and psychological viewpoints to provide a useful and broad-based framework for investigating the sport injury rehabilitation process, and offers possible explanations for how psychological factors can affect sport injury outcomes. The bio-psychosocial model (Brewer, Andersen, & Van Raalte, cited in Brewer, 2001, Figure 13) provides such a framework and incorporates seven key components: injury characteristics, socio-demographic factors; biological factors; social/contextual factors; psychological factors; intermediate biophysical outcomes; and sport injury rehabilitation outcomes.

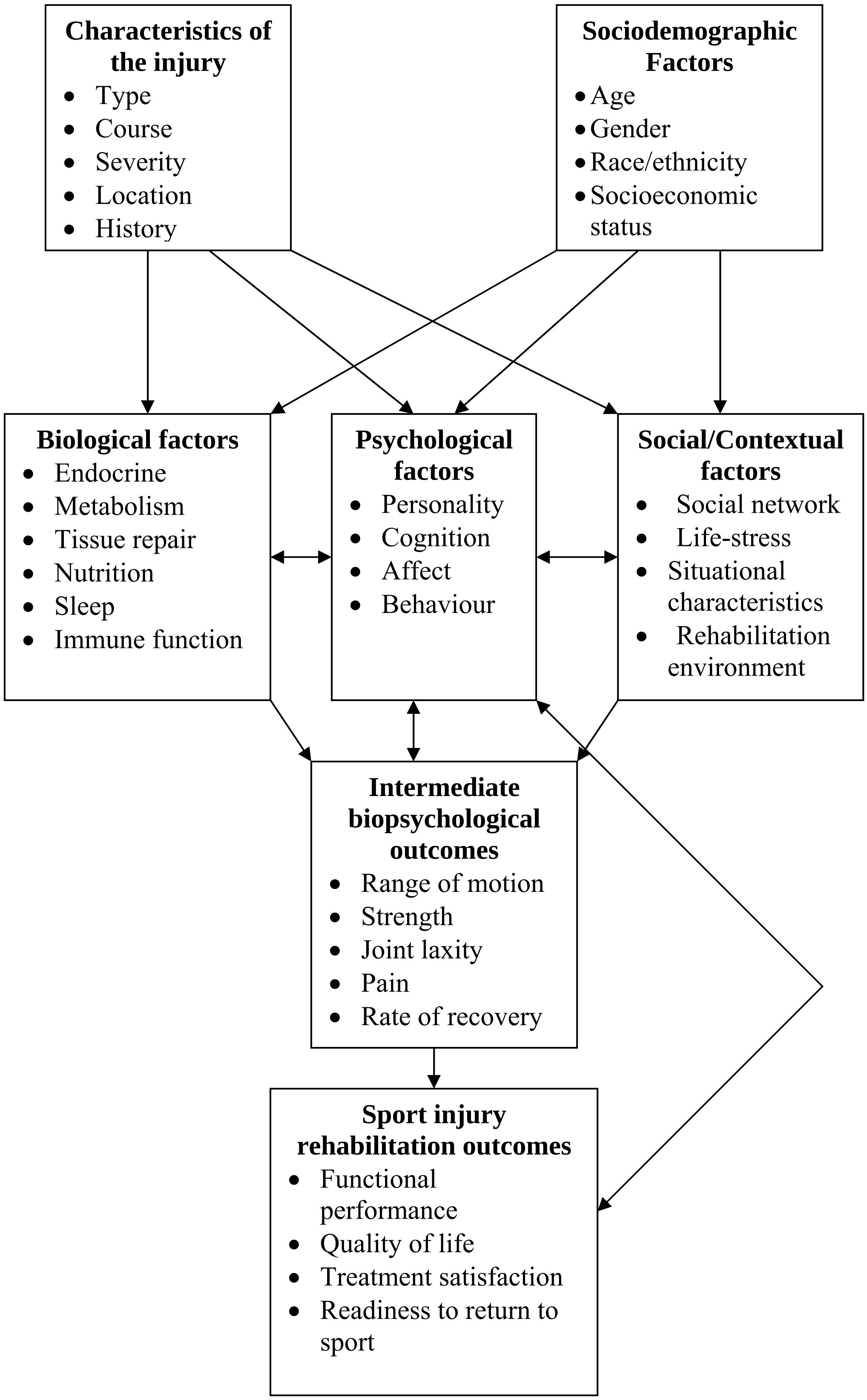
The model posits that injury occurrence sets off the sport injury rehabilitation process. The nature of the injury (i.e., severity and location etc) is proposed to influence biological, psychological, and social/contextual factors. Also exerting a parallel effect on biological, psychological, and social/contextual factors are the sociodemographic factors (gender, age, and ethnicity etc), which also provide the background against which sport injury rehabilitation occurs. In addition, biological and social/contextual factors are suggested to influence intermediate bio-psychological outcomes. Central to the model is the role of psychological factors, which have reciprocal relationships with both biological and social/contextual factors. Psychological factors are also posited to directly affect intermediate bio-psychological outcomes as well as with the end point of the model, sport injury rehabilitation outcomes. As can be seen in Figure 13, relationships between psychological factors and intermediate bio-psychological outcomes, and sport injury rehabilitation outcomes are bidirectional.

Although the model does not highlight the proposed relations between the psychological factors, it offers a theoretical basis for understanding possible mechanisms for psychological interventions affecting rehabilitation outcomes. For example, an intervention aimed at affecting psychological factors (e.g., motivation) could positively affect the amount of rehabilitation one performs and in turn influence the intermediate psychological outcomes (e.g., strength), which could influence rehabilitation outcomes. In addition, increases in motivation associated with an intervention could also directly affect the rehabilitation outcomes (e.g., readiness to return to sport).

A number of studies have examined the role that psychological factors have on rehabilitation outcomes as well as determining the efficacy of psychological interventions on psychological factors, intermediate bio-psychological and sport injury rehabilitation outcomes (cf., Cupal, 1998). In her review, Cupal (1998) argued that despite the existing support for the hypothesised role of cognitive behavioural factors in sport injury rehabilitation outcomes, there have only been a few controlled investigations of psychological interventions in the context of sport injury rehabilitation. Despite this, existing findings suggest that cognitive-behavioural interventions can positively affect physical and psychological factors in sport injury rehabilitation (cf., Cupal, 1998; Cupal, & Brewer, 2001).

Various psychological interventions have been advocated or used in the rehabilitation setting. Imagery or visualisation is one technique that has received empirical support as a viable psychological-based intervention (e.g., Cupal & Brewer, 2001). Much of this research stemmed from the early work of Ievleva and Orlick (1991) who found that injured athletes who used more imagery had an increased recovery compared to peer-groups that did not use these techniques. More recently, Sordoni, Hall, and Forwell (2000) found that injured athletes in a rehabilitation programme reported using significantly more motivational imagery than they did cognitive imagery. In addition, competitive athletes reported using imagery more during rehabilitation compared to recreational athletes. In an extension of this study Sordoni, Hall, and Forwell (2002) found injured athletes reported using healing imagery to the same degree as motivational and cognitive imagery. Interestingly, healing imagery, but not motivational imagery (as hypothesised) was mildly correlated to self-efficacy.

Figure 13. A Bio-psychosocial Model of Sport Injury Rehabilitation (Adapted from Brewer, Andersen & Van Raalte, cited in Brewer, 2001).



From an intervention perspective, Sthalekar (1993) presented a case study of a partially paralysed water-skier suffering from phantom limb pain and found that imagery associated with hypnotic relaxation was associated with a reduction in pain, increased range of motion, and improvement in activities of daily living. In another study, also using a case study design, Nicol (1993) found that imagery, relaxation, counselling, and hypnosis was beneficial in reducing pain and inflammation associated with a repetitive strain injury.

Carroll (1993, cited in Cupal, 1998) also examined the influence of mental practice with six-injured collegiate athletes with relaxation and guided imagery. Using case-study techniques with a small sample that included a control group, the findings reflected enhanced recovery and reduced mood disturbance for some athletes. In another study, Brewer, Jeffers, Petitpas, and Van Raalte (1994) provided evidence indicating positive athlete perceptions for imagery, goal setting, and counselling, highlighting these as viable intervention strategies. A limitation of many of these studies is the examination of multiple components to the intervention, making it difficult to delineate whether the positive effects are due to imagery or due to another component of the intervention such as relaxation. A recent study by Newsom, Knight, and Balnave (2003) addresses this limitation and offers support for the use of imagery to limit strength loss after immobilization of the wrist. Eighteen-health university students were assessed for hand grip-strength, as well as wrist flexion and extension strength before having their non-dominant wrist immobilised in a cast. Participants were then randomised to either an experimental group that undertook three-5-minute mental imagery sessions daily (during which they imagined they were squeezing a rubber ball), or a non-imagery control group. At post-strength testing, results showed no significant pre-to-post test change in wrist-flexion or extension strength for the imagery group, whereas, the control group experienced a significant decrease in strength. No statistical group differences were found for grip strength. This study provides some preliminary evidence for the effectiveness of imagery in limiting strength loss during a period of limb immobilisation and requires further examination.

Goal setting has also been recommended within a sport-rehabilitation setting (e.g., Ievleva & Orlick, 1991; Theodorakis, Malliou, Papaioannou, Beneca, Filactakidou, 1996). Danish et al. (1992), and Petitpas and Danish (1995) support the use of goal setting within the injury rehabilitation, arguing that goal setting helps injured athletes to specify intentions in a positive manner, and enhances intrapersonal and interpersonal skills base. With respect to goal setting research, findings in the injury rehabilitation setting, Theodorakis and colleagues (Theodorakis, Beneca, Malliou, & Goudas, 1997; Theodorakis et al., 1996) have found that participants in an intervention condition required to set performance goals during a quadriceps-strengthening programme showed greater performance improvements and increases in self-satisfaction compared to a no-goal control condition. Gilbourne and Taylor (1998) also highlight the importance of goal setting in the sport injury rehabilitation setting and offer a task orientated approach to developing a goal setting programme which they argue could increase motivation, empower injured athletes, and influence their ability to cope with the demands of rehabilitation.

Other researchers have examined the role of electromyographic (EMG) biofeedback to enhance physical rehabilitation outcomes for common sport-related knee injuries (Draper, 1990; Draper & Ballard, 1991; Krebs, 1981; Levitt, Desinger, Wall, Ford, & Cassisi, 1995). In an early paper (Sprenger, Carlson, & Wessman, 1979) presented a case report of a 28-year old man following a medial meniscectomy, who experienced delayed rehabilitation. The patient was admitted for additional treatment, which included biofeedback of the vastus medialis. Improvement in range of motion was seen at 4-weeks with 0-degrees extension and 100-degrees flexion. When a comparison was made with other meniscectomy patients (n = 4) the biofeedback patient showed superior improvement. Later studies have provided support for EMG feedback improving outcomes following uncomplicated meniscectomy (Krebs, 1981), anterior cruciate ligament reconstruction (ACLR) (Draper, 1990), and for the reduction of patellar-femoral pain (Wise, Fiebert, & Kates, 1984). In addition EMG has also been found to be superior to electrical stimulation for increasing peak torque but not for increasing the rate of complete knee extension (Draper et al., 1991). However, in response to Draper et al's findings, Snyder-Mackler (1991) raised serious concerns regarding their methodology including: (a) the absence of a muscle exercise only condition; (b) the inadequate intensity of ES current; and (c) absence of a pre-operative assessment (which may have been valuable in this case). In a more methodological sound piece of research, Levitt, et al. (1995) assessed the effectiveness of EMG biofeedback in the rehabilitation of 51-patients undergoing minor arthroscopic knee surgery. Both control and treatment groups received verbal and written explanations of postoperative isometric exercises. The treatment group received additional instruction in the use of biofeedback equipment during exercise. Results showed that patients given EMG biofeedback during postoperative exercises experienced significantly greater extensor torque and quadriceps muscle recruitment than the control group. Although not directly examined, possible mechanism effects for biofeedback could be related to: (a) evoking greater interest in the prescribed exercise protocol, thus increasing motivation; or (b) the firing of motor units and/or recruitment of new units through enhanced proprioceptive information. Insight into these mechanisms is required if the link between interventions and outcome is to be elucidated.

Ambulatory surface integrated EMG biofeedback has also been examined and found to be effective for increasing peak torque and quadriceps muscle fibre recruitment two weeks after minor arthroscopic knee surgery. In addition, biofeedback combined with relaxation techniques proved valuable in the reducing re-injury anxiety in a female basketball player (Rotella & Campbell, 1983).

Although not directly related to rehabilitation, Kellis and Baltzopoulos (1996) provided evidence that participants who received visual feedback during resisted eccentric knee extension and flexion testing reported improved performance compared to a control (non-visual feedback) group. Specifically, the visual feedback group was approximately 7.2% and 6.4% higher for mean extension peak moments, and 8.7% and 9% for knee flexion at slow and fast speeds respectively. The authors suggest that visual feedback appears to be a motivating factor for maximum muscular moment exerted. This research provides possible avenues for investigating the role of visual feedback in a rehabilitation strength-conditioning programme.

Although a significant amount of evidence has been collected suggesting biofeedback to be a useful adjunct to regaining knee strength there has been limited effect shown in females. It is also necessary to determine whether the biofeedback treatment effects remain evident over time.

A number of other intervention techniques have been investigated. For example, Theodorakis, et al. (1997) provided evidence showing self-talk to be effective in increasing quadriceps strength following injury. From a different perspective again, Ross and Berger (1996) examined whether a stress-inoculation training programme (Meichenbaum, 1985) altered subjective pain, anxiety, and physical function outcomes following arthroscopic surgery for meniscus injury. Participants in the intervention received 2-one hour stress inoculation sessions prior to physiotherapy sessions, whilst the control condition, participated in physiotherapy only. The intervention group reported less state anxiety and subjective pain over time compared to the control group. In addition the mean number of days to recovery for the treatment group was significantly less than the mean number of recovery days for the control group. This approach of using SIT is endorsed by Hedgpeth & Sowa (1998) who suggest that incorporating stress management into athletic injury rehabilitation affords the athlete many benefits by allowing them to successfully cope and adjust to injury as well as to the rehabilitation process.

Cupal and Brewer (2001) have also examined the effects of guided imagery and relaxation on knee strength, re-injury anxiety, and pain among patients undergoing surgical reconstruction of the anterior cruciate ligament (ACLR). This study addressed a significant methodological concern of previous studies by including a placebo (contact control) condition in the research design. The intervention included ten-relaxation and guided imagery sessions spaced approximately 2-weeks apart during a 6-month recovery period. Sessions were designed to provide mental rehearsal of the physiotherapy goals. Videotape of individual's surgical procedures (from an arthroscopic perspective) served as a visual baseline. All sessions included the following three aspects: (a) highlighting the specific physiological process (es) at-work during the various stages of recovery (oedema, pain, and inflammation); (b) accommodating individual's perceptions by including suggestions to promote positive emotional coping responses; and (c) inclusion of various imagery modalities (internal, external, kinaesthetic) to enhance vivid mental experiencing (Cupal, & Brewer, 2001). The treatment group showed significantly greater knee strength and significantly less re-injury anxiety and pain at 24-weeks post surgery compared to the placebo and control conditions. The use of imagery and relaxation techniques was also recently investigated by Johnson (2000) who found improved mood for those in the intervention compared to the control condition**.** Although Cupal and Brewer's study (in particular) offers sound support for guided imagery and relaxation augmenting rehabilitation outcomes post ACLR, this research does not provide any insight into the potential mechanisms for the positive effects found with knee strength improvement. The authors do suggest that these effects on rehabilitation outcomes could possibly be mediated through immunological and physiological processes (Cupal & Brewer, 2001). Specifically, it is possible the guided imagery and relaxation had an influence on the autonomic system, by affecting the complex interrelationships in the healing process (e.g., cytokines and interleukin factors). An alternative mechanism might be psychological in nature, in which guided imagery and relaxation affects psychological factors, such as coping, anxiety or motivation, which increases ones response or effort in rehabilitation. Further research is necessary to integrate psychological theory and medical research and practice by exploring the complex psycho-physiological/immunological relations.

An intervention area that has received limited attention in the realm of athletic injury rehabilitation is observational learning, or modelling (Flint, 1991). Modelling typically involves viewing oneself or another perform a task or behaviour, which serves as a source of behavioural and verbal cues to gain new behaviours, attitudes and skills (Bandura, 1986). The fact that modelling has only received limited support in the rehabilitation setting is surprising, because empirical evidence exists to support its role in motor skill acquisition, psychological responses, and behaviour change in physical activity contexts (McCullagh, 1998; McCullagh & Weiss, 2001, 2002; McCullagh, Weiss, & Ross, 1989; Weiss, Ebbeck, & Wiese-Bjornstal, 1993; Williams, Davids, & Williams, 1999). Indeed, modelling has also been examined within a variety of clinical contexts (e.g., Kulik & Mahler, 1987; Thelen, Fry, Fehrenbach, & Fratutschi, 1979) to reduce preoperative anxiety (Anderson & Masur, 1983; Durst, 1990; Karl, Pauza, Heyneman, & Tinker, 1990; Robertson, Gatchel, & Fowler, 1991; Robinson & Kobayashi, 1991), to educate patients (Cull et al., 1998; Dunn, Shenouda, Martin, & Schultz, 1998; Krouse, 2000; Lin, Lin, & Lin, 1997), and to assist with self care activities (Meade, McKinney, & Barnas, 1994; Mynaugh, 1991; O'Donnell, San Doval, Duran, & O'Connell, 1995). Moreover, a recent review of preparation interventions for adult patients undergoing surgery and / or invasive medical procedures found that modelling combined with instruction in coping strategies is highly effective in producing positive outcomes (O'Halloran & Altmaier, 1995).

Despite the above evidence, only one investigation by Flint (1991) has explored the effectiveness of modelling as a viable psychological-intervention to enhance physical and psychological rehabilitation outcomes in an athletic setting. This is unfortunate, because Flint has argued that the extension of this technique into the "realm of sport injury rehabilitation affords motivation, injury-rehabilitation information and behavioural cues for recovering athletes" (Flint, 1999, p. 221). In her innovative study, Flint examined the role of coping models compared to no models on psychological factors and functional outcomes following a rehabilitation programme post-anterior cruciate ligament reconstruction (ACL). Ten-female basketball athletes were assigned to watch a coping model video of peers participating in rehabilitation from ACL surgery. The coping model video showed female athletes similar in age, basketball position, and type of injury progressing through the rehabilitation process to full recovery. Flint found that at 3-weeks post-surgery athletes who watched the modelling videotape had greater self-efficacy than the 10-matched participants that served as the control group. At 2-months post-surgery the intervention group had higher perceived athletic competence and could identify with at least one of the coping models in the video highlighting the role of model similarity in the coping model procedure. Differences in the expected direction were also seen in the early attainment of functional milestones (i.e., walking, jogging, running, and return to full function), although these differences were not statistically significant. Flint's study had a modest sample size and hence was underpowered, which may have accounted for the non-significant results for functional milestones. In addition, the modelling intervention was introduced post-operatively and did not provide an indication of its benefit for reducing pre-operative anxiety.

Although not directly related to an athletic rehabilitation context, other evidence exists to support the role of instructional videotapes in the rehabilitation setting for modifying dietary habits (Pace, Henske, & Whitfill, 1983; Wong & Wong, 1985), increasing knowledge (Lin et al., 1997), compliance (Roddey, Olson, Gartsman, Hanten, & Cook, 2002), and confidence to perform exercises (Weeks et al., 2002). Of these, Lin et al. (1997), Roddey et al. (2002), and Weeks et al. (2002) have the most applicability to this review. Although not specifically a modelling intervention, Lin et al. (1997) compared the effects of pre-admission and post-admission education programmes in a sample of 60-total knee arthroplasty patients. Pre-admission patients were provided with one-to-one teaching using an instructional booklet, before completing knowledge and anxiety questionnaires. When patients were admitted to hospital they were also asked to watch an instruction videotape developed by the researchers with identical content to the booklet, before completing knowledge questionnaires again. The control group received one-to-one teaching and the instructional video pre-operatively, but after being admitted to hospital. Those who viewed the videotape reported significantly greater knowledge, performed post-operative exercises more regularly and accurately, and demonstrated greater range of motion (ROM) compared to the control condition. No differences in state anxiety were found between the groups.

Roddey, et al. (2002) compared the effect of an instructional video (highlighting exercises to be performed at home given to the patient by a physiotherapist) with one-on-one instruction sessions (with the same physiotherapist) following surgical rotator cuff repair. Findings revealed no significant differences in compliance to treatment between the two groups, nor were there any significant group differences in self-reported outcomes. A number of methodological issues can be highlighted from these two studies. First, the Lin et al. (1997) results are confounded because the videotaped instruction was used in addition to the instructional booklet and individual teaching. Separation of the various instructional modalities would have allowed direct comparison of these techniques. Second, with respect to the Roddey et al. (2002) study, the physiotherapist could be considered a mastery model, both on the videotape, and during the one-on-one instruction. In essence, participants were exposed to a mastery model in both scenarios and could have been a cause for the resulting lack of group differences. In addition, no control condition was used therefore differences between the intervention and a control condition could not be elucidated.

In a different approach, Weeks et al. (2002) examined the role of videotape instruction (dynamic modelling) to still photographic illustrations (static modelling) for influencing the quality of performance, motivation, and confidence of participants to complete simple and complex exercises. Participants were randomised to either a static or dynamic-demonstration modelling group and were scheduled for an acquisition and retention session 24-hours apart. During the acquisition phase individuals watched the respective modelling modalities before performing a series of simple and complex physiotherapy rehabilitation exercises. After a 24-hour period had elapsed, participants returned to perform identical exercises in the absence of modelling (retention phase). Both sessions were videotaped for subsequent rating of form by two independent raters. Results showed that the dynamic modelling group had significantly higher ratings of form in the acquisition and retention phases compared to the static modelling group. The dynamic modelling group also reported greater confidence and motivation to continue the exercises in a home-based environment.

As modelling is the intervention to be examined in the study that follows (Study 3) it seems prudent to provide an outline and critique of the: (a) theoretical framework to underpin modelling; and (b) factors that lead to more effective modelling.

Theoretical Perspective to Modelling

A number of theoretical and conceptual approaches have been used to explain how people acquire skills and behaviour through observation (McCullagh & Weiss, 2001).

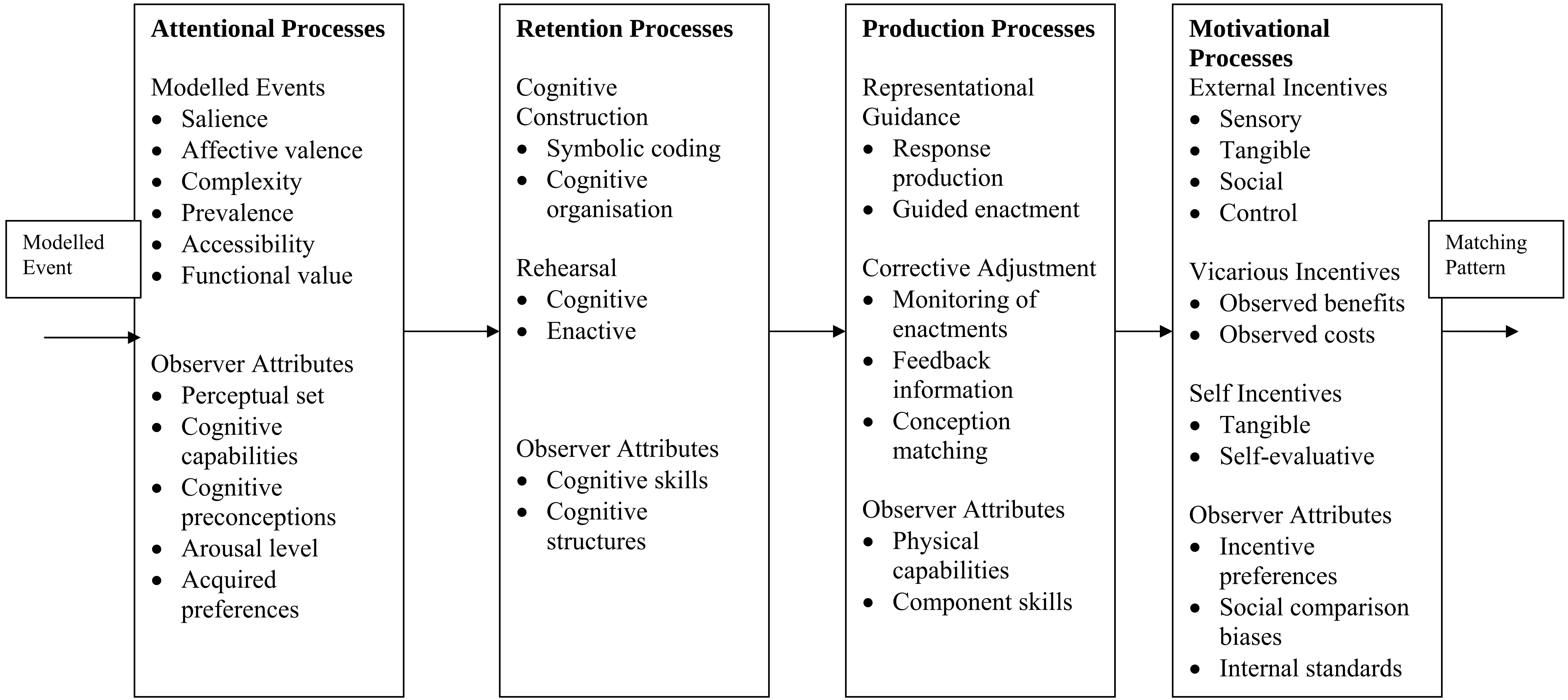
However, Bandura's (1986) social cognitive theory (SCT) has received the most empirical attention and support. According to social cognitive theory, modelling or observational learning is one of the primary modes used by individuals to gain socialisation information and cognitive skills. Behaviours, attitudes and skills can be learned via behavioural and verbal cues provided by a model (Bandura, 1986).

According to Bandura (1997), modelling or observational learning is primarily an information processing activity. Bandura has identified four components that govern observational learning: attention, retention, production, and motivation (Figure 14). Of these, attention is the first aspect of the observational learning process and requires that observers selectively attend to task-salient features to gather the essential factors necessary to successfully reproduce the modelled event. Attention is influenced by characteristics of both the modelled event and characteristics of the observer (McCullagh & Weiss, 2001). Although selective attention is important in the modelling process to ensure the appropriate information is extracted from the model presentation, it is insufficient for successful modelling to occur. Because this information must be remembered, retention the second major sub-process governing observational learning involves the active process of transforming information about events into symbolic representations by the observer. These symbolic cues serve as internal models for response production comparison and guidelines for response corrections. These representations can be verbal, visual, or imaginal in nature. Once this information is retained it must be translated into some form of action that represents the modelled event. The third process, production is when conceptions are translated into appropriate courses of action (Bandura, 1997) and is dictated by the organization of the component sub-skills of the observed behaviour (Bandura, 1986). According to Bandura (1986) the behavioural production of modelled acts involves a conception-matching process by which the feedback from the response is compared to the representation. Based on this comparison process, modifications to the behaviour are made (McCullagh, 1998). The ability to physically reproduce the requisite skills demonstrated by the model is a necessity at this stage. The more extensive the sub-skills that individuals possess, the easier it is to integrate them based on modelled information to produce new behaviour patterns (Bandura, 1997). Finally, without the motivation (the fourth sub-function of modelling) to emulate the observed actions, the preceding processes are redundant. Motivation determines whether the modelled behaviour will be enacted or not. Positive incentives, be they external, vicarious, or self can provide additional motivation to perform the observed behaviour (Bandura, 1986; Flint, 1991). Finally, it must be noted that modelling is not mimicking, rather it is a learning process allowing an observer to execute new behaviours not previously in their repertoire (Starek & McCullagh, 1999).

The Role of Self-efficacy in Observational Learning

Self-efficacy refers to “people’s beliefs about their capabilities to exercise control over events that affect their lives” (Bandura, 1989, p. 1175) and their “beliefs in their capabilities to mobilise the motivation, cognitive resources, and courses of action needed to exercise control over task demands” (Bandura, 1990, p. 101). Sources of self-efficacy are derived from four major sources of information; enactive mastery experiences, vicarious experiences, verbal persuasion, and affective and physiological states. Enactive mastery experience is the strongest source of self-efficacy and provides information about an individual’s capabilities to perform the task or behaviour. Vicarious experiences impacts on a person’s belief about performing a task or behaviour in relation to the capabilities of others. Verbal persuasion can act to modify the perception of an individual’s capabilities and physiological states can influence personal beliefs in capabilities or can influence interpretations of vulnerability to maladaptive behaviours (McCullagh & Weiss, 2001).

Figure 14. Four Sub-Processes Governing Observational Learning (Adapted from Bandura, 1997).



Of these various sources of efficacy information, enactive mastery experience and vicarious experience are the two that have the most applicability to modelling. Enactive mastery experiences are the most influential source of self-efficacy information because they provide the most authentic evidence of whether one can generate whatever it takes to succeed (Bandura, 1997). Individuals tend to act on their efficacy beliefs and assess the adequacy of self-appraisal from achieved performances. Generally, performance successes increase beliefs of personal efficacy, whereas repeated performance failures generally lower them. Enactive experiences are not the sole source of information about people's capabilities. Efficacy appraisals are partly influenced by vicarious experiences mediated through modelled attainments (Bandura, 1997). Hence, modelling acts as another effective tool for promoting a sense of self-efficacy. As the observer views the model, symbolic representation or verbal coding takes place and these cues are placed in memory. Through this vicarious experience, judgment criteria are established and new behavioural patterns can be learned. Judgements about capabilities are often comparative in nature, thus seeing an individual (similar to oneself) perform a novel task or demonstrate a particular behaviour can enhance the perception about the observer's capacity to recreate the action (Bandura, 1986). In summary, observational learning and self-efficacy are inexorably linked. Observational learning is a key source of efficacy beliefs that, in turn, influences thoughts, emotions, and behaviours (McCullagh & Weiss, 2002).

Model Effectiveness: The Role of Model Characteristics

A number of key factors are related to the effectiveness of modelling and these include the model type (i.e., self, or participant), skill level (i.e., a mastery vs., a coping model), model similarity (e.g., whether the model and the observer share physical characteristics such as size, age and gender), and model number (the greater the number of models the greater the chance of the observer identifying with one of them).

Modelling can refer to either viewing oneself (self-observation) or viewing others (participant modelling). For self-observation the observer can either view them self, either in a mirror, or more commonly it involves watching edited video images (2-4 minutes long). These edited vignettes are reviewed repeatedly to promote skill acquisition or behaviour change (i.e., adjusting to challenging situations as part of a training or therapy protocol) (cf., Dowrick, 1999). Feed-forward also a form of self-modelling and involves watching oneself during edited video vignettes executing a given behaviour in excess to what they had actually achieved (McCullagh & Weiss, 2002).

More than 150-studies exist examining the use of self-modelling in a variety of training and clinical context (Dowrick, 1999). Insofar as sport psychology and rehabilitation is concerned some evidence exists supporting for the utility of this technique. For example, Maile (1985, cited in Dowrick, 1999) examined the role of feed-forward self-modelling on the performance of a 24-year old female weightlifter. During a 2-month cycle the weightlifter watched a 2.5-minute self-modelling tape of one of her lifts in which the weight lifted exceeded that previously achieved. In 25-weeks Maile reported a 26% overall performance gain and an increase of 80% for each lift being achieved in the self-model phase for that lift. Other examples of feed-forward in sport have been associated with the learning of complicated skills in gymnastics (Dowrick, 1997), triple lutz in figure skating, and Eskimo rolling in kayaking (Franks & Maile, 1991).

Halliwell (1990) provides an anecdotal report that professional hockey players who watched self-observational music videos in association with visualisation techniques were associated with positive changes in confidence and performance, particularly among those players returning from injury or experiencing a performance slump.

McCuallgh (see Balf, 1986; Livermore, 1996, cited in McCullagh & Weiss, 2002) reported on the use of self-observation techniques with Olympic archers to provide information about upcoming competitions and as a source of self-efficacy information, with significant clinical improvements observed. Starek and McCullagh (1999) compared the effectiveness of peer versus self-modelling as a teaching aid in a sample of adult novice swimmers. Participants in the self-modelling condition performed better compared to those who watched someone else (peer). No differences between conditions were found in state anxiety or swimming self-efficacy.

In a non-clinical environment, Houlihan et al. (1996) demonstrated the effectiveness of videotaped peer and self-modelling procedures to increase the number of monthly community outings made by a 41-year old man with profound mental retardation. In a randomised controlled study, Stanton (1985) investigated the impact of edited and non-edited self-modelling procedures on work productivity (money earned) on a sample of mentally retarded adults. Following a ten-day baseline period participants were videotaped performing their respective tasks. They were then randomly assigned to one of three conditions, edited self-modelling, non-edited self-modelling, and control. The edited self-modelling videotapes contained only instances of appropriate work behaviour, whereas the non-edited version contained both appropriate and inappropriate behaviour. No significant group differences were found in work productivity. Stanton (1985) concluded that any variability in the amount of money earned (work productivity) was accounted for primarily by the individual differences within the treatment group rather than the treatment conditions themselves.

With respect to athletic injury rehabilitation, I am unaware of any research that has specifically examined the role of self-observation in this setting. This is surprising because this could provide a fruitful avenue for further investigation. For instance, watching edited information so that the performance on rehabilitation type exercises is greater than achieved (feed-forward) may prove fruitful in improving physical outcomes (e.g., knee strength, range of motion). Also viewing oneself performing rehabilitation exercises may promote correct biomechanical technique again leading to improved functional outcomes.

Participant modelling involves viewing or having contact with an external model executing a given skill or behaviour and has been found to be an effective technique for transmitting behaviour patterns (Feltz, 1982; Feltz, Landers, & Raeder, 1979; Flint, 1991; McAuley, 1985; Weinberg, Sinardi, & Jackson, 1982). Participant modelling represents the technique used most frequently in modelling research. Typically, participant modelling involves watching another person demonstrate a skill or behaviour, however, there is evidence supporting the use of puppets to act as models. For example, Shapiro (1997) illustrated how a medical clinician used a puppet model to help alleviate children's anxiety, when faced with medical stressors.

For skill acquisition, participant modelling typically involves the use of a three-stage approach from the presentation of the target behaviour to the final unassisted completion of the task. First, a model demonstrates the appropriate behaviour, then guided physical practice or the use of physical props are utilised to assist the observer in completing all aspects of the task. In the final stage, gradual removal of assistance occurs until the observer can complete the task alone. Participant modelling provides both successful performance accomplishments and social support for the observer and thus helps to reduce performance fears and enhance self-confidence (McCullagh et al., 1989). Considerable evidence exists to support the use of participant modelling in the development of self-efficacy and the promotion of motor-skill learning (Bandura & Adams, 1977; Feltz, 1982; McAuley, 1985). McAuley (1985) found that participants exposed to modelling conditions had greater efficacy to perform a gymnastic task, demonstrated better performance, and reported lower levels of anxiety compared to a control group.

Model observer similarity. With respect to participant modelling, the importance of model-observer similarity has drawn the attention of many researchers. Two variables have received considerable attention and include model age in relation to observer age and the presentation of mastery versus coping models (Bandura, 1977; McCullagh, Weiss & Ross, 1989; Thelen et al., 1979).

For model similarity, support has been extensive, demonstrating that the observer/model relationship can have an impact on both motor skill acquisition and the transmission of behaviour patterns (Gould & Weiss, 1981; Kulik & Mahler, 1987; Schunk, Hanson, & Cox, 1987; Thelen et al., 1979). Early research in the area of snake phobia highlighted the importance of age-related model similarity, particularly when dealing with children. For example, Weissbrod and Bryan (1973) found a reduction in fear among children that viewed similar or younger aged models. However, Kornhaber and Schroeder (1975) found that children who viewed age-similar models demonstrated greater fear reduction than when viewing adult models. In a sporting context Gould and Weiss (1981) found support for the similarity hypothesis when participants that viewed a similar model (a female non-athlete) performed better on a leg-extension task and reported higher self-efficacy than subjects who viewed a dissimilar model.

Another aspect of model similarity refers to the level of competence, skill, or expertise portrayed by a model, which is often distinguished by a mastery or coping model. A mastery model is one that exhibits the skill in an errorless fashion. The observer gain cues and symbols and processes these for use in own performance. A coping model however, does not repeatedly exhibit exemplary behaviour but demonstrates negative cognitions, affect, and behaviours that may precede or accompany performance on tasks that are perceived as difficult or fearful (McCullagh & Weiss, 2002). Through repeated trials the coping model gradually verbalises positive thoughts and emits more positive affect and correct performance. Schunk (1987) suggested coping models are similar to observers (i.e., fear, low confidence, and low ability) but provide information (e.g., problem solving) and motivation (e.g., self-efficacy) to help observers gradually engage in behaviours and skilled performance.

In an early study Meichenbaum (1971) reported that a coping model (on film) was more effective than a mastery model in reducing anxiety. Schunk, Hanson, and Cox (1987) provided a comparison of mastery versus coping models among children with difficulty learning mathematics. The mastery model demonstrated flawless exemplary performance, whilst the coping model, verbalised increasing levels of confidence and ability statements over trials. Those viewing the coping models reported greater self-efficacy and performance compared to those exposed to the mastery models. Despite these effects, several studies (e.g., Ginther & Roberts, 1982; Zachary, Freedlander, Huang, Silverstein, & Leggott, 1985) have failed to produce specific support for coping models.

Within a recreation-related setting, support for coping models has been found. Lewis, (1974) examined coping models with children who were fearful of swimming. Children were randomised into one of four conditions: coping model-plus-participation group; coping model only group; participation group; and a control group. Results showed that the coping model-plus participation group had a greater reduction in avoidance behaviour compared to the other three conditions immediately following the intervention. Weiss, McCullagh, Smith, and Berlant (1998) extended these early findings by examining the effects of modelling on fear of swimming, self-efficacy, and swim skills. Children took part in swim lessons over three days in addition to one of the following three modelling conditions: peer mastery, peer coping, or control. Results showed that those children that participated in the mastery and coping conditions had greater self-efficacy, performance, and greater reduction in swim fear from pre-to post-test. Coping models had the greatest effect on self-efficacy.

Modelling and Rehabilitation

Although modelling has repeatedly been shown to be effective reducing pre-operative anxiety in a variety of clinical situations (Karl et al., 1990; Melamed & Siegel, 1975; Robinson & Kobayashi, 1991; Thelen et al., 1979) this issue has not been examined in the sport rehabilitation setting. Indeed, if modelling is to be effective as an intervention to augment rehabilitation practices then it should be instigated pre-operatively and continue through the rehabilitation programme. Among the many factors associated with improved recovery time from an injury, motivation and efficacy to commence rehabilitation and perform activities have been highlighted (Quinn & Fallon, 2000). Both motivation and self-efficacy to rehabilitate have also been found to be good predictors of adherence to athletic injury rehabilitation programmes (cf., Brewer, 1998; Brewer et al., 2003; Duda, Smart, & Tappe, 1989; Fisher, Domm, & Wuest, 1988; Taylor & May, 1996). Interventions that increase rehabilitation practices and adherence may also ultimately improve rehabilitation outcomes (Brewer et al., 2003). Modelling certainly fits the bill as a viable intervention to promote improved rehabilitation outcomes. For example, when one considers Flint's (1991) data, the modelling condition showed an increase in self-efficacy and appeared more motivated to adhere to the rehabilitation. Moreover, individuals that watched dynamic modelling instructions reported they would be more motivated to continue home-based physiotherapy exercises compared to those who viewed static modelling instructions (Weeks et al., 2003).

Pain also has significant physical and psychological effects in almost every aspect of recovery (Heil, 1993; Pargman, 1993). The discernment of pain has been highlighted as the most pervasive and debilitating obstacle to effective rehabilitation experienced by injured athletes (Taylor & Taylor, 1998). Although modelling has been found to reduce perceptions of fear and anxiety associated with invasive medical procedures (cf., Anderson & Masur, 1983), I am unaware of any research that has specifically examined the role of modelling to reduce perceptions of pain associated with sport related injury. Modelling as an intervention has the potential to help reduce a person's perception of expected pain and anxiety, and to increase their rehabilitation self-efficacy and motivation early on in the rehabilitation process. This is particularly important when one considers the comments of De Carlo, Sell, Shelbourne, and Klootwyk (1994) who argued that if certain problems are allowed to develop early in the ACL postoperative period, they will be very difficult to eliminate in the long term and will ultimately have a detrimental effect on the patient's outcome.

The population examined by Flint (1991) also provides a suitable avenue for continued research, because acute disruption of the anterior cruciate ligament (ACL) of the knee is one of the more prevalent and debilitating sport- and recreation-related injuries (Derscheid & Feiring, 1987; Roos, Ornell, Gardsell, Lohmander, & Lindstrand, 1995). In the United States (U.S.) epidemiologic studies estimate that approximately 1 in 3000 individuals sustain ACL injuries each year. This figure corresponds to an overall injury rate approaching 100,000 injuries annually. In New Zealand (NZ) knee injuries represent 25% of all new ACC claims costing $NZ, 13 753 000. Elective surgical reconstruction of the ACL represented 4.7% of all elective surgical cases in NZ from January to September 2001 at a cost of over $4 million (ACC, 2002).

Anatomically, the anterior cruciate ligament (ACL) is approximately three-centimetres long and originates on the lateral femoral condyle within the intercondylar notch and inserts into the tibial plateau medial to the anterior horn of the lateral meniscus. It serves as a knee-joint stabiliser and is the primary restraint to anterior tibial translation, as well as counteracting excessive rotation and valgus stress (Evans, Hall, Chew, & Stanish, 2001; Kennedy, Weinberg, & Wilson, 1974). ACL tears usually occur during sudden cut or deceleration actions and therefore can typically result from non-contact injury.

Surgical reconstruction of the anterior cruciate ligament (ACLR) is associated with an extensive period of rehabilitation (6-9-months) involving home and clinic-based strength and flexibility exercises along with cryotherapy (icing) (DeCarlo et al., 1994; Shelbourne & Nitz, 1990). Given the nature of rehabilitation associated with ACLR opportunity exists to examine the potential utility of psychological interventions to augment the recovery process post surgical repair (Cupal & Brewer, 2001). The purpose of the third study (Study 3) is to examine the effectiveness of a video coping modelling intervention in promoting recovery following surgery for a common sport-related injury (anterior cruciate ligament reconstruction). It is predicted that athletes who receive a coping modelling video intervention will report lower pre-operative anxiety and perceptions of expected pain and will report greater self-efficacy and motivation for rehabilitation compared to the non-intervention group. It is also hypothesised that participants in the intervention group will show greater improvements in functional milestones (e.g., range of motion and crutch use) than those in the non-intervention group.

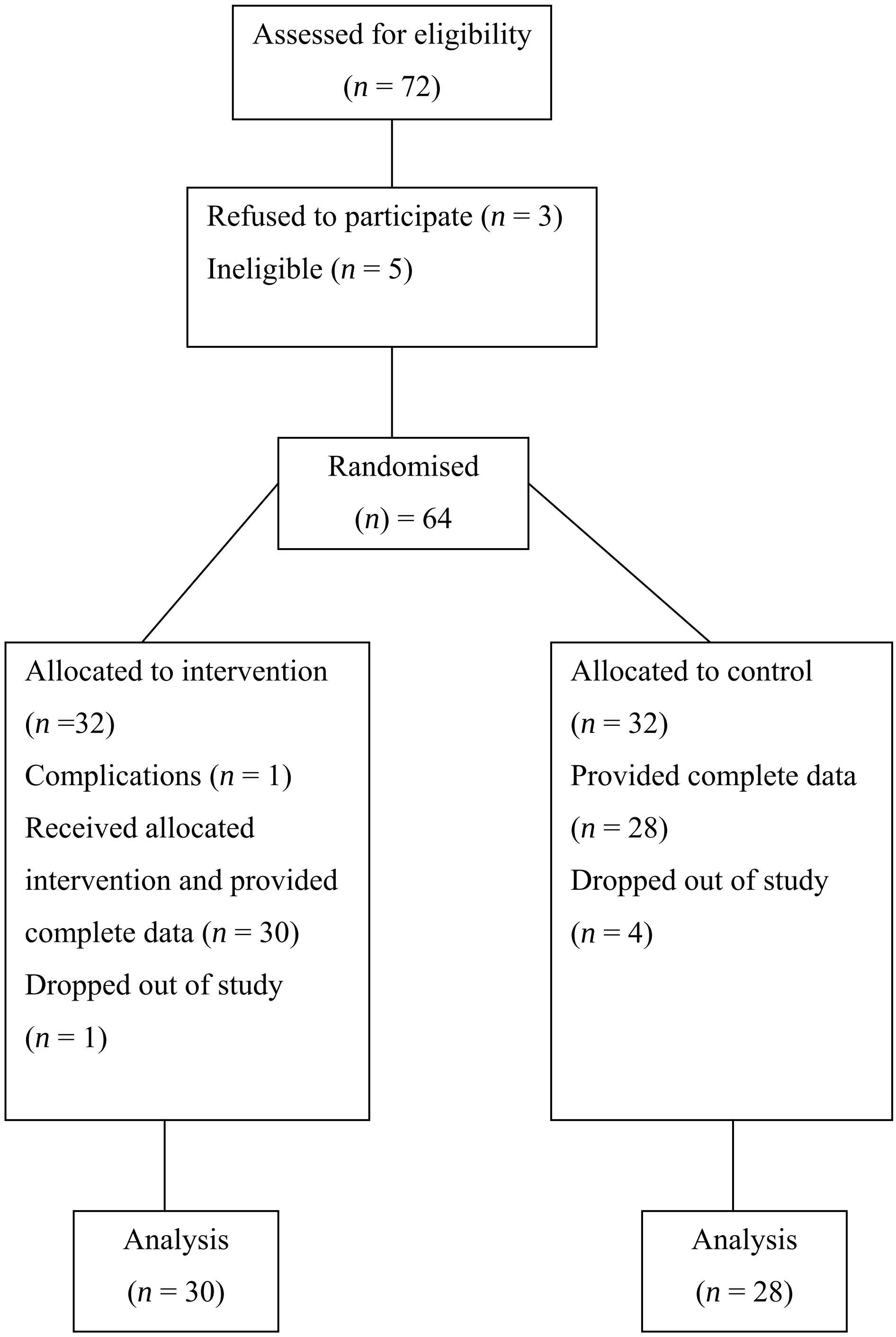
Chapter 11
Methods – Study 3

Participants and General Recruitment Procedure

Sixty-four participants scheduled for anterior cruciate ligament reconstruction were initially recruited into the study. Four withdrew from the study and one had a post-operative complication that disrupted the standard rehabilitation protocol, hence the final sample was 58 (Figure 15). Participants ranged in age from 15 to 53 years of age (M = 30.80), with a greater distributions of males (40, 68%) than females (18, 32%). The following ethnic groups were represented; NZ Pakeha, 71%, NZ Maori, 14%, Pacific Islands, 5% and other 10%. Rugby was over represented as the major cause of injury (32%) followed by soccer (19%), snow-sports (11%), netball (9%), water sports (5%), and miscellaneous activities (24%).

Participants were recruited prospectively from the Auckland Bone and Joint Surgery, and fulfilled the following criteria: (1) orthopaedic specialist diagnosis of ACL injury; (2) sport-related anterior cruciate ligament injury in a sport or recreation related event; (3) no previous ACL injury or reconstruction surgery; (4) functionally normal contralateral knee; (5) absence of multi-ligament involvement; and (6) aged between 15-55 years. The investigator approached all participants fulfilling the inclusion criteria to determine their interest in the study. All (except for three) agreed to participate. It was anticipated that there would be a 10% attrition rate (i.e., those that will not provide data throughout the project or those that develop surgical complications which hinder physical progress).

Figure 15. Participant Recruitment Flowchart for Study 3.



Psychological Measures

Pain Assessment. A single item assessed "perception of expected pain" and asked participants to "write down a number on a scale ranging from 0 (no pain) to 100 (pain as bad as it could be) that best describes how much pain you think you will experience after your knee surgery" (Appendix P). Assessments occurred at baseline and pre-operatively. Research suggests that scales of this nature are appropriate for measuring perceptions of pain (Jensen, Karoly, & Braver, 1986).

Anxiety. The State Trait Anxiety Inventory (STAI) was used to measure state anxiety at baseline and pre operatively (Appendix L). The STAI has been shown to have both construct validity and reliability (Smith, Smoll, & Wiechman, 1998). Participants were asked to respond to 20 statements that describe, "how they were feeling right now" on a scale of "1, Almost never to 4, Almost Always." Possible scores could range from 20-80. Reliability was acceptable for this scale at the two time points (baseline, $\alpha = .90$ and pre-operative, $\alpha = .91$).

Rehabilitation self-efficacy. Four-types of self-efficacy were assessed, all using adaptations of the Self-Efficacy Scale (McAuley & Mihalko, 1998). The self-efficacy scales assessed self-efficacy for performing a series of progressively more difficult knee-rehabilitation exercises or functional task outcomes (walking with crutches, walking without crutches, and jogging) on a scale of 0% (no confidence) to 100% (complete confidence). Using the self-efficacy scales participants rated their confidence on a scale ranging from 0% (no confidence at all) to 100% (completely confident) to perform various tasks.

The first type of self-efficacy referred to as crutches self-efficacy (CSE) assessed confidence to successfully perform increasing levels (duration and difficulty) of walking with crutches following their ACL reconstruction (Appendix Q). The scale was administered prior to discharge, and participants rated their confidence to walk with crutches for increasing periods of time (i.e., 10, 20, and 30 minutes) at two speeds (i.e., slow and moderate pace). A key was provided to define the various intensity levels. An example of one of the questions is "I believe that I can walk for 10-minutes at a slow pace without stopping". Scores were summed and divided by the number of items (6), with greater values indicating greater efficacy to exercise for longer periods of time and at a greater level of intensity. Reliability for the CSE was acceptable at the pre-discharge assessment (α = .95).

The second type was referred to as walking self-efficacy (WSE) and assessed confidence to successfully perform increasing levels (duration and difficulty) of walking without crutches following ACLR (Appendix R). The scale was administered prior to discharge, and again at 2-and 6-weeks. Participants rated their confidence to walk for increasing periods of time (i.e., 10, 20, and 30 minutes) at three speeds (i.e., slow, moderate, and moderately fast pace). A key was provided to given to define the various intensity levels. An example of one of the questions is "I believe that I can walk for 10-minutes at a slow pace without stopping". Scores were summed and divided by the number of items (9), with greater values indicating greater efficacy to exercise for longer periods of time and at a greater level of intensity. Reliability was excellent at the respective assessments (i.e., pre-discharge, α = .97; 2-weeks post-operative, α = .97; and 6-weeks post-operative, α = .95).

The third type was jogging self-efficacy (JSE) and assessed confidence to successfully perform increasing levels (duration and difficulty) of jogging following ACLR (Appendix S). The scale was administered at 2-and 6-weeks. Participants rated their confidence to jog for increasing periods of time (i.e., 10, 20, 30 minutes) at three speeds (i.e., slow, moderate, and moderately fast pace). A key was provided to given to define the various intensity levels. An example of one of the questions is "I believe that I can jog for 10-minutes at a slow pace without stopping". Scores were summed and divided by the number of items (9), with greater values indicating greater efficacy to exercise for longer periods of time and at a greater level of intensity. Reliability was excellent at the respective time periods (2-weeks, α = .98 and 6-weeks, α = .95).

The fourth type was referred to as exercise self-efficacy (ESE) and assessed confidence to successfully perform increasing amounts (frequency and duration) of rehabilitation exercises following ACLR (Appendix T). The scale was administered prior to discharge and again at 2-and 6-weeks. Participants rated their confidence to complete rehabilitation exercises for increasing periods of time (i.e., 10 and 20 minutes) at three different time periods (i.e., once, twice and three times a day). An example of one of the questions is “I believe that I can perform the rehabilitation exercises once a day for 10-minutes each session”. Scores were summed and divided by the number of items (6), with greater values indicating greater efficacy to perform rehabilitation exercises more frequently and for longer periods of time. Reliability was excellent at the respective time periods (i.e., pre-discharge, α = .96; 2-weeks post-operative, α = .93; and 6-weeks post-operative, α = .95).

Motivation. Motivation was assessed at pre-discharge, 2-and 6-weeks post-operatively using the Situational Motivation Scale (SIMS; Guay, Vallerand, & Blanchard, 2000). The SIMS is a sixteen-item scale that assesses intrinsic, extrinsic, and amotivation (Appendix U). Indices of reliability and validity have been found to be satisfactory (Guay, et al., 2000). The stem question for this measure was adapted slightly for the present study—and asked “Why are you *currently* planning to follow the rehabilitation programme after your operation?” and then asked participants to rate the degree to which various motivational statements (e.g., because I think this activity will be interesting, and I do this activity but I am not sure if it is worth it) corresponded to them on a scale of 1 (corresponds not at all) to 7 (corresponds exactly). Scores for the 4-subscales were summed with higher values representing greater amounts of the respective motivation (intrinsic motivation, identified regulation, external regulation, and amotivation). Potential scores for the subscales could range from 4-28. Reliability was acceptable for the motivation subscales, with α values ranging from .63 to .94.

Functional Milestones

Range of motion. Range of motion (ROM) was assessed at baseline, 2-and 6-weeks post ACLR using standardised goniometry procedures (Gerhardt, Cocchiarella, & Lea, 2002). Range of motion values for extension and flexion were obtained. Difference values (i.e., flexion minus extension) were used in final analyses, with greater scores representing greater ROM.

Crutch use. Participants were questioned at 2-weeks post ACLR to determine the length of time they required the use of crutches to assist with walking (in days). Higher scores represented longer periods of crutch-assisted walking.

Knee assessment. The International Knee Documentation Committee System (IKDC, Anderson, 1994; Hefti, Muller, Jakob, & Staubli, 1993) was used to clinically evaluate the knee at two different time periods (baseline and 6-weeks post-operatively, Appendix V). Each category in the IKDC assessment is graded as: A (normal); B (nearly normal); C (abnormal); and D (severely abnormal). Numerical values were given to each letter (i.e., A = 1 and B = 2 etc.) to assist with analysis. The scale incorporates an objective (surgeon's) and subjective (patient) assessment. Patient symptoms are evaluated at the following four activity levels: (a) strenuous activity (jumping, pivoting, and hard cutting); (b) moderate activity (heavy manual work, skiing, and tennis); (c) light activity (light manual work and walking); and (d) sedentary (house work and ADLs). Overall evaluation is determined by the worst grade in the following four categories; (a) patient subjective assessment; (b) symptoms (pain, swelling, and giving way); (c) range of motion; and (d) ligament evaluation (Lachman test, pivot shift test, and anterior draw).

The Intervention

A coping model video (DVD) was developed to represent the first 6-weeks of rehabilitation post ACL reconstruction. The video was divided into two-parts and detailed three-four-individuals who served as coping models, at various stages of the ACL rehabilitation process. The first part (9-min in duration) represented the pre-operative to 2-weeks post-operative period, whereas the second part (7-min) represented the 2-6-week post-operative period. The video consisted of edited interviews and various action shots of the models performing a variety of tasks (e.g., stair climbing, and walking). Models in the video demonstrated and verbalised increasing confidence in dealing with various aspects of the rehabilitation process (coping). The models participated in an interview format describing how they sustained their injury, their thoughts and feelings associated with the injury, as well as problems, concerns they experienced during their recovery from surgery and the rehabilitation process. Emphasis was placed on how the models overcame any problems faced during rehabilitation, as well as what they expected with respect to functional outcome.

Four models were filmed to ensure that observers would identify with at least one model with respect to age and gender, etc. This approach was taken to enhance attentional and motivational properties of the video. Again, consistent with Bandura's (1986) SET it was anticipated that individuals viewing the video would pick up relevant cues and information specific to their own stage of progression. This information would then be processed, retained, and result in increased confidence and motivation to perform rehabilitation exercises, which in turn should lead to earlier attainment of functional milestones.

In addition to the participants verbalising thoughts and concerns, narration was also included to help summarise and emphasise key elements of the video. As highlighted by Thelen et al. (1979) narration should facilitate attention to the model and verbal labelling of the critical model behaviour and thereby should increase the effectiveness of the modelling intervention.

Development of the Video

The modelling video was developed by the author in association with the University of Auckland's Department of Education and Media Studies. To provide further insight in to the development of the video, the script from Dr Flint's modelling doctoral dissertation (1991) was examined for content. Dr Flint was also contacted to discuss, various aspects of her video, specifically highlighting possible areas for improvement (Flint, Personal communication, November 2002). Finally, information was gleaned from the Practical Guide to Using Video in the Behavioural Sciences (Dowrick, 1991). The modelling DVD is provided in Appendix W.

In line with suggestions from the sources highlighted above, the following steps were taken to create the modelling video.

- Discussion with the orthopaedic surgeon to highlight the salient rehabilitation stages, expected rehabilitation milestones, as well as pre-and post-operative procedures.
- Basic scripting of the video to provide an overall plan of what the video would look like and what relevant information was to be highlighted.
- Discussion with education and media services to clarify filming procedures, techniques, and processes.
- The filming of 4-models who had successfully completed 6-weeks of rehabilitation post-ACLR.
- Time coding for all filming. This permitted the dialogue matching the filming to be isolated and audio-taped.
- All audio-taped dialogue was then transcribed to a text format.

- Transcribed dialogue (with time-codes) was then reviewed and edited to create a text script matching the overall video plan.
- The script was reviewed for content and theoretical consistency.
- The digital video was edited to ensure the content matched the edited text dialogue.
- The edited video was reviewed for content and theoretical consistency
- The final stages included further editing, narration and inclusion of graphics.

Editing and production of the videotapes required approximately 50-hours over a 2-month period.

Design

Study 3 was a randomised controlled prospective repeated measure design. A schematic representation of the study design is provided in Figure 16. Ethical approval was secured before proceeding with the present study. Both verbal and written information was given to all participants (Appendix O). Once written consent (Appendix N) was obtained, participants provided demographic information (age, gender, ethnicity, and injury information). All participants were then randomised to one of two conditions (intervention vs. control) using Statistical Packages for Social Sciences (SPSS) 11.5 software. Comparison of baseline group means for age, injury severity, and psychological variables revealed no differences, suggesting pre-treatment group equivalence on these variables.

Baseline data collection. Participants completed the IKDC subjective (S) form, STAI, and the expected pain assessment. Range of motion (ROM) measurements and the IKDC objective assessment were also obtained (Figure 16).

Pre-operative period. On the day prior to their operation, participants in the intervention watched the modelling video before completing the STAI and expected pain assessment, whereas the control group completed the psychological measures only (Figure 16.

Pre-discharge. Prior to discharge from hospital, the intervention group watched the modelling video before completing the psychological inventories (crutch, walking, and exercise self-efficacy scales, and SIMS), whereas the control group completed the psychological inventories only (Figure 16).

Two weeks post-operative. Participants were assessed again 2-weeks post–operatively. The intervention group watched the modelling video before completing the psychological inventories (walking, jogging, and exercise self-efficacy scales, and SIMS), whereas the control group completed the psychological inventories only. Functional milestones (ROM and crutch use) were also assessed (Figure 16).

Six weeks post-operative. At the 6-week post-operative assessment the intervention group watched the modelling video before completing the psychological inventories (walking, jogging, and exercise self-efficacy scales, and SIMS), whereas the control group completed the psychological inventories only. Functional milestones (ROM and IKDC subjective and objective) were also assessed (Figure 16).

Figure 16. Study 3 Design Flow Diagram.

Intervention Group	**TIME**	**Control Group**
Baseline Data Collection		**Baseline Data Collection**
3-7 days pre-op		3-7 days pre-op
Psychological Instruments Administered		Psychological Instruments Administered
Functional milestones assessed		Functional outcomes assessed
Pre-operatively		**Pre-operatively**
Watched 0-2 week video		
Psychological Instruments Administered		Psychological Instruments Administered
Pre-Discharge		**Pre-Discharge**
Watched 0-2 week video		
Psychological Instruments Administered		Psychological Instruments Administered
2-weeks Post-operatively		**2-weeks Post-operatively**
Watched 2-6 week video		
Psychological Instruments Administered		Psychological Instruments Administered
Functional Outcomes Assessed		Functional Outcomes Assessed
6-weeks Post-operatively		**6-weeks Post-operatively**
Watched 2-6 week video		
Psychological Instruments Administered		Psychological Instruments Administered
Functional Outcomes Assessed		Functional Outcomes Assessed

Rehabilitation Programme

Traditionally the rehabilitation following ACL reconstruction has been conservative in nature and represented a protracted programme to optimise functional outcomes (Paulos, et al., 1981). These programmes focussed on immobilising the patient's leg in some form of cast or brace for a period of 6-weeks or more. The rationale being that the ACL graft was weakened during the first 8-postoperative weeks and needed protection (see Geerstema, 2002 for a review). More recently, the accelerated ACL rehabilitation programme has been developed and represents the more the common approach to rehabilitation post ACLR. This programme usually consists of 4-phases: a pre-operative phase; an immediate post-operative phase; concentrated rehabilitation phase; and finally a sport-specific activity phase (Geerstema, 2002). This accelerated approach has also been enhanced due to improved surgical techniques (e.g., arthroscopic surgery) and generally focuses on early mobilisation and ROM exercises.

In the pre-operative phase the main goals are to reduce swelling, regain full ROM, and re-establish normal gait pattern in order to prevent post-operative complications (Mohtadi, Webster-Bogaert, & Fowler, 1991; Shelbourne, et al., 1991). The immediate post-operative phase usually lasts 1-2 weeks during which, the main goals are to reduce swelling and pain, to increase quadriceps strength, regain good leg control, and increase ROM. The Cryo-Cuff compression device is initiated at this time to reduce swelling in the knee. The Cryo-Cuff is a large, vinyl bladder that fits directly over the knee and is secured with Velcro straps. The bladder is filled with ice-cold water through a portable canister and tubing system. With the bladder filled, the cuff provides cold compression to the postoperative knee. Patients are encouraged to use the Cryo-Cuff as much as possible in the first 7-10 days post-operatively. In addition, patients are discharged on crutches and are encouraged to weight-bare as tolerated with the Cryo-Cuff in place. Physiotherapy is commenced as soon as possible to facilitate ROM, as this is the most critical factor in the early phases post ACLR. Experience has shown that early terminal extension of the index limb is the key to a successful result (Mohtadi et al., 1991; Shelbourne, Whitaker, McCarroll, Retttig, & Hirschman, 1989; Shelbourne & Nitz, 1990). Patients typically return for their first post-operative clinic assessment 10-14 days after the operation.

The concentrated rehabilitation phase usually lasts 4-6 weeks with goals being to control swelling, maintain full hyperextension, increase flexion to 130^{O} normalise gait, and progress toward strengthening and participation in sport specific activities. Within the first 6-weeks continued ROM progression to non-weight bearing is essential. Strengthening exercises are commenced through closed kinetic quadriceps strengthening which is essential to maintaining leg-control (DeCarlo, Shelbourne, McCarroll, & Retttig, 1992). Progression to other exercise modalities follows (e.g., leg-presses squats, lunges, bicycling, and swimming). Early achievement of quadriceps strength and early passive terminal extension appears to set the tone for the entire rehabilitation programme and a successful outcome (DeCarlo et al., 1992). The final phase focuses on sport specific activities with the patient continuing physiotherapy and rehabilitation exercises, progressively increasing strength and agility. As strength, agility, and pro-prioception continue to improve the patient will work toward full activity, which depending on progress of the patient will be 6-9-months after surgery (DeCarlo et al., 1992; Shelbourne & Nitz, 1990).

In the present study the orthopaedic surgeon advocated the application of the accelerated rehabilitation programme. As highlighted, treatment goals in the initial 6-weeks of ACL rehabilitation focus on pain management, reduction of swelling in the knee, and restoring ROM. Because of this, there is potentially less variability in rehabilitation practices during this period compared to the weeks that follow. The modelling intervention therefore focussed on this initial 6-week period.

Chapter 12
Results – Study 3

Treatment of the Psychological Data

To address the first hypothesis of the first study that participants receiving a modelling intervention would have significantly lower pre-operative anxiety and perceptions of expected pain, and significantly greater rehabilitation self-efficacy and motivation compared to their control counterparts, two forms of analyses were conducted. When baseline data were available to serve as a covariate, 2-way (intervention vs. control) ANCOVAs were performed on each of the dependant measures (pain and anxiety variables). Prior to conducting these analyses, the assumptions underlying the use of ANCOVA (i.e., reliability of covariates, linear relationship between the dependent variable and covariates, and homogeneity of regression slopes) were tested and satisfied (Tabachnick & Fidell, 2001). The alpha level for the ANCOVA analyses was .05, with effect sizes reported (Eta-square $ή^2$). All skewed data were subjected to logarithmic transformation to reduce a potential spurious influence of extreme scores (Tabachnick & Fidell, 2001).

When baseline data were not available, a series of repeated measure ANOVA's were conducted. The alpha value for these ANOVA analyses was .05. Any significant interactions were examined with planned multiple comparison Bonferroni tests. Corresponding measures of effect sizes, Eta-square $ή^2$ and Cohen's *d*, are reported. All data were assessed for the various requirements of ANOVA (Hair, Anderson, Tatham, & Black, 1992). All skewed data were subjected to logarithmic transformation to reduce a potential spurious influence of extreme scores (Tabachnick & Fidell, 2001).

Path analysis was also conducted to elucidate the degree to which the psychological variables mediated the relationship between the modeling intervention and functional outcome measures. For this form of analysis to take place variables had to meet the initial conditions of mediation as described by Baron and Kenny (1986).

Descriptive Data. As can be seen in Table 8, participants appeared to have relatively low levels of state anxiety. There are overall increases in walking and jogging self-efficacy across time. Also of note are the persistent lower levels of amotivation for the intervention condition across time. Table 9 presents the bivariate correlations of the variables of interest. Due to the number of variables and the various time points examined in the present study, the correlation tables have been separated to ensure readability. One-way ANOVAs revealed no significant group differences on the baseline demographic (age, height, weight, and gender), psychological (perception of expected pain and state anxiety) and functional variables (IKDC and ROM).

Closer examination of the correlations revealed a number of patterns between the psychological variables, which are worthy or comment (Table 9). State anxiety at baseline was inversely related to exercise self-efficacy at pre-discharge (r = -.28, $p < .05$). Anxiety at baseline and preoperatively was related to amotivation at discharge (r = .38 and r = .48 respectively). Baseline perceptions of expected pain were inversely related to walking self-efficacy at 6-weeks (r = -.36 $p <.01$). Amotivation at discharge was inversely related to exercise self-efficacy at discharge (r = -.36, $p < .01$). Also of interest were the moderate relations between exercise efficacy at 2-weeks and intrinsic motivation (r = .35 $p < .01$), identified regulation (r = .32 $p < .05$) and amotivation (r = -.28 $p < .05$). Finally, amotivation at 2-weeks was inversely related to walking self-efficacy at 6-weeks (r = -.32 $p < .05$), whereas as intrinsic motivation was related to exercise self-efficacy at 6-weeks (r = .29 $p <$ .05)

Table 8. Study 3 Descriptive Statistics of the Variables of Interest.

Variable	*n*	*M*	*SD*	Range	Skewness
Baseline perception of pain	58	63.17	19.86	0-100	.88
Pre-op perception of pain	58	61.38	17.62	20-100	-.06
Baseline state anxiety	58	35.64	8.40	22-55	-.31
Pre-op state anxiety	58	37.58	8.55	23-59	.60
Discharge IM	58	14.06	4.96	4-24	-.57
Discharge IR	58	25.22	3.06	13-28	4.90
Discharge ER	58	20.36	5.91	4-28	1.61
Discharge AM	58	5.97	2.95	4-19	5.73
2-weeks IM	58	14.75	5.00	6-25	-.84
2-weeks IR	58	21.87	2.99	11-28	3.62
2-weeks ER	58	20.31	4.87	6-22	.85
2-weeks AM	58	6.71	4.06	4-19	2.58
6-weeks IM	58	14.28	4.94	4-26	.04
6-weeks IR	58	25.42	2.63	12-28	10.69
6-weeks ER	58	18.53	5.78	4-28	-.01
6-weeks AM	58	6.18	3.98	4-22	6.58

IM = Intrinsic motivation; IR = Identified regulation;
ER = External regulation; AM = Amotivation;

Table 8 continued.

Variable	*n*	*M*	*SD*	Range	Skewness
Discharge CSE	58	65.28	24.72	1.67-100	-.03
Discharge WSE	58	51.88	24.34	0-93	-.42
Discharge ESE	58	82.08	19.07	16.67-100	2.54
2-week WSE	58	71.15	23.01	7.80-100	1.10
2-week JSE	58	39.57	26.13	0-100	-.51
2-week ESE	58	84.54	14.60	41.67-100	.76
6-week WSE	58	91.32	9.84	60-100	2.23
6-week JSE	58	53.38	26.52	0-100	-.54
6-week ESE	58	87.12	12.07	51.67-100	1.97
ROM (baseline)	58	130.82	10.44	105-145	-.56
ROM 2-weeks	58	102.71	15.50	69-125	-.74
ROM 6-weeks	58	122.94	8.82	105-145	-.15
IKDC (O) (baseline)	58	3.15	.58	2-4	-.14
IKDC (S) (baseline)	58	52.91	12.28	24-82	-.12
IKDC (O) (6-weeks)	58	2.42	.48	2-3	-1.83
IKDC (S) (6-weeks)	58	59.17	8.98	33-80	.41
Crutch use in days	58	7.38	3.75	1-21	1.92

CSE = Crutches self-efficacy; WSE = Walking self-efficacy;
JSE = Jogging self-efficacy; ESE = Exercise self-efficacy;
ROM = Range of motion
O = Objective; S = Subjective

Table 9. Study 3 Bivariate Correlations for the Variables of Interest.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Anxiety (B)	1	.74**	.07	.02	-.18	.01	-.28*	.06	-.06	.08	.38**	-.22	-.13	-.21	.07	-.10
2. Anxiety (P)		1	.22	.13	-.19	-.10	-.23	.20	-.17	.17	.43**	-.09	-.08	-.14	.15	-.09
3. Pain (B)			1	.34**	-.05	-.11	-.14	.09	-.28*	-.15	.20	-.13	-.04	-.16	-.04	-.20
4. Pain (P)				1	-.21	-.24	-.24	-.13	-.17	-.17	.17	-.01	-.14	-.26	-.12	-.19
5. CSE (D)					1	.70**	.60**	-.05	-.04	-.06	-.01	.24	.17	.06	-.05	-.16
6. WSE (D)						1	.51**	.02	-.02	-.01	-.03	.16	.11	.22	.06	-.04
7. ESE (D)							1	-.06	.11	.07	-.36*	.33*	.36*	.38*	-.01	.11
8. IM (D)								1	.26*	.03	.07	-.09	.19	.05	.67**	.44**
9. IR (D)									1	.14	-.54**	-.13	-.02	-.01	.18	.56**
10. ER (D)										1	.01	.04	.09	.07	-.04	-.06
11. AM (D)											1	-.13	-.03	-.22	.01	-.35**
12. WSE (2W)												1	.62**	.52**	.01	.02
13. ESE (2W)													1	.32*	.35**	.32*
14. JSE (2W)														1	.04	.04
15. IM (2W)															1	.61**
16. IR (2W)																1

CSE = Crutches self-efficacy; WSE = Walking self-efficacy; JSE = Jogging self-efficacy; ESE = Exercise self-efficacy

IM = Intrinsic motivation; IR = Identified regulation; ER = External regulation; AM = Amotivation

B = Baseline; P = Pre-operative; D = Discharge; 2W = 2-weeks; 6W = 6-weeks

** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).

Table 9 continued.

	17. ER (2W)	18. AM (2W)	19.WSE (6W)	20. JSE (6W)	21. ESE (6W)	22. IM (6W)	23. IR (6W)	24. ER (6W)	25. AM (6W)	26. Crutches	27. ROM (2W)	28. ROM (6W)	29. IKDC (O)	30. IKDC (S)
1. Anxiety (B)	.22	.16	-.19	-.21	-.06	.20	-.09	.16	.19	.08	-.03	-.13	.03	-.20
2. Anxiety (P)	.14	.25*	-.12	-.19	.01	.23	-.17	.10	.13	.06	.17	-.03	.12	-.14
3. Pain (B)	.06	.25*	-.36**	-.01	.18	.01	-.18	-.01	.20	.09	.23	-.12	.25	-.35**
4. Pain (P)	-.07	.11	-.11	.09	.05	-.17	-.05	-.05	-.03	.06	.02	-.01	.04	-.12
5. CSE (D)	-.12	-.01	.08	.02	.13	-.12	-.08	-.09	.07	-.18	.06	-.09	-.15	.18
6. WSE (D)	-.12	-.09	.02	.11	.06	-.03	-.06	-.21	.05	-.43**	.13	-.08	-.01	.13
7. ESE (D)	-.08	-.15	.30*	.13	.14	-.07	.03	.01	-.09	-.18	-.08	-.13	-.17	.19
8. IM (D)	.14	.10	-.18	-.03	.21	.70**	.15	-.06	.08	-.14	.12	.09	-.03	.04
9. IR (D)	.28*	-.55**	.08	.09	-.13	.04	.47**	.08	-.48**	.02	.14	.34**	-.38**	.27*
10. ER (D)	.65**	-.10	.30*	.03	-.01	-.12	.06	.52**	-.28*	.09	-.06	.11	-.17	-.03
11. AM (D)	.09	.64**	-.32	-.24	.17	.15	-.50**	.03	.61**	-.03	.01	-.19	.21	-.22
12. WSE (2W)	-.14	.16	.39**	.19	.36**	-.06	.12	-.04	-.04	-.02	.14	.05	-.06	.02
13. ESE (2W)	.09	.28*	.29*	-.02	.63**	.28*	.19	-.08	.09	-.07	.10	.04	-.10	.06
14. JSE (2W)	-.01	.04	.26*	.41**	.09	.01	.05	.04	-.03	-.07	.07	-.02	-.02	.21
15. IM (2W)	.05	.18	-.13	-.08	.29*	.74**	.13	-.28*	.03	-.09	.08	.14	-.05	.12
16. IR (2W)	.08	-.14	-.02	-.02	.20	.53**	.47**	-.31*	-.16	.01	.01	.13	-.15	.18

CSE = Crutches self-efficacy; WSE = Walking self-efficacy; JSE = Jogging self-efficacy; ESE = Exercise self-efficacy; IM = Intrinsic motivation; IR = Identified regulation; ER = External regulation; AM = Amotivation B = Baseline; P = Pre-operative; D = Discharge; 2W = 2-weeks; 6W = 6-weeks

** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).

Table 9 continued.

	17	18	19	20	21	22	23	24	25	26	27	28	29	30
17. ER (2W)	1	.03	-.02	-.03	-.02	.03	.09	.51	-.01	.15	-.09	.01	-.07	-.16
18. AM (2W)		1	-.28*	-.18	.17	.12	-.35**	-.13	.65**	.05	-.06	-.21	.32*	-.20
19. WSE (6W)			1	.34*	.13	-.24	.14	.18	-.42**	.03	-.26	.11	-.17	.11
20. JSE (6W)				1	.16	-.23	.26*	.08	-.16	.05	-.08	.15	-.09	.09
21. ESE (6W)					1	.43**	.18	-.14	.15	-.22	-.01	.02	-.15	-.02
22. IM (6W)						1	.17	-.18	.19	-.12	-.06	.05	-.14	.09
23. IR (6W)							1	.09	-.43**	-.02	.02	.28*	-.38**	.23
24. ER (6W)								1	-.02	.19	.05	-.08	-.18	-.11
25. AM (6W)									1	.01	-.05	-.35**	.33**	-.23
26. Crutch use										1	-.16	.25*	.09	-.15
27. ROM (2W)											1	.18	-.03	.18
28. ROM (6W)												1	-.53**	.34**
29. IKDC (O)													1	-.67**
30. IKDC (S)														1

CSE = Crutches self-efficacy; WSE = Walking self-efficacy; JSE = Jogging self-efficacy; ESE = Exercise self-efficacy;

IM = Intrinsic motivation; IR = Identified regulation; ER = External regulation; AM = Amotivation B = Baseline;

P = Pre-operative; D = Discharge; 2W = 2-weeks; 6W = 6-weeks

** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).

Anxiety and pain. ANCOVA results revealed no condition effect (control versus intervention) for pre-operative anxiety, F (1, 56) = 85, p = .36, Eta squared ($\acute{\eta}^2$) = .02. As can be seen in Figure 17 both groups showed a general increase in state anxiety from baseline to the pre-operative assessment. With respect to pain, a significant condition effect was found, F (1, 56) = 5.42, $p < .05$, Eta squared ($\acute{\eta}^2$) = .10. As can be seen in Figure 18 the modelling condition showed a linear decrease in perceptions of pain from baseline (M = 62.17) to pre-operative (M = 55.33), whereas the control showed an increase from baseline (M = 64.24) to pre-opertaive (M = 66.79).

Rehabilitation Self-Efficacy and Motivation

Crutches self-efficacy. Because crutch self-efficacy was only assessed at pre-discharge, a one-way ANOVA was performed. Results revealed significant group differences, F (1, 56) = 6.38, $p < .01$, d = .53. The modelling group reported greater confidence to walk with crutches (M = 72.85) compared to the control (M = 57.17) at the pre-discharge assessment.

Walking self-efficacy. Repeated measures ANOVA results revealed a significant time effect, F (2, 55) = 79.50, $p < .01$, $\acute{\eta}^2$ = .74, whereas the time x condition approached statistical significance, F (2, 55) = 2.70, p = .07, $\acute{\eta}^2$ = .08. As can be seen in Figure 19, the modelling group reported greater self-efficacy after viewing the video at pre-discharge (M = 59.20) compared to the control group (M = 44.04). Follow up analyses revealed significant group differences at pre-discharge (t = 2.47, p = .01, d = .62), but not at the 2-week (t = -.50, p = .62, d = .13) and 6-week assessments (t = 1.43, p = .16, d = .33).

Jogging self-efficacy. A significant time effect was found for jogging self-efficacy, F (1, 56) = 13.43, p <.01, $\acute{\eta}^2$ = .19. Figure 20 shows a linear increase in jogging self-efficacy from

2 to 6-weeks post-operatively for both groups. No significant time x condition effect was found, *F* (1, 56) = .01, *p* = .93, $ή^2$ = .01.

Exercise self-efficacy. No significant time effect, *F* (2, 55) = 2.18, *p* = .12, $ή^2$ = .07 was seen for exercise self-efficacy, but a significant time x condition interaction effect, *F* (2, 55) = 3.07, *p* = .05, $ή^2$ = .10 was evident. Follow up analyses revealed significant differences at pre-discharge (*t* =2.27, *p* = .03, *d* = .47), but not at the 2-week (*t* = -.12, *p* = .90, *d* = .03), and 6-week (*t* = -.10, *p* = .32, *d* = .26) assessments. The modelling group (*M* = 87.38) reported greater efficacy to perform rehabilitation exercises after watching the video compared to the control group (*M* = 76.38) at pre-discharge only (Figure 21).

Motivation. No significant time effects were seen for intrinsic motivation, *F* (2, 55) = .89, *p* = .41, $ή^2$ = .03, or amotivation, *F* (2, 55) = 1.76, *p* = .18, $ή^2$ = .06. Nor were there any significant time x condition effects for intrinsic motivation, *F* (2, 55) = .86, *p* = .43, $ή^2$ = .03, or amotivation, *F* (2, 55) = 2.09, *p* = .13, $ή^2$ = .07. A significant time effect, *F* (2, 55) = 3.72, *p* = .03, $ή^2$ = .12, but not a significant time x condition effect, *F* (2, 55) = .39, *p* = .67, $ή^2$ = .01 was observed for external regulation. For identified regulation, a significant time effect was found, *F* (2, 55) = 56.06, *p* < .01, $ή^2$ = .67, whereas the time x condition approached significance, *F* (2, 55) = 2.50, p = .09, $ή^2$ = .08 (Figures 22-26). Follow up analyses revealed no significant differences at the various assessment time points (pre-discharge, *t* = 1.28, *p* = .21, *d* = .33; 2-weeks, *t* = -.56, *p* = .58, *d* = .17; and 6-weeks *t* = 1.36, *p* = .18, *d* = .27).

Treatment of the Functional Data

In order to provide a full test of the second hypothesis of the present study, that participants receiving a modelling intervention (video) would have superior functional outcomes than their control counterparts, 2-way (intervention vs. control) ANCOVAs on each of the dependant measures (ROM and IKDC variables) were performed. Baseline scores served as the covariate. Again, the assumptions underlying the use of ANCOVA were tested and satisfied (Tabachnick & Fidell, 2001). The alpha level for the ANCOVA analyses was .05, with effect sizes reported (Eta-square $ή^2$). Skewed data were again subjected to logarithmic transformation (Tabachnick & Fidell, 2001).

Functional Outcomes

Descriptive data. Correlations between the functional outcome variables showed the following pattern of relationships (see Table 9). Range of motion at 6-weeks was related to IKDC objective and subjective scores ($r = -.53$, $p < .01$ and $r = .34$, $p < .01$ respectively).

IKDC measures. A significant condition effect was found for IKDC objective scores, F (2, 55) = 6.53, $p = .01$, $ή^2 = .11$. As can be seen in Figure 27, the modelling group ($M = 2.24$) scored significantly lower (i.e., better function) at 6-weeks compared to the control group ($M = 2.60$). The condition effect for IKDC subjective scores approached significance, F (2, 55) = 3.01, $p = .08$, $ή^2 = .05$. The modelling group ($M = 61.18$) reported higher scores on the IKDC (S) scale (i.e., less disability) at 6-weeks compared to their control counterparts ($M = 57.02$) (Figure 28).

Range of motion. Repeated measures ANOVA showed a significant time effect, F (1, 56) = 18.73, $p < .001$, $ή^2 = .25$, but a non-significant interaction effect, F (1, 56) = 1.46, $p = .23$, $ή^2 = .03$. As can be seen in Figure 29, there was there was a linear decrease in ROM for both groups from baseline to 2-weeks and a linear increase in ROM from 2-to 6-weeks.

Crutch use. Time spent walking on crutches was assessed at one time point only, so a one-way ANOVA was performed. Significant group differences were found, F (2, 56) =

19.65, $p < .01$, $d = .94$, suggesting that the modelling group ($M = 5.55$ days) spent significantly less time on crutches compared to the control group ($M = 9.34$ days).

Testing for Mediation. Walking self-efficacy (discharge) and crutch use were the only variables that met the initial conditions of mediation (Baron & Kenny, 1986). Results showed that the intervention was related to both discharge walking self-efficacy (path coefficient, .35) and crutch use (.43). Walking self efficacy was also related to crutch use (.31). However the indirect effect of the intervention to crutch use through walking self-efficacy (.11) was less than the direct effect of the intervention to crutch use. Hence, no support for mediation was found.

Figure 17. State-Anxiety Condition Effect (ns).

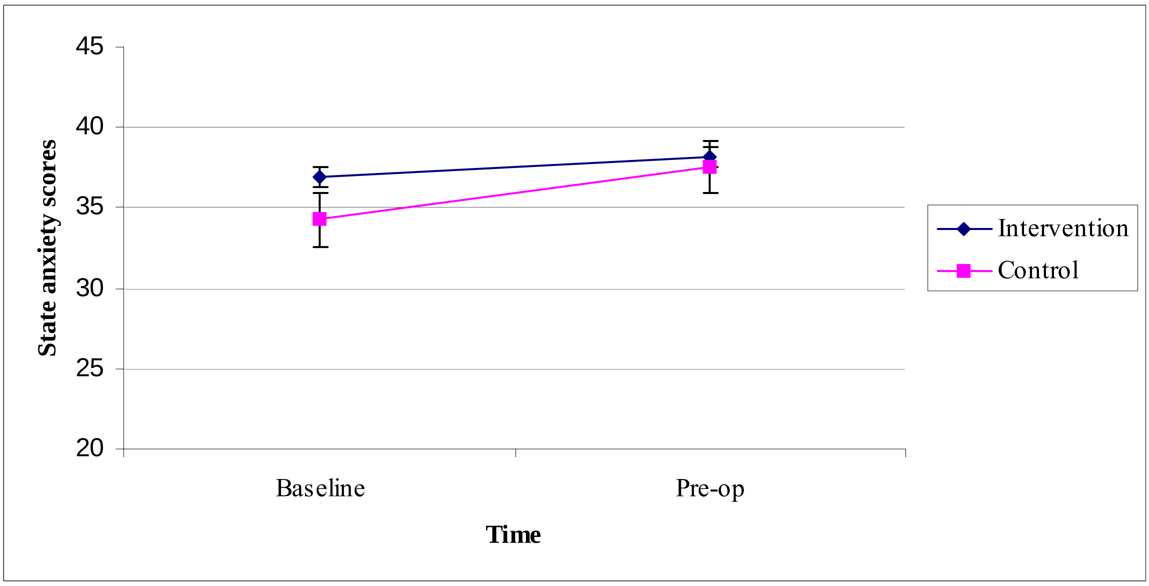


Figure 18. Perception of Expected Pain Condition Effect.

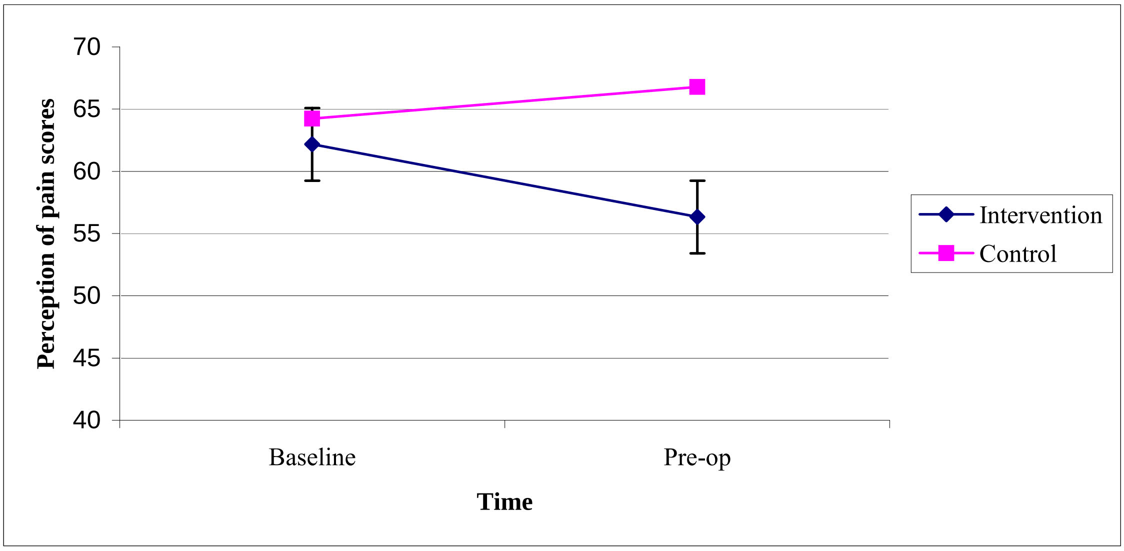


Figure 19. Walking Self-Efficacy Condition Effect.

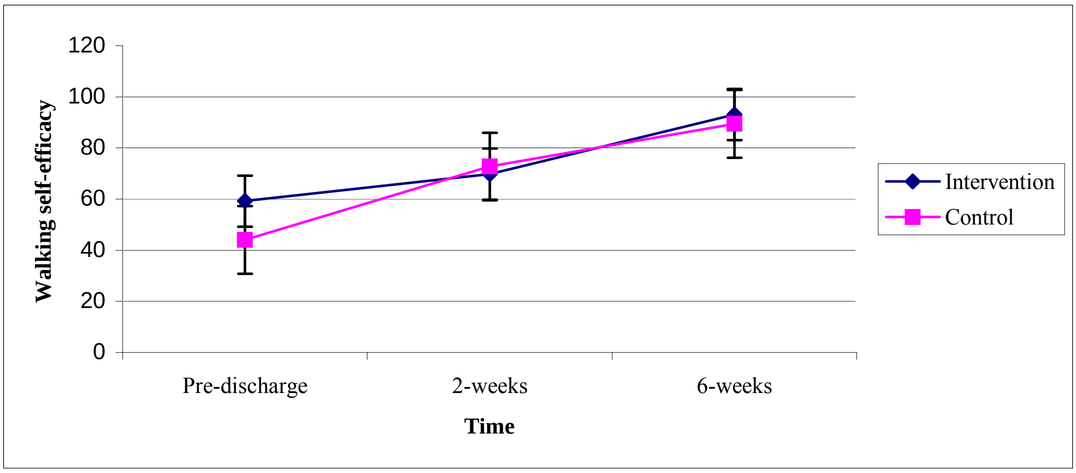


Figure 20. Jogging Self-Efficacy Condition Effect (ns).

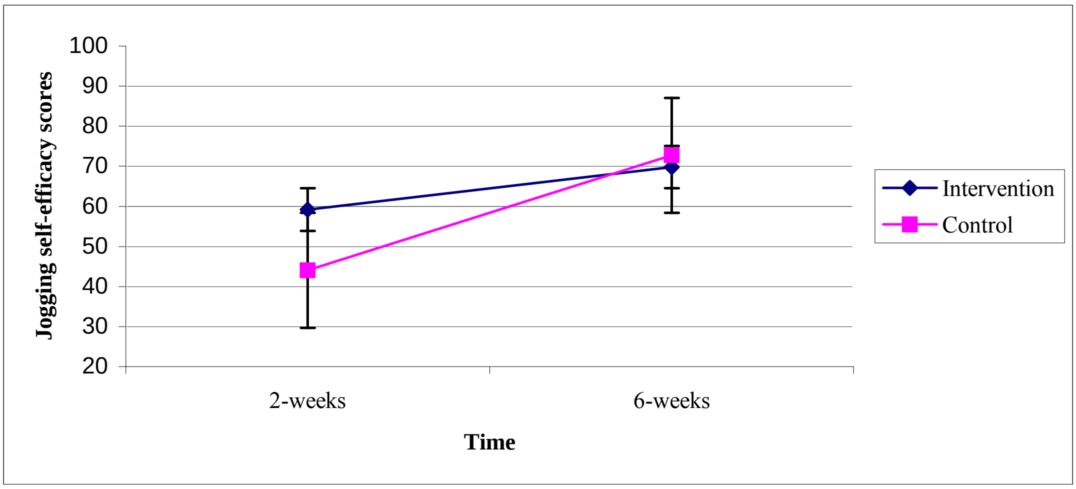


Figure 21. Exercise Self-Efficacy Condition Effect.

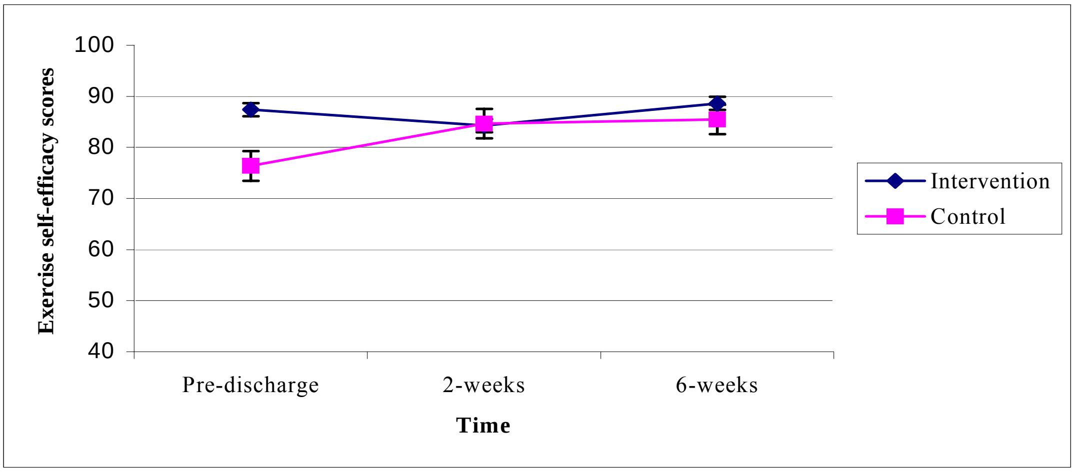


Figure 22. Intrinsic Motivation Condition Effect (ns).

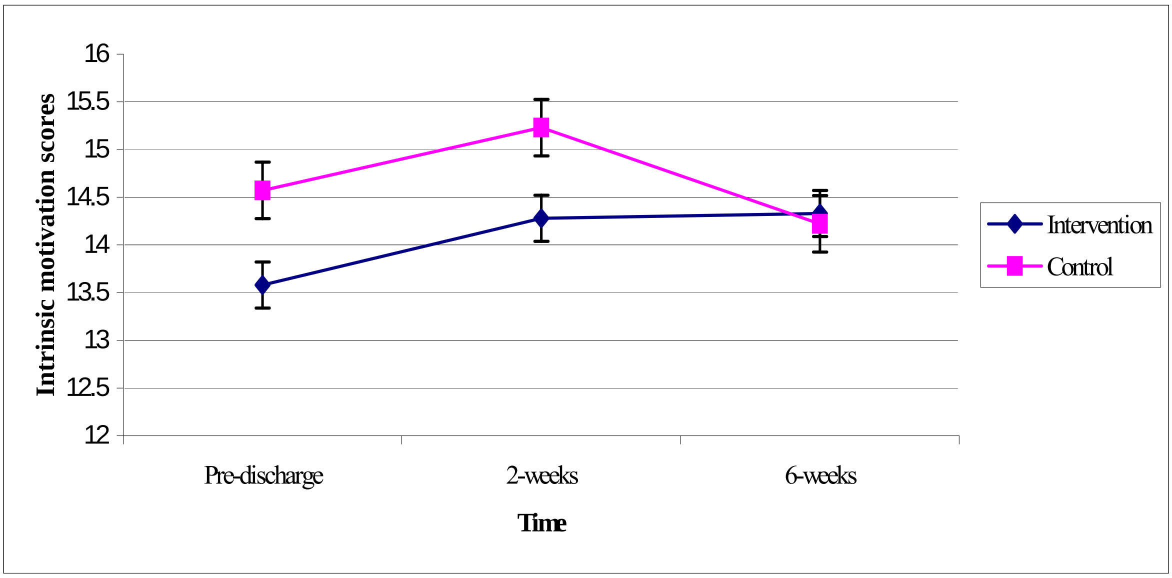


Figure 23. Identified Regulation Condition Effect (*p* = .07).

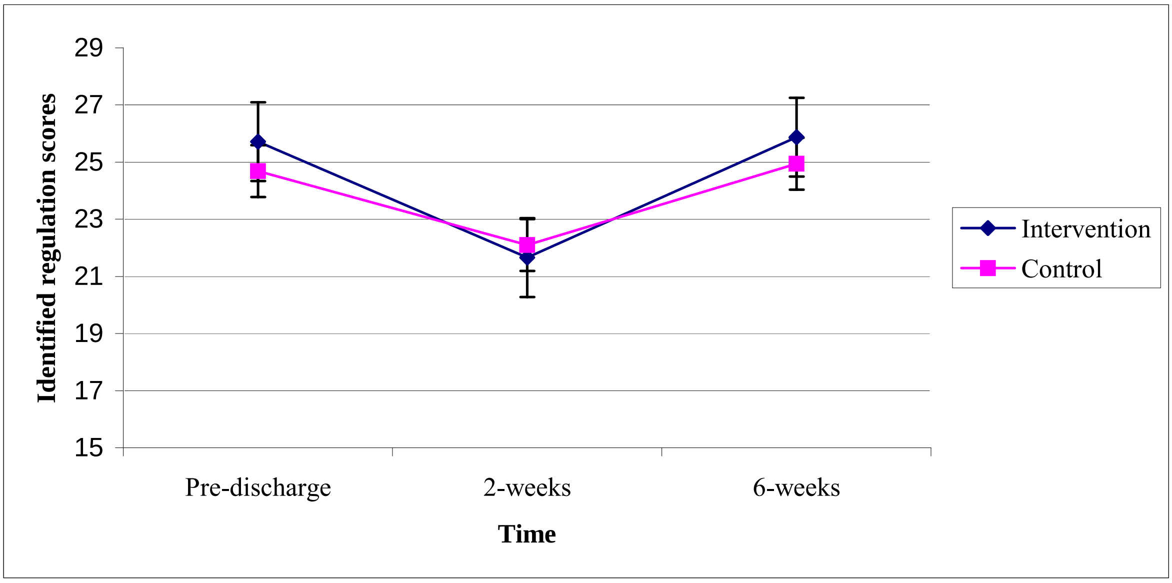


Figure 24. External Regulation Condition Effect (ns).

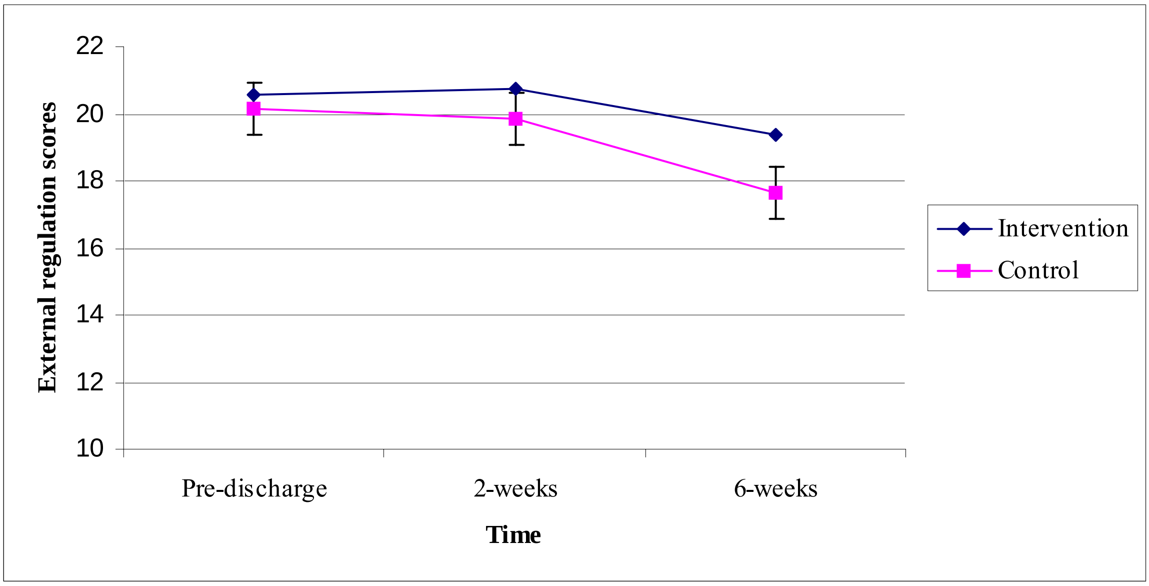


Figure 25. Amotivation Condition Effect (ns).

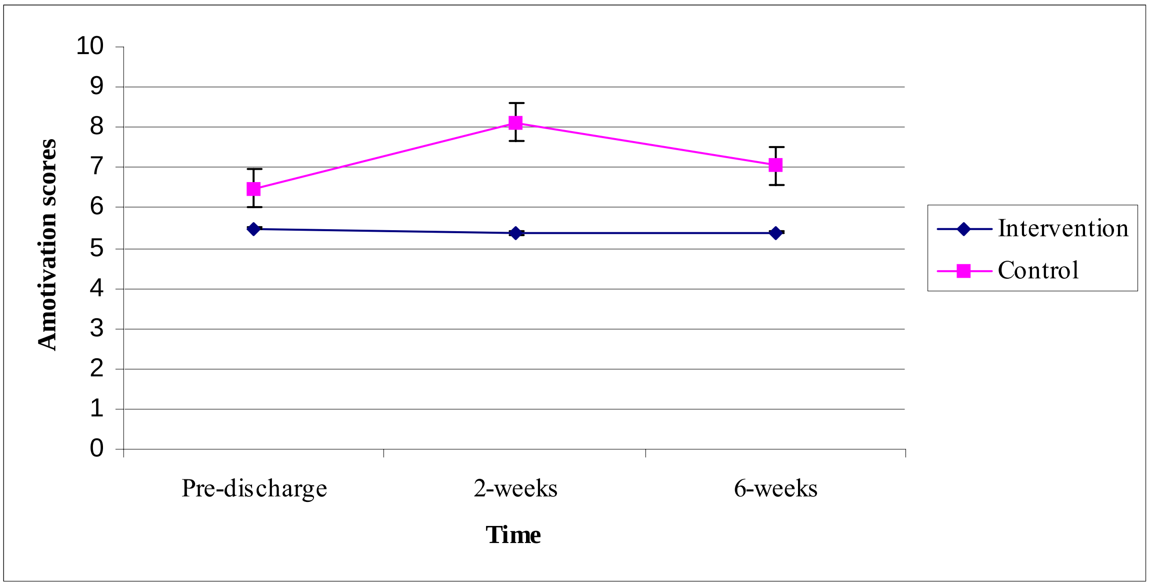


Figure 26. IKDC objective (O) condition effect.

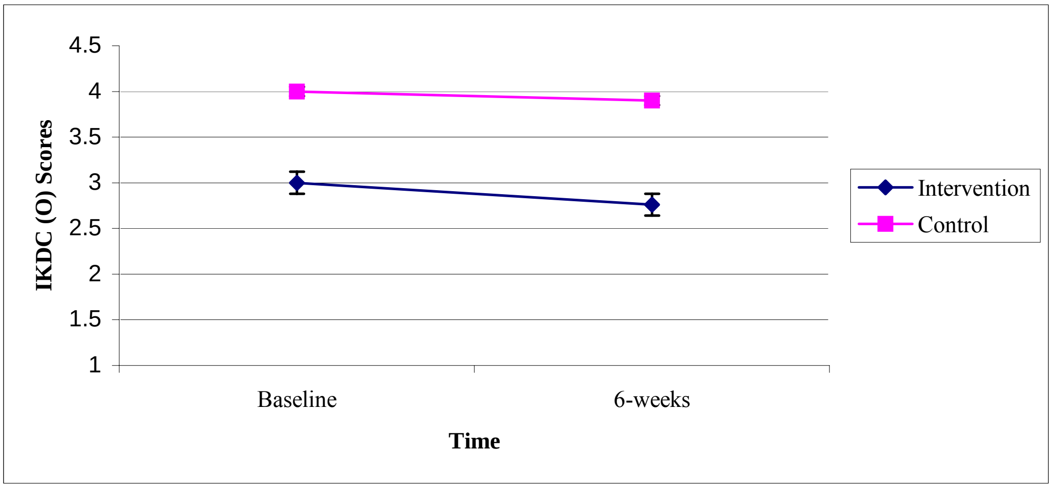


Figure 27. IKDC subjective (S) condition effect (*p* = .08).

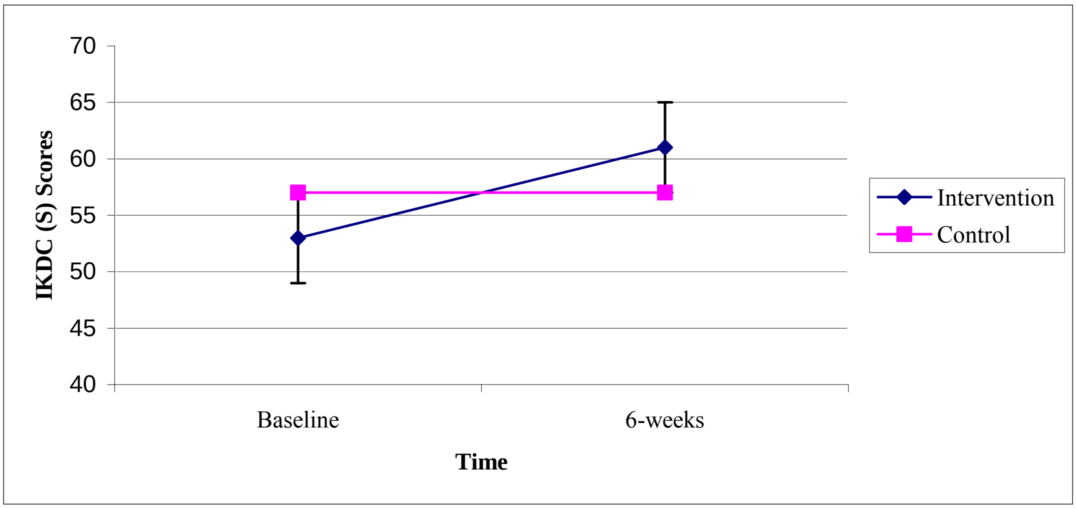
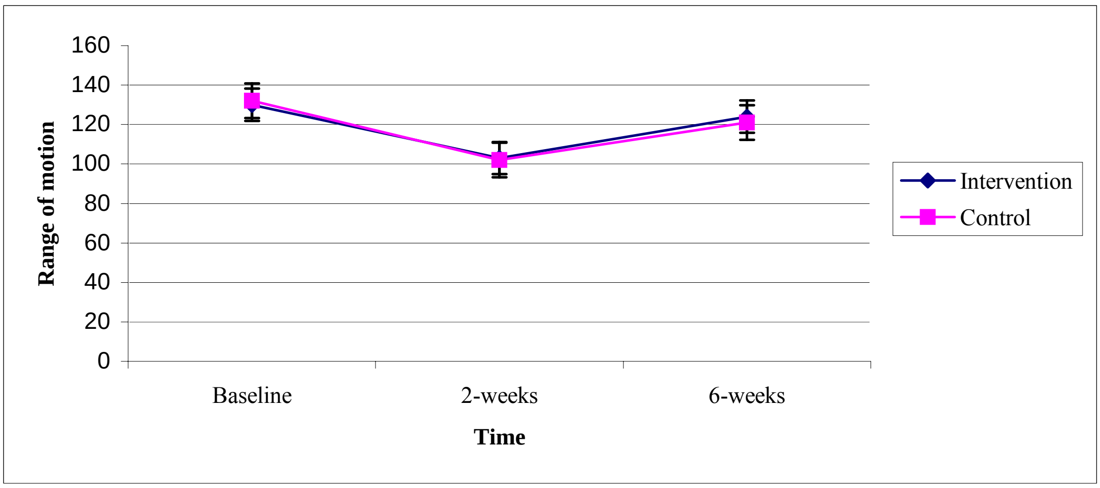


Figure 28. Range of motion condition effect (ns).



Chapter 13
Discussion – Study 3

The purpose of Study 3 was to examine the effectiveness of a coping modelling video intervention at reducing pre-operative anxiety and perceptions of expected pain, as well as increasing self-efficacy and motivation to rehabilitate following ACLR. Also examined, was the effectiveness of the modelling video to facilitate improvements in functional outcomes. Overall, results provide support for these propositions, however beyond these general observations a number of issues related to specific results need to be highlighted.

First, the modelling video did not support a condition effect on pre-operative anxiety. This is surprising given the existing body of knowledge that has found modelling to be effective in reducing pre-operative anxiety (e.g., Melamed & Siegel, 1975; Robertson et al., 1991; Robinson & Kobayashi, 1991). One possible explanation for this non-effect is the low levels of state anxiety experienced by both groups throughout the study. The descriptive data (Table 8) reveal relatively low mean state anxiety scores (35-37) across time compared to the maximum possible score of 80. These low pre-operative state anxiety values, suggest participants did not perceive the ACLR to be an overly anxiety evoking procedure. Another plausible explanation is that the video did not specifically show any aspect of the pre-operative or operative period, rather the video retrospectively highlighted thoughts and feeling of the models around this period. It is possible that following a model throughout the pre and intra-operative periods would have been more relevant and meaningful. Previous research (Padilla et al., 1981; Shipley, Butt, Horowitz, & Farbry, 1978) for reducing anxiety has focussed specifically on the procedural and coping aspects of distressful hospital procedures. The proximity of the state anxiety assessment may also account for the lack of effect. Participants were asked to complete the STAI the day before their operation, whereas completing this state-measure immediately prior to the procedure may have elicited a different response. Assessment of state anxiety more proximal to the operation was logistically very difficult but could have proved more fruitful.

Second, a significant condition effect was found for perception of expected pain, suggesting an immediate effect (reduced perception of expected pain) for those who watched the modeling video (Figure 18), and provides insight into the value of modelling in altering perceptions of pain pre-operatively. Although actual pain was also assessed in the present study at baseline, pre-operatively, and prior to discharge, the intervention had no effect on these variables. This was expected and is most likely due to the lack of pain symptoms experienced pre-operatively, and the adequate pre-discharge analgesia levels.

The effectiveness of modelling affecting perceptions of pain is an area that has received limited attention in the athletic rehabilitation setting. A number of studies have supported the effectiveness of modelling in reducing anxiety, discomfort and response to stressful medical stimuli (cf., O'Halloran & Altmaier, 1995), but only a few have shown support for modelling reducing pain (e.g., Padilla et al., 1981). This is surprising because perceptions of pain have been highlighted as one of the most stressful medical aspects for hospital patients, (Van der Ploeg, 1988). Although, the results from this study offer support that vicarious information provided through a modelling video can help to ameliorate perception of expected pain, other research is warranted to explore whether the nature of pain (i.e., intensity and frequency) can be altered through modelling. For example, non-pharmacological pain-management can be classified into two general categories, pain reduction and pain focussing (Heil, 1993). The various techniques used during pain focussing (i.e., association and disassociation) and pain reduction (i.e., relaxation training and meditation; cf., Taylor & Taylor, 1998) might be presented using a modelling format. Coping models might demonstrate or convey a variety of non-pharmacological pain management techniques, which would lead to the observer to adopt these pain management modalities.

Third, self-efficacy results showed that the modelling video was effective in increasing early functional self-efficacy (i.e., crutches and pre-discharge walking self-efficacy). Despite viewing a video at different time periods, no differences in later self-efficacy (2-week, 6-week walking, and jogging self-efficacy) were found. For exercise self-efficacy a significant time x condition effect was also found. Follow up analyses revealed the modelling group had greater self-efficacy to do rehabilitation early on in the programme (pre-discharge), but these differences were not evident at 2-and 6-weeks. As can be seen from Figure 21, the modelling group maintained higher exercise self-efficacy values after watching the video, whereas the control condition showed increasing self-efficacy over the rehabilitation periods. Considered together, these finding suggest that the vicarious experiences obtained through the modelling video was valuable in providing early sources of efficacy, however the enactive mastery experience gained over time was a more powerful source of efficacious beliefs, thus diminishing the effect of the modelling video. These findings are in line with Bandura's (1997) suggestion that enactive mastery experience is the most powerful source of self-efficacy. In addition, these findings are consistent with Flint's (1991) work, in that early increases in self-efficacy are associated with watching a coping modelling video after ACLR, but these differences do not persist across time. In other rehabilitation settings (cardiac) the temporal patterns of task-self-efficacy have been found to increase from baseline and then stabilise (Blanchard, Rodgers, Courneya, Daub, & Black, 2002). This study explored self-efficacy over a short time-period (6-weeks), however it is not clear what happens to self-efficacy after this point. A possible ceiling effect could exist, in that once self-efficacy levels are maximised for walking after ACLR, they stabilise (as found in other research settings).

Fourth, the motivation findings from the present study offer no real support for the hypothesis that the modelling video would increase rehabilitation motivation. Repeated measures analysis revealed no significant time x condition effects for intrinsic motivation, external regulation and amotivation, although the condition effect for identified regulation approached statistical significance. Despite these effects the modelling group appeared to have persistently lower levels of amotivation across time, as well as a decrease in IR at 2-weeks. These results are surprising as it was hypothesised that watching the modelling video would increase motivation. The lack of effects may be related to a ceiling effect for the variables of interest. For example, descriptive data for identified regulation (IR) reveal consistently high mean scores (21-25), which are close to the maximums of 28. If IR scores are high for both groups then the intervention is unlikely to have much of an impact. Findings offer some preliminary support for the effectiveness of a modelling video in reducing lack of motivation (amotivation) as a reason for performing rehabilitation after ACLR.

Flint (1991) in her study found evidence for differences in motivation between a modelling group and a control group. Specifically, the modelling group appeared more motivated to adhere to the rehabilitation programme. The current study did not examine adherence, but more work is required to fully understand the role that motivation has in the rehabilitation process. One model in the ACL video did specifically highlight the need to set goals (i.e., a 2-week and 6-week goal). Another model also stated "psychologically prepare that first six weeks after the operation—just mentally in a new diary make sure that the time is in there to be able to do it because that's the hardest thing, is fitting it in, you know this is a new part of my life that wasn't there before, you know getting up, breakfast, go to work etc – now there is a lot of rehabilitation work and it takes not just time but it takes energy out of your life that you would have put into other things as well so you know be mentally prepared for that is pretty important". The application of metacognition (goal-setting and planning) techniques to increase rehabilitation motivation is advocated. Tuckman (1999) presented a case study in which various motivation strategies such as metacognition were incorporated favourably during the recovery of an injured marathon runner. It is possible that a coping modelling video that focused more on these motivation strategies, (e.g., goal-setting) would be more effective in increasing specific levels of motivation.

Fifth, with respect to functional outcomes, the modelling group reported significantly less time using crutches and better scores on the IKDC objective and subjective assessments. These improvements in outcomes support the use of a modelling video in the first 6-weeks after ACLR. The obvious question is whether these differences in function would persist across time. Examination of this issue was outside the scope of this thesis, however 6-month follow up knee strength Biodex assessments are currently being performed. It is plausible that the early differences in functional outcomes found at 6-weeks might be a kick-start to improved strength and functional outcomes 6-months post-operatively. Moreover, improved function indirectly suggests limited post-operative problems, which might ultimately have a detrimental effect on the patient's outcome (DeCarlo et al., 1994).

It is somewhat surprising that group differences (modelling and control) were not found for range of motion. It was anticipated that increased confidence to perform rehabilitation exercises and to walk with and without crutches, as well as changes in motivation may be reflected in range of motion differences. However, these findings are more in line with Flint's (1991) findings that the modelling and control groups demonstrated comparable time lines for achieving physical landmarks. It is possible that the sample size was not large enough to reflect small differences in ROM within the time frame examined.

Sixth, path analysis failed to show that the psychological mediated relations between the modeling intervention and functional outcome variables. Other important conceptual patterns were found between the psychological variables of interest. For example, perceptions of expected pain was inversely related to self-efficacy measures, suggesting that those people with lower perceptions of pain at baseline were more likely to have greater confidence to perform rehabilitation related tasks. In addition, two motivation variables showed some consistent patterns with the self-efficacy measures. Insofar as amotivation is concerned, inverse relations were found with exercise and walking self-efficacy. These associations suggest that low lack of motivation is associated with greater confidence to perform rehabilitation tasks. Also of note is that intrinsic motivation was positively associated with exercise self-efficacy. Amotivation refers to the relative absence of motivation (intrinsic or extrinsic). When amotivated, individuals do not perceive contingencies between their action and the outcomes of their actions and no longer identify any good reasons to continue doing the activity (Vallerand & Fortier, 1998). Whereas, intrinsic motivation generally refers to the impetus to perform an activity for itself and the pleasure and satisfaction derived from participation (Deci & Ryan, 1985). The combined patterns found in the present study suggest that either low levels of lack of motivation or higher levels of intrinsic motivation are associated with efficacious beliefs to perform rehabilitation. Whilst correlations do not infer causation, these patterns are in line with theory, that feeling competent or confident on a given task is likely to increase intrinsic motivation (cf., Vallerand, 1997), and can possibly reduce amotivation.

Seventh, the present results provide some insight into the components of the bio-psychosocial model (Brewer et al., 2001). Psychological factors (perception of expected pain, anxiety, and self-efficacy and motivation) were related to intermediate bio-psychological outcomes (ROM and crutch usage). Psychological factors were also related to sport injury rehabilitation functional outcomes (e.g., IKDC). Less robust were the relations between the intermediate bio-psychological outcomes and sport injury rehabilitation outcomes. This is not surprising given the nature of this study. Only the first 6-weeks post ACLR were examined, which essentially represents the early recovery period. During the first 6-weeks strengthening exercises are commenced and the ACL graft is still relatively weak, hence objective assessments of knee strength (Biodex), joint laxity (KT1000), and subjective assessment of readiness to return to sport could not be assessed.

Eighth, there are several limitations to the present study that need to be considered when interpreting the data. Similar to the second study in this thesis, the researcher developed and implemented the intervention, which may have influenced the results through an expectancy or experimenter bias. Again, the probability that participant's increased their self-efficacy and had decreased perceptions of expected pain are more likely to be a function of the intervention rather than through some Pygmalion responses (Andersen & Stoove, 1998). In the present study a placebo "control" condition was not used. This would have eliminated any concerns that intervention effects were a result of the Hawthorn phenomena and not the modelling video. Indirect support for not using an attention control condition is offered through the results of a recent study by Cupal and Brewer (2001). In their study, participants that took part in a guided imagery and relaxation intervention had greater knee strength post ACLR compared to control and attention control groups. No differences were found between the control and attention control group. Although it is acknowledged that the Cupal and Brewer study used a different intervention, their treatment was more involved compared to the present stud. It is therefore unlikely that a placebo video group would have provided different results from those seen with the control group used in this study.

The issue of observed power is also relevant in the present study which had slightly less group numbers than that required to provide optimal statistical power of 80% (observed power ranged between 40% and 60%). Larger group numbers or adjusting the alpha level to .10 from .05 would have changed non-significant trend effects to statistically significant effects (e.g., walking self-efficacy). In line with Cohen's (1988) guidelines for effect sizes (.01 = small, .06 = medium and .14 = large), effect sizes in this study ranged in magnitude from small to large. Finally, the present findings represent data from a group of patients with anterior cruciate ligament injury and may therefore not be reproducible in patients with differing types of orthopaedic injuries. In short, this sample contains selection biases that limit the generalisability of the findings.

Ninth, the role of modelling in the athletic rehabilitation setting is a fertile area for future research. Opportunities exist for the use of self-modelling techniques to be used—particularly feed-forward modelling. For example, using this technique in a rehabilitation setting, athletes could watch themselves performing leg-weight training at a level greater than that actually achieved. A non-feed-forward condition could act as a control. In line with previous feed forward findings (e.g., Maile, 1981) significant increases in performance (weights lifted) should result. This increase in weight lifted should conceptually be related to some form of knee strength assessment. An area that has not been examined is the use of modelling on behaviour such as adherence to rehabilitation progress. Numerous studies have investigated the role that psychological factors have on attendance to, and effort exerted during rehabilitation programmes (cf., Brewer, 1994). For example, according to the Theory or Planned Behaviour (Ajzen, 1985) intention is one of the most powerful determinants of behaviour. Perceived behavioural control (PBC) is also proposed to influence behaviour. Attitude, PBC, and subjective norm are posited to influence each other as well as intention. It is plausible that influencing these variables (particularly PBC) using a modelling intervention could improve adherence to a prescribed rehabilitation programme.

To summarise, watching a modelling video was associated with a decrease in perceptions of expected pain and increases in self-efficacy. Functional outcome improvements also resulted from watching a coping modelling video. Findings underscore the value of a modelling video intervention in the athletic rehabilitation setting.

Chapter 14
Summary of all Studies

Three studies were performed to examine the role of psychological factors in the prediction, prevention, and rehabilitation of sport-related injury. As far as injury prediction is concerned, Study 1 tested the Williams and Andersen (1998) revised stress-injury model. It was predicted through the model that athletes with a history of stressors, a shortage of coping resources, and personality dispositions that augment the stress response, would be the most vulnerable to injury. Specifically, Study 1 examined which multiple moderator variables must co-occur in a specific pattern or combination to maximise relations between life-stress and injury. To this end, four hundred and seventy rugby players from 37 teams participated in the study and completed measures (Life Event Scale for Collegiate Athletes [LESCA]; Social Support Questionnaire [SSQ]; Ways of Coping Scale [WCS], and the Sport Anxiety Scale [SAS]) corresponding to variables in the Williams and Andersen revised stress-injury model at the beginning of the playing season. The number of injuries sustained and the amount of time loss due to injury were recorded throughout the season. Data were analysed using product moment correlations between life-stress and injury for groups of participants who fall in the upper and lower third of the moderator variables (i.e., coping resources—type of coping and, social support, history of stressor—previous injury, and personality—competitive anxiety) distributions. As expected a mild positive relationship was found between life-stress and injury time loss ($r = .09$, $p < .05$) and number of injuries sustained ($r = .11$, $p < .05$) respectively. Results also showed that previous injury, the type of coping, social support, and competitive anxiety interacted in a conjunctive fashion to produce a maximum moderator effect. In short, a notable increment in systematic variance occurred, with up to 24% of the injury time loss variance being accounted for by the life-stress variable within specific subgroups.

These findings highlight the value of using a theory-driven multiple moderator approach to better understanding how life-stress relates to sport injury. These results also support and extend those of Smith et al. (1990). Specifically, these findings provide evidence that other moderator variables (i.e., worry, concentration disruption, and previous injury) interact with coping and social support to maximise life-stress and injury relations. Implications of this study lay in the ability to identify "at-risk" players preseason to provide support and potentially reduce time missed due to injury.

Study 2 extended previous research that suggests resiliency to injury could be increased either by teaching the athlete appropriate psychological coping skills, dealing with anxiety, or increasing the amount of social support available (e.g., Kerr & Goss, 1996). Specifically, the purpose of Study 2 was to determine whether a stress management intervention programme could effectively reduce injury among athletes identified from Study 1 to be most vulnerable to injury. A second purpose was to examine what might explain a positive response by exploring psychological and stress response variables.

Fifty-one rugby players who were found to be most vulnerable to injury (i.e., a rugby player with many recent life-stresses, inappropriate coping skills, and high competition anxiety, or a history of previous injury) from Study 1 were recruited and randomly assigned to either an intervention (stress management programme) or a control condition. Participants completed psychological inventories (Athletic Coping Skills Inventory-28 [ACSI] and the Sport Anxiety Scale [SAS]) at the beginning (Time 1) and end (Time 2) of the 2002 rugby season. Prospective and objective injury data were obtained for number of injuries and time loss.

In addition, stress-response testing was performed at the beginning (Time 1) and end (Time 2) of the 2002 rugby season. All participants completed stress response testing on a purpose built apparatus that presented stimuli for peripheral and central vision tasks (cf., Harrington, 1981; Andersen & Williams, 1999). Two forms of response data were collected: (a) reaction time data (in ms); and (b) perceptual sensitivity, or d' prime. Two tests were performed including a non-stressed (Trial 1) and stressed condition (Trial 2). The non-stressed involved the athlete standing still, facing the device and responding to a number of visual stimuli (light emitting diodes). When a stimulus was detected the reaction time switch was depressed. The stressed condition followed the same format as Trial 1 with the addition of the following combined tasks: running on a treadmill, listening to white noise through headphones, and counting the flash rate of a central red light.

Prior to the start of the 2002 rugby season participants in the intervention group started a 6-session stress management programme that lasted 4-consecutive weeks. Emphasis was placed on how athletes could modify their reaction to stress. Participants were contacted monthly to reinforce the intervention, discuss implementation of the skills, and any relevant issues.

ANCOVA results showed a significant condition (control versus intervention) effect for total time missed, but not for number of injuries sustained. Participants in a stress management intervention reported missing less time due to injury at the end of the 2002 season compared to their non-intervention counterparts. Furthermore, the intervention group appeared to only marginally increase the amount of time missed in 2002 compared to 2001, whereas the control group missed significantly more time due to injury.

ANCOVA results provided some insight into the potential mechanism for injury reduction. A significant condition effect was found for total coping resources. The intervention group showed an increase in the amount of coping resources at Time 2 compared to Time 1, and showed greater coping resources than did the control group at Time 2. The intervention group also showed a decrease in worry at Time 2 compared to Time 1, and less worry than the control group at Time 2. Finally, a condition effect for concentration disruption (CD) approached statistical significance, with the intervention group showing a less CD at Time 2 compared to the control group at Time 2.

Paired t-tests revealed significant differences for reaction time and perceptual sensitivity between Trial 1 (non-stressed) and Trial 2 (stressed) (except for central reaction times at Time 1) inferring that Trial 2 was more stressful than Trial 1. ANCOVA results showed no significant condition effects for peripheral and central reaction times, peripheral perceptual sensitivity (d'), and central perceptual sensitivity (d'). Non-stressed central d'-prime at Time 2 was negatively correlated with injury time missed.

Overall, results support the recommendation that a stress management programme is effective in preventing further time loss due to injury for athletes with an "at-risk" injury profile.

A third study was performed to examine the role of psychology in the athletic rehabilitation setting (Study 3). Previous intervention studies have investigated imagery, relaxation, goal setting, and biofeedback for influencing psychological and functional outcomes. Despite this, only one investigation by Flint (1991) has examined the effectiveness of a coping modelling intervention in improving psychological and functional outcomes in an athletic injury rehabilitation setting. The purpose of Study 3 was to extend the work of Flint by investigating whether a coping modelling intervention could decrease pre-operative anxiety and perceptions of expected pain, as well as increase self-efficacy and motivation to rehabilitate after ACLR. A second purpose was to determine whether the modelling intervention would improve functional outcomes in the early post-operative period (6-weeks) following ACLR.

Sixty-four patients undergoing arthroscopic ACLR were randomised to receive a coping modelling intervention or to act as a control. Participants completed psychological measures (State-trait Anxiety Inventory, [STAI]; Perception of Expected Pain assessment;

Crutches Self-Efficacy Questionnaire, [CSE]; Walking Self-Efficacy Questionnaire, [WSE]; Jogging Self-Efficacy Questionnaire, [JSE]; Exercise Self-Efficacy Questionnaire [ESE]; and Situational Motivation Scales [SIMS]) at different time points during a 6-week period. In addition, the following functional outcomes were assessed, days walking with crutches, range of motion (ROM), and International Knee Documentation Committee assessment (IKDC). A series of ANCOVA and repeated measure ANOVA analyses were conducted. ANCOVA results revealed a significant condition effect for perceptions of expected pain, but not for state anxiety. Significant group differences were found for crutch self-efficacy with the intervention group reporting less use of crutches than the control group. Repeated measure ANOVA results showed a time x condition effect for exercise self-efficacy. No other effects were found for self-efficacy. No significant time x condition effects were found for motivation. ANCOVA results supported the use of modelling for improving functional outcomes (IKDC scores and crutch use). Findings support the use of a coping modelling intervention in decreasing perceptions of expected pain, increasing self-efficacy, and promoting earlier functional outcomes after ACLR.

Chapter 15
Conclusions

Within the limitations imposed in the three studies, the following conclusions are drawn.

- A small relationship exists between life-stress and number of injuries sustained (r = .11) and time missed due to injury (r = .10).
- Social support and coping moderate the life-stress injury relationship.
- Previous injury and personality variables act in a conjunctive fashion with social support and coping to maximise the life-stress injury relationship.
- Psychological variables are useful in the prediction of rugby players most vulnerable to injury.
- A cognitive behavioural stress management (CBSM) intervention is effective in reducing injury vulnerability among NZ rugby players identified with an "at-risk" psychological profile to injury.
- A CBSM intervention is effective in increasing coping skills, decreasing worry, and concentration disruption.
- An ecologically valid stressful environment can produce increases in reaction time and decreases in perceptual sensitivity among NZ rugby players identified with an "at-risk" psychological profile to injury.
- Reaction time and perceptual changes from non-stressed to a stressed condition were not directly related to injury measures.
- A coping modelling video is effective in decreasing perceptions of pain for those undergoing surgical reconstruction of the anterior cruciate ligament (ACLR).
- A coping modelling video is effective in increasing efficacious beliefs to perform rehabilitation related task and exercises in the early post ACLR rehabilitation period.
- Early functional outcomes resulted from watching a coping modelling video.

APPENDIX A. STUDY 1 CONSENT FORM

DEPARTMENT OF SPORT AND EXERCISE SCIENCE

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Building 734, Tamaki Campus
Morrin Road, Glen Innes
Auckland, New Zealand
Telephone 64 9 373 7599 ext 86860
Facsimile 64 9 373 7043

ATHLETE CONSENT FORM

Title: Psychological Factors and Sport Injury (STUDY 1)

Researchers: Mr Ralph Maddison and Dr Harry Prapavessis

I have been given and have understood an explanation of this research project.
I have had an opportunity to ask questions and have them answered.
I understand that I may withdraw myself, or any information traceable to me at any time without reason.

- I agree that my coach/trainer will tell you about my injuries
- I understand that participation in this study is confidential and no material that could identify me will be used in any reports on this study.
- I agree to complete all the questionnaires.
- I have had time to consider whether to take part in this research project.
- I know whom to contact if I have any concerns as a result of participation in this study.
- I am aware of the risks involved in this study and do not hold the researchers responsible for any problems I may experience.
- I agree to take part in this research

Signed:

Name:
(please print clearly)

Date:
For any queries regarding ethical concerns please contact:

Chair, The University of Auckland Human Subjects Ethics Committee,
The University of Auckland, Research Office – Office of the Vice Chancellor, Private Bag 92019, Auckland. Tel. 373- 7999 extn 8939

Approved by the University of Auckland Human Subjects ethics committee, February 2001 for a period of three years. Reference 2000/352

APPENDIX B. STUDY 1 PARTICIPANT INFORMATION

DEPARTMENT OF SPORT AND EXERCISE SCIENCE

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Building 734, Tamaki Campus
Morrin Road, Glen Innes
Auckland, New Zealand
Telephone 64 9 373 7599 ext 86860
Facsimile 64 9 373 7043

Sports Science Research Participant Information for Study 1

Project Title
Psychosocial Factors and Sport Injury: Prediction and Prevention.

Researchers and Contact Address.

Dr Harry Prapavessis (Senior Lecturer) Department of Sport and Exercise Science, Tamaki Campus, University of Auckland, Private Bag 92019, Auckland.
Phone: 09 3737599 ext. 6860, e-mail: h.prapavessis@auckland.ac.nz

Ralph Maddison (MSc.) PhD candidate Department of Sport and Exercise Science, Tamaki Campus, University of Auckland, Private Bag 92019, Auckland
Phone: 09 3737599 ext. 6887 or 021 985 613 mobile, e-mail: ralph.m@clear.net.nz

Background Information

Physical injury is an inevitable yet unfortunate consequence of participation in sport and physical activity. Sport injury has emerged as a major public health concern within New Zealand. A number of physical factors have been examined that may contribute to and prevent injury occurrence. Much less attention has been directed toward psychological factors that may predict and prevent sport injury.

Some research has examined various factors such as an individual's life-stress, anxiety, and social support. However research into injury prediction and prevention has been limited due to the investigation of only one or two factors at a time. What this means is that there is limited understanding of the inter-relationships between psychological factors and how they might help to predict injury occurrence.

Project Objectives
The purpose of Study 1 is to examine whether a variety of psychological factors (e.g., life-stress, coping, anxiety, & previous injury) can predict injury occurrence among male rugby players.

Subject Requirements
Study 1: To be included in this study you need to be aged greater than 15-years of age and play rugby for a school-based or club rugby team. You will be required to complete a consent form and 6 Questionnaires. The questionnaires will take approximately 20-30 minutes to complete.

Risks
There is no risk from participating in this study, however if you have any problems with answering these questions Dr Harry Prapavessis will be available to discuss any issues that may arise. Dr Peter McNair will also be available to assist you with any physical injury questions or issues that might arise.

Benefits
No financial incentive will be available to those participating in Study 1. All subjects who complete the questionnaires will be invited to a presentation of the completed study at the end of 2001. This presentation will outline the relevant findings from this study. In addition a written copy summarising the main findings will also be readily available.

Freedom of Consent
It is the researchers' intentions to include only those subjects that freely choose to participate in this study. Participation is voluntary and you are free to withdraw consent at any time. This will have absolutely no influence on your present and or future involvement with the University of Auckland, or your rugby team. Your consent to participate in this research will be indicated by your signing and dating of the consent form. Signing the consent form indicates that you have freely given your consent to participate, and there has been no coercion to participate.

Confidentiality
All data collected for this research will be treated with absolute confidentiality. All questionnaires will be numerically coded and no names will be included in the data collection or analysis. Reported results will not include any names whatsoever.

Data and Results
Recorded data will be retained for a period of six years in a secure place at the Department of Sport and Exercise, University of Auckland, under the care of Dr Harry Prapavessis. This is to conform to the University's Code of Practice.

Inquiries
Any questions concerning the research are welcome at any time. Please feel free to ask for clarification of any point, which you feel, has not be explained to you're complete satisfaction.

Any queries regarding ethical concerns please contact:
The Chair, university of Auckland, Private Bag 92019, Auckland; phone (09) 3737599 ext. 8939: facsimile (09) 373 7432
Approved by the University of Auckland Human Subjects ethics committee, February 2001 for a period of three years. Reference 2000/35.

APPENDIX C. LIFE EVENTS SURVEY FOR COLLEGIATE ATHLETES (LESCA)

Instructions.

Listed below are 66 events that sometimes occur in the lives of athletes. These events often produce change within an individual's life that requires some adjustment by the individual. For each event that you have experienced within the last year (18 weeks):

1. ONLY TICK the BOX in the COLUMN if the event has occurred to you in the last 18-weeks. If you have not experienced an event within the last 18 weeks, leave the item blank.
2. IF the event has occurred, then TICK the box that indicates the effect it had on you. A rating of –4 would indicate that the event had an extremely negative effect on you. A rating of +4 would indicate that the event had an extremely positive effect on you. For those events that have happened more that once, indicate the average effect across all occurrences.

Note: After ticking whether the event had taken place within the past year, please Tick ONE of the numbers on the following scale: extremely negative = -4; negative = -3; moderately negative = -2; somewhat negative = -1; somewhat positive = +1; moderately positive = +2; positive = +3; extremely positive = +4.

	Event Occurred in the Last 18 weeks?	Effect on you Extremely negative = -4; Negative = -3; Moderately negative = -2; Somewhat negative = -1; Somewhat positive = +1; Moderately positive = +2; Positive = +3; Extremely positive = +4. PLEASE TICK THE BOX THAT IS MOST APPROPRIATE -4	-3	-2	-1	+1	+2	+3	+4
1. Marriage?	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Death of partner (girlfriend, spouse, significant other,)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Major change in sleeping habits (increase or decrease in amounts of sleep)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Death of close family member (s)? e.g., Father, Mother, Brother, Sister, Grandfather, Grandmother,	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Major change in eating habits (increase or decrease in food intake)	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Death of close friend(s)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Outstanding personal achievement?	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Partner pregnant?	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Sexual difficulties?	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Being fired from job?	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Being apart from partner (girlfriend, spouse etc.,) because of sport?	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Seriousness illness or injury of close family member(s)? e.g., Father, Mother, Brother, Sister, Grandfather, Grandmother, Other	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Major change in the number (more or less) of arguments with partner?	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Major personal injury or illness?	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Major changes in the frequency (increase or decrease) of social activities due to participation in sport?	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Serious injury or illness of close friend?	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Breaking up with partner (e.g., girlfriend, spouse etc.,)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Beginning a new school experience or work experience?	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Engagement?	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Academic ineligibility or probation?	☐	☐	☐	☐	☐	☐	☐	☐	☐

21. Being dismissed from school or home residence?	☐	☐	☐	☐	☐	☐	☐	☐	☐
22. Failing an important exam?	☐	☐	☐	☐	☐	☐	☐	☐	☐
23. Major change in relationship with coach (better or worse)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
24. Failing a course?	☐	☐	☐	☐	☐	☐	☐	☐	☐
25. Major change in length and/or condition of practice/training (better or worse)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
26. Financial problems concerning school or work?	☐	☐	☐	☐	☐	☐	☐	☐	☐
27. Major change in relationship with family member (s) (better or worse)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
28. Conflict with roommate or flatmate?	☐	☐	☐	☐	☐	☐	☐	☐	☐
29. Partner having an abortion?	☐	☐	☐	☐	☐	☐	☐	☐	☐
30. Major change in the amount (more or less) of academic or work activity (homework or class time)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
31. Pressure to gain/lose weight- due to participation in sport?	☐	☐	☐	☐	☐	☐	☐	☐	☐
32. Discrimination from team-mates/coaches?	☐	☐	☐	☐	☐	☐	☐	☐	☐
33. Major change in relationship (s) with team-mate(s) better or worse?	☐	☐	☐	☐	☐	☐	☐	☐	☐
34. Suspended from team?	☐	☐	☐	☐	☐	☐	☐	☐	☐
35. Major change in use of alcohol/drugs (increased or decreased)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
36. Beginning sexual activity?	☐	☐	☐	☐	☐	☐	☐	☐	☐
37. Major change in relationship(s) with friend(s) (better or worse)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
38. Recovery from injury/illness/operation?	☐	☐	☐	☐	☐	☐	☐	☐	☐
39. Major change in level of responsibility on team (increased or decreased)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
40. Divorce or separation of your parents?	☐	☐	☐	☐	☐	☐	☐	☐	☐
41. Major change in level of responsibility on your team (increased or decreased)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
42. Receiving an academic scholarship?	☐	☐	☐	☐	☐	☐	☐	☐	☐
43. Not attaining personal goals in sport?	☐	☐	☐	☐	☐	☐	☐	☐	☐
44. Major change in playing status on team?	☐	☐	☐	☐	☐	☐	☐	☐	☐
45. Injury to teammates?	☐	☐	☐	☐	☐	☐	☐	☐	☐
46. Being absent from school classes or work because of participation in sport?	☐	☐	☐	☐	☐	☐	☐	☐	☐
47. Troubles with athletic association and/or athletic director?	☐	☐	☐	☐	☐	☐	☐	☐	☐
48. Difficulties with trainer/physician?	☐	☐	☐	☐	☐	☐	☐	☐	☐
49. Major change in playing time (playing more or less) – due to injury?	☐	☐	☐	☐	☐	☐	☐	☐	☐

50. Major errors/mistakes in actual competition?	☐	☐	☐	☐	☐	☐	☐	☐	☐
51. Losing your athletic scholarships or funding?	☐	☐	☐	☐	☐	☐	☐	☐	☐
52. No recognition/praise of accomplishments from coaching staff?	☐	☐	☐	☐	☐	☐	☐	☐	☐
53. Pressure from family to perform well?	☐	☐	☐	☐	☐	☐	☐	☐	☐
54. Loss of confidence due to injury?	☐	☐	☐	☐	☐	☐	☐	☐	☐
55. Unable to find a job?	☐	☐	☐	☐	☐	☐	☐	☐	☐
56. Change in coaching staff?	☐	☐	☐	☐	☐	☐	☐	☐	☐
57. Major change in level of academic or employment performance (doing better or worse)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
58. Making career decisions (interviewing for jobs or universities)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
59. Being dropped from the team?	☐	☐	☐	☐	☐	☐	☐	☐	☐
60. Continual poor performance of the team?	☐	☐	☐	☐	☐	☐	☐	☐	☐
61. Change in work or school schedule?	☐	☐	☐	☐	☐	☐	☐	☐	☐
62. Major change in family finances (increased or decreased)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
63. Major change in attitude toward sport (like enjoy more or less)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
64. Victim of harassment/abuse (emotional /physical/sexual)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
65. Victim of a personal attack (robbery/assault etc.)?	☐	☐	☐	☐	☐	☐	☐	☐	☐
66. Other events might have occurred to you in the past year (and affected you in a positive or negative manner) but were not included in this list. If there were such events, please list here and rate them	☐	☐	☐	☐	☐	☐	☐	☐	☐

APPENDIX D. THE WAYS OF COPING SCALE

Instructions. Please read each statement. Then TICK THE BOX next to the statement that indicates how much you use this strategy when dealing with stressful events such as competition

	Statement	Does not apply	Applies sometimes	Used most of the time	Used a great deal
1	Go on as if nothing happened	☐	☐	☐	☐
2	I train harder, longer or more often.	☐	☐	☐	☐
3	Ask someone I respect for advice	☐	☐	☐	☐
4	I try to relax myself.	☐	☐	☐	☐
5	Wish that I can change what is happening.	☐	☐	☐	☐
6	Talk to someone who can do something concrete about the problem.	☐	☐	☐	☐
7	Try to make myself feel better by eating, drinking or smoking prior to games.	☐	☐	☐	☐
8	Take it out on other performers.	☐	☐	☐	☐
9	I avoid other players.	☐	☐	☐	☐
10	I daydream or imagine a better time or place than the one I am in.	☐	☐	☐	☐
11	I try to keep my feelings from interfering with my concentration on the game.	☐	☐	☐	☐
12	Take a big chance or do something risky.	☐	☐	☐	☐
13	Hope things will change.	☐	☐	☐	☐
14	Talk to someone about how I am performing.	☐	☐	☐	☐
15	I know what has to be done, so I am doubling my efforts to make things work out.	☐	☐	☐	☐
16	Refuse to believe it is happening.	☐	☐	☐	☐
17	Accept it, since nothing can be done.	☐	☐	☐	☐
18	Try harder.	☐	☐	☐	☐
19	Maintain my pride and keep my cool.	☐	☐	☐	☐
20	Change something about my performance.	☐	☐	☐	☐
21	Wish that the situation would resolve itself.	☐	☐	☐	☐
22	Have fantasies or wishes about how things might turn out.	☐	☐	☐	☐
23	Do something which I don’t think will work but at least I’m doing something	☐	☐	☐	☐
24	Talk to someone about it.	☐	☐	☐	☐
25	Stand my ground and fight harder	☐	☐	☐	☐
26	I look for help.	☐	☐	☐	☐

APPENDIX E. SOCIAL SUPPORT QUESTIONNAIRE

We would like to ask you some questions about the people that are important to you in your day-to-day life. These include Parent, Friends, Teachers, Coaches, Teammates, and others. There may be people in your life who provide you with caring and emotional support. These are people that you count on to care about you, regardless of what is happening to you, and who accept you totally, including your good and bad points.

Instructions. Please rate each of the people below in terms of how helpful they would be in providing you with caring and emotional support if you needed it. CIRCLE the appropriate number to indicate your rating or place an X to indicate people, who are not part of your social network,

	Do not have or rarely see	**Not at all helpful** 1	2	**Somewhat helpful** 3	4	**Very Helpful** 5
1 Father	________	1	2	3	4	5
2 Mother	________	1	2	3	4	5
3 Step-father	________	1	2	3	4	5
4 Step- mother	________	1	2	3	4	5
5 Bothers, Sisters	________	1	2	3	4	5
6 Other relatives (e.g., Whanau grandparents)	________	1	2	3	4	5
7 Teachers	________	1	2	3	4	5
8 School counsellor	________	1	2	3	4	5
9 School principal	________	1	2	3	4	5
10 Best adult friend	________	1	2	3	4	5
11 Clergy, priest etc.	________	1	2	3	4	5
12 Best friend	________	1	2	3	4	5
13 Partner / girlfriend etc.	________	1	2	3	4	5
14 Head Coach	________	1	2	3	4	5
15 Assistant coach	________	1	2	3	4	5
16 Closest team-mate	________	1	2	3	4	5
17 Other team-mates	________	1	2	3	4	5
18 Team trainer/Physio	________	1	2	3	4	5
19 Team manager	________	1	2	3	4	5
20 Athletic organisation	________	1	2	3	4	5

In general, when the occasion arises, are you the type of person who turns to others for caring and emotional support?

Never Sometimes Always

1 2 3 4 5 6 7

APPENDIX F. THE SPORT ANXIETY SCALE (SAS)

Instructions. Read each of the statements below. Then TICK THE BOX of the statement that indicates how you <u>USUALLY</u> feel prior or during competition.

	Statement	Not at all	Somewhat	Moderately so	Very much so
1	My stomach gets upset before or during competition.	☐	☐	☐	☐
2.	My body feels tense.	☐	☐	☐	☐
3.	I'm worried about reaching my goal.	☐	☐	☐	☐
4.	I feel my stomach sinking.	☐	☐	☐	☐
5.	I have self-doubts.	☐	☐	☐	☐
6.	My mind wanders during sport competition.	☐	☐	☐	☐
7.	I feel tense in the stomach.	☐	☐	☐	☐
8.	My heart pounds before competition.	☐	☐	☐	☐
9.	I am concerned about choking under pressure.	☐	☐	☐	☐
10.	I feel nervous	☐	☐	☐	☐
11.	My heart races.	☐	☐	☐	☐
12.	I'm concerned about performing poorly.	☐	☐	☐	☐
13.	Thoughts of doing poorly interfere with my concentration during competition.	☐	☐	☐	☐
14.	I have lapses in concentration during competition because of nervousness.	☐	☐	☐	☐
15.	I sometimes find myself trembling before or after a competitive event.	☐	☐	☐	☐
16.	I'm concerned I won't be able to concentrate.	☐	☐	☐	☐
17.	My body feels tight.	☐	☐	☐	☐
18.	While performing, I often do not pay attention to what's going on.	☐	☐	☐	☐
19.	During competition, I find myself thinking about unrelated things.	☐	☐	☐	☐
20.	I'm concerned that others will be disappointed with my performance.	☐	☐	☐	☐
21.	I am concerned that I may not do as well in competition as I could.	☐	☐	☐	☐

APPENDIX G. THE SOCIAL DESIRABILITY SCALE

Instructions. Please complete all questions. Please circle the answer to each of the statements that best applies to your actions.

1. It is sometimes hard for me to go on with my work if I am not encouraged.	True	False
2. I sometimes feel resentful when I don't get my way.	True	False
3. On a few occasions, I have given up doing something because I thought too little of my ability.	True	False
4. There have been times when I felt like rebelling against people in authority even though I knew they were right.	True	False
5. No matter who I'm talking to, I'm always a good listener.	True	False
6. There have been occasions when I took advantage of someone.	True	False
7. I'm always willing to admit it when I make a mistake.	True	False
8. I sometimes try to get even rather than forgive and forget.	True	False
9. I am always courteous, even to people who are disagreeable.	True	False
10. I have never been irked when people expressed ideas very different from my own.	True	False
11. There have been times when I was quite jealous of the good fortune of others.	True	False
12. I am sometimes irritated by people who ask favours of me.	True	False
13. I have never deliberately said something that hurt someone's feelings.	True	False

APPENDIX H. INJURY REPORTING FORM

Injury Reporting Form **Date** **Team:**

Game Injury sheet

Name	Did the player play this week?	If he did not play the full game how many minutes did he play?	If an injury occurred in the game tick **YES**	How many minutes of play did the player miss due to injury?	If the player returned to play did they require any modification to play (i.e., strapping, headgear, change of position)?
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
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	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □
	YES □ NO □	min	YES □	min	YES □ NO □

Training Injury Sheet

Name	Did the player train this week?	If he did not train was it due to injury	If an injury occurred during training tick **YES**	How many minutes of training did the player miss due to injury?	If player returned to the training field did they require any modification to play (i.e., strapping, headgear, change of position)?
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐
	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐	min	YES ☐ NO ☐

APPENDIX I. STUDY 2 CONSENT FORM

DEPARTMENT OF SPORT AND EXERCISE SCIENCE

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Building 734, Tamaki Campus
Morrin Road, Glen Innes
Auckland, New Zealand
Telephone 64 9 373 7599 ext 86860
Facsimile 64 9 373 7043

ATHLETE CONSENT FORM

Title: Psychological Factors and Sport Injury (STUDY 2)

Researchers: Mr Ralph Maddison and Dr Harry Prapavessis

I have been given and have understood an explanation of this research project. I have had an opportunity to ask questions and have them answered.

I understand that I may withdraw myself, or any information traceable to me at any time without reason.

- I agree that I will tell you about my injuries
- I agree to complete all questionnaires
- I agree to participate in the stress-reaction testing
- I agree that my coach/trainer will tell you about my injuries
- I understand that participation in this study is confidential and no material that could identify me will be used in any reports on this study.
- I have had time to consider whether to take part in this research project.
- I know whom to contact if I have any concerns as a result of participation in this study.
- I am aware of the risks involved in this study and do not hold the researchers responsible for any problems I may experience.
- I agree to take part in this research

Signed:

Name:
(please print clearly)

Date:

For any queries regarding ethical concerns please contact: Chair, The University of Auckland Human Subjects Ethics Committee,
The University of Auckland, Research Office – Office of the Vice Chancellor, Private Bag 92019, Auckland. Tel. 373- 7999 extn 8939
Approved by the University of Auckland Human Subjects ethics committee, February 2001 for a period of three years. Reference 2000/352

APPENDIX J. STUDY 2 PARTICIPANT INFORMATION

DEPARTMENT OF SPORT AND EXERCISE SCIENCE

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Building 734, Tamaki Campus
Morrin Road, Glen Innes
Auckland, New Zealand
Telephone 64 9 373 7599 ext 86860
Facsimile 64 9 373 7043

Sports Science Research Participant Information for Study 2
Project Title: Psychosocial Factors and Sport Injury: Prediction and Prevention.

Researchers and Contact Address.

Dr Harry Prapavessis and Ralph Maddison, Department of Sport and Exercise Science, Tamaki Campus, University of Auckland, Private Bag 92019, Auckland. Phone: 09 3737599 ext. 6860, e-mail: h.prapavessis@auckland.ac.nz

Ralph Maddison (MSc.) PhD candidate. Department of Sport and Exercise Science, Tamaki Campus, University of Auckland, Private Bag 92019, Auckland. Phone: 09 3737599 ext. 6887 or 021 985 613 mobile, e-mail: ralph.m@clear.net.nz

Background Information

Physical injury is an inevitable yet unfortunate consequence of participation in sport and physical activity. Sport injury has emerged as a major public health concern within New Zealand. A number of physical factors have been examined that may contribute to and prevent injury occurrence. Much less attention has been directed toward psychological factors that may predict and prevent sport injury.

Some research has examined various factors such as an individual's life-stress, anxiety, and social support. However research into injury prediction and prevention has been limited due to the investigation of only one factor at a time and at only one given time frame within a season. What this means is that there is limited understanding of the relationships these factors might have together in predicting injury occurrence and whether the strength of the relationship between these various factors and injury change over time. In addition there has been limited research examining psychological interventions that might be useful in the prevention of injury.

Project Objectives

The purpose of study 2, is to examine whether a psychological intervention programme can prevent the occurrence of injury among male rugby players

Subject Requirements

Study 2: To be included in this study you need to be aged greater than 15-years of age and play rugby for a school-based or club rugby team and have participated in study I. Following study I, participants that presented with an injury in the proceeding year will be invited to participate in the second study. You will be required to complete a similar consent form and Questionnaires (as in Study I). You will be required to perform a test assessing your peripheral vision once at the beginning of the season and again at the end of the season. Each of these sessions will take 60-90 minutes in duration. In addition, you may be required to attend 6 x 1-hour information sessions aimed at increasing your awareness of factors that are thought to reduce the occurrence of injury. Strategies such as controlling your thoughts and emotions in stressful situations during competition will be emphasised. If you are in the control group, you will not be expected to participate in these sessions.

Risks
It is anticipated that you might experience slight physical discomfort whilst participating in the peripheral vision test. No other risks are anticipated risks from participating in this study. If you have any concerns regarding any psychological aspect of the study then Dr Harry Prapavessis will be available to discuss any issues that may arise. Dr Peter McNair will also be available to assist you with any physical injury questions or issues that might arise.

Benefits
No financial incentive will be available to those participating in study 2. All subjects who complete the study will be invited to a presentation of the completed study at the end of 2002. This presentation will outline the relevant findings of this study. In addition a written copy summarising the main findings will also be readily available.

Freedom of Consent
It is the researchers' intentions to include only those subjects that freely choose to participate in this study. Participation is voluntary and you are free to withdraw consent at any time. This will have absolutely no influence on your present and or future involvement with the University of Auckland or your rugby team. Your consent to participate in this research will be indicated by your signing and dating of the consent form. Signing the consent form indicates that you have freely given your consent to participate, and there has been no coercion to participate.

Confidentiality
All data collected for this research will be treated with absolute confidentiality. All questionnaires will be numerically coded and no names will be included in the data collection or analysis. Reported results will not include any names whatsoever.

Data and Results
Recorded data will be retained for a period of six years in a secure place at the Department of Sport and Exercise, University of Auckland, under the care of Dr Harry Prapavessis. This is to conform to the University's Code of Practice.

Inquiries
Any questions concerning the research are welcome at any time. Please feel free to ask for clarification of any point, which you feel, has not be explained to you're complete satisfaction. Any queries regarding ethical concerns please contact: The Chair, university of Auckland, Private Bag 92019, Auckland; phone (09) 3737599 ext. 8939: facsimile (09) 373 7432

Approved by the University of Auckland Human Subjects ethics committee, February 2001 for a period of three years. Reference 2000/352

APPENDIX K. ATHLETIC COPING SKILLS INVENTORY-28

Directions. Various statements that athletes have used to describe their experiences are given below. Please read each statement carefully and then recall as accurately as possible how often you experience the same thing. There are no right or wrong answers. Please put an X in the circle that indicates how often you have these experiences when playing sports.

		Almost Never	Sometimes	Often	Almost Always
1.	On a daily or weekly basis, I set very specific goals for myself that guide what I do.	o	o	o	o
2.	I get the most out of my talent and skills.	o	o	o	o
3.	When a coach tells me how to correct a mistake I've made, I tend to take it personally and get upset.	o	o	o	o
4.	When I'm playing sport, I can focus my attention and block out distractions.	o	o	o	o
5.	I remain positive and enthusiastic during competition, no matter how badly things are going.	o	o	o	o
6.	I tend to play better under pressure because I think more clearly.	o	o	o	o
7.	I worry quite a bit about what others think of my performance.	o	o	o	o
8.	I tend to do lots of planning about how to reach my goals.	o	o	o	o
9.	I feel confident that I will play well.	o	o	o	o
10.	When a coach or manager criticizes me, I become upset rather than helped.	o	o	o	o
11.	It is easy for me to keep distracting thoughts from interfering with something I am watching or listening to.	o	o	o	o
12.	I put a lot of pressure on myself by worrying about how I will perform.	o	o	o	o
13.	I set my own performance goals for each practice.	o	o	o	o
14.	I don't have to be pushed to practice or play hard; I give 100%.	o	o	o	o
15.	If a coach criticizes or yells at me, I correct the mistake without getting upset about it.	o	o	o	o
16.	I handle unexpected situations in my sport very well.	o	o	o	o
17.	When things are going badly, I tell myself to keep calm, and this works for me.	o	o	o	o
18.	The more pressure there is during a game, the more I enjoy it.	o	o	o	o
19.	While competing, I worry about making mistakes or failing to come through.	o	o	o	o
20.	I have my game plan worked out in my head long before the game begins.	o	o	o	o
21.	When I feel myself getting too tense, I can quickly relax my body and calm myself.	o	o	o	o
22.	To me, pressure situations are challenges that I welcome.	o	o	o	o
23.	I think about and imagine what will happen if I fail or screw up.	o	o	o	o
24.	I maintain emotional control regardless of how things are going for me.	o	o	o	o
25.	It is easy for me to direct my attention and focus on a single object or person.	o	o	o	o
26.	When I fail to reach my goals, it makes me try even harder.	o	o	o	o
27.	I improve my skills by listening carefully to advice and instruction from coaches.	o	o	o	o
28.	I make fewer mistakes when the pressure is on because I concentrate better.	o	o	o	o

APPENDIX L. THE STATE-TRAIT ANXIETY INVENTORY (STAI)

Instructions. A number of statements which people have used to describe themselves are given below. Read each statement and, using the scale below, write the appropriate number in the space to the right of the statement to indicate how you feel about your knee joint surgery. There are no right or wrong answers.
Do not spend too much time on any one statement but give the answer that seems to describe how you **feel right now**.

1	2	3	4
Almost Never	Sometimes	Often	Almost Always

1. I feel pleasant……………………………………………………… _______
2. I tire quickly…………………………………………………………. _______
3. I feel like crying……………………………………………………… _______
4. I wish I could be happy as others seem to be ……………………….. _______
5. I am losing out on things because I can't make up my mind soon enough _______
6. I feel rested………………………………………………………….. _______
7. I am "cool, calm and collected"……………………………………. _______
8. I feel that difficulties are piling up so that I cannot overcome them _______
9. I worry too much over something that doesn't really matter…….. _______
10. I am happy…………………………………………………….. _______
11. I am inclined to take things hard………………………………… _______
12. I lack self-confidence…………………………………………… _______
13. I feel secure…………………………………………………… ________
14. I try to avoid facing a crisis or difficulty………………………… ________
15. I feel blue……………………………………………………… ________
16. I am content…………………………………………………… ________
17. Some unimportant thought runs through my mind and bothers me… _______
18. I take disappointments so keenly I can't put them out of my mind… ________
19. I am a steady person…………………………………………… ________
20. I get in a state of tension or turmoil as I think over my recent concerns and interests………………………………………….. _________

APPENDIX M. THE STRESS INNOCULATION PROGRAMME

SESSION 1. INTRODUCTION AND CONCEPTUALISATION.

Objectives:

- To provide the athlete with a conceptual framework for understanding the nature of his response to potentially stressful competitive events. Specifically, to highlight to the athlete the potential role that cognition and behaviour have on life and athletic pursuits.

- To explain potential mechanisms of injury, both cognitive and somatic. Highlighting the role that the stress response has on injury vulnerability.

- To clearly outline the purpose of the programme, highlighting the content to be covered in subsequent sessions.

Introduction

How we perceive and deal with potentially stressful situations can have a significant impact on how our bodies respond to competition and training. For example if during our lives we have an accumulation of stress such as losing our job, death of a friend or family member then these factors may affect our ability to deal with other potentially stressful situations that occur in sport (e.g., important games, regaining playing status etc.). If such potential situations occur in sport unchecked then it is possible that we run the risk of getting injured.

For instance, a number of potential mechanisms for the occurrence of injury have been suggested. The first is that potentially stressful situations (i.e., competition) may increase generalised muscle tension that interferes with the fluidity of movement.

Second increased mental (cognitive) stress combined with the muscle tension may contribute to visual attention narrowing and increased distractibility that may put an athlete more at risk of injury. This increased distractibility in the field of vision could lead to deficits such as missing or delayed responses to important cues such as players coming in from the side in a tackle.

With this in mind, a number of psychological skills can be learned and incorporated into you performance to help reduce the risk of injury. The skills are based on controlling arousal, dealing with competition and life-stress as well as increasing your attention under stress.

This booklet will provide you with information to support the sessions you attend. Using this information will allow you to review work covered but also to think about incorporating the skills that you learned in to your own performance.

SESSION 2. AROUSAL & RELAXATION

Objectives.

- Discuss the role of arousal and introduce concept of relaxation and autogenic techniques
- Practice progressive relaxation based on Jacobsen's technique.
- Give audiotapes.

In sport the term arousal can refer to an energising function that is responsible for harnessing the body's resources for intense and vigorous activity. It is often used to describe the physiological and psychological reactions of the body that occur all the time. In your everyday life your arousal levels move up and down depending on what you are doing. Your lowest feeling of arousal occurs when you are sleeping and your highest level occurs when you are very excited, angry, nervous or scared.

If you imagine that arousal is like a car engine which when in neutral can vary in the RPM but does not travel anywhere. Like a human, when the then car is in motion and the speed is too fast for the road conditions, inappropriate levels of energy in the car (rpm) can disrupt efficient driving performance. The ideal rpm intensity should match the situation (e.g., high rpm to accelerate) to produce the greatest efficiency. This is not always the case, for example the engine may be revving but the car is not going well, because the handbrake is on. This is similar to what happens to performance, when we have negative, self-defeating thought processes, which can interfere with the natural co-ordination of a skill being performed. Without the proper activation or arousal an athlete can be like a car spinning its wheels and going nowhere.

Although arousal levels change and this is a natural state, too much can lead to unpleasant emotional reactions associated with the autonomic nervous system. This is often referred to as stress or anxiety. Stress can be a good thing and is related to the right amount of nervousness or excitement needed to perform well. Too much or negative stress can be detrimental to performance.

Readiness, being psyched energized activated aroused, or whatever you want to call it, is an integration of the mind-body feeling of confidence, or mastery. You can learn to reach this state voluntarily by practicing the various skills highlighted in this programme.

One of the first steps in being able to control your body and mind is to identify what type of thoughts and feelings you experience when you are training and competing and whether these reactions help or hinder your ability to perform well.

EXERCISE 1:
To help you to identify the thoughts and feelings that you have during games and training I would like you to complete the following exercise.
On the next page you will see a list of common symptoms that can occur in competition situations when an athlete reacts to an event either positively (e.g., psyched up), or negatively (e.g., worried, too nervous). Now think back to how you typically feel before and during competition. Now look at the list of feelings and circle any of the reactions that you normally experience. Please feel free to add more to the list if you experience reactions that are not already listed.

REACTIONS TO COMPETITION (GAMES)

Headaches	Nausea	Vomiting	Stomach ache	Tiredness	Diarrhoea
Shaking	Deep sighs	Yawning	Pacing	Worry	Anger
Vagueness	Anxiety	Frustration	Indecision	Boredom	Confident
Irritability	Confusion	Moodiness	Daydreaming	Dry mouth	Excited
Muscle Tightness	Poor attention control	Negative expectations	Positive thoughts	Excessive heart - pounding	Low energy levels
Clear thinking	Laughing	Hopeful	Feel loose	Smiling	Focused
Satisfied	Joking	Good mood	Enthusiastic	Relaxed	Decisive
Fast reactions	Prepared	In control	Elated	Butterflies	High self-esteem
High self-belief	Positive expectations	Hopeful	Low self-belief	Alert	Fatigue
Happy					

Once you have circled the reactions that you typically experience I would like you to place a + if you think these things help your performance or a – if you think they hinder performance.

This exercise highlights an array of physical and psychological reactions to competition that you experience. This is important because now you are aware of which ones help or facilitate performance and which ones hinder performance.

With this in mind, the goal is to work and maintain ones that are helpful to performance and to be able to recognise and deal with ones that hinder performance or in other words, we need to learn how to maximise the Positives and minimise the Negatives.

A number of the techniques covered in this programme (e.g., relaxation) will build on this work to ensure more helpful reactions.

TECHNIQUE 1. RELAXATION:

Relaxation is a useful technique to assist with performance, decrease muscle tension. Various degrees of relaxation exist, for example complete relaxation is beneficial for regeneration and, promoting recovery following games, training or injury. Indeed relaxation also promotes sleep and insomnia problems before competition. Momentary relaxation can be useful increases speed of reaction, restores balance and gives awareness of kinaesthetic sense. The most useful contribution relaxation has for an athlete is to teach them the regulation of muscle tension.

Learning to relax is an ongoing process and must be practiced as you would practice a physical skill. Various types of relaxation method, but these can be broadly placed into muscle to mind techniques such as progressive relaxation or min to muscle techniques like autogenic training and imagery. These relaxation techniques can be easily learned.

Relaxation exercises: You can reach the deeper states of relaxation more easily by lying down, but when your body is tired you are more likely to lose the quality of alertness in this position and drift towards sleep. This won't matter if you are relaxing to bring balance and rest after a demanding match or an exhausting day, but when you relax before a competition or before doing a visualisation exercise, it is best to be in a comfortable position that is well supported. Eventually you can learn to relax in a standing position by taking two or three deep breaths.

Breathing forms the basis for relaxation techniques. Breathing properly is important as it helps performance by increasing the amount of oxygen in the blood. This helps carry more energy to muscles and helps remove any waste.

Relaxation breathing and all breathing techniques should come from the diaphragm. To help with diaphragmatic breathing concentrate on filling the lower sections of your lungs with air, first by pushing the diaphragm down and forcing the abdomen out. Continue filling the middle portion of the lungs by expanding your chest and raising the rib cage. Then fill up the upper part of the lungs by raising the chest and shoulders slightly. This should be done smoothly and continuously. Hold for several seconds then exhale by pulling the abdomen in and lowering the shoulders and chest. Then pull in the abdomen right at the end to push all the air out, before letting the abdomen and chest be completely relaxed.

You should practice this 30-40 times per day. Try doing this every time the phone rings. Take a big breath before answering. Do this breathing before rugby training, after training or before doing specific rugby skills like kicking the ball.

Progressive Relaxation Script. (Adapted from Williams & Harris, 1998).

Instructions: Listen to the relaxation tape as many times as possible over the next few weeks (a minimum of twice per week). Concentrate on the difference between the relaxed-state versus the non-relaxed state. Practice PR either by sitting or lying down.

"Sit or lie in a comfortable position and try to pit yourself in a relaxed state. Close your eyes and take a long, slow, deep breath through your nose, inhaling as much air as you can. Then exhale slowly and completely, feeling the tension leaving your body as you exhale. Take another deep breath and let the day's tensions and problems drain out with each exhalation."

[Pause]

"Relax as much as possible and listen to what I say. Remember not to strain to relax. Just let it happen. During the session, try not to move any more than necessary to stay comfortable. Particularly, try not to move the muscles that have already been relaxed"

"As we progress through each of the 16 muscle groups, you will first tense the muscle group for approximately 5-7 seconds and then relax for about 30-seconds. Do not start tensing until I say "NOW". Continue to tense until I say "OK". The word OK cues you to immediately let go of the tension."

"Begin with tensing the muscles in your dominant hand and lower arm by making a tight fist NOW. Feel the tension in the hand, over the knuckles, and up into the lower arm….OK, relax by simply letting go of the tension. Notice the difference between the tension and the relaxation" [pause 20-secs]……."Make another fist NOW" [pause 5 seconds]. "OK relax, just let the relaxation happen, don't put out any effort" [pause 20-seconds].

"Next tense the muscles of the dominant biceps by pushing down against the floor or back of the chair. Tense NOW. Feel the tension in the biceps without involving the muscles in the lower arm or hand….OK, release the tension all at once…….Just let it happen……..Tense the biceps NOW………..OK, release it. . Notice the difference between the tension and the relaxation" [pause 20-secs].

"With your non-dominant hand make a tight fist NOW. Feel the tension in your hand and lower arm, but keep the upper arm relaxed…..OK, relax by simply draining all of the tension out………NOW tense again……OK feel the difference between the tension and the relaxation……Also notice the different feeling for each new muscle group…….Now push elbow down to tighten the non-dominant biceps again…… OK, relax…….Now, tense the biceps again……….OK, notice the decrease in tension, drain it all out, and enjoy the feelings of relaxation" [pause 20-secs].

"Notice the sensations you have in the muscles of both arms and hands……..Perhaps there is a sort of flow or relaxation-perhaps a feeling of warmth and even heaviness in these muscles. Notice and enjoy the feelings of relaxation."

"Turn your attention to the muscles in your face. We will tense and relax the face by progressing through three-muscle group. Tense the muscles in your forehead by raising your eyebrows NOW. Feel the tension in your forehead and scalp (pause 3-5 seconds). OK, relax and enjoy the sensation of relaxation…….NOW, frown again……….OK, relax. Release all the tension……..Your forehead should feel smooth as glass."

"Next, squint your eyes very tightly and at the same time wrinkle your nose. Tense NOW. Feel the tension in the upper part of the cheeks and through the eyes. OK, relax……..NOW, tense again……….OK, release all the tension……."

"Next pull the corners of your mouth back and clinch your teeth (not too hard). Tense NOW. You should feel the tension all through the lower part of your face and jaw. OK, relax……. NOW, tense again……….OK, release all the tension……"

"Next tense the muscles of the neck by trying to pull the chin downward and upward simultaneously. NOW, tense. OK, relax. Drain all the tension from the muscles in the neck…….See if you can get your neck and face to feel completely relaxed. NOW, tense the neck again. Feel the discomfort……..OK, relax……Drain all the tension out. Remember is simply the absence of tension".

"Take a deep breath and hold it while raising your shoulders upward and pulling your shoulder blades back. Tense NOW. Feel significant tension in the chest, the shoulders and the upper back. OK, relax. Drain all the tension out…NOW hold your breath and raise your shoulders up and back. OK, exhale and drain all the tension out. Let your shoulders drop completely. Enjoy the spreading sensation of relaxation…"

"Next tighten the abdomen as though you expect a punch while simultaneously squeezing the buttocks together. Tense NOW. You should feel a good deal of tightness and in the stomach and buttocks….OK, release the tension, gradually letting it all drain out. Just let it happen…….NOW tense again……OK, relax. Feel the sensation of relaxation spreading into those muscles."

"Turn your attention to your right leg. Tighten the muscles in your right thigh by simultaneously contracting all the muscles in your thigh together. Tense NOW. Try to localise all the tension to your thigh only…….Note the sensation. OK, relax. Contrast the tension and the relaxation sensations. Remember relaxation is merely the absence of tension; it takes no effort, except merely releasing the tension……….NOW, tighten the right thigh again………OK, release the tension—just passively let it drain out. Enjoy the feeling of relaxation……."

"Next flex your right ankle as though you are trying to touch your toes to your shin. Tense NOW. You should be feeling tension all through your calf, ankle, and foot. Contrast this tension with when you tensed the thigh. OK, relax. Simply release the tension; let go of any remaining tension…….NOW tense again……….OK, slowly release all the tension……"

"Tense all the muscles in your right foot by either pointing your toes or curling the toes tightly inside your shoes, but don't tense very hard or you might cramp the muscles. Tense NOW. Note the sensation of tension in your arch and ball of the foot. OK, relax. As all the tension drains out, feel the spreading sensation of relaxation……..and perhaps warmth, heaviness or even tingling. All these sensations are normal. NOW tense again…….OK, slowly release all the tension. Let your foot, ankle, and calf feel very relaxed."

"Turn your attention to your left leg. Tighten the muscles in your left thigh by simultaneously contracting all the muscles in your thigh together. Tense NOW. Try to localise all the tension to your thigh only…….Note the sensation. OK, relax. Contrast the tension and the relaxation sensations. Remember relaxation is merely the absence of tension;

it takes no effort, except merely releasing the tension……….NOW, tighten the right thigh again………OK, release the tension—just passively let it drain out. Enjoy the feeling of relaxation…….”

“Next flex your left ankle as though you are trying to touch your toes to your shin. Tense NOW. You should be feeling tension all through your calf, ankle, and foot. Contrast this tension with when you tensed the thigh. OK, relax. Simply release the tension; let go of any remaining tension…….NOW tense again……….OK, slowly release all the tension……”

“Tense all the muscles in your left foot by either pointing your toes or curling the toes tightly inside your shoes, but don’t tense very hard or you might cramp the muscles. Tense NOW. Note the sensation of tension in your arch and ball of the foot. OK, relax. As all the tension drains out, feel the spreading sensation of relaxation……..and perhaps warmth, heaviness or even tingling. All these sensations are normal. NOW tense again…….OK, slowly release all the tension. Let your foot, ankle, and calf feel very relaxed.”

“Relax all the muscles of your body—let them all go limp. You should be breathing slowly and deeply. Let all traces of tension drain out of your body. Scan your body for any places that might still feel tension. Wherever you feel tension, do an additional tense and relax. You may notice a sensation of warmth and heaviness throughout your body, as though you are sinking deeper and deeper into the chair or floor. Or you may feel as though you are as light as air, as though floating on a cloud. Whatever the feelings you have, go with them. Enjoy the sensation of relaxation.”

“Before opening, your eyes take several deep breaths and feel the energy and alertness flowing back into your body. Stretch your arms and legs if you wish. Open your eyes when ready.”

Following relaxation:
Brief discussion with players to identify what the relaxation felt like and how successful they were at relaxation. Identify any areas that could be improved (e.g., spotting tension, when it occurs and using the technique).

SESSION 3. AROUSAL AND RELAXATION CONT'D

Objectives

- Evaluate relaxation techniques, and discuss application (encourage open discussion).
- Introduce the role of breathing techniques to enhance relaxation and to direct focus.
- Practice a number of techniques, including, breathing and counting, followed by breathing and self-statements.

TECHNIQUE 2. ABBREVIATED PROGRESIVE RELAXATION

Introduce abbreviated PR to be used whenever possible, but pay particular attention to using the technique when getting ready for competition, training etc.
Tense each muscle group for 5-10 seconds and then relax for 20-30 seconds.

"Make a tight fist with both hands, tighten the biceps and forearms, hold and relax for 20-30 seconds".

"Tense all facial muscles while employing the tension procedure for the neck, hold and relax for 20 seconds".

"Take a deep breath and hold it, raising the shoulders up while making the stomach hard and tightening the buttocks. Hold and then let go…..relax".

"Tighten the muscles of both thighs, while curling up the toes and tightening the calves as the same time. HOLD……Relax and let all the tension go……."

"Take one abdominal breath and let all the remaining tension go………"

TECHNIQUE 3. BREATHING EXERCISE 5-1 COUNT

Introduce Breathing Exercises to help with relaxation and focus
Breathing exercise 5-1 count.

"Say to yourself and visualise the number 5 as you take a full, slow deep breath, exhale fully and completely. Now breathe in and say to yourself and visualise the number 4. As you begin to breathe out, say to yourself "I am more relaxed than I was at number 5. Go nice and slowly. Continue the process until you get to number 1. As you approach number 1 you should feel totally calm and relaxed".

TECHNIQUE 4. AUTOGENIC RELAXATION

Autogenic Relaxation script (Adapted from Sherman & Poczwardowski, 2000).

Shrug your shoulders and relax your neck muscles through a couple of neck rolls
Lets start with a couple of deep abdominal breaths – inhale 1, 2 –
Exhale 1, 2, 3, 4 (repeat several times).
Inhale fully; exhale completely.
As you are breathing, you might notice how you get calmer and calmer, more and more relaxed. As you continue to breathe, inhale fully and exhale completely.

I want you to listen to the sound of my voice as you begin to feel more and more relaxed (pause). Your mind and your body are intimately connected, so as I make a suggestion to you, you may either repeat the suggestions to yourself, or just think about them, and your body will respond. As we discussed, just let it happen. As you practice, you will get better and better at doing this.

I want you to direct your attention to your right arm. Your right arm is feeling heavy now. Your right arm s feeling comfortably heavy now. And say to yourself. My right arm is heavy (repeated 7-10 times). As your right arm gets heavier and heavier, Nellie it feels like it is sinking into the mat, getting more and more heavy – very heavy and very comfortable (pause). Now direct your attention from your right arm to your left arm. Your left arm is feeling some heaviness now……..

These directions continue through the rest of the body: left arm, legs, hips, torso and head. Continue to breathe rhythmically and diaphragmatically.

Now I suggest to you that any time you choose, by taking a couple of abdominal breaths, you can return to the relaxed state you are in now. By doing this, you will be able to focus your attention on the task at hand – whether it is preparing to go on the mat or training. As a result you will be able to consistently perform at your potential for the task at hand (pause). I am going to be quiet momentarily to allow you to just experience this relaxed state. I will speak to you in a couple of minutes.

Ok I want to suggest again that any time you choose, by taking a few abdominal breaths, you can return to the relaxed state you are in right now. Now we are going to slowly reverse the process and help you become more awake and alert and ready to take on the day with a renewed freshness and relaxed piece of mind. In a moment I'll start to count from one to five. As I count, you will feel more and more energy come to your body and become more and more alert. One – with each inhalation, you are felling more and more awake – more and more fresh and alert – good. Two -, continuing to breathe a bit more rapidly and feeling more and more energy. Three -, inhale and exhale halfway here and more alert. Four – you are ready to open your eyes feeling renewed and ready to complete any task. Five – you are completely refreshed, energised, yet relaxed and comfortable. Go ahead and open your eyes…………good.

SESSION 3. DEALING WITH NEGATIVE THOUGHTS

Objectives

- Evaluate breathing techniques and application/
- Introduce the concept of self-talk and dealing with unwanted thoughts.

It is common for athletes to have combination of negative and positive thoughts, when competing and training. However, self-defeating or negative thoughts or self-talk can be detrimental to performance and one's self-confidence. A number of techniques are available to encourage positive thinking and discourage negative thinking.

It is important for athletes to identify when they make self-defeating statements and what causes them to make these statements. Athletes must be aware of when and where (i.e., the situation) they use self-talk or make self-defeating statements. Therefore it is necessary to highlight your internal dialogue (or conversations). Once you have identified the nature of the self-talk you use, then various techniques can be used to improve this.

The first step in this process is to monitor the type of self-talk you use and the situational factors associated with this talk.

EXERCISE 2.

Over the next week I would like you to keep a log of thoughts and performance situations. Write down any thoughts you might have as soon as possible to having them. Write down what you say, the situation surrounding these thoughts. For example, try to understand what you say to yourself before good performances and not so good performance.

SELF TALK LOG

DATE	What do I say?	What thoughts precede good performance?	What thoughts precede poor performance?	How frequently do I talk to myself

Techniques for controlling self-talk and self-defeating statements.

Thought stoppage is an effective method for eliminating negative or counterproductive thoughts. Awareness of when these thoughts occur, the situation and the content needs to be developed. Once awareness of when self-talk occurs (e.g., through the self-talk log) then a trigger can be developed to stop or interrupt the self-talk/negative thoughts.

The trigger can be a word such as STOP or a physical action such as snapping the fingers or slapping the thigh. It is helpful if this cue word or phrase is something that you would normally say, and is meaningful to you. When a negative or unproductive thought starts, you say your cue word out loud or silently in your head, so that the negative thought is interrupted. Try o choose the most natural trigger. You must attempt to practice this skill as much as possible. To get better at it you need to develop a routine where you use this technique as often as possible. You can also try to imagine situations where you use self-talk or negative thoughts. Then in your mind you can imagine using this technique to stop the thoughts.

Once you can identify and begin to stop unwanted thoughts various techniques can be used to change these to a positive. In this programme we will consider a technique called reframing (Gauron, 1984) which is the process of creating alternative frames of reference or different ways of looking at the world.

Reframing allows you to acknowledge the issue or thought but allows you to view this from a different perspective. For example, if you say, "I am feeling tense and anxious about playing today", this can be reframed to" I'm feeling excited and ready to play today". Practicing and developing this skill will assist you to control your internal dialogue or talk in a positive and useful manner.

EXERCISE 3:
IDENTIFY UNWANTED THOUGHTS

Write down a situation where you would normally think negatively or were not productive. Write down the negative or unproductive statements that you would say to yourself.

IDENTIFY WHEN THESE OCCUR

Over the next week keep I would like you to keep another log of any negative thoughts that might occur. For example, you might not want to go to training because you are tired or you might have unwanted thoughts before a game (lethargy, not wanting to play, too nervous Write your thoughts in the table on the following page. Some examples of how to complete the table are shown below. When you are aware of these thoughts, use you CUE to STOP these thoughts then try to use the reframing technique as highlighted below. The idea being that when the situation arises again in the future, you can use the thought stopping and reframing procedure to eliminate the negative or unproductive thoughts.

Situation	Negative thoughts	Positive reframing thoughts
Improving technique when tired	"I'm stuffed" or "My legs are killing me" or "Thank goodness, there's only a few minutes to go"	"Come on" "Head straight" "Breathe" "Push through it" " Relax the shoulders" "Concentrate on what I have to do".
Re-directing attention after an error	"I can't believe I did that!" "How could I be so stupid" "I can't seem to do anything right" "my passing doesn't feel right".	Okay, move on" "now's not the time" "head back in the game now!"
How to help to control effort	I'm so tired" "I'm completely stuffed"	"Come on, push it" "go harder"
To boost confidence	"I've played badly every time I've come here" "I hate playing this team"	"I'm looking forward to this game" "I've trained hard and am playing well
To deal with the pressure of expectations	"I've got to have a great game" "today I can't make any mistakes" "I have to win or else"	"I can do this" "just focus on getting the job done" "play as I normally do and the game will take care of itself" "I've done the work, now time to enjoy it"

YOUR THOUGHTS & SITUATIONS

Situation	Negative thoughts	Positive replacement thoughts

Promoting positive thinking

Not only is it important to begin to deal with self-defeating statements and negative self-talk, it is also important to continue to highlight the good things that you do. Using positive self-statements or affirmations can be useful. However, the key thing is that you must believe what you are telling yourself. It is important to highlight things that you are consistently good at, and can be considered your strengths.

EXERCISE 4.

In the next exercise I would like you to write three things that you think you do very well in your sport. Think about all aspects of your sport including technical, motivation, attitude and mental skills. Once you have thought of three things you do well, remind yourself of these things everyday for the next week. This exercise is especially helpful at times when you might be feeling a little bit worried or unmotivated.

1. I am good at__________________

2. I am good at__________________

3. I am good at__________________

SESSION 4: IMAGERY / VISUALISATION

Objectives.

- Evaluate coping self-statements and cognitive restructuring and discuss application (encourage open discussion).
- Introduce role of imagery in sport.
- Introduce application to rugby and use in games and training scenarios.
- Practice imagery.
-

Imagery is a process by which sensory experiences are stored in the memory and recalled internally and performed in the absence of physical practice. In other words mental imagery is the skill of using your imagination to improve performance and to help you achieve goals. It involves creating pictures in your mind of what you want to achieve, these become the mental movies for future success. It is important that you begin to use imagery in conjunction with physical practice. It is also important to practice mental skills (as with physical skills) on a regular basis.

EXERCISE 5: Below are three ways you can use visualisation. Fill in the type of mental images that you might be able to use.

The Type of Situation	The Images or Mental Movies
Long Term Success of Goal Achievement	
At Training	
Competition Performance	
Injury Prevention	

KEY POINTS:

The following points are important to consider when using imagery.

- Attempt to use all your senses to enhance the vividness of the image. It is important to try to capture the kinaesthetic or 'feeling' aspect as possible when imaging.
- When practicing - attempt to control image (want to image correct response not negative).
- Use imagery in practice or training as well as for competition.
- When you are using imagery, imagine in real time (i.e., the time that things happen in real life).
- Internal perspective - seeing the image form inside own body
- External perspective - seeing image as if you are on a video
- Develop coping strategies through imagery.

EXERCISE 6:

- Start with a simple image.
- For the next week set aside 5 minutes a day, either before practice or before going to sleep (or both) to work on your imagery skills.
- Let yourself relax (use your relaxation technique).

Read the following script:

Get in to a comfortable position and close your eyes. Take 2-deep abdominal breaths (as discussed). Take a moment to scan yourself, check to see if there are any areas of tension. You can use your relaxation technique to help release this tension.

Try to imagine the place where you usually train.......... See the clubhouse and training ground in your mind's eye.
Imagine what it looks like, how it smells, how it feels when you walk in, the people there, the first things you usually do when you begin practice, the look and feel of the field or clubrooms.
Try to imagine and feel yourself-doing your initial warm up. What does it feel like, imagine how you feel, when you first start, your breathing, and muscles……
Now imagine yourself doing the stretching exercises…….feeling the muscles stretch out nice and relaxed………..
Now imagine your throwing and passing the ball. You are moving freely, smoothly, relaxed and with perfect form. The ball is going exactly where you want it to. Now close you eyes and try to imagine this scenario.

PRACTICE:

- Practice the scenario during the next week. Take your time and go slowly
- Once you have control begin to image yourself performing other rugby-related skills. Like tackling players, breaking through the line or through tackles.
- To ensure that your attention is not narrowed when placed under stress, practice imaging yourself feeling and being relaxed after periods of exertion (i.e., running with the ball, scoring a try etc.,).
- Also try to imagine that you have a wide sense of attention after such exertion.
- You must create and control the images in your mind.
- When imaging try to keep up with the feel as well as the image. Sometimes it helps to actually move the body in line with the image or you may prefer to lay still.

EXERCISE 7.
Using the following table, tick each day that you were able to practice your imaging skills. Make a note of how long you were able to keep the movie going without getting distracted. You can also make a note of what senses you were able to use effectively during the visualisation exercise.

	WEEK 1	**WEEK 2**	**WEEK 3**	**WEEK 4**
MONDAY				
TUESDAY				
WEDNESDAY				
THURSDAY				
FRIDAY				
SATURDAY				
SUNDAY				

SESSION 5. GOAL SETTING

Objectives

- Evaluate imagery use and application.
- Introduce goal setting
- Introduce concept of pre-performance plans and routines.

The purpose of goal setting is to give you a specific target to help motivate you to train and compete at your best. Once you have identified what those targets are, you then need to have some plan to make those goals become a reality otherwise goals just become a 'wish list'. Part of developing a plan is to think of specific activities that you can do to help make your goals a reality. Goal setting has been shown to be effective for facilitating athletic performance, however not all types of goals are equally effective.

For examples specific goals are better than “do your best” goals or “no” goals at all. It is important that in the sporting environment goals be expressed in terms of specific measurable behaviours. For example, increasing speed over 100 metres by 1sec by the end of the year or increasing one’s maximum life on the bench press by 5 kilograms.

Goals need to be moderately difficult but realistic. A relationship between goal difficulty and performance has been shown, in that the more difficult the goal, the better the performance. However, goals must not exceed a person’s capabilities.

Set short term as well as long-term goals. Long-term goals are important, however the approach of combining short – and long term goals has found to be more effective. Short-range goals are important as they allow the athlete to see immediate improvements in performance, which can help to increase motivation. Without short-term goals, an athlete can lose sight of the long-term objective. This combination approach should be thought of as a series of steps leading eventually to the long-term target.

Set performance as well as outcome goals. Outcome goals such as winning, beating a particular opponent are common amongst athletic performers. However outcome goals have been shown to be less effective than performance goals. Performance or process goals involve focusing on specific target within their control, such as decreasing 100-metre sprint time. Another example would be to focus on some aspect of performance such as task-relevant procedures that need to be executed for good performance (process goal). Adopting this approach the athlete can then control their own performance or focus on processes, rather than focus on the outcome (which may not be under their direct control).

Set goals for competition and practice. This approach allows the athlete to continually focus their attention on reaching certain targets. Research has shown that elite athletes commonly set clear daily practice goals. Common practice goals may include starting practice on time, making five sincere positive statements, running to and from all practice drills.

Set positive as opposed to negative goals. Whenever possible, goals should be stated positively and not negatively. This approach helps athletes to focus on success and not failure.

Identify target dates for goal achievement. Not only should goals describe the behaviour of focus in specific measurable terms, but also they should target the date or time line, with which the goals need to be attained. This helps to motivate athletes by giving some urgency to achieving the targets.

Identify goal-achievement strategies. Not only is it important to specify goals but also athletes need to identify necessary strategies to achieve these goals. For example if the goal is to improve level achieved at the next beep test in 6-weeks, then a strategy is to include an additional speed session 1 x per week.

Record goal once they have been identified. Once goals have been identified it is easy for athletes to focus their attention on these. However, during a full season, goals are often forgotten and therefore it is important for goals to be written down. In addition some form of record needs to be maintained for monitoring goals, like a diary or notebook.

Evaluate goals. Goal setting is an on-going process. Athletes can improve in performance and need to re-set goals. It is also important to receive feedback about how present performance is related to short- and long-term goals. This evaluative approach is important for both the athlete and the coach to monitor and regulate future targets for performance.

Below are a few basic guidelines for goal-setting to remind you about how to and what to include. Goals should be ……………..

- **SPECIFIC**………. to what you want to achieve. You should have some sort of target that you can measure. For example a level of accuracy, a time or a date for achieving the goal. Focus on Performance and not Outcome goals
- **MEASURABLE** ……you should be able to measure whether you have achieved this goals
- **ACHIVEABLE**…. and challenging. Your goals need to be difficult enough that they challenge and motivate you, but not so difficult that they cannot be achieved.
- **REALISTIC**……….to achieve, based upon things like your current competition level, fitness and time commitment.
- **TIME LINED**……..you need to set a target date in which to achieve your goals. Do you have time to achieve your goal, and is this realistic?

EXERCISE 8: GOAL SETTING
Using the guidelines above fill in the table below to highlight what your goals are for the short, mid, and long term. When writing your goals out make sure they are SMART Goals. Also make sure you name specific local, regional, national or international competitions. For this year: Two years time: Three to five years time:

TIME FRAME	GOALS	PLAN
SHORT TERM		
MEDIUM (2002 season)		
LONG TERM (2-5 years)		
DREAM		

EXAMPLE:

GOAL: To be more organised so that I get to competition venues in plenty of time, and don't forget any of my gear.

PLAN: I will make a list of all the things that I need to take to a competition, get it laminated, and pin it inside my bag. I will: pack my bag the night before so that I know I have everything as I pack ready for the next day. Check all my gear against my list as / pack it, so I don't forget anything.

SESSION 6. EVENT PLANNING

To optimise your ability to deal with competition stress and arousal it is important that you develop a consistency to the way in which you prepare. For example if you know that you like to get to the ground early to warm up and get ready then this is something you should strive to do prior to each performance. Developing a pre-performance plan allows you to identify things that help to optimise performance and to include these factors as much as possible during subsequent performances. Also it allows you to have a baseline plan which can be adjusted in the future.

Many athletes have some consistency in they way they physically prepare, especially when they are part of a team environment. However it is less common to have a plan about how you would like to mentally prepare for competition. For example regulating how you feel before games dictates whether you need to adopt a relaxation strategy to decrease arousal or some form of energising technique.

The first part of developing a plan is to write down all the things that you like to happen before playing a game. It is important to draw on past performances to highlight things that may have worked well in the past. Write all these thoughts down under the heading of physical and mental preparation.

For example physical preparation may include some of the following. Make sure bag is packed the night before, eat light 3-hours before game………then water (etc) only. Get to game 60-mins before, unpack bag, go for light jog etc………
Mental preparation suggestions might be ………..get to game early, have a look at conditions, remind self of performance goals for the day. Listen to music before game to relax. Monitor self; use relaxation strategies (breathing). Before game, use energising imagery, reinforce verbal cues. During game, verbal cues to maintain focus, use of relaxation breathing strategies to restore optimal arousal.

The plan is something you can use at each game and can be kept in your gear bag. Refer to this as much as possible before the game to serve as a reminder of what you want to do and how you want to feel.

The next exercise involves you writing down (in the table provided) things that you feel you would like to include in you pre-performance plan.

EXERCISE 9. PRE-PERFORMANCE PLANNING

	Physical	Psychological	Other
The evening and morning leading up to competition			
The hour leading up to competition			
Immediately before competition			

SESSION 6. REVIEW

Objectives

- To highlight the key points from the previous sessions.
- Quick review of the various techniques
- To encourage the application of these techniques
- To explain that telephone contact will be made monthly to reinforce application of the programme.

REVIEW: EXERICSE 10

Consider all the things that have been covered in the past 3-weeks. Identify what aspects are important to you and may be useful in the prevention of injury and improving performance. What aspects do you think you need to practice over the next 12-15 weeks? Use the table below to highlight when you practiced the various skills. Also indicate whether you feel you are having success in the implementation on the various skills

WEEKS	RELAXATION TECHNIQUES	POSITIVE THINKING/SELF TALK	IMAGERY	GOAL-SETTING
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				

APPENDIX N. STUDY 3 CONSENT FORM

DEPARTMENT OF SPORT AND EXERCISE SCIENCE

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Building 734, Tamaki Campus
Morrin Road, Glen Innes
Auckland, New Zealand
Telephone 64 9 373 7599 ext 86860
Facsimile 64 9 373 7043

Consent to Participate in Research

Psychosocial factors and recovery after knee surgery

Researchers and Contact Address.
Ralph Maddison (PhD student, sport and exercise science)
Phone: 09 3737599 ext. 6631 or 027 2444789 mobile, e-mail: r.maddison@auckland.ac.nz
Dr Harry Prapavessis (Senior Lecturer, Sport & Exercise Science)
Phone: (09) 3737599 ext. 6860, e-mail: h.prapavessis@auckland.ac.nz
Mr Mark Clatworthy (orthopaedic surgeon)
Phone (09) 520 9632, email: mclatworthy@akldbonejointsurg.co.nz

Aim: The purpose of this study is to understand whether watching a viewing a modelling video will affect psychological factors such as anxiety, motivation and confidence, as well as reaching functional milestones earlier.

The researchers conducting this study support the principles governing both ethical conduct of research, and the protection at all times of the interests, comfort and safety of the participants. This form and the accompanying information sheet are given to you for your own protection. They contain a detailed outline of the procedures. Your signature below indicates eight things:

1. I have been given and understood an explanation of the research study. I have had an opportunity to ask questions and have them answered.
2. I understand that I may withdraw myself, or any information traceable to me at anytime without giving a reason and that, this in no way will affect my future involvement with the University of Auckland.
3. I understand that participation in this study is confidential and no material that could identify me will be used in any reports on this study.
4. I agree to complete all the questionnaires.
5. I agree to the assessment of range of motion and knee laxity following the ACL operation.
6. I have had time to consider whether to take part in this research project.
7. I know whom to contact if I have any concerns as a result of participation in this study.
8. I am aware of the risks involved in this study and do not hold the researchers responsible for any problems I may experience.

Signed:

Name:
(please print clearly)

Approved by the University of Auckland Human Subjects ethics committee, May 2002 for a period of 3 years.

APPENDIX O. STUDY 3 PARTICIPANT INFORMATION

DEPARTMENT OF SPORT AND EXERCISE SCIENCE

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Building 734, Tamaki Campus
Morrin Road, Glen Innes
Auckland, New Zealand
Telephone 64 9 373 7599 ext 86860
Facsimile 64 9 373 7043

Sports Science Research Participant Information

Project Title: Psychosocial Factors and Acute Recovery Following Anterior Cruciate Ligament Reconstruction (ACL)

Researchers and Contact Address.
Ralph Maddison, Dr Harry Prapavessis (Department of Sport & Exercise Science, Tamaki Campus, University of Auckland, Private Bag 92019, Auckland) Mr Mark Clatworthy (orthopaedic surgeon, Ascot Hospital, Auckland) and Professor Peter McNair (Department of Physiotherapy, Auckland University of Technology).

Ralph Maddison (PhD student, sport and exercise science)
Phone: 09 3737599 ext. 6990 or 6302459 (hm) or 021 1946799 mobile, e-mail: ralph.m@clear.net.nz

Dr Harry Prapavessis (Senior Lecturer, Sport & Exercise Science)
Phone: 09 3737599 ext. 6860, e-mail: h.prapavessis@auckland.ac.nz

Background Information

Acute injury of the anterior cruciate ligament (ACL) of the knee is one of the most common and debilitating sport and recreation-related injury. Rehabilitation following surgical reconstruction of the ACL is a quite a long process with home and clinic based treatment involving cryotherapy (or icing) and exercises designed to build strength and improve flexibility.

Psychological interventions have been shown to have a positive effect on rehabilitation outcomes. One intervention that has been suggested to have a positive impact during rehabilitation is viewing a modelling video. The modelling videotape will allow a person undergoing surgical reconstruction of the ACL to pick up relevant cues and information that will assist during the rehabilitation process.

Project Objectives

The purpose of this study is to examine the effectiveness of viewing a modelling video on the rehabilitation process.

Subject requirements and procedure

To be included in this study you need to be scheduled for an anterior cruciate ligament reconstruction (ACLR) under the care of Mr Mark Clatworthy (orthopaedic surgeon). You will be asked to complete a consent form and 4 questionnaires at a number of time points. These will be 2-3 days before surgery, the day before surgery, 2-weeks and 6-weeks post-operation. The questionnaires will take approximately 10-20 minutes to complete. Knee function (strength & flexibility) will also be assessed at 2-weeks and 6-weeks post-operation. Finally those persons randomly allocated to the intervention will be asked to watch a video (approximately 15-minutes in length), prior to completing questionnaires at the time-points highlighted above. All those participating in the study will receive standardised rehabilitation procedures.

Risks
The risks of participating in this study are considered absent. The standardised rehabilitation procedures following ACLR will not change as a result of this study. However if you have any problems with answering these questions Dr Harry Prapavessis and Mr Mark Clatworthy will be available to discuss any issues that may arise.

Benefits
No financial incentive will be available to those participating in this study. All subjects who participate in this study will receive a written report summarising the main findings of this study.

Freedom of Consent
It is the researchers' intentions to include only those subjects that freely choose to participate in this study. Participation is voluntary and you are free to withdraw consent at any time. This will have absolutely no influence on your present and or future involvement with the University of Auckland. Your consent to participate in this research will be indicated by your signing and dating of the consent form. Signing the consent form indicates that you have freely given your consent to participate, and there has been no coercion to participate.

Confidentiality
All data collected for this research will be treated with absolute confidentiality. All questionnaires will be numerically coded and no names will be included in the data collection or analysis. Reported results will not include any names whatsoever.

Data and Results
Recorded data will be retained for a period of six years in a secure place at the Department of Sport and Exercise, University of Auckland, under the care of Dr Harry Prapavessis. This is to conform to the University's Code of Practice.

Inquiries
Any questions concerning the research are welcome at any time. Please feel free to ask for clarification of any point, which you feel, has not be explained to you're complete satisfaction. Any queries regarding ethical concerns please contact:
Dr Dennis Moore, Chair, university of Auckland, Private Bag 92019, Auckland; phone (09) 3737599 ext. 8939: facsimile (09) 373 7432

Approved by the Auckland Ethics Committee May 2002 for a period of 3 years.

APPENDIX P. PERCEPTION OF EXPECTED PAIN QUESTION

Instructions:

Pain

"Please write down a number between 0-100 that best describes how much pain you think you will experience after your knee surgery. A zero would mean no pain and a 100 would mean pain as bad as it could be".

____

APPENDIX Q. CRUTCH SELF-EFFICACY SCALE (CSE)

Instructions: Following your ACL operation you will be required to perform a number of activities as part of your rehabilitation. We are interested in your confidence to perform the following activities at differing times.

Please indicate below how confident you are that you will be able to successfully carry out each of the following activities below during the next two weeks.

For example if you have complete confidence that you can walk at a slow pace for 30 minutes without stopping then you would circle a number closer to the 100%. However if you have little confidence that you can walk at a slow pace for 30-minutes then you would circle a number closer to 0% end of the scale.

KEY:
Slow pace is placing crutches in front of leg and bringing the injured leg up to it.
Moderate pace is walking with crutches at a speed that resembles normal walking without crutches.

Walking with crutches on a flat surface

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
No Confidence At all **Somewhat Confident** **Completely Confident**

I believe that I can walk with crutches

For 10 minutes at a **slow pace** without stopping ________________________

For 20 minutes at a **slow pace** without stopping ________________________

For 30 minutes at a **slow pace** without stopping ________________________

For 10 minutes at a **moderate pace** without stopping _____________________

For 20 minutes at a **moderate pace** without stopping _____________________

For 30 minutes at a **moderate pace** without stopping _____________________

APPENDIX R. WALKING SELF-EFFICACY SCALE (WSE)

Instructions: Please indicate below how confident you are that you will be able to successfully carry out the following activity during the next 2-weeks.

KEY:
Slow pace is walking with the leading foot and bringing up the injured leg to meet it.
Moderate pace is walking freely at your normal pace
Moderately fast is brisk walking

Walking without crutches on a flat surface

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
No Confidence At all					**Somewhat Confident**				**Completely Confident**	

I believe that I can walk unaided without crutches

For 10 minutes at a **slow pace** without stopping ____________________

For 20 minutes at a **slow pace** without stopping ____________________

For 30 minutes at a **slow pace** without stopping ____________________

For 10 minutes at a **moderate pace** without stopping ________________

For 20 minutes at a **moderate pace** without stopping ________________

For 30 minutes at a **moderate pace** without stopping ________________

For 10 minutes at a **moderately fast pace** without stopping ___________

For 20 minutes at a **moderately fast pace** without stopping ___________

For 30 minutes at a **moderately fast pace** without stopping ___________

APPENDIX S. JOGGING SELF-EFFICACY SCALE (JSE)

Instructions: Please indicate below how confident you are that you will be able to successfully carry out the following activity during the next 6-weeks

KEY:
Slow pace is jogging easily without effort (no heavy breathing)
Moderate pace is jogging freely with some effort (some heavy breathing and a bit of sweating).
Moderately fast equates to running with no restriction (heavier breathing, increased heart rate and sweating).

Running/Jogging

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
No Confidence At all					Somewhat Confident				Completely Confident	

I believe that I could run/jog

For 10 minutes at a **slow pace** without stopping _________________

For 20 minutes at a **slow pac**e without stopping __________________

For 30 minutes at a **slow pace** without stopping __________________

For 10 minutes at a **moderate pace** without stopping _______________

For 20 minutes at a **moderate pace** without stopping _______________

For 30 minutes at a **moderate pace** without stopping _______________

For 10 minutes at a **moderately fast pace** without stopping ___________

For 20 minutes at a **moderately fast pace** without stopping ___________

For 30 minutes at a **moderately fast pace** without stopping ___________

APPENDIX T. EXERCISE SELF-EFFICACY SCALE (ESE)

Instructions. Please indicate below how confident you are that you will be able to successfully carry out each of the following activities below using the following scale

Rehabilitation exercises

0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
No Confidence At all					**Somewhat Confident**				**Completely Confident**	

I believe that I can perform the rehabilitation exercises

Once a day for 10 minutes each session ___________________________

Twice a day for 10 minutes each session __________________________

Three times a day for 10 minutes each session ______________________

Once a day for 20 minutes each session ____________________________

Twice a day for 20minutes each session ____________________________

Three times a day for 20 minutes each session _______________________

APPENDIX U. SITUATIONAL MOTIVATION SCALE (SIMS)

Instructions. Following an ACL injury people take part in rehabilitation for a number of reasons. We are interested in your reasons for taking part in the rehabilitation programme.

Read each of the following items carefully and using the scale below place a number that best describes the reasons why you are planning to follow the rehabilitation programme.

1 = corresponds not at all
2 = corresponds very little
3 = corresponds a little
4 = corresponds moderately
5 = corresponds enough
6 = corresponds a lot
7 = corresponds exactly

Why are you currently planning to follow the rehabilitation programme after your operation?

1.	Because I think this activity will be interesting	___________
2.	Because I am doing it for my own good	___________
3.	Because I am supposed to do it	___________
4.	There may be good reasons to do this activity, But personally I don't see any	___________
5.	Because I think this activity is pleasant	___________
6.	Because I think the activity is good for me	___________
7.	Because it is something I have to do	___________
8.	I am doing this activity but I am not sure if it is worth it	___________
9.	Because the activity is fun	___________
10.	By personal decision	___________
11.	Because I don't have a choice	___________
12.	I don't know; I don't see what this activity brings me	___________
13.	Because I feel good about doing this activity	___________
14.	Because I believe that this activity is important to me	___________
15.	Because I feel I have to do it	___________
16.	I do this activity, but I am not sure it is a good thing to pursue it	___________

APPENDIX V. INTERNATIONAL KNEE DOCUMENTATION COMMITTEE FORM

APPENDIX W. MODELLING DVD

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