Attentional and explanatory style characteristics of injured professional rugby league players: A prospective study.

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Ethics Statement

The research presented and reported in this thesis was conducted within the guidelines for research ethics outlined in the *National Statement on Ethics Conduct in Research Involving Human* (1999*),* the *Joint NHMRC/AVCC Statement and Guidelines on Research Practice* (1997*),* the *James Cook University Policy on Experimentation Ethic*s. *Standard Practices and Guidelines* (2001), and the *James Cook University Statement and Guidelines on Research Practice* (2001*).* The proposed research methodology received clearance from the James Cook University Experimentation Ethics Review Committee (approval number HA73).

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Abstract

Injury has both physical and psychological sequelae for athletes. In addition to this, psychological variables influence the nature and duration of the injury experience. Psychological research into the injury experiences of professional rugby league players is limited and fragmented. The aim of the research was to determine which psychological variables may be related to the subsequent injury experiences of professional rugby league players. During a two year prospective study, professional level rugby league players (N=53) completed psychometric scales and had their injury experiences recorded. The psychometric scales utilised consisted of the Test of Attentional and Interpersonal Style (TAIS) and the Extended Attributional Style Questionnaire (EASQ). The injury variables included the number of injuries, injury severity, and time taken to resume playing.

A comparison of playing position indicated that forwards spent less time on the field due to being involved with a greater amount of full body contact ($F_{1,\,47}$=16.78, p=0.00; d=0.98). Forwards sustained more injuries than backs as a result of more physical contact ($F_{1,\,47}$=4.21, p=0.04; d=0.24). Such differences supports the continued differentiation between playing position in future studies on professional rugby league players.

Discriminant function analysis revealed one significant function ($\lambda = 0.15$, $p<0.01$) indicating that professional rugby league players, who are overloaded by information (OIT), have lowered self-esteem (SES), and lower physical orientation (PO) had more severe injuries. Classification procedures correctly classified 84.9% of participants into their respective injury severity groups. The TAIS and the EASQ had adequate test-retest reliability indicating attentional, control, interpersonal and attributional variables to be stable over time. Spearman rank order correlations between TAIS and EASQ subscales revealed that players who tend to make global attributions were more likely to have better attentional style ($p<0.05$), less likely to become overloaded ($p<0.01$), process information more successfully ($p<0.01$) and have higher self-esteem ($p<0.01$). Participants who made both global and stable attributions were more likely to have better attentional style ($p<0.05$), less likely to become overloaded by information ($p<0.01$), were less impulsive ($p<0.05$) and had higher self-esteem ($p<0.01$). In the instance of stable attributions, individuals were less likely to worry ($p<0.05$) and better able to express themselves ($p<0.05$). When explanatory style was compared with severity of injury, players who made global ($F_{2, 53}=5.91$, $p=0.00$, d=0.86) and stable ($F_{2, 53}=5.60$, $p=0.00$; d=0.84) attributions had a higher proportion of severe injury ratings. Utilisation of a prospective design is recommended for future research with injured athletes. Further research on the mechanisms underlying the relationship between attentional and attributional style and injury is recommended.

Key words: Rugby league, injury, attentional and interpersonal style, explanatory style, discriminant function analysis

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"A candle loses nothing by lighting another flame"

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"The instant an athlete is injured, much of what he or she has worked for is taken away. This has a devastating impact, because, for athletes, physical condition and athletic ability are the major components of self-worth."

(Faris, 1985, p.545)

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Chapter one

Introduction

Introduction

Injury has repercussions for athletes involving physical, emotional, and psychological sequelae. Physical injury is generally a negative experience that athletes intend to avoid (Pargman, 1999). Given the competitive and physical nature of many sports, such avoidance is difficult (Vitenbroek, 1996). Rugby league is an international collision sport with high injury rates for players (National Health and Medical Research Council, 1994). However, despite this, few attempts have been undertaken to gain an empirical understanding of psychological processes, personality characteristics, and their influences on injury experience in professional rugby league players.

Research conducted on psychosocial aspects of athletic injury is incomplete and in places, unclear (Johnston & Carroll, 2000). The following chapter introduces the reader to the research project by presenting the key areas under investigation, namely athletic injury, attributional style, and attentional style in elite rugby league. The statement of the problem, research hypothesis, significance, delimitations and limitations will then be outlined. This will be followed by definitions of key terms and a summary of the chapter.

The sport of rugby league

Rugby league is an international sport that has been played since 1906. It is a collision sport whereby players require a combination of agility, speed, stamina, power, endurance, and strength (Gabbett, 2001; O'Connor, 1996). The game involves two teams of 17 players each. Thirteen players are on the field at any one time while a further four players are used for interchange purposes during the game. The aim of the game is to score the most number of points within an 80 minute period. Points may be accrued by scoring a 'try', whereby a player crosses the opposition's 'try line' and places the ball on the ground, whilst keeping the ball in contact with their own body. Points may also be gained at specific times when players attempt to kick the ball through two goal posts.

Players are permitted to play with the hands and feet, allowing the ball to be carried, passed or kicked. When passed, the ball is required to travel backwards. Players may also kick the ball down the field, with the aim of gaining ground towards the opposition team's try line. This action has the effect of forcing the opposition team to commence their tackle count as far away from the kicker's try line as possible. This may also give the kicking side opportunities to regain possession if their opponents infringe any rules or make a mistake in play.

Players carrying the ball are frequently tackled to the ground by opposition team members. A tackle occurs when a player carrying the ball is grasped around the body or legs by an opposing player(s). A team may be tackled a maximum of six successive times before being required to hand the ball to the opposition team. If during the tackle sequence, an opponent touches the ball in any way, the referee may order the tackle count to start again.

The 13 players on the field fulfil the role of 9 different playing positions (Full back, Wing (x 2), Centres (x 2), Halfback, 5/8, Lock, Second Row (x 2), Front Row (x 2), and Hooker). The players' positions can generally be categorised into six forwards and seven backs (Huxley, 1988). The differences between these two positions highlight the 'engine room' qualities of the forward in receiving and making the majority of the tackles (known as 'hits'). Forwards typically encounter most of the full body contact throughout the game. Backs, in contrast are responsible for developing the plays in attack, and frequently have greater speed and agility than the forwards. Backs are typically physically smaller than forwards (O'Connor, 1996).

During a rugby league game, players will vary activities including standing, walking, jogging, running at low, moderate and high speeds, sprinting and specific skill execution (for example, kicking, jumping, passing, catching and tackling) (Gabbett, 2002). The ratio of high intensity activity to low intensity activity differs for forwards (1:6) and backs (1:8) (Meir, Arthur, & Forrest, 1993). A player may be involved in intermittent passages of play varying from 5-90 seconds (Douge, 1988). Typically players will spend 2.9% of playing time sprinting or combining sprinting with other high intensity activity including stepping, tackling or passing (Meir et al., 1993). The game requires that players draw upon several fitness components, including speed, agility, strength, anaerobic and aerobic power.

The variety of motor skills required of rugby league players is best understood by applying Gentile's (2000) taxonomy. The taxonomy (refer Appendix A) differentiates motor behaviour according to the environmental context in which it is performed (ie. stationary or in motion) and the function of action when performed (ie. body location and manipulation of objects). This classification system was designed for practical and theoretical application. Practically the taxonomy assists physiotherapists to characterise patients and plan for appropriate activities. Theoretically the taxonomy differentiates various movements and allows a broad comparison of physical activity (Magill, 2004). The taxonomy would categorise the motor skills of rugby league as requiring body transport (walking and running), object manipulation (the ball), regulatory conditions (playing field) in motion with intertrial variability (variability of conditions).

Rugby league is currently played by approximately 58200 people over the age of 18 years within Australia. At the elite level, 14 teams play in the National Rugby League competition. These participants are typically male and aged between 18 and 24 years of age (Australian Sports Commission, 2000).

Whilst items such as shoulder pads and mouth guards may be worn, protective equipment such as that worn in the National Football League (for example, helmets) is not. Injury is a common outcome from direct and indirect trauma such as twisting injuries and muscle and tendon injuries. In a 3-year prospective study conducted with elite rugby league players, 27.7% of injuries were classified as major (ie. resulted in a player missing five or more games) (Gibbs, 1994). Further, a study conducted with amateur players found that 30% experienced major injuries (Gabbett, 2001).

The predominant injuries experienced by rugby league players are ligament and joint injuries (53.9% of all injuries), with the knee (24.1%) being the most commonly injured joint (Gibbs, 1993). The forwards who are involved in more physical contact during a game typically sustain more injuries than the backs (Gibbs, 1993; Seward, Orchard, Hazard, & Collinson, 1995).

A report on football injuries to the head and neck concluded, "… there is an absence of good overall data on injuries in football" (National Health and Medical Research Council, 1994, p. 2). Further, the report concluded that indicators of risk within the elite population of football players should not be generalised to the general public. It was concluded that the two groups (professional players and general population) should be considered separately.

A recent literature search revealed 40 articles relating to rugby league and psychological constructs. Of these, 26 were published in applied publications (for example, Aldous, 1998; Mellors, 2000; Smith, Seward, Blundell, & Middleton, 1998). Of the remaining 14 references, the content related to models of stress (for example, Anshel, 2001), sociology of rugby league contexts (for example, Hill & Green, 2000; Hutchins & Phillips, 1997), substance abuse (for example, Lawson & Evans, 1992), head injury (for example, Hinton-Bayre & Geffen, 2002; Hinton-Bayre, Geffen, & McFarland, 1997), mental toughness (for example, Golby, Sheard, & Lavallee, 2003), and cohesion and anxiety (for example, Prapavessis & Carron, 1996; Hanton, Jones, & Mullen, 2000). Other research conducted with rugby union and soccer players considered the relationship of mood state, anxiety, stress, and social support with athletic injury (Lavallee & Flint, 1996). This literature search demonstrated the lack of psychological research within the sport of rugby league, particularly in relation to psychological constructs such as personality factors.

Sporting injury

Sporting injuries have been described as impacting on the preparation for, participation in, and overall employment of an athlete. Athletes may experience changes including missing or modifying training sessions and competition, or premature retirement from the sport. In addition, such injuries have been described as having substantial direct and indirect economic costs (Gabbett, 2001; Bergandi, 1985). Injury is likely to be a stressful experience, particularly for athletes who derive their main source of income from sport.

The incidence rate of injury in sporting endeavours varies according to the operationalisation of injury. However in the case of the United States of America an annual figure of 17 million injuries per year has been suggested (Heil & Fine, 1993). Figures for collegiate and secondary school populations range from 3 to 5 million annually (Kraus & Conroy, 1984). Despite improvements in athletic equipment, and rule changes that have resulted in less hazardous competitive conditions, the proportion of sport injuries continues to increase (Lee, Garraway, Hepburn, & Laidlaw, 2001; Scher, 1998). It is estimated that 80% of athletes will experience injury at some time in their career and will be absent from competition and/or practice for at least three weeks (Pargman, 1999).

Sporting injury has been defined as, "… a medical or physical condition that requires the athlete to miss at least one day of practice and/or competition" (Petrie & Falkstein, 1998, p. 37). Sportsafe (1998) specified that in operationalising injury severity, the nature of the injury, duration and type of treatment, sports time lost (training and competing), working time lost, permanent damage, and costs of sports injury could all be considered. Time loss is an objective determinant by which to measure injury. The severity of the injury may not necessarily be reflected within this definition, making time loss inappropriate in research that considers whether the psychological attributes of an athlete contributes to the time absent from training or competition. Severity of injury is a more informative measure which, when defined by a medical professional will allow comparisons of severity amongst athletes. To assume that duration of injury equates with injury severity may undermine the psychological variables that are to be explored. The aim of a sports injury surveillance system is to answer questions relating to the number of injuries, frequency of occurrence, duration of incapacity and severity of the injury. With a clear understanding of the answers to these questions, the foundation is laid for sound methodological research (van Mechelen, 1997a).

Injury severity has been defined in a number of ways (Finch, 1997). Different definitions make comparisons between research results problematic. A standard method for understanding injury severity is needed to enhance comparability across research (van Mechelen, 1997a). Further, six criteria commonly utilised to describe sporting injury severity have been offered (Van Mechelen, 1997b). These criteria included the nature of the injury, type of treatment and duration, amount of sporting time lost, amount of working time lost, any permanent damage, and financial cost. The conclusion made by the author was that choice of severity indicators utilised should be dependent upon the research question posed. It could also be argued that such indicators should be selected on the basis of the target population involved. For example, professional rugby league players within Australia have their health expenses met by their employers and associated private health funds. The majority of these players are paid an annual salary, and are not dependent upon match payments for income. Therefore, financial costs of acute injury are less likely to be a factor of concern when considering injury severity for such athletes.

There are differences in the way in which severity of injury has been understood. Research needs to give consideration to the conceptualisation and operationalisation of severity to ensure it is appropriately applied to the target research population.

Psychological theory and injury

Psychological theories provide a framework to consider, understand and in some instances predict human behaviour (Babbie, 1999). Valid psychological measures provide mechanisms under which theories may be tested, and can provide links between research and practise (Nideffer, 1987). It is therefore, important to examine athletic injury utilising psychological measures and empirical research design to gain a greater understanding of the injury experience. Several researchers have indicated sporting injury can be partly attributed to psychosocial factors (Anderson & Williams, 1988; Bergandi, 1985; Blackwell & McCullagh, 1990; Pargman, 1999; Patterson et al, 1998; Sanderson, 1977, Valliant, 1981).

Personality

Personality is a consideration of the individuality of and commonality between people. Personality may be defined as, "… those characteristics of the person or of people generally that account for consistent patterns of behaviour" (Pervin, 1989, p. 4). Varying according to theoretical orientation, the definition may make reference to the stability of those characteristics over time. A behavioural perspective (for example, Eysenck, 1970) would suggest that personality characteristics are deterministic and genetically driven. An adaptive approach (for example, Mischel, 1976) would view personality as adjusting to life circumstances.

Most definitions of personality emphasise the concepts of distinctiveness, stability and consistency. Personality considers unique characteristics and how such individual characteristics can be applied as general principles (Phares, 1988).

Personality has been a frequently investigated area within sport and exercise psychology, with such investigations attempting to explain, understand, or predict the behaviour of athletes (Dunn & Syrotuik, 2003; Solomon, 2001; Storch, Werner, & Storch, 2003). Over a long history of examination, the personality research within the sporting domain has at times been contentious and fiercely debated. Indicative of this debate, Morgan (1980) compared the sceptical and credulous viewpoints of personality.

The sceptical position is described as viewing personality as an unsuitable determinant of describing and predicting a person's behaviour. This view is based upon low variance reported of personality characteristics for predicting athletic success. With variance values rarely exceeding 0.2, the sceptical view argues personality characteristics have little utility in predicting behaviour and should therefore, not be included as a research variable (Morgan, 1980). In a text on sport psychology, Vanek, Hosek, Rychtecky, & Slepicka (1980) did not include a chapter on personality. The reason for such an exclusion included criticisms of standard personality inventories and inability of research to demonstrate personality differences between athletes and non-athletes. Previous personality research in sport settings was described as being ‘static’ in nature with psychometric scales assuming personality characteristics to be stable and global across all situations. Authors ascribing to the sceptical position include Kroll (1976), Rushall (1975), and Martens (1975).

In contrast, the credulous view argues that personality characteristics are useful to predict a person’s behaviour. Researchers with a credulous perspective would recommend consideration of personality characteristics in the composition and selection of athletes for sporting teams (for example, Le Unes and Nation, 1982). The credulous perspective argues differences in the personality characteristics of athletes and non-athletes (Morgan, 1980).

In research with elite netball players, psychological measures were tested to distinguish between selected and non-selected athletes for an international competition (Miller & Miller, 1985). Non-selected were those who missed out on selection. Results indicated no difference between the two groups of athletes. The conclusion suggested that the relationship between personality and performance is tenuous and lent support to the sceptical position. The authors failed to mention particular limitations of their research, including sample size, sampling methodology and that they were all elite netball players.

A guiding principle for psychological research should be that until firm conclusions can be made, research should continue to consider all possible outcomes. Specifically, "(s)ocial scientific theory has to do with what *is*, not with what *should be*" (Babbie, 1999, p. 13). Morgan (1980) stated, "… it appears reasonable to conclude that sport psychologists who have adopted the sceptical or the credulous position are equally wrong" (p. 72). This position was supported by Bakker et al. (1990) who argued neither view to be correct.

The assumption of a sceptical view opposes a fundamental position of the scientific perspective. The appropriateness of personality variables to discriminate between athletes has not been determined. A strength of the scientific approach is its impartiality, requiring all ideas and conclusions be subject to evaluation and scrutiny. A lack of support for a theory or conclusion about personality may be due to a real effect, limitations in research design or absence of appropriate measures to accurately portray the variables (Cozby, Worden, & Kee, 1989). Thus to assume that personality has no potential contribution or should not be used to discriminate between athletes may be a premature conclusion. Whilst research findings in the area remain inconsistent, the further pursuit of personality research in sport is therefore, warranted. Extensive literature exists indicating that personality factors contribute to athletic performance in a variety of sports (for example, basketball (Evans & Quarterman, 1983), tennis (Singer, 1969), hockey (Williams & Parkin, 1980), American football (Daus, Wilson, & Freeman, 1986; Garland & Barry, 1990; Kroll & Peterson, 1965; Kroll & Crenshaw, 1968; Schurr, Ruble, Nisbet, & Wallace, 1984), rowing (Morgan & Johnson, 1978), rock climbers (Robinson, 1985), and endurance athletes (Clingman & Hilliard, 1987)). It is therefore, valid to conduct research adopting a credulous view, testing the influence of personality factors on the injury experience of athletes.

Theoretical views of personality

Considering athletes according to the presence or absence of particular personality characteristics has been argued as a mechanism for predicting behaviour (Nideffer, 1976). A number of competing theories exist to explain the role of personality and its relationship with behaviour.

Essentially, most of these theories acknowledge there is a contribution from both internal (ie. personality characteristics) and external (ie. situational and environmental) influences on behaviour. Where the theories differ is in the weight they ascribe to these determinants and how they perceive the determinants interact with each other.

The evaluation of personality theories should follow the criteria of comprehensiveness, parsimony, and research relevance (Pervin, 1989). Comprehensiveness is achieved by considering the quantity of phenomena the theory encompasses and the relevance of that material to understanding human experience, when compared with other theories. The aim of a parsimonious approach is to explain the theory as coherently and simply as possible. The aim here is to avoid ambiguity and remain clear in explaining abstract concepts. Finally, critical consideration of personality theories should achieve relevance through research. Further, Pervin (1989) argued that the concepts included in theories should be empirically translatable. That is, they should include concepts that can be clearly conceptualised and operationalised, and then tested through hypotheses. Instead of the purpose of a theory being to define a truth, it should instead contribute to existing knowledge and provide opportunity for further development of research questions and investigations. The trait approach is the theoretical view adopted in this dissertation. A summary of the theory and responses to Pervin's (1989) evaluation criteria follow.

Trait theory is based upon the assumption that individuals hold broad predispositions to respond to situations in a particular way and these traits are organised hierarchically. Whilst theorists may disagree as to the composition of traits most agree that traits are central to the personality of an individual (Phares, 1988).

The notion that people can be described according to typology is a long held view (Liebert & Spiegler, 1982). Examples supporting this can be found within the bible, Greek discussions of the four 'humors' paralleling the basic elements of air, earth, fire, and water, and the works of William Shakespeare. These examples fall into a dispositional view. Dispositions are considered relatively enduring and stable characteristics experienced with a degree of consistency and generality. In classifying human behaviour, a difference has emerged between the use of 'types' and 'traits'. Essentially, types are discrete categories into which people can be placed. For example, a person could be classified as being selfish or generous. In contrast, traits are described as being continuous categories, acknowledging the experience of characteristics by degree (for example, conscientiousness classified along a seven point scale) (Pervin, 1989).

Trait theorists caution the assumption that traits remain consistent over time in all situations. This caution is based upon the presence of temporary dispositions (states) in transient situations. An example of the contrast between these two is evident with anxiety. Spielberger (1966) contrasted A-trait with state anxiety. A-trait was used to describe a tendency of some people to respond to most situations with feelings of apprehension and worry. State anxiety was utilised as a descriptor for people who experience a general heightened state of apprehension and worry and a heightened physiological state in response to particular situations. Advocates of the trait view argue that dependant upon the demands of a situation, state like characteristics may mask underlying trait dispositions.

An ideographic approach to personality focusing on people holding three types of traits was advocated by Allport (1961). These traits were cardinal, central, and secondary traits. Cardinal traits described an overriding trait that dominates a personality. Central traits are the key six or so traits that are readily observable in a person's day to day behaviour. Secondary traits are those exhibited less regularly and only in specific situations. Allport's focus in trait theory was that whilst individuals may share similar characteristics they will be manifested differently within each individual.

Cattell (1979) sought to uncover basic traits of human experience. Utilising factor analysis, a list of some 18000 trait characteristics was reduced to 16 basic personality factors (Allport, 1961). Cattell believed these 16 factors to be source traits, the building blocks of surface traits (common observable behaviours). Cattell's approach differed to Allport's, in that it took a nomothetic approach, aiming to find general principles to apply to most people (Liebert & Spiegler, 1982).

Following Cattell's method, Eysenck (1970) used factor analysis to determine what dimensions best represent the traits experienced by people. Whilst identifying 32 traits, Eysenck placed these characteristics along two personality continuums. Namely, these were introversion-extroversion and stable-unstable. Unlike other theorists who considered the environment as contributing an important role in determining traits, Eysenck held a physiological view that understood traits to be biologically determined (Phares, 1988).

Criticisms of the trait approach are based upon a reliance on self-report inventories, an overemphasis on consistency, a tendency to borrow concepts and names from other disciplines, and the question as to whether trait theory is actually a theory. Self-report inventories have methodological concerns when there is opportunity for subjects to 'fake' or make their responses appear more favourable than they are actually perceived. Therefore, measures utilising a trait perspective need to be valid and reliable. Allport explained much of his theory through biology and Cattell explained through concepts found in psychoanalysis. Whilst the incorporation of other theories could be viewed as a willingness to consider the merits of other theories, Phares (1988) argued that such borrowing lends the approach as too simplistic. Further questioned is the use of the term trait theory, arguing that rather than being theoretical in nature, the theorists have simply placed traits into a hierarchical structure with ambiguity as to how behaviour may be predicted from it. In contrast, trait theory has been applauded for seeking to identify and classify those personality dispositions that are consistent and stable.

Given the current body of knowledge, this dissertation will consider the possible relationship between personality characteristics and athletic injury. Of the contrasting theoretical positions, personality will be considered under the framework of the trait position. This perspective assumes that individuals have enduring, stable characteristics, in addition to characteristics that may vary according to changing circumstances or conditions. This perspective is advocated as it is strongly supported by current and previous research. Given the trait perspective will be the theoretical framework underlying this research, it is necessary to review the specific components of personality for consideration. The two key foci for this thesis are attention and explanatory style.

Attention

The process of selecting, processing, and interpreting information during perceptive tasks is a complex one. Even for a task such as catching a high ball in a game of rugby league, a player is likely to be receiving information through a number of senses. For example, vision is likely to be used to perceive the height, speed, and spin of the ball; auditory sounds from team mates, opposition players, crowd noise, and coaches may be present. Additionally, the player needs sensory awareness of body position in relation to where the ball is likely to fall, and movements of surrounding team mates and opposition players.

Attention itself is subject to many interpretations and understanding. Frequently terms such as alertness, arousal, concentration, vigilance and others are used interchangeably, as if equivalent (Summers & Ford, 1995). Attention has been defined as, "… a combination of facilitations and inhibitions, previously to the processing of a signal" (Nougier, Stein, & Bonnel, 1991, p.308). Attention and its effects on performance have long been discussed within psychology (for example, Garfield & Bennett, 1984; Nideffer 1989; Orlick & Partington, 1988). Specifically, the ability to process certain sources of information, whilst omitting others is vital to successful performance in many sports (Nougier et al., 1991).

The global concept of attention encompasses three key areas. The first is the area of alertness. Alertness refers to the ability to endure long and tedious tasks; it specifically refers to the ability to remain attentive to the task at hand. Selectivity is the second component, encompassing the ability to choose one kind or source of information over another. For example, in the earlier example of receiving the high ball in rugby league, the player has access too many pieces of information. However the greater likelihood of catching the ball will come from attending to the most relevant pieces of information. The final component of attention is the ability of a person to attend to more than one piece of information or stimulus at a time (Posner & Boies, 1971). The notion that people have a limited central processing capacity for information has been considered for some time (for example, Broadbent, 1958; James, 1890).

A commonly argued position is that attention can best be conceptualised along two broad continuums, namely width (ie. broad/narrow), and direction (ie. internal/external) (Nideffer, 1976, Silverman, 1964; Wachtel, 1967). These two continuums (when considered in combination with each other), explain most attentional requirements of participating in sport (Nideffer, 1976). Embedded into this notion is that different situations require different types of attentional processing for optimal performance. In situations of high arousal, Nideffer (1981) proposed that individuals have a dominant attentional style that they will typically defer to. Further, it was suggested as arousal levels increase for individuals, the typical response is to voluntarily narrow the attentional focus and to become more internally focused. Essentially this suggests that a person experiencing high levels of arousal has greater awareness of their own physiological sensations (for example, heart rate, perspiration) and has a greater need to minimise and exclude information. Nideffer and Sharpe (1978) identified that performance demands require a combination of attentional dimensions.

To further explore these concepts, a psychometric instrument was considered necessary to measure cognitive attentional styles and interpersonal characteristics (Nideffer, 1976). Psychological inventories have served a number of functions with both theoretical and practical applications. The role of such inventories is as follows,

> Ideally, psychological tests are designed on the basis of sound theoretical constructs (Rotter, 1973). When this is true, valid instruments can bridge the gap between theory and practice. Under these conditions tests provide the applied researcher with a means of evaluating the underlying psychological theory. These same instruments also provide practitioners with a tool for applying theory to their practice (Nideffer, 1987, p.18).

The confusion surrounding personality research findings largely stem from methodological problems, including inappropriate operationalisation of variables (Morgan, 1980). For example, in sporting research the description of the 'elite' athlete, may in fact be describing a person competing at international level of competition, through to age group champions competing at a state level. Further criticisms suggested that personality measures be selected with considered thought, and should attempt to address issues of both state and trait characteristics within the measure. Further methodological concerns were raised by LeUnes and Nation (2002), including insufficient use of multivariate data analysis and an over-reliance on single data collection points. The authors argued that such design limitations fail to achieve the essence of the experiences of subjects, and instead provide a single one-off view.

Acknowledging criticisms of some personality measures, Nideffer (1976) argued that assessment measures should aim to relate to a specific situation, be clear and unambiguous, and have good utility on the basis of sound theoretical constructs. In developing the Test of Attentional and Interpersonal Style (TAIS), Nideffer (1976) attempted to present a scale designed to predict behaviour on the interactional nature of personal attentional processes, physiological arousal, and interpersonal characteristics.

Explanatory style

Explanatory style is the manner in which an individual typically explains negative events in their life. Potential links between explanatory style and health have been investigated for over 15 years. A connection has been made between negative explanatory style and negative health implications (Bennett & Elliott, 2002). This suggests that those who attribute negative events to stable, internal, and specific causes are more likely to experience poorer health than those who attribute such events to unstable, external, and general causes (Peterson, 1995). Links between explanatory style and immunocompetence have been made indicating that pessimism and lowered immune system functioning are related (Kamen-Siegel, Rodin, Seligman, & Dyer, 1991).

A number of scales have been developed to measure explanatory style (for example, Hanrahan, Grove, & Hattie, 1989; Peterson et al., 1982; Russell, 1982; Scheier & Carver, 1985a). The Expanded Attributional Style Questionnaire (EASQ) (Peterson & Villanova, 1988) has demonstrated good reliability and validity. With such a measure it is possible to consider how injury may influence the internality of thoughts, the perceived stability of such a deficit, and how pervasive such an experience may be viewed.

Explanatory style has been argued as having potential applications to sport injury rehabilitation (Pargman, 1999). Explanatory pessimism and dispositional optimism are argued to have heath related consequences for injured athletes (Grove & Bianco, 1999). Injured athletes with a pessimistic attributional style may be more likely to experience feelings of helplessness and depression, and have behavioural consequences such as failure to comply with rehabilitation programs (Grove & Bianco, 1999). An optimistic outlook and sport injury rehabilitation was found to be negatively correlated with the time taken to recover from Grade II ankle and knee injuries (Ievleva & Orlick, 1991). Further, Bianco, Malo, and Orlick (1999) concluded an optimistic style to have value for elite skiers experiencing long recovery periods from injury. Knowledge of how personality variables relate to the injury experience of athletes will have practical application for sport practitioners, coaches and athletes.

Statement of the problem

Few studies have explored the interrelationship between attributional and attentional style in injured athletes, including rugby league players. The research that has been conducted has addressed attributional or attentional style, yet none has addressed both. Research conducted thus far, suggests that attributional style and attentional style are related to injury experience. How these variables interrelate within the experiences of rugby league footballers is as yet unknown. This study aimed to:

1. Identify the interrelationship between measures of attributional and attentional style, and injury experience in professional rugby league players.
2. Determine which personality variables were discriminated according to level of injury severity in professional rugby league players.

Research hypotheses

For the purposes of this study it was assumed that attributional style and attentional characteristics can be measured through psychometric testing. Further it was assumed that recordings of injury experience could be used to categorise athletes according to injury. It was hypothesised that:

1. Playing position and TAIS subscale scores will be related.
2. Injury severity and TAIS subscale scores will be related.
3. EASQ and TAIS subscale scores will be related.
4. Attentional variables will discriminate between professional rugby league players with differing levels of injury severity. Specifically higher scores on broad external focus (BET), broad internal focus (BIT), narrowed attentional focus (NAR), information processing (INFP), self-esteem (SES), and physical orientation (PO) will be related with lower severity of injury ratings. Lower scores on overloaded external attention (OET), overloaded internal attention (OIT), reduced attentional focus (RED), information processing (INFP), self-esteem (SES), and physical orientation (PO) will be related with higher severity of injury ratings.
5. Explanatory style variables will discriminate between professional rugby league players with differing levels of injury severity. Specifically, higher scores on globality, stability and internality will be related to lower severity of injury ratings.

Significance of the study

The aim of this research was to consider how attentional and attributional characteristics may interact together, and the influence of these factors on the injury experiences of professional rugby league players. Whilst there appears to be general agreement that psychological processes influence a person's behavioural decisions, the understanding of how personality and attributional characteristics are related to athletic injury remains unclear. Longitudinal research in the area of injury of elite rugby league players is limited. Given the number of people playing professional rugby league, the current research is important and may have application for athletes in other similar sports.

Psychological research with rugby league footballers remains largely unexplored. Previous research in other codes of football suggests that player position and personality characteristics are related. This has not been explored in rugby league. A question to be addressed within this research is the influence of playing position on the research variables.

This research provided a prospective longitudinal study, considering attentional and explanatory style, for professional rugby league players who sustained injuries over the course of two playing seasons. A further significance of this research was the utilisation of multiple testing over a longitudinal time frame. Much of the research conducted with elite athletes is limited to cross-sectional design, due to timeframe and funding limitations. This research provided an insight to the experiences of these athletes over an extended period.

Limited use has been made of psychological research utilising discriminant function analysis in rugby league. Therefore, an aim of the study was to use discriminant analysis to evaluate and identify differences amongst rugby league players according to injury experience. It was anticipated that the use of this technique may encourage further use of discriminant function analysis in other research projects.

Despite, the frequency with which the TAIS and EASQ have been utilised within sporting research; To date, no research has considered these two measures in combination. Thus, findings from this research will contribute to furthering psychological knowledge, both in the disciplines of sport psychology and psychometric testing. Further, it is anticipated that there will be opportunity for practical application of the results of this research.

Delimitations of the study

This study was delimited to:

1. Male rugby league players competing in the Australian National Rugby League Competition.
2. The investigation of responses of 53 male professional rugby league players to two psychometric scales, the Test of Attentional and Interpersonal Style (TAIS) completed on two occasions, and the Extended Attributional Style Questionnaire (EASQ) completed on four occasions.
3. Injury information relating to the type and severity of injury. Injury information does not consider the mechanism of injury (ie. how it was sustained) or the place of injury (ie. whether sustained in a game or in training).

Limitations

The conclusions of this study were limited by the following factors:

1. The sample size.
2. Non-random selection of subjects.
3. The validity and reliability of the instrumentation.

4. The recording of injury type and severity.

Definition of terms

1. Attention. Cognitive resources, mental effort, or concentration devoted to a cognitive process.
2. Attentional direction. The degree to which an individual's attention is focused internally or externally
3. Attentional focus. An individual's ability to focus in the most appropriate style and on the correct stimuli.
4. Attentional style. An individual's tendency to attend to environmental cues in a personalised manner.
5. Attributions. Estimates of the causes of our own or someone else's behaviour.
6. Behavioural Control (BCON). Measures the tendency of a person to establish one's own rules rather than strictly adhering to the rules of others.
7. Box's M. Statistical test for the equality of the covariance matrices of the independent variables across the groups of the dependent variable. If the statistical significance is greater than the critical level, then the equality of the covariance matrices is supported.

8. Broad external focus (BET). Measures the tendency to assess the environment, to read, react to and integrate multiple environmental cues at once
9. Broad internal focus (BIT). Measures the ability to analyse, plan, anticipate and to deal with multiple internal cues.
10. Centroid. Mean value for the discriminant Z scores of all objects within a particular category or group.
11. Classification function. Method of classification in which a linear function is defined for each group.
12. Classification matrix. Matrix assessing the predictive ability of the discriminant functions(s) or logistic regression.
13. Control (CON). Measures the need of an individual to be in control in interpersonal situations and with actually being in control.
14. Discriminant function. A variate of the independent variables selected for their discriminatory power used in the prediction of group membership.
15. Discriminant loadings. Measurement of the sample linear correlation between each independent variable and the discriminant Z score for each discriminant function.
16. Discriminant weight. Weight whose size is determined by the variance structure of the original variables across the groups of the dependent variable.

17. Discriminant Z score. The predicted value of the discriminant function.
18. Information processing (INFP). Measures a person's desire for and enjoyment of a diversity of activity.
19. Injury. A physical condition that requires an athlete to miss at least one day of competition.
20. Intellectual expression (IEX). Measures the willingness of a person to express thoughts and ideas in front of others.
21. Narrow focus (NAR). Measures the ability to narrow attention when required and to avoid distraction.
22. Negative affective expression (NAE). Measures a willingness to confront issues, to set limits on others, and to express anger.
23. Obsessiveness (OBS). Measures the speed of decision making, worry, and anxiety.
24. Overloaded by external stimuli (OET). Measures the tendency to become distracted and overloaded by too many environmental cues.
25. Overloaded by internal stimuli (OIT). Measures the tendency to make mistakes because of an overly analytical focus or thinking about too many things at once.
26. Personality. Those characteristics of the person or of people generally that account for consistent patterns of behaviour.

27. Positive affective expression (PAE). Measures the tendency to express support and encouragement to others.
28. Reduced attentional focus (RED). Measures the tendency to make mistakes because of a failure to attend to all task relevant cues, a failure to shift from an external focus to an internal one, and vice versa.
29. Self-esteem (SES). Measures an individual's feelings of self-worth and self-confidence.
30. Variate. Linear combination that represents the weighted sum of two or more independent variables that comprise the discriminant function.
31. Vector. Representation of the direction and magnitude of a variable's role as portrayed in a graphical interpretation of discriminant analysis results.

Summary

Over the previous three decades, the role of psychological variables and their relationship with athletic injury has rarely been considered. Personality and attributional style characteristics of athletes have also been investigated, although very few studies have examined the interrelationship between injury, personality characteristics, and attributional style.

Rugby league is a high impact, contact sport requiring the physical capacities of agility, strength, power and stamina. Injury is a common experience in this sport however; the role of psychological variables on injury in rugby league is limited. Knowledge of the role of attention and explanatory style within the injury experience has remained relatively unexplored.

Attention is an important variable in understanding the sporting experience. The ability of an individual to control information inputs, their surroundings, and other interpersonal skills such as self-esteem, obsessiveness and expression of positive and negative affect is likely to relate to their injury experience.

Explanatory style has been demonstrated to impact upon a person's physical health. Previous research indicates that an individual's perception of the world is likely to impact upon their experiences within it. It therefore, holds that such style is likely to influence an athlete's experiences during injury.

The aim of this thesis was to document a research study undertaken on 53 professional rugby league footballers. The psychological variables of interest include explanatory style (both positive and negative), and attentional variables (including broad, narrow, and internal attention, control variables including information processing, and interpersonal variables including self-esteem, obsessiveness, intellectual expression, positive and negative expression of affect, introversion and extroversion, and personal control). Injury variables were recorded indicating the severity of the injury and the duration of the rehabilitation process. Discriminant function analysis was used to determine the role of these psychological variables in athletic injury.

Chapter two

Literature review

Introduction

The sport of rugby league has a history dating back some 200 years. In the 1800's, refinements were made to the football rules in the public schools of England. Eventually this game became known as 'association football' (or soccer). Whilst schools such as Eton, Harrow, and Winchester were largely playing the same game, the school of Rugby developed a markedly different game. By the 1830's, handling the ball was permitted and the goal posts were extended to six metres in height. Popular opinion states that the sport of rugby developed at the school of the same name, when student William Webb Ellis, frustrated with the game of football picked up the ball with his hands and elected to run. This defining moment in sporting history is considered by many to be nothing more than a myth. The documentation of Ellis's apparent run did not appear until 1875, four years after Ellis's death and at a time with no living individual to corroborate the story (Fagan, 2000a).

The Rugby Football Union (RFU) was formed in 1871. This body represented 21 clubs, primarily located in southern England and London. Within 20 years, the majority of northern clubs were comprised of men from a working class background. Many of these players were employed in the coal mines and financial remuneration was based upon time spent working. Thus restrictions including work hours until 1pm on Saturdays effected the availability of blue collar workers to play. Clubs would often financially compensate workers to allow them to play, an action viewed unacceptable by the RFU.

Further suggestions that the game make changes to increase it's appeal to spectators brought tensions to boiling point. In the early 1890's, the RFU introduced the term 'Amateurism' to ensure rugby remained within the control of the middle-class. In response to this conflict, the Northern Union was formed in August 1895. The inaugural competition was titled the Northern Rugby Football League (NRL). The split between the two games ensured that rugby union would be considered an 'amateur' sport to be played by the middle-class. Gradually changes were made to rugby league; including reducing teams to 13 a side, removing line-outs, and the introduction of the play-the-ball (Fagan, 2000b).

The modern game of rugby league is a high contact sport, where professional athletes can achieve high financial remuneration and great personal success. With this success comes increased pressure on athletes to perform, with possibility of injury resulting in disappointing consequences.

Psychological research within the sport of rugby league is minimal. Few studies incorporating psychological variables in a sporting context have been published (Anshel, 2001; Crowe & O'Connor, 2001; Golby et al., 2003; Hanton et al., 2000; Hinton-Bayre & Geffen, 2002; Hinton-Bayre et al, 1997; Hinton-Bayre et al., 1999; Lawson & Evans, 1992). The aim of this dissertation was to investigate the relationship between personality and attributional characteristics of injured elite rugby league players. This chapter provides an overview and critical analysis of the research on personality and attributional style within a sporting context. In particular, this chapter focuses on the research utilising the TAIS (Nideffer, 1976), and the EASQ (Peterson & Villanova, 1988). The chapter also considers the role of psychological research in better understanding the experience of an injured athlete.

Attention and sporting performance

Attention research is important for assisting athletic performance (Wann, 1997). The two key areas of focus have been the relationship between attention and performance, and the attentional characteristics of athletes. Sporting performance and attention is positively correlated (Thomas & Over, 1994). Human capacity to process information is limited. Thus, tasks which involve multiple components require a division of attention, and a decrease in the quality of performance (Easterbrook, 1959; Eysenck, 1984). Athletes who are better able to attend to multiple requirements are more likely to experience successful athletic performance (Cox, 2002).

Sporting success is reliant upon the athlete's ability to selectively attend to the most relevant stimuli (for example kicking a goal versus observing the crowd). The term used to describe an athlete's ability to appropriately attend during competition is attentional focus (Cox, 2002). This term encompasses an athlete's ability to broaden and narrow their attention as necessary. Attentional narrowing can be explained through the process of cue utilisation (Easterbrook, 1959). In any sporting event a number of physical and environmental cues are available to the athlete. Some cues will be relevant to performance (for example, team mates setting up for a particular play), whilst others will be irrelevant to performance (for example, a fight breaking out in the crowd). An athlete may pick up on both relevant and irrelevant cues in situations of low arousal; thus resulting in poor performance. As arousal levels increase, the athlete's attention begins to narrow. Narrowing will continue until irrelevant cues are screened out and performance should be optimal. Should an athlete's arousal levels continue to increase, relevant cues may be screened out, thus resulting in a decline in performance. When an athlete performs in an overaroused state, they are likely to be easily distracted, shifting their attention randomly across stimuli (both relevant and irrelevant) (Easterbrook, 1959).

Cue utilisation was tested with karate athletes with conditions of low arousal resulting in poorer performance than when under high arousal (Williams & Elliott, 1999). The authors concluded that changes in search strategies may be due to peripheral narrowing or greater susceptibility to peripheral distracters.

Performance demands require a combination of attentional dimensions. (Nideffer & Sharpe, 1978). For example, a broad-internal focus is needed when analysing and planning play in rugby league, compared with the narrow-external focus required when converting a goal.

Figure 1 provides an example of the four components of the continuum in the example of a rugby league player converting a goal.

External

	Quadrant I *Assess*	Quadrant IV *Perform*	
Broad			Narrow
	Quadrant II *Analyse*	Quadrant III *Rehearse*	

Internal

Figure 1. Theoretical explanation of attentional style during a goal conversion.

Explanatory notes:

Quadrant I: a Broad External Focus. The player becomes aware of the environmental conditions including wind, angle and distance to the goal posts.

Quadrant II: a Broad Internal Focus. The player moves their cognitions to the type of kick required, perhaps reflecting on previous experience in similar circumstances.

Quadrant III: a Narrow Internal Focus. The player moves their cognitions to the task at hand, visualising the kick.

Quadrant IV: a Narrow External Focus. The player engages in the task of kicking the ball, keeping their focus on external elements, yet narrow to the relevant cues (Krug, 1999).

Attentional style is a trait-like characteristic and over time, a dominant attentional pattern develops. This style is likely to be deferred to in times of pressure or overarousal (Nideffer & Pratt, 1981). Dependent upon the needs of a situation, this attentional style may or may not be appropriate. Individual or team sports might require a particular configuration of attentional style to optimise performance in a particular situation (Nideffer, 1978). Comparisons of athletes competing in closed versus open skill sports show differences in attentional style. For example, within archery, a narrowed attention to the target is warranted. In comparison, a broad attention is required when viewing the opposition in a game of rugby league.

The theory argues that within an open sport, play becomes more variable, thus an athlete will generally require a broad external focus. Therefore, a fullback in rugby league kicking a high ball may require broad vision, processing the elements of play and positioning of team mates and opposition players. This would contrast with a player in a defensive position in the process of making a tackle, who needs to keep their consciousness narrow, ensuring their concentration remains on the task at hand (Bond & Sargent, 1995; Van Schoyck & Grasha, 1981).

Requirements for attention vary within and across sports (Nideffer, 1978). Further, it has been argued,

> As a general rule, as situations become more complex and change rapidly, a participant will need an externally focused attentional style. Thus, a linebacker in football might need a broad external focus, whereas a tennis player or base ball batter might need a narrow focus to perform well. Conversely, as the demand for analysis or planning increases, the need for an internal or reflective attentional style becomes apparent. Thus, a weight lifter or shot putter would need a relatively narrow internal focus, whereas a quarterback in football determining what play to call might need a broad internal focus (Van Schoyck & Grasha, 1981, p. 274).

Thus it would be expected that in an open sport such as rugby league, a player such as a fullback might need to complete a range of tasks. Within a short period of play, the fullback may be required to catch a high ball, run the ball up the field negotiating through the efforts of opposing players to tackle, and set up a pass for team mates using a variety of broad and narrow, internal and external attentional skills.

An understanding of the interrelatedness between arousal levels and attentional style is crucial to successful performance (Nideffer, 1981). When an individual's arousal levels match an appropriately required focus of attention then success could be achieved. However, when the arousal level is inappropriately matched to the attentional focus, over or underarousal will negatively impact on performance. It could be considered that the athlete who holds an appropriate level of arousal for a given situation is quickly able to shift their attentional focus as the needs of a performance situation changes. Anxiety and performance are negatively related. Increased anxiety reduces the available cues an individual has available, thus reducing the effectiveness of their ability to attend to the current situation (Easterbrook, 1959).

Attention may be measured through behavioural assessment, physiological indicators, and self-report (Landers & Richards, 1980). Unlike the behavioural and physiological measures which tend to view attention at a single point in time, self-report scales tend to view attention as a stable personality characteristic.

Attentional style is an important determinant of sport performance. Knowledge of an athlete's attentional abilities and the environmental demands of the sport would provide useful information for coaches, athletes and sport psychologists. Psychological screening could be utilised in player selection. Additionally, attentional weaknesses could be addressed through specific training and screening (Zaichkowsky, 1984).

Key research in the conceptualisation and measurement of attention through self-report measures was conducted by Nideffer (1976; 1977a; 1977b; 1978; 1985; 1987; 1989; 1990; 1992). An outcome of the research by Nideffer (1976) was the development of the Test of Attentional and Interpersonal Style (TAIS). The scale serves as a measurement tool for attentional style, control and interpersonal factors.

The Test of Attentional and Interpersonal Style

The Test of Attentional and Interpersonal Style (TAIS) is a psychometric instrument that measures variables of attentional style, control and interpersonal factors (Nideffer, 1976). The TAIS was formulated by Nideffer (1974) on the basis of theories presented by Shakow (1962), and Cromwell (1968). Within the TAIS, 17 variables reflect 6 attentional processes, 2 behavioural and cognitive control measures, and 9 variables of interpersonal style. The initial questionnaire was developed based on a sample of 302 undergraduate students. Questionnaire construction resulted in 144 items being included in the scale. Median test-retest reliability for the scale was 0.83. Subscales were found to be internally consistent (Nideffer, 1974).

The attentional subscales were designed to measure an individual's capacity to respond to a rapidly changing external environment (BET), to plan and think analytically (BIT), and to narrow ones focus and remain attentive to the task at hand (NAR). The other three attentional subscales attest to an individual's tendency to become overloaded by internal stimuli (OIT), overloaded by a focus on the external environment (OET) and indicate difficulties from shifting one's attention from a narrow focus to a broad one (RED), (Nideffer & Sharpe, 1978).

The control subscales were constructed to gain an understanding of an individual's cognitive activity and processing (INFP) and tendency to be impulsive (BCON). The interpersonal subscales provide information on one's need to be in control (CON), self-image (SES), and level of participation in physical activity (PO). Additionally they will describe the tendency an individual has to worry (OBS), be outgoing (EXT) or enjoy personal space (INT), express thoughts and ideas to others (IEX), and express negative (NAE) or positive (PAE) emotions.

The TAIS has had wide-spread use in research and applied settings (Bond & Sargent, 1995; Nideffer, 1990; Owen & Lanning, 1982; Summers & Maddocks, 1986; Vallerand, 1983). The TAIS has been extensively used at the Australian Institute of Sport (AIS) since the early 1980's as a diagnostic tool to determine an individual's attentional style (Bond & Sargent, 1995). Interventions are then implemented to assist the athlete in improving their sporting performance.

Reliability and validity of the TAIS

Test-retest reliability of the TAIS has been measured within several studies (Nideffer, 1977b; Van Schoyck & Grasha, 1981; Summers & Ford, 1995). Test-retest correlations have ranged from 0.60 on the OBS scale to 0.93 on the PO scale with a median correlation of 0.83.

A useful indicator of the construct validity of a psychometric scale are predictable group differences on test scores. Using Discriminant function analysis, Nideffer (1978) concluded that the TAIS could discriminate between heterogeneous groups (for example, business executives, music students, psychiatric patients, hospitalised patients, psychology students and applicants for police training. Psychiatric patients were more overloaded by internal (OIT) and external (OET) stimuli, the students and business executives tended to be intellectually expressive (IEX), and had an analytical attentional focus (BIT). Police applicants were more physically oriented (PO) than the other groups.

Further analysis on the music students was able to discriminate according to the instrument played. Brass players and voice majors were more in control of interpersonal situations (CON) and more extroverted (EXT). Violin players reported the ability to both narrow attention (NAR) and ignore relevant information thus narrowing too much (RED) and making errors. This analysis demonstrated the ability of the TAIS to discriminate between differing groups (Nideffer, 1978).

The ability of the TAIS to discriminate between good, average and poor decision makers in basketball was tested (Vallerand, 1983). The results of the analysis indicated only two scales (OET and OIT) were included in the significant equation. The research hypotheses were not supported and the author’s conclusion was that the results were ambiguous. This research can be criticised for administration of a translated version of the TAIS to French speaking participants. It was reported that, "… it's structure was quite similar" (p. 457) to the English version. This is despite 38% of the items indicating non-significant interscale correlations. Further, the conceptualisation of decision making within the research design was subjective, being based upon identification by three 'experts'. Players were categorised into the dependent variable in relation to their scores with other players, thus making the categories data-driven rather than distinguished according to ability. Thus it may be that participants were placed in categories due to the nature of the sample, rather than real differences. This research questions the usefulness of the TAIS as a sport performance predictor and suggests a need for further research (Vallerand, 1983).

The main criticisms of the TAIS are of its factor structure and validity as a general measure. These criticisms were largely brought about following attempts to develop sport-specific versions of the TAIS (ie. in tennis (Van Schoyck & Grasha, 1981), baseball and softball batting (Albrecht & Feltz, 1987) and basketball (Vallerand, 1983)). In developing the scales, factor analysis was used to determine the independence of the attentional subscales. The analyses revealed dependence between the scales (Van Schoyck & Grasha, 1981).

A criticism of the six attentional subscales is that rather than measure width and direction, they measure ‘scanning’ and ‘focusing’ (Bergandi, Schyock, & Titus, 1990; Dewey, Brawley, & Allard, 1989; Landers, 1982; Van Schoyck & Grasha, 1981). ‘Scanning’ was the label for the factor which included respondents who score high on a broad external (EXT) and broad internal (BIT) focus of attention, and high on information processing (INFP). Respondents also scored low on the scale measuring the tendency to make errors of underinclusion (RED). The ‘focus’ factor included respondents who were able to narrow their attention (NAR), and resist the tendency to become distracted by internal (OIT) and external (OET) stimuli (Van Schoyck & Grasha, 1981).

The suggestion of scanning and focusing instead of width and direction to understand attention has been criticised (Nideffer, 1990). Nideffer (1990) questioned the methodology of the authors (ie. Dewey et al., 1989; Vallerand, 1983; Van Schoyck & Grasha, 1981) who advocated scanning and focusing, and the utility of reducing the 7 subscales to 2. In critiquing their methodologies, Nideffer (1990) argued that Vallerand (1983), Van Schoyck and Grasha (1981), and Dewey et al. (1989) misunderstood the theory behind the TAIS, and conducted factor analysis on only 7 of the 17 subscales. Particular concern was raised regarding the small sample size (N=40) used by Dewey et al. (1989) in their factor analysis of the 7 subscales. For such an analysis, a sample of 300 would be more appropriate to allow correlations to be reliably estimated (Comrey, 1973).

The degree of dependence between the subscales on the TAIS (ie. not orthogonally rotated) does not preclude the existence of the variables (Nideffer, 1990). Further, the purpose of reducing the number of subscales should be considered. To reduce the 6 attentional subscales and INFP to two global measures would greatly impact upon the utility of the TAIS as an applied measure. A smaller number of subscales (and questionnaire items) may suit the researcher aiming for brevity from testing measures. However, practitioners seeking to develop a programme to specifically target the strengths and limitations of an individual athlete are more likely to appreciate greater detail. Statistically, it may be preferred for variables to stand alone, however Nideffer (1990) argued that the reality of human experience is that such variables are usually related. Specifically Nideffer stated,

> Far from being upset by the fact that various attentional and/or interpersonal characteristics are intercorrelated, we should take comfort from the fact that correlations exist, because these increase our predictive abilities (for example, we are likely to be correct if we assume a tall person is heavier than a short person, just as we are

> going to be correct if we assume a person who can effectively attend to external information (BET) will be more likely to effectively attend to internal information (BIT). (1990, p. 292).

The TAIS was further criticised following an attempt to establish construct validity with the Digit Span and Block Design subtests of the Weschler Adult Intelligence Scale (WAIS) (Turner & Gilliland, 1977). The authors hypothesised significant positive correlations between the WAIS subscales and the external (EXT), internal (INT), and narrowing (NAR) scales of the TAIS. Significant negative correlations were predicted between the WAIS and the overloaded (OET, OIT) and reduced (RED) attention subscales. Correlational analysis of the WAIS and TAIS subscales resulted in 1 of 24 subscales being statistically significant. The authors concluded that performance on the WAIS was not significantly related to the TAIS. Further, they suggested a need for validation of the TAIS against a behavioural measure before implementing the scale in any form of personality assessment.

In response to the criticisms argued by Turner and Gilliland (1977), Nideffer (1977b) made two arguments. First the underlying assumption that the Weschler subtests provide an appropriate behavioural measure of attentional functioning was questioned. Nideffer further argued that the relationship hypothesised by Turner and Gilliland (1977) are only appropriate for a population with less than average IQ. This is due to the low correlation between the Weschler subtest of digit span and IQ. When Nideffer (1977b) re-analysed data utilised in the original construction of the scale, results confirmed the hypothesis proposed by Turner and Gilliland (1977). Nideffer (1977b) suggested that rather than the construct validity of the TAIS being questionable; that the re-analysis of the data strengthened the construct validity of the scale.

TAIS score comparisons were made by DePalma and Nideffer (1977) between 108 psychiatric and nonpsychiatric patients. Discriminant Function Analysis indicated that psychiatric participants were more overloaded by internal and external stimuli and less effective in narrowing their attentional focus for task related participants than control participants. Further, participants with psychoses or neuroticism were more introverted and less pleasant in social settings. These findings were consistent with previous experimental research indicating differences between psychiatric subgroups on attentional and interpersonal variables and provided further support for the construct validity of the TAIS. The TAIS has been utilised within a variety of populations. Of particular interest to the current study is it’s application in sport settings.

Sport Specific TAIS Scales

It has been proposed that sport-specific TAIS scales provide a situation-specific frame of reference within a particular sport (Albrecht & Feltz, 1987). The scales for the sports of tennis (T-TAIS) (Van Schoyck & Grasha, 1981), baseball and softball batting (B-TAIS) (Albrecht & Feltz, 1987), and basketball (BB-TAIS) (Summers, Miller, & Ford, 1991) are also suggested as a more meaningful test for athletes of those sports. These scales are all shorter than the original TAIS.

The TAIS has received criticism for its inability to distinguish athletes from non-athletes (Van Schyock & Grasha, 1981). In designing a TAIS scale, specific to the needs of tennis (T-TAIS), Van Schyock and Grasha (1981) compared responses according to the skill level of the tennis players in their sample. The results did not clearly indicate a difference in T-TAIS scores for players of different levels of ability. Some differences were identified for BIT, BET and INFP scores; however significant differences were not reported.

Given individual variability between athletes, it should not be surprising that athletes and non-athletes do not differ on TAIS responses. Different attentional skills were noted by athletes holding different court positions in volleyball (Ahrabi-Fard & Huddleston, 1991). Therefore, to combine the profiles of these athletes may account for any similarity with a control sample. These conclusions were made on the basis of a single study, utilising a small (n=90) non-random sample. It would appear that more research with a larger sample size is warranted before making such generalised conclusions.

A sport specific version of the TAIS for use with baseball and softball batters (B-TAIS) was developed by Albrecht & Feltz (1987). The authors found higher test-retest reliability for the B-TAIS than the TAIS and a positive relationship between attentional subscales and batting performance. Their research also revealed r^2=0.25 between the two scales, suggesting strong convergent validity. It was further argued that the B-TAIS provides additional information not apparent from the TAIS, however the authors acknowledged that devising and developing norms for instruments for each sport would be an unrealistic task.

It was suggested that administration of the TAIS should be prefaced with, “When I am participating in my sport…”as this would allow athletes to place it in context for themselves (Albrecht & Feltz, 1987). It should be noted that a change to the instructions of the scale have not been tested for effects on validity. Consistent with this suggestion, Van Schoyck and

Grasha (1981) criticised the TAIS for what the authors saw to be its inability to relate to a particular element of an individual's life, specifically their sport. However, in making this criticism, Van Schoyck & Grasha (1981) failed to acknowledge the instructions given to their respondents when administering the scale. The TAIS scale instructions state,

> Where possible relate the questions to your own performance situation and use your peers as a frame of reference such that the 'average' person at your level would answer 'sometimes' for most of the questions (Nideffer, 1977a, p. 6)

The use of a sport specific questionnaire may have utility in an sport such as golf, where a participant requires a taxonomy of motor skills that require body stability and stationary regulatory conditions (Gentile, 2000). However, in a team sport such as rugby league, players hold particular positions with specific roles. For example, in rugby league the requirements of a prop forward are different to those of a hooker. Sport-specific versions of the TAIS would not allow for comparisons across sports, and therefore, limit generalisations of findings (Vallerand, 1983). Instead of designing a scale for each position within a sport, it may be more appropriate to ensure that athletes answer the TAIS, with their sporting position in mind. This was the intention of the original instructions of the manual, and following these is less likely to result in ambiguity (Nideffer, 1977b).

To complete the TAIS whilst considering a particular frame of reference was criticised as decreasing the face validity of the scale (Albrecht & Feltz, 1987; Ford & Summers, 1992). However, it would not be possible for an individual to complete the items in the scale without having to apply some frame of reference. Uncontrolled response sets would be a key factor in reducing the correlation between predictor variables and the dependent measure (Nideffer, 1987). For some items which are of a general nature (for example, 'All I need is a little information, and I can come up with a large number of ideas') responses may be dependent upon the context (for example, social, occupational, sport). It is therefore, more valid to have all respondents considering their answers within the same context (for example, sport) than to utilise a number of different environments throughout the questionnaire. It would appear that by considering the questions in relation to the respondents' sport, they are more likely to answer with consistently stable responses than if they were undirected and so utilised a number of different reference points (for example, sporting, work and personal) in answering the scale.

The focus of the current research is on the sport of rugby league. A version of the TAIS specifically adapted for rugby league has not been developed. Given that the scale instructions advise respondents to answer the questions in relation to their specific context, the need for a sport specific version is not considered necessary.

Research utilising the TAIS in sporting contexts

The TAIS results of 1798 elite Australian athletes were correlated with variables including age and gender to consider any difference according to sport classification (Bond & Nideffer, 1992). The results revealed differences amongst athletes on TAIS subscales, according to age (15 of the 17 subscales), gender (14 of the 17 subscales), and interaction effects of these variables on the self-esteem and expression of anger subscales. It would appear that within a team of athletes, attentional variability might be expected. For example, in the game of rugby league, the team is broadly differentiated according to the positions of forwards and backs. The physical and tactical requirements of these positions differ thus making it likely for attentional requirements to vary.

Athletes participating in open team sports typically scored higher on extroversion (EXT) and broad-external focus of attention (BET). Athletes in team and individual sports did not highlight major differences on the interpersonal scales (Bond & Nideffer, 1992). Whilst the study did not specifically investigate the nature versus nurture debate, the question of psychological best fit and utility of the scale in talent identification was raised. The authors suggested that biological or environmental factors might be useful in explaining gender differences in scores. Given this conclusion, other variables may be related to interpersonal differences, such as the explanatory style of the athlete. Explanatory style has not previously been considered in relation to the TAIS.

An attentional style training program was designed for division one soccer players by Ziegler (1994). The author designed activities to address attentional weaknesses following consideration of the attentional subscales of four players. Following the intervention, players were tested on accuracy of executing a soccer drill. Utilising a multiple baseline design, Ziegler (1994) found improved accuracy when players worked on their attentional deficiencies.

Volleyball players rated as either good or poor concentrators were assessed according to their attentional scores (Wilson, Ainsworth, & Bird, 1985). TAIS scores and EEG frequency during a stressful activity (competing in a video game) were considered. The results differed for the attentional styles of the poor and good concentrators. Those athletes rated to be better concentrators had a narrower focus for both internal and external events.

The attentional style of varsity level basketball players was correlated with shooting percentages for field goals and free throws over 31 games (Wilson & Kerr, 1991). A significant relationship ($p<0.05$) was found between the ability to narrow attention (NAR) and a higher percentage of field goals. The authors concluded that players who are better able to narrow their attention, and thus result in greater accuracy do so because they are better able to screen out irrelevant external stimuli.

A study conducted with gymnasts, track and field athletes, and swimmers, showed that attentional style facilitates performance (Zaichkowsky, Jackson, & Aronson, 1982). With variance explained by the TAIS ranging between 0.4-0.6 for performance, it was concluded that the TAIS is useful as a descriptive tool of athletes. The authors maintained that for talent identification, other variables including anthropometry and other physical and psychological variables should be considered in conjunction with psychometric measures.

The effects of relaxation training, attentional training and a combination of relaxation and attentional training on high school male athletes were considered by Owen & Lanning (1982). The participants met criteria of high state anxiety and were exposed to either one of the three treatment conditions or a control group. The results demonstrated that all three interventions reduced anxiety; however an improvement in attentional focus was not evident. Owen and Lanning (1982) suggested that this may be due to the trait-like characteristics of attentional style and therefore, a more lengthy intervention is likely to be necessary to result in subsequent change.

The possibility of attentional style being associated with athletic injury was compared across 17 sports by Bergandi & Witting (1988). The research hypothesised that an athlete's ability to narrow or broaden their attention to specific perceptual cues might increase or decrease an athlete's risk of incurring injury. Multiple regression analyses were performed to determine if attentional effectiveness, overload, and anxiety would predict injury experience. The interpretation of the study was limited by low statistical power and a limited amount of injury for some sports. Despite this, the authors concluded that the TAIS may be useful to predict incidence of injury. Further, the authors identify a possible sport-specific relationship with injury that should be explored further.

The TAIS was administered to nine university golf team members to explore its relationship with golfing performance (Kirschenbaum & Bale, 1980). Negative correlations were reported between golf score and OET, RED, and OBS subscales. A significant positive correlation was found between golf score and BIT. This finding suggested that a lower golf score (the desirable outcome) is associated with players who are sensitive to overarousal from external stimuli and narrowed attention, are more likely to ruminate or worry and are likely to view themselves to be analytical and philosophical. This would suggest that the need for a golfer to be sensitive to their surroundings and to be focused on internal cues is adaptive to playing better golf (Kirschenbaum & Bale, 1980). The study included a small sample size, thus caution should be exercised in interpreting the results. Kirschenbaum & Bale (1980) do not provide detail of the golfing skills of the participants. Whilst being members of the university team, without knowledge of their golfing ability, these scores may be reflective of less competent players. This criticism further reduces the generalisability of the results.

Research with power lifters by McGowan, Talton, and Tobacyk (1990) tested the hypothesis that success in powerlifting would be related to higher scores on narrowing (NAR) and internalising (BIT) attention. A short form version of the TAIS was completed by participants. Consisting of 12 items, the authors present no validity or reliability statistics to justify its use. Rather they present a quote from Nideffer and Pratt (1985) which states, "… this form is pretty good at identifying … tendencies" (p. 24).

Participants were labelled according to those who had placed from first through to fourth place (rated 'successful') from those who had placed lower (rated 'unsuccessful'). The rationale for this distinction was not presented, despite resulting in uneven groups, where 60 participants were classed as 'successful' and 29 participants were classed as 'unsuccessful'. Placings are dependent upon the standard of the competition. Therefore, 'placing' may not be the most appropriate way to distinguish the ability of the participants. An alternative approach may have been to ask participants or their coaches to rate success with respect to the best lift achieved by that athlete.

McGowan et al. (1990) questioned the theoretical foundation of the TAIS, suggesting the 'scan' and 'focus' dimensions should be considered rather than width and direction. The decision to compare successful and unsuccessful athletes according to placing rather than in relation to personal best is problematic. The discussion of limitations of the research provided by the authors was insufficient. It is for this reason that caution should be exercised in accepting their conclusions.

Age, playing position, and playing standard in relation to TAIS scores was investigated for rugby union players (Maynard & Howe, 1989). The results indicated that TAIS scores did not differentiate according to the playing standard of the participants. This may be due to an inability of the instrument to differentiate, or to the methodological design of the study. Participants were compared according to whether they had played representative rugby union or not. Reasons as to why a participant may not have represented were not considered. This does not accommodate players who had the ability but were not available for representation for reasons such as work, financial or family commitments.

Maynard and Howe (1989) failed to describe the manner in which the test was administered. If the participants were asked to answer the TAIS in relation to how they compared to the *average* athlete, then it may be the case that the representative and non-representative participants used different response sets, thus only allowing discrimination within, rather than between the groups.

Further, results demonstrated an effect for age and the narrowing (NAR) subscale. Specifically, the older athletes were better able to report narrowing of attention. It is unknown whether this finding is more accurately a reflection of the respondents age, or experience within the game. Years of experience playing rugby union were not reported.

Differences according to playing position were found. Specifically, the halfbacks scored significantly higher on the broad external (BET) and reducing (RED) subscales. This finding suggested that these players were better able to integrate external environmental stimuli, without becoming overloaded by task relevant information. Given the key role of a half back in rugby union is decision making, this finding is consistent with what would be expected. This finding suggested the importance of playing position as a variable when utilising the TAIS in sporting research.

Summary of the TAIS

Attentional style is conceptualised as a trait-like characteristic which athletes will typically defer to in instances of high arousal or stress. The TAIS is a frequently used measurement tool of attentional style. Since its first publication the TAIS has been tested within a number of research settings, across different sports and has compared athletes at different levels of ability.

Despite some criticisms of the TAIS, many studies have demonstrated a relationship with levels of performance across team and individual sports. Team sports have included baseball, softball batting (Albrecht & Feltz, 1987) and cricket (Summers & Maddocks, 1986). Individual sports have included swimming (Nideffer, 1976a), shooting (Landers, Furst, & Daniels, 1981), golf (Kirschenbaum & Bale, 1984), and diving (Nideffer, 1987). Sufficient research exists to support further use of the TAIS.

It has also been suggested that the TAIS is worthy of consideration in research into the causes of athletic injury (Bergandi & Witting, 1988; Sachs, Sitler, & Schwille, 1999). Athletic injury may physically result from either contact with another player or equipment, intrinsic causes such as a sprain or tear, or from chronic overuse injuries (van Mechelen, 1997b). Therefore, variability in attentional style (for example, narrowing or broadening attention) may be related to athletic injury. Injury may be more likely to occur for athletes with an individual profile which scores higher on OET, OIT, and RED; and lower on BET, BIT, and NAR.

Attributions and explanatory style

In making sense of the surrounding world, individuals make attributions to understand and explain cause and effect relationships (Heider, 1958; Kelley & Michela, 1980). Within sporting contexts, attributions fulfill a need to understand the reasons for an outcome. Information can then be placed in context with personal experience, allowing for evaluation of the outcome (Brawley, 1984). It is important to gain an understanding of the function of attributions in sporting environments (Grove & Heard, 1997; Hanrahan, Grove, & Hattie, 1989; Martin-Krumm, Sarrazin, Peterson, & Famose, 2003).

Typically attributions are considered to be stable or unstable, and internal or external. Within the stable-unstable continuum, an attribution refers to whether the cause is short or long term (for example, luck which may be short term versus ability which is long term). For the internal-external continuum, an attribution refers to whether the cause is due to the individual or others and/or external circumstances (for example, ability which is internal versus task difficulty which is external). Additional dimensions considered in understanding attributions are globabilty and intentionality (Weiner, 1985). Global attributions are those which refer to whether the outcome has specific or far-reaching consequences. Intentionality refers to whether the action was planned or unplanned.

Other dimensions have been suggested to contribute towards explanatory style. Such dimensions include desirability, predictability, controllability, recurrence, success, and difficulty. In research with college students, Peterson (1991) considered all of the aforementioned dimensions in addition to internality, globality, and stability. Factor analysis resulted in a two factor solution labelled ‘Predict and control’ and ‘Big deal’. These two factors referred to the degree of predictability and controllability in relation to the event and the magnitude of the event and its consequences. Peterson (1991) concluded that in utilising particular dimensions, others may also be included. This was based upon the argument that when attributing the cause of a particular event, a person may also think about its potential consequences. Internality was found to correlate with ‘Predict and control’ and not ‘Big deal’, and stability and globality were found to correlated with ‘Big deal’ and not with ‘Predict and control’. Explanatory style may include other dimensions; however care should be taken in selecting the dimensions relevant to the phenomena under exploration (Peterson, 1991a).

In a reconsideration of the initial theory, Abramson, Seligman, and Teasdale (1978) utilised attribution theory to explain the relationship between learned helplessness and lowered self-esteem. Essentially they argued that how an attribution is made (ie. along the dimensions of stability, locus and globality) directly affects an individual's self-esteem. Specifically, an individual who attributes a negative situation or outcome to internal, controllable, and global dimensions (ie. "It's my fault, it happens all the time, and it has far-reaching implications") is likely to impact negatively upon that individual. Stable attributions will affect the stability of deficits, global attributions will affect the globality of deficits, and internal attributions will affect the degree of self-esteem loss (Peterson, 1991a).

Early criticism of the learned helplessness model, argued the relationships between attributions and subsequent consequences as inadequately explained by linear models (Munton, 1985-86). In contrast, numerous studies emphasised the need to consider attributions within their relative context (Jones et al., 1972; Kelley & Michela, 1980; Storms & McCaul, 1976). To this end, Munton (1985-86) suggested that attributions are better considered within a naturalistic rather than experimental environment.

Explanatory style is a "… cognitive personality variable that reflects how people typically explain the causes of bad events involving themselves" (Peterson, 1991a, p. 1) and is a narrower construct than attributional style. Peterson (1991b) argued that explanatory style is trait-like and further adds, "I would not be uncomfortable with an even stronger description of the construct. I believe that traits are returning to a respectable place within personality psychology" (p. 54). Critical of the change, Abramson, Dykman, & Needles (1991) argued that Peterson (1991) failed to provide a rationale for what they consider to be an unnecessary change. In reply, Peterson (1991b) suggested that until future research provides evidence to expand the meaning, the narrower term of explanatory style remains appropriate.

A tendency for expectations of success is described as dispositional optimism (Carver & Scheier, 1981; Scheier & Carver, 1985a; 1985b; 1987; 1988; 1993). Individuals with this tendency typically demonstrate behaviours such as active coping, seeking of social support, positive reinterpretation, and acceptance. Additionally, optimism has been negatively associated with denial, distancing and goal disengagement. Human behaviour is considered by Carver and Scheier (1981) to be driven to maintain and achieve particular goals. Therefore, the authors viewed human behaviour as being self-regulatory, and that optimism featured when anticipating success of a goal, despite any difficulties or challenges.

Optimism has been defined as, “a trait-like expectancy for successful outcomes” (Grove & Heard, 1997, p. 402) and “a mood or attitude associated with an expectation about the social or material future … one which the evaluator regards as socially desirable, to his [or her] advantage, or for his [or her] pleasure” (Tiger, 1979, p. 18). For optimism to be viewed as a personality characteristic, it should be relatively stable over time. Optimism and sport-related confidence were found to be positively correlated with problem-focused coping strategies and negatively correlated with emotion-focused coping strategies when dealing with sporting performance slumps (Grove & Heard, 1997). Test-retest reliability of optimism measures have ranged from 0.69-0.79 over periods from 3 years to 4 weeks respectively (Scheier & Carver, 1993).

Attribution research

The notion that attributions and explanatory style is linked to positive well-being has been explored extensively (for example, Kamen-Siegel et al., 1991; Peterson, 1988; Peterson, Seligman, Yurko, Martin, & Friedman, 1988; Scheier & Carver, 1987, 1992). Specifically, the findings in relation to explanatory style have demonstrated that optimistic and pessimistic styles differ in the way individuals cope and behave in stressful situations. The research within this area has progressed and modified since the first discussions of learned helplessness in 1967.

Learned helplessness is a tendency to develop a ‘helpless’ or ‘hopeless’ response following repeated exposure to an adverse event. Initial research in this area (Seligman, 1975) occurred with dogs repeatedly exposed to mild electric shock. With time, these animals responded to the adversive stimuli by giving up and not attempting to escape.

Following this work, a theory of depression based upon its interaction with learned helplessness was proposed (Seligman, 1975). Specifically the theory argued that a belief that one’s controllability over personal circumstances was limited resulted in the individual making inappropriate decisions. The notion that one does not have control over life outcomes was argued to be sufficient to result in depressive sequelae.

Interest in learned helplessness was strong in the 1970-80’s with over 2000 publications in the area. The learned helplessness phenomenon has been studied in a variety of settings (Overmier & Seligman, 1967). Of particular interest is how this concept relates in the sport setting. Research in the 1970's explored the relationship between attributions and learned helplessness for children's sporting experiences. Children who participated in sport were interviewed to understand the consequences of attributing negative outcomes to ability rather than effort (Dweck & Reppucci, 1973; Lukins, 1991). Negative attributions were found to result in a child dropping out of sport (Duda, 1992; Dweck & Reppucci, 1973). Further, negative attributions were related to lowered self-esteem (Lukins, 1991).

An individual's expectations of an outcome will influence their subsequent actions (Scheier & Carver, 1993; Scheier et al., 1989). Men undergoing coronary artery bypass graft surgery were interviewed on the day prior to surgery, 6-8 days following surgery, and 6 months post surgery (Scheier et al., 1989). The results indicated that positive explanatory style significantly predicted rate of recovery in the period immediately following surgery. Other behavioural post surgery indicators such as sitting up in bed and mobility were more quickly attained by patients rated with a positive explanatory style. These differences continued at the 6 month follow up interview. Optimistic patients were more likely to have returned to full time work and have commenced vigorous physical activity. These results provided further support for the relationship between positive expectation and improved behavioural and physical indicators.

The link between optimism and coronary artery bypass recovery was considered by Scheier et al. (1989). Patients were classified as optimists and pessimists and compared across mood state and coping strategies prior, during and post surgery. Optimism was demonstrated to have positive consequences at all three points in time. Improvements were indicated in both object and subjective indicators.

The use of a positive explanatory style was found to be predictive of both effort and conversion of sales by sales recruits selling insurance (Corr & Gray, 1995). It was argued that such results affirm the position of explanatory style as a predictor of performance, rather than only being a response to experience.

Undergraduate students with a negative explanatory style experienced more days of illness over a 30 day period and more doctor visits over a 12 month period than students with an optimistic explanatory style (Peterson, 1995). Comparisons between participants in the highest quartile (ie. most negative) with those in the lowest quartile (ie. least negative) having more than twice the number of days of illness and over three times the number of doctor visits. The participants in this study were not randomly sampled, however, it remains of value as it utilised a large sample with a longitudinal design.

Explanatory style and mental toughness was compared in ice hockey players eligible for the National Hockey League draft (Davis & Zaichkowsky, 1998). Mental toughness was conceptualised as a culmination of an athlete’s response to adversity, ability to achieve when under stress, degree of effort and enthusiasm, and skill. Athletes who were rated as being mentally tougher were more likely to have a pessimistic explanatory style. This contradicted the hypothesis that mentally tougher athletes would have a more optimistic explanatory style. Davis and Zaichkowsky (1998) suggested that this contradictory finding might be due to an unstable explanatory pattern found in successful athletes with high expectations for further success.

The authors acknowledged the challenge in operationalising a subjective concept such as ‘mental toughness’ and suggested that further work was needed to clarify the concept. However, the authors failed to appropriately rationalise the variables used to operationalise mental toughness. The defining of variables occurred following discussion with five talent scouts, the general manager, coach and two assistants. Mental toughness was defined as, "… the term which is often used to describe the resistance to negative affect during adversity in a game or after loss of a game" (Davis & Zaichkowsky, 1998, p. 1076). Given the cognitive nature of the definition, the inclusion of ability as a measure of mental toughness was inappropriate. Caution is warranted in considering the findings of this research, given the inclusion of performance ability as part of a psychological measure.

Explanatory style was examined to compare athletes' reactions to a disappointing athletic performance (Seligman, Nolen-Hoeksema, Thornton, & Thornton, 1990). In a series of studies with swimmers, results indicated that coach judgments of a swimmer's resilience and the athlete's explanatory style predicted the number of poor swims the athlete would complete during the season.

In a second study, swimmers (N=33) were asked to swim their best event. Upon completion of the event the athletes were told a time that was comparably slower than the actual time attained. Following a rest period of approximately 30 minutes swimmers were asked to swim the event again. The results indicated that swimmers with an optimistic explanatory style performed at least as well in their second swim, following the disappointing time. The performances of swimmers with a pessimistic explanatory style declined following the disappointing feedback. In summarising the research, Seligman et al. (1990) stated, “Explanatory style predicted swimming performance beyond measures of talent, suggesting that actual performance is jointly determined by talent and habitual patterns of subjective beliefs about the causes of event” (p. 145).

The hypothesis that higher self-esteem is more likely to result in positive self-evaluations was examined in collegiate footballers (Felson, 1981). Participants with higher self-confidence ratings assessed their ability as higher on ambiguous (decision making) and unambiguous (sprint speed) tasks than participants with lower self-confidence ratings. Felson (1981) suggested this was due to a need by individuals with high self-esteem to have self-perceptions that maintained the view that they and others hold of them.

In research on University students, Hale (1993) was unable to distinguish academically successful and unsuccessful athletes according to explanatory style. The conclusions further indicated that non-elite athletes viewed good events more positively than elite athletes. The limitations of this research lay in the methodology, which compared elite and non-elite performers. Non-elite performers were those participants who had ‘dropped out’ of their college athletic programs. Therefore, the composition of the two samples may not have been sufficiently different to draw the conclusion that attributional style does not adequately predict academic and athletic performance.

The relationship between attributional style, health, sport and performance show generally consistent results. Those individuals with a more positive explanatory style tend to report higher levels of subjective well-being perform better and report better levels of health.

Limitations of explanatory style research

As with any highly published research area, the construct of explanatory style, and the research methodologies used to test it have received a number of criticisms. The key criticisms have included a low correlation of the concept with other variables, controllability as a major dimension of attributional style, confounded variables, and longitudinal versus cross-sectional research (Scheier & Carver, 1993). Explanatory style has been described as a “velcro” construct (Peterson, 1995). This refers to the tendency of other variables (for example, depression, deficits in help-seeking, social estrangement, poor health) to adhere to it. Whilst valuable progress has been made in the development of explanatory style as a construct, Peterson (1991a) argued for further work to follow by suggesting that, "… researchers make use of the measures already available, heed the good suggestions about reporting of data suggested by Carver (1989) and others, and get about the business of investigating substantive questions about explanatory style" (Peterson, 1991a, p. 8).

Attribution measurement

There have been five standardised instruments predominantly utilised within attributional research. Two of these instruments, the Attributional Style Questionnaire (ASQ) and the Life Orientation Test (LOT) have been used frequently in recent research. An overview of all these tests with particular detail provided on the ASQ and LOT is detailed below.

The Causal Dimension Scale (CDS) examines an individual's explanation for why an event occurred (Russell, 1982). The respondent indicates the degree to which internal-external, stable-unstable, and global-specific factors contributed to the outcome of an event along a 9-point likert scale. The CDS has received general support within a number of studies (Grove, Hanrahan, & McInman, 1991; McAuley & Duncan, 1989; Vallerand, 1987; White, 1993). Despite these endorsements, the CDS has received criticism relating to it's reliability and the orthogonality of the scale. The controllability subscale has low internal consistency and the dimensions of controllability and locus of causality overlap in a way considered to be problematic (Biddle & Hill, 1992). In response to these criticisms, a revision of the scale (CDSII) was developed (McAuley, Duncan, & Russell, 1992). However, despite these revisions, the CDSII has not been widely used.

The Sport Attributional Style Scale (SASS) measures attributional style along the five dimensions of internality, stability, globality, controllability, and intentionality (Hanrahan et al., 1989). Despite reporting a good factoral structure and construct validity the measure has not been extensively utilised.

The Life Orientation Test (LOT) (Scheier & Carver, 1985b) was designed to measure dispositional optimism. Debate has arisen, regarding the validity of the LOT in measuring optimism, with some researchers suggesting the LOT is confounded with neuroticism (Smith, Pope, Rhodewalt, & Poulton, 1989) and with mastery (Marshall & Lang, 1990). Scheier, Carver, and Bridges (1994) acknowledged criticisms of the scale and suggested a modification of the LOT, whilst maintaining that the original measure is still a useful instrument.

The Attributional Style Questionnaire (ASQ) consists of 6 good events and 6 bad events, to which respondents attribute their perceived major cause of the event (Peterson et al., 1982). The cause is then rated from 1 to 7 along attributional dimensions of internal/external, stable/unstable, and global/specific. The authors argued that the instrument has good construct, criterion, and content validity and modest reliability.

Identifying concerns with the reliability coefficients, Peterson and Villanova (1988) increased the number of items of the ASQ from 6 to 24 the aim being to ensure better consistency and stronger reliability. Additionally, the scale included only items considered to be ‘bad’ or negative in nature. The renamed Expanded Attributional Style Questionnaire (EASQ) demonstrated improved internal consistency of each dimension. Internal consistency as measured by Cronbach’s (1951) coefficient alpha were 0.88 for globality, 0.85 for stability, and 0.66 for internality (Peterson & Villanova, 1988). A limitation of the expanded scale (in some settings) is the increased demands on time to complete the scale (Whitley, 1991a).

In an attempt to determine if the EASQ could be shortened without reducing subscale reliability, the EASQ-S was developed (Whitley, 1991a). Inter-item correlations and internal consistency were similar for the two scales. Both Peterson (1991b) and Whitley (1991a) agreed that the decision to utilise the EASQ-S should primarily be determined by the time available to complete the measure. Whitely (1991b) concluded, “The EASQ-S provides a reliable and valid alternative to the EASQ for situations in which scale length is an important consideration” (p. 538). Further, Peterson (1991a) stated that, “If a short version of the EASQ is necessary on these grounds, then researchers should increase their sample size to offset the loss of power due to a less reliable measure” (p. 182).

It would seem initially that the LOT and ASQ may in fact be measuring similar constructs. However, upon closer examination it is evident that subtle differences exist. The LOT specifically considers the ‘expectations’ that an individual has in relation to a specified event, thus reflecting their level of optimism. In contrast, the ASQ considers the perceived causality of events. The LOT determines the level of expectation an individual has that a goal can be achieved. The ASQ reflects how such goals may be brought about (Peterson, 2000).

Of the attribution scales available, the EASQ is the preferred instrument for use within sport settings. The EASQ has better validity and reliability than other scales. Further, the scale assesses how a person typically responds to ‘bad’ events. As an athletic injury is an undesirable experience, the EASQ is the more appropriate measure.

Psychological responses to injury

There is support for the notion that psychological variables may contribute to physical injury, which does not simply result from inappropriate body positioning, sporting contact, physical conditioning, or other external factors (Bergandi & Witting, 1988; Burckes, 1981; Jackson et al, 1978; Moore, 1966; Rosenblum, 1979; Sanderson, 1977; Valliant, 1981; Yaffe, 1983). Psychological variables including a fear of success, depression or guilt were suggested by Rosenblum (1979) as correlates to athletic injury. Such conclusions support the value in exploring the role of personality variables in understanding athletic injury.

Cognitive appraisal models are designed to account for individual differences in responding to athletic injuries (Brewer, 1994). Such models have been proposed by a number of researchers (for example, Lazarus & Folkman, 1984; Wiese-Bjornstal & Smith, 1993; Weiss & Troxel, 1986).

Each model is based upon the premise that following an injury, an athlete will have a cognitive response eliciting an affective outcome. The affective response is argued to result in behavioural consequences. It has been argued that it is inappropriate to apply a model based on non-athletic populations to understand the injury experience of athletes.

Level of involvement in sport and exercise was investigated for its effects on the psychological impact of injury on athletes (Johnston, 2000). Participants who incurred injuries resulting in at least 21 days of incapacitation from sports involvement were included in the study. Results indicated that injury had an observable emotional effect that diminished according to self-rated recovery. The study did not find differences between athletes with low involvement in sport (ie. one hour or less of sport participation per week) and athletes with high involvement in sport (ie. eight or more hours of sport participation per week). Thus, the findings supported an impact of injury on the psyche of the athlete, irrespective of level of involvement.

Several personality variables have been considered in relation to athletic injury. For example, athletes who scored high on a Type A measure experienced significantly more injuries than those athletes with lower scores (Fields, Delaney, & Hinkle, 1990). High scores on defensive pessimism and elevated levels of life stress resulted in athletes experiencing more illness and injury than athletes scoring low on both measures (Perna and McDowell, 1993). Research with collegiate volleyball players found low levels of coping support to be related with increased injury (Williams, Tonymon, & Wadsworth, 1986). The research with coping support appears to be equivocal as several studies (Blackwell & McCullagh, 1990; Rider & Hicks, 1995; van Mechelen et al., 1996) found no relationship between coping support and athletic injury.

Comparisons were made between football, volleyball, and cross-country athletes, according to positive state of mind early in the season. Those with a positive state of mind incurred significantly fewer injuries than those who did not (Williams, Hogan, & Anderson, 1993). Williams and Anderson (1998) suggested that an athlete’s cognitive state may provide a ‘buffering’ effect, which reduces the impact of stress and therefore, results in fewer injuries.

When international, collegiate, and recreational athletes were interviewed regarding their emotional responses to previous injury experiences, they identified experiencing a range of emotions, including anger, irritability, frustration, enthusiasm, happiness, and enthusiasm (Quakenbush & Crossman, 1994). A pattern emerged indicating that with time the frequency and intensity of negative emotions decreased, in contrast to positive emotions that increased. These findings were limited by the small non-random sample, and reliance on participants to self-report on affective experiences occurring up to 12 months prior to the interview. Despite these limitations, the research gives insight into the emotional sequelae of injury for some athletes.

The potential utility of the TAIS in predicting athletic injury was considered for 335 athletes across 17 different sports (Bergandi & Witting, 1988). Low power and small sample size in some sports reduced the potential of the research to fully test the hypotheses. However, attentional style was able to explain injury variance in men’s basketball (28%), women’s volleyball (56%), women’s softball (49%), and women’s gymnastics (29%). The authors argued the importance of further exploration of the TAIS as a predictor of injury.

A criticism of research into the relationship between personality characteristics and injury has been the lack of a theoretical foundation to explain how such factors may result in injury (Williams & Anderson, 1998). The role of attention in sporting experience has been tested through the TAIS by Nideffer (1989) who suggested that an athlete who scores high on subscales such as OET, OIT, and RED may be at risk of overload, and may not be attuned to environmental conditions, increasing the risk of injury. Similarly, for athletes scoring pessimistic profiles on the EASQ, cognitive-behaviour therapy would argue that negative explanatory style leads to negative affect, increasing the risk of the athlete exposing themselves to more injury-prone situations. The theoretical work of Nideffer in attentional style and Seligman in attributional style are worthy of testing in injury research.

It has been suggested that there is a need for further research into the relationship between personality characteristics and sporting injury (Williams & Anderson, 1998). In particular constructs such as negative mood states and a negative state of mind should be explored in terms of their relationship with athletic injury (Grove, 1993).

Attributions and sporting injuries

Much of the attribution research has centred on athletes' responses to sporting outcomes. It is surprising that few studies have focused on other aspects of the sporting experience, such as injury. Attributions made for rapid or slow recovery from sport injuries was compared according to gender (Grove, Hanrahan, & Stewart, 1989). Males with low self-esteem made more global and stable attributions than females with similar levels of self-esteem. In contrast, the males with high self-esteem were less likely to make attributions of such a negative consequence. These patterns suggested that males with low self-esteem would be more likely to experience hopelessness or helplessness in situations of prolonged or problematic rehabilitation. The authors argued that attributional style might have links with personality dispositions such as hardiness. This lends support to further consideration of personality variables (for example, self esteem, expression of positive and negative affect) and their effect of injury (Grove et al., 1989).

Nezu, Nezu, and Nezu (1986) conducted research which suggested a link between explanatory style, anxiety and depression. Such an increase in arousal and subsequent increases in tension and anxiety may make athletes more vulnerable to making mistakes and incurring injury. Athletes should be aware that their cognitive mindset influences physiological reactions within the body. Negative interpretations and affect will lead to physiological responses that will potentially inhibit performance, and potentially increase the risk of injury (Lynch, 1988).

Mortality and health-related behaviours are associated and given that lifestyle influences physical condition, the role of explanatory style as an influence of lifestyle choice is vital (Peterson, 1995). Individuals with a negative explanatory style tend to respond passively and in a helpless manner when becoming ill (Lin & Peterson, 1990).

Udry, Gould, Bridges, and Beck (1997) examined responses by athletes to season-ending injuries. They stated that any possible relationship between personality dispositions such as optimism and injury consequences is unknown. Their recommendation was that future research should address this question.

The prevalence and estimated physical and psychological cost of injuries has led to a wealth of research in this area. Whilst not categorised as a sport, it is appropriate to view ballet as an ‘athletic’ endeavour (Patterson et al, 1998). In an epidemiological study on 104 dancers, 23% of participants experienced 52% of all injuries (Garrick & Requa, 1993). It was concluded that a relatively small proportion of the sample accounted for a disproportionately high proportion of the number of overall injuries. It was also concluded that there was a need to conduct research identifying physical and psychological factors that may increase the risk of injury (Garrick & Requa, 1993).

A prospective study explored the impact of life stress and the moderating influence of social support on the injury experience of dancers (Patterson et al., 1998). This research indicated that minor negative events (such as 'daily hassles') correlated positively with subsequent injuries. The authors identified that the strength of this relationship was, "… substantially larger than those found in prospective studies involving athletes" (Patterson et al., 1998, p.109). They further concluded that stressful life events could be viewed as an important vulnerability factor. A criticism of the study was the failure of the authors to identify any limiting factors within the research design, analysis or interpretation. The sample utilised was non-random, thus making generalisations beyond the sample inappropriate. In addition, the authors attributed any differences between their results and the results of previous studies as real differences within their sample. The authors did not pose any consideration that differences may have resulted from methodological limitations or the statistical analysis.

Petrie and Falkstein (1998) were critical of much of the previous injury research due to concerns regarding methodological design. The authors argued that a prospective study is preferable to a retrospective design given that injury acts as a stressor and may cause changes in predictor variables in particular life stress measures. The utilisation of a long-term prospective approach to studying injury in rugby league was argued by Gabbett (2001). The challenge identified by Petrie and Falkstein (1998) involved the scheduling of pre- and in-season measures in what is usually a busy time for both athletes and coaching staff. A further recommendation was the consistent administration of scales including the use of standardised instructions.

The issue of consistency of variables over time is an important one in longitudinal research. The stability of a number of psychosocial variables for volleyball and soccer players was considered over a 10 week period (Petrie & Stoever, 1997). The variables were then considered in relation to injury statistics for the season. Whilst the variables did not correlate with injury, the variables themselves did change throughout the course of the season. Psychosocial variables such as competitive trait anxiety and positive life stress decreased through the course of testing. Other variables such as social support, negative life events, and athletic identity experienced little variability (Petrie & Stoever, 1997). The importance of testing on multiple occasions, rather than treating the data collection period as a static one-off measure is therefore, important.

Gender, type of sport, and competitive level may be moderating variables in the stress-injury relationship (Petrie & Falkstein, 1998). Future research needs to control for such variables. A further moderating variable is the playing status (ie. starter versus non-starter) of the athlete. For sports (such as American Football) which have such clearly defined roles, this may be a variable necessary of consideration. However for sports where playing roles have greater ambiguity, such consideration may not be necessary. For example, in Australian Rugby League four players will start the game sitting on the interchange bench. The decision as to who fulfills this role varies from game to game and may form part of a strategic plan whereby a strong player is brought into the game (in an impact role) following the commencement of the game. Therefore, the players who commence the game on the bench may not necessarily be a less competent athlete (Murray, 2004; Sheens, 1998).

Time of game, location, and game outcome has been demonstrated to not significantly effect injury rates (Seward et al, 1995). Current injury status and previous injury experience are important moderator variables (Petrie & Falkstein, 1998). Being healthy and injury-free is necessary for participants at the commencement of research exploring sporting injury.

Methodologies utilised for recording injury experience has essentially relied on recording by a team health professional (for example, doctor or physiotherapist) (Gabbett, 2000; Gissane, Jennings, White, & Cumine,

1997) or athlete self-report (for example, Gabbett, 2001, Meir, McDonald, & Russell, 1997). In the research conducted by Meir et al. (1997), retired athletes were asked to recall all injuries that had occurred during their playing careers that resulted in them being unable to play for five or more consecutive games. Such research is clearly limited to the respondent's ability to correctly recall such events. Research methodology that is vulnerable to memory and attribution bias effects has been criticised (Brewer, Van Raalte, Linder, & Van Raalte, 1991). To ensure greater consistency and accuracy in such records, monitoring by a team health professional is desirable in injury research.

Research with rugby league players

Research exploring the psychological experiences of rugby league players is limited. Most research investigating 'football' involves soccer or gridiron players. The emerging professionalism of rugby league has resulted in greater involvement of sport science, including psychology. A review of the literature conducted by the current author was unable to uncover any psychological research on rugby league players in relation to psychometric measures such as the TAIS or EASQ. To date, most rugby league research has focused on physiological issues. The research that has been conducted appears to have occurred somewhat sporadically, with a few research papers published each decade since the 1970’s. There is considerable scope for research into the sport of rugby league (Brewer & Davis, 1995).

Injury data for amateur rugby league players (N=600) over three consecutive seasons was recorded by Gabbett (2000). The results indicated that forwards differed significantly from backs on the incidence of injury. Forwards incurred an average of 182.3 injuries per 1000 playing hours, compared to backs at 142.0 injuries per 1000 playing hours. Similarly, in research with professional rugby league players (Gissane et al., 1997), forwards had a higher overall rate of injury than backs (139.2 per 1000 playing hours, compared with 92.7 per 1000 playing hours, respectively). The higher rate of injury experienced by forwards over backs is attributed to the more active physical involvement of forwards in attack and defence (Gibbs, 1993; Gissane et al., 1997).

With the limited amount of rugby league research, there is value in considering the research conducted on American (gridiron) football players. Whilst the games are different in many aspects, both rely on physical contact in attacking and defensive manoeuvres. Therefore, consideration of research findings in this football code is useful.

Personality characteristics of intercollegiate gridiron players were compared according to playing position (Nation & LeUnes, 1983), The participants completed the Profile of Moods States (McNair, Lorr, & Dropplemann, 1971), the F-scale (Sanford, 1972) (used to measure authoritarianism), and the Locus of Control Scale (Levenson, 1972). The research findings indicated that personality characteristics differed according to playing position (ie. offensive lineman, offensive backs, wide receivers, defensive linemen, defensive backs, and linebackers). Whilst the sample was non-random, the results suggested merit in considering differences in personality characteristics according to playing position. However, such research does not address the question as to why differences may occur. For example, whether differences are due to the 'type' of individual required for the position, or whether factors such as playing position, game demands and crowd expectations mould the player to demonstrate specific 'types' of personality characteristics, is unknown.

Research on rugby union and soccer players investigated personality characteristics and achievement oriented behaviour, aggression, and attitudes towards physical activity (Reid & Hay, 1978). The results indicated differences between the two sports in athletic aggression, risk, and catharsis. The conclusions of the research raise interesting questions as to the role of aggression in rugby league players and the relationship of that aggression to injury.

Summary

Athletic injury has negative physical and psychological sequelae. Psychological constructs that may increase athletes susceptibility towards injury needs to be further investigated. The purpose of this research is to consider the role of attentional and explanatory style in the injury experiences of professional rugby league players.

Sporting success is dependent upon an individual's ability to attend to relevant information and exclude irrelevant stimuli. Effective attention requires a combination of broad-narrow and internal-external dimensions. Rugby league is likely to require an athlete utilise the four components of attentional style.

The tendency of an individual to attend in a consistent manner is referred to as attentional style. Attentional style is argued to be trait-like and consistent over time. When experiencing high levels of arousal or stress, an individual is argued to defer to their dominant attentional style.

Attentional style is best measured by the TAIS. The TAIS measures attentional processing, behavioural and cognitive control and interpersonal style. The TAIS has been utilised extensively in research and applied settings. Test-retest reliability for the scale is good. Sport specific versions of the TAIS have been developed, however administration of the scale following the instruction manual is the preferred measure. The value of considering attention in relation to understanding the injury experience has been argued (Bergandi, 1985).

Attributions are the stable/unstable, internal/external and global/specific causes used to explain human experiences. Explanatory style is the trait-like explanations of negative events in a person's life. A negative explanatory style has been linked to diminished performance. Specifically, a pessimistic explanatory style is associated with depression, lowered expectations, passivity, lowered achievement and poorer health (Peterson, 1991; Peterson & Seligman, 1984, 1987; Seligman & Schulman, 1986).

Given the benefits of interventions such as cognitive behaviour therapy, it is important to understand the role of explanatory style in the injury experience (Peterson, 1995). If a positive explanatory style is associated with a decrease in injury experience and a negative explanatory style is associated with an increase in the injury experience, then this information will be beneficial to athletes, coaches, and psychologists who work with athletes.

Psychological literature within rugby league is limited. The need for research, particularly for sporting injury is apparent. Rugby league is a sport which has a high risk of injury. Whilst limited in rugby league, the prevalence and physical and psychological cost of sporting injuries has led to considerable research in the area. Several recommendations have been offered to improve the methodological design of injury research. Specifically, studies should utilise a prospective design using multiple testing. Wherever possible moderating variables such as gender, type of sport and competitive level should be controlled. Further, current injury status and previous injury experience needs to be considered. The responsibility of monitoring injuries is more accurately recorded by a health professional, than rely on the recall of the athlete.

Personality differences according to playing position has been demonstrated in American (Gridiron) football. Further support for positional differences has been found in rugby union and soccer. Differences in injury experience have also been found according to playing position. Therefore, playing position should be considered within any analysis.

Given the complexities of psychological and health experiences, it is unlikely that one psychological variable will explain the entire injury occurrence and rehabilitation experience. However, a starting point needs to be gained in order to understand the relationship between explanatory style, personality characteristics and injury experience. From this understanding, further research could seek to gain insight into any existing causal relationships.

Chapter three

Method

Introduction

The aim of this research was to gain an understanding of the relationship between sporting injury experience and psychological variables including attentional and explanatory style. The injury experience often has negative physical and psychological consequences for an athlete. The participants involved in the current research were male professional rugby league players. The aim of this chapter is to outline the characteristics of the participants of the research. The instruments utilised within the research will then be detailed. The procedure of the research will then be detailed, followed by a summary of the statistical techniques used within the research.

Participants

Male professional rugby league players playing in the Australian National Rugby League (NRL) competition (N=53) gave their informed consent to participate in this study (refer Appendix B). Ethical approval to conduct this research was granted by the Experimental Ethics Review Committee of James Cook University.

Testing occurred over a 24 month period, during which two 26 week seasons of rugby league competition were completed. Of the 53 participants, 6 participated in the first year only, 15 participated in the second year only, and 32 participated in both the first and second year. The reasons for participant involvement in only the first or second year of the study included players who were recruited into the team in the second year or players who were released from the club following the first year. A player may be released following the end of a playing contract, retirement, being contracted to another club or career ending injury.

Participants were predominantly Caucasian, with 6 players from Aboriginal or Torres Strait Islander background. Demographic characteristics of the participants are detailed in Table 1. The age of each player was taken as the age at the first competition game of each season (early March). During the time of testing, players competed in the first grade of the NRL competition. All participants were members of a senior grade squad, and had played a minimum of five first grade games. Participant selection met criteria considering gender, type and level of sport as moderating variables (Petrie & Falkstein, 1998). Within this study all three moderating variables were controlled as the sample included male rugby league players, competing at the same level of professional competition.

Table 1. Characteristics of the participants.

Characteristic	Mean	Minimum	Maximum
Mean age (years)	24.39 ±2.69	19	31
Mean height (cm)	184.21 ±5.52	173	195
Mean weight (kg)	94.21 ±9.94	73	117
Playing experience (years)	4.88 ±3.26	1	11

The health status of participants should be known at the commencement of any research that intends to monitor changes in health over time (Peterson, 1995). Being injured may increase the risk of future injury as injury acts as a stressor. This criteria was adopted as athletes should be, "free from any time-loss injury or restrictions on any type of participation" (Williams & Roepke, 1993, p. 21). All participants were asymptomatic of injury at the time of testing. This determination was made by the team physiotherapist.

Playing status (ie. starter or non-starter) of American Football players was recommended by Petrie and Falkstein (1998) to be included as a variable in football research. However, the playing status of the participants in this study was not included in data collection as the playing status of rugby league players may vary between games. Being a non-starter (ie. commencing the game on the bench) may satisfy a strategic plan adopted by the coach to utilise the strengths of an individual player, once play has commenced. Thus the status of being a starter or non-starter in rugby league may have less relevance than in American Football.

Participants were categorised according to playing position as either a forward or back. The dichotomous categories of forward and back were chosen over categorising players according to their specific playing position (for example, hooker, five-eighth, winger). Previous research (Gabbett, 2000, Gissane et al., 1997, Huxley, 1988) has operationalised playing position in rugby league according to being a forward or back. It is typical for rugby league coaches, players and officials to categorise players as forwards or backs (Denton, 2002).

Instrumentation

Attentional style was determined using The Test of Attentional and Interpersonal Style (TAIS) (Nideffer, 1976) which consists of 144 items scored on a 5-point rating scale. The test is designed to measure attentional processes, control factors, and interpersonal measures across 17 subscales. Scoring of the measure presents raw and standardised T scores for each subscale. The nature of the data makes it suitable for analyses requiring interval level measurement (Howell, 1999).

The attributional characteristics of the participants were determined using the Expanded Attributional Style Questionnaire (EASQ) (Peterson & Villanova, 1988). This instrument is a 24 item questionnaire consisting of a series of hypothetical events. Respondents are required to write down a cause and then rate the cause on the three attributional dimensions of locus, stability, and globality. The EASQ was selected in preference to the short form of the Expanded Attributional Style Questionnaire (EASQ-S). The EASQ-S was developed as an option for researchers requiring a measure that is relatively quick to complete (Whitely, 1991a). Where possible the EASQ should be chosen over the EASQ-S as the preferred measure due to its greater reliability and validity (Peterson, 1991b). The club administration ensured that the participants were available to complete the longer measure. Given this opportunity, the EASQ was selected for its better psychometric properties.

Four measures were utilised to analyse the EASQ data. These measures included the subscales of globality, internality, and stability. A composite measure of the three subscales to assess overall attributional style was utilised. The utility of reporting a composite as the key mechanism for understanding explanatory style has been criticised (Carver, 1989). The criticism is based upon an inability to distinguish the role of the individual dimensions. Peterson and Seligman (1984) had earlier refuted this criticism, arguing that a person who scores high on all three dimensions of explanatory style is more likely to be passive and demoralised than a person who scores low on the three dimensions. Peterson (1991) argued that a composite captures the essence of helplessness, to which each dimension makes a contribution. Thus it would appear that both the individual dimensions and an overall composite could each contribute towards further understanding of attributional style. Therefore, the three dimensions and overall composite score were considered within this research.

Procedure

The principal researcher administered the EASQ and the TAIS to ensure control of the testing procedure. This study was conducted prospectively as it is considered more likely to ensure reliability and validity of the data (Petrie & Falkstein, 1988).

The EASQ was administered to the total participant population on four occasions: 8 weeks prior to the year 1 competition, week 12 of the year 1 competition, 8 weeks prior to the year 2 competition, and week 12 of the year 2 competition. This procedure was adopted for purposes of test-retest reliability (Petrie & Falkstein, 1998).

The TAIS was administered to the total participant population on two occasions, 8 weeks prior to the year 1 competition and 8 weeks prior to the year 2 competition. The TAIS was not administered as often as the EASQ, as Nideffer (1976), reported test-retest reliability coefficients for the scales ranging from 0.60 to 0.93, with a median score of 0.83. It is argued that participation in elite sport does not result in personality changes (Bakker, et al, 1990). Therefore, it would be expected that personality measures during the course of a season should remain stable.

Player injuries were recorded for the 24 month period by the team physiotherapist. Injuries were classified into categories of mild (treatment is required with no modification of activity), moderate (modification to treatment and activity), severe 1 (non-participation for 1-14 days), severe 2 (non-participation for 14-28 days), or severe 3 (non-participation for more than 28 days). The emphasis of this research was to focus on injuries that prevented participants from playing their sport. Therefore, the results of this research refer only to injuries classified as Severe 1, 2, or 3. The injury reporting guidelines utilised within this study are consistent with those utilised in other studies (Estell, Shenstone, & Barnsley, 1995; Gabbett, 2001; Gibbs, 1993; Hodgson Phillips, Standen, & Batt, 1998).

In addition to recording injury status an overall 'injury rating' was given to each participant. This rating summarised the participant's injury experiences over the duration of data collection and was determined by tabulating for each participant the number of injuries sustained and the severity of each injury. This rating was necessary as a classification measure for use within the statistical analysis of the data. Games missed due to medical illness were not included as they were not caused from participation in competition or training. A summary of the overall classification system is summarised in table 2.

Table 2. Overall classification system for injury.

Number of injuries	Severity rating	Overall classification
2 or less	Severity 1	Low injury rating
2 or less	Severity 2-3	Moderate injury rating
3 – 4	Severity 1	Moderate injury rating
3 – 4	Severity 2-3	High injury rating
5 or more	Severity 1	Moderate injury rating
5 or more	Severity 2-3	High injury rating

Data analysis

Prior to data analysis, demographic variables, psychological measures and injury data were screened for accuracy of data entry, presence of missing values, and fit between the distributions and the assumptions of univariate and multivariate analysis. Three players whose contracts were terminated (two during year one and one during year two) were not included in the study as a full set of data was not generated for them.

For all analysis conducted utilising the general linear model, testing for skewness, kurtosis, linearity and homoscedasticity were evaluated.

Transformation of data or non-parametric tests were utilised in the instance of any violation of these assumptions.

Analysis of the injury data and psychological variables was completed in two sections. The first analyses considered the demographic details of the participants and included univariate and multivariate analysis on the psychometric and injury data. The second analyses included Discriminant Function Analysis.

Data at other levels of measurement were examined through box plots and histograms. For data of ordinal and interval level, the Kolmogorov-Smirnov test was used to test the assumption of normality of distribution. The test is founded on the largest absolute difference between the observed frequencies and the normal distribution (Kinnear & Gray, 1999).

The data collected in this study included nominal, interval and ratio levels of measurement. A summary of the major variables and their respective level of measurement is provided in table 3. The number of games a player missed during the season was not recorded as a variable. As players could miss games for reasons other than injury (for example, not selected, suspension, representative honours), it was not considered a useful measure in the context of the study.

Table 3. Study variables and level of measurement

Type of variable	Description of variable	Level of measurement
Demographic	Age of player (years)	Ratio
	Number of first grade games	Ratio
	Number of years playing first grade	Ratio
	Position on field (forward or back)	Nominal
ASQ	ASQ score	Interval
	ASQ rating	Nominal
	Stability subscale score	Interval
	Globality subscale score	Interval
	Locus subscale score	Interval
Game	Average number of minutes played per game	Ratio
	Number of games played	Ratio
	Number of minutes played	Ratio
Injury	Number of days injured	Ratio
	Number of injuries sustained	Ratio

Table 3. Study variables and level of measurement continued

	Number of physiotherapy appointments attended	Ratio
	Percentage of games missed per injury	Ratio
	Severity of injury	Nominal
TAIS	Behavioural control (BCON)	Interval
	Broad external focus (BET)	Interval
	Broad internal focus (BIT)	Interval
	Expression of negative affect (NAE)	Interval
	Expression of positive affect (PAE)	Interval
	Extroversion (EXT)	Interval
	Information processing (INFP)	Interval
	Intellectual expression (IEX)	Interval
	Introversion (INT)	Interval
	Need to be in control (CON)	Interval
	Obsessiveness (OBS)	Interval
	Overload by too much narrowing (NAR)	Interval
	Overloaded by external factors (EXT)	Interval
	Overloaded by internal factors (INT)	Interval
	Physical orientation (PO)	Interval

Table 3. Study variables and level of measurement continued

	Self-esteem (SES)	Interval
	Tendency to narrow focus (NAR)	Interval

Statistical analyses included *t*-test, Analysis of Variance (ANOVA), Kruskal-Wallis Test, Chi-square, Sign test, Friedman's test, Spearman's rank-order correlation, z scores, and Discriminant Function Analysis. Bonferroni corrections have been included in consideration of Type I error rate when a large number of significance tests were conducted.

Discriminant Function Analysis is a statistical technique which examines group differences of several variables concurrently. As a technique it tests the null hypothesis that the group means of sets of independent variables of two or more groups are equal (Klecka, 1980). Broadly, Discriminant Function Analysis clarifies how groups differ, that is, 'discriminating' between groups on a set of variables. Further it classifies through use of mathematical equations which group an individual most likely resembles (Hair, Anderson, Tatham, & Black, 1998).

Discriminant Function Analysis is able to address four key research questions. The first is whether significant differences are present between average scores on a set of variables for specific groups. The second is which independent variables account for the most difference between two or more groups. The third is classifying individuals into groups on the basis of their independent variable scores. The fourth is determining the composition of the dimensions of discrimination between the groups formed from the independent variables (Hair et al, 1998).

Discriminant Function Analysis attempts to classify participants into groups (dependent variables) according to certain participant characteristics (independent variables). Discriminant Function Analysis requires the dependent variable to be measured at a nominal level. The independent variable should be measured at an interval or ratio level.

Assumptions of Discriminant Function Analysis include a randomly selected population and normally distributed data. The variance of the predictor variables should be the same in the populations into which participants will be classified. There must be at least two groups and at least two cases per group. It is assumed that the relationship between the independent and dependent variables are linear (Klecka, 1980). Although these assumptions exist, they are not necessary to all of the statistical procedures that form Discriminant Function Analysis. Furthermore, Discriminant Function Analysis is such a robust technique that it may tolerate minor violations of these assumptions, particularly when large samples are utilised. The sample should have more cases per group than the number of independent variables (Hair et al, 1988).

The first step in utilising Discriminant Function Analysis is to determine the independent and dependent variables. Whilst two or more categorical dependent variables can be selected, they must be mutually exclusive.

Discriminant Function Analysis is an underutilised statistical technique in sport psychology research (Biddle, Markland, Gilbourne, Chatzisarantis, & Sparkes, 2001). The number of studies that have included Discriminant Function Analysis within attentional and attributional research in sport is limited (for example, Bond & Nideffer, 1992; Nideffer, 1977; Vallerand, 1983). Discriminant Function Analysis has some diverse examples in sport literature. For example, Smith and Spinks (1995) used biomechanical variables including mean propulsive power, propulsive work consistency, stroke-to-stroke consistency, and stroke smoothness to discriminate between novice, state, and national level rowers. Lemon (1998) used Discriminant Function Analysis to determine any significant differences in information processing between recreational and elite classical ballet dancers. Six information processing variables were assessed including perception, decision making and response selection, response execution, attention resources, working memory and long-term memory. Discrimination between the elite and recreational dancers was made on the basis of these information processing variables.

A Discriminant Function Analysis was performed to determine whether scores on the TAIS could discriminate athletes according to the type of sport they compete in (Bond & Nideffer, 1992). Correct classification of 1798 athletes into one of three sport types occurred for 57.1% of closed skill individual sport athletes, 41.5% of open skill individual sport athletes, and 49.6% of team sport athletes.

The possible relationship between TAIS variables and decision making for 29 basketball players was assessed with Discriminant Function Analysis (Vallerand, 1983). Using a step-wise method of entry, scores on the OIT and OET scales maximised the differences for poor and good decision makers. Vallerand (1983) concluded that such a finding did not support the research hypotheses and was unable to explain why OET might best characterise good decision making. The results were explained through limitations in the research including the operationalisation of decision making, limitations of the TAIS to be applied to basketball and the presentation of the TAIS in French and possibly varying from the English version. Vallerand concluded that the study should be replicated and further research utilising the TAIS should be conducted.

The current research aims to test for group distinctiveness and test for prediction of group membership. Given these aims, Discriminant Function Analysis was chosen in order to determine which psychological variables characterise the injury status of professional rugby league players. Classification procedures were used to predict membership of cases into low, moderate and high injury participant groups. A sufficient sample was sought to ensure the stability of the results obtained through Discriminant Function Analysis (Tabachnick & Fidell, 1989). The psychological characteristics of participants and playing position were the independent variables of the analysis, while the number and severity of injuries was the dependent variable.

The Statistical Package for the Social Sciences (SPSS v11.0) was utilised to examine the data. A significance level of 0.05 was adopted for this study. Where appropriate results will be reported mean ±standard deviation.

Summary

This thesis explored the injury experience of professional rugby league players over a 2 year period. Participants completed psychometric tests prior to and during the playing period. Attentional and attributional style was measured utilizing the TAIS and EASQ, respectively. The injury experience of the participants was classified according to whether they had incurred a minor, moderate, or severe injury. Statistical analyses included parametric and non-parametric analysis to determine any differences between the groups and relationships between the variables.

Chapter four

Results

Introduction

The results presented in this chapter detail the descriptive data for the research, the injury experience for the participants, and the analysis of the psychological inventories. The chapter begins with a presentation of the descriptive data for the demographic variables. The descriptive data is then compared, according to the year of participant inclusion for the study. A comparison of forwards and backs is then considered in relation to any differences in the injury data or scores on the psychological variables. The analysis of the psychological inventories is then presented. Specifically this analysis explores the reliability of the measures and the measures in relation to the research hypotheses. The results of the discriminant function analysis are then presented.

Screening of data

Kurtosis and skewness were examined for each ratio level variable. Distributions are not considered to be asymmetrical unless the skewness value equals two (Ferber, 1949). For a variable to be normally distributed, the kurtosis value must not exceed three. Appendix C reports the skewness and kurtosis values for the ratio level variables included in the study. These results indicated that the majority of the variables were normally distributed. However, the mean number of games missed per injury exceeded acceptable skewness and kurtosis values. This result indicated the variable was asymmetrical and significantly 'peaked'. Caution was exercised in interpreting the results relating to this variable.

In order to ensure accuracy, the data were initially screened for missing values, incorrect entries, and outliers. Outliers within data sets are problematic as they can result in Type I and Type II errors and lead to non-generalisable results (Tabachnik & Fidell, 1989). The data were screened for outliers through consideration of Z scores. A summary of the z scores for each variable in the research is detailed in AppendixD. Three variables indicated extreme z scores; these being the proportion of games missed per injury in year one, the proportion of games missed per injury in year two, and BCON (Behavioural Control). Given that the focus of this study was the prevalence and effect of injury, it was decided not to transform the two injury variables. Additionally, the BCON variable was not initially transformed. Once further analysis was conducted on these variables, consideration of their skewness was taken into consideration.

Data at other levels of measurement were examined through box plots and histograms. For data of ordinal and interval level, the Kolmogorov-Smirnov test was used to test the assumption of normality of distribution (Kinnear & Gray, 1999). Results of this analysis are reported in Appendix E. These results indicated the variables were normally distributed.

Screening of data within the current study indicated most variables met assumptions of normality of distribution. With these assumptions satisfied, parametric statistics were utilised to analyse the data. For those variables not meeting the assumptions of normality of distribution (ie. BCON, proportion of games missed per injury in year one, and proportion of games missed per injury in year two) caution was exercised in interpreting those results. In analysis where ANOVA was performed, data was assessed for homogeneity of variance. When homogeneity of variance was evident ($p>0.05$), parametric analysis was considered appropriate. When heterogeneity of variance was evident ($p<0.05$), non-parametric analysis was conducted.

Demographic variables

Data was collected for participants in either the first, second or first and second year of the study. This occurred depending upon which year(s) the participants were contracted to play with the rugby league team. An ANOVA was utilised to determine if the demographic variables significantly differed at the data collection points. The results of this analysis are detailed in Table 4.

Significant differences were not found between the age of participants, number of years playing rugby league, or the total number of first grade rugby league games played by the participants. The Levene statistic demonstrated heterogeneity of variance of the total number of first grade games ($p<0.05$). As this data was not normally distributed, a Kruskal-Wallis test was calculated. The result of the non-parametric analysis supported the outcome of the ANOVA that the number of first grade games played did not significantly differ across time of participation in the study (H (2)=1.251, $p=0.54$).

Table 4

Demographic results of the sample according to year of inclusion in study

Variable	Year	Mean	Min	Max	F Stat	p	Levene statistic	p
Age (years)	First	24.4 ±4.1	19	31	0.01	0.99	1.17	0.32
	Second	24.4 ±3.4	20	29				
	Both	24.3 ±3.1	20	31				
Years playing (years)	First	5.6 ±3.5	1	11	0.47	0.63	2.96	0.06
	Second	4.2 ±4.2	1	11				
	Both	4.8 ±2.6	2	11				
Total first grade games (games)	First	95.2 ±84.4	5	220	1.30	0.28	9.00	0.00
	Second	72.9 ±92.6	5	241				
	Both	51.7 ±45.9	5	182				

Significant differences did not emerge for player's age, years playing and total number of first grade games, Therefore, data was combined. The summary data for the total sample isdetailed in Table 5. The typical participant in the study was 24 years old, had been playing rugby league at the elite level for nearly 5 years and had played on average, 67 first grade rugby league games.

Table 5

Combined demographic results for the sample

Variable	Mean	Min	Max	P_{50}
Age (years)	24.3 ±2.7	19	31	23
Experience (years)	4.8 ±3.2	1	11	3.5
Total first grade games (games)	66.8 ±69.5	5	241	23

Consideration was then given to the representativeness of the sample to the larger population of elite rugby league players in Australia. The sample was not randomly sampled, thus preventing generalisation of the results of this study. However as population data for some demographic variables was available, it is useful to consider how the sample compares with the population. Table 6 details the data for the sample compared with the data for the population. The population data was calculated by accessing the player data for all rugby league players participating in the National Rugby League for the two playing seasons of the study (National Rugby League, 2000).

The sample data was compared to the population data by calculating z scores. It can be concluded that age of the sample differs significantly from the population. Specifically the participants within the study were older than the population of elite rugby league players. In a three year prospective study with elite rugby league players, Gibbs (1993) reported a mean sample age of 22.07 years. The number of years playing and number of first grade games played does not differ between the sample and population. Non-random sampling precluded generalising beyond the current sample; however similar demographic characteristics were shared on the variables of experience and number of first grade games played.

Table 6

Comparison of demographic results for the study sample and population

Variable	Sample Mean	Population Mean	z score
Age (years)	24.3	21.70 ±.5	4.95
Experience (years)	4.8	3.71 ±.4	0.05
Total first grade games (games)	66.8	60.04 ±10.3	1.15

The playing position of participants was compared according to year of involvement in the study. A chi-square analysis revealed no significant difference between the duration of involvement in the research and participant playing position ($\chi^2(2, N=53)=0.33$, $p=0.85$). This result indicated that no differences were apparent between playing positions at each year of involvement in the study. The effect size of this result was small (d=0.08, $p=0.85$). Table 7 details the frequency data for the year of involvement and playing position. Across the two years of data collection, 21 forwards and 32 backs participated in the research.

Table 7

Frequency distribution of playing position according to year of involvement in study

Year	Forward	Back	Total
One	6	9	15
Two	3	3	6
One and two	12	20	32
Total	21	32	53

Analysis of playing and injury data

Tables 8-18 detail the descriptive data for playing and injuryresults. These variables were considered in relation to the year of involvement in the study. Accompanying each table are the results and discussion of the ANOVA and homogeneity of variance tests.

Table 8 details the mean number of games played during the season of each year, according to playing position and year of involvement in the study. A two-way ANOVA indicated no significant difference in the mean number of games played by forwards and backs ($F_{1, 47}$=0.08, *p*=0.78). Further, there was no significant difference in the mean number of games according to the year of participation in the study ($F_{2, 47}$=0.07, *p*=0.93). There was no significant interaction effect between playing position and year of participation in the study($F_{2, 47}$=0.38, *p*=0.69). Therefore, regardless of year of participation in the study, forwards and backs did not differ on the mean number of games played. A total of 26 games were played each season by the team. All participants played an average of 11.00 ±7.09 games per season.

Table 8

Mean ±SD number of total games played each season according to playing position and year of involvement in study

Year	Position	Mean
One	Forward	12.00 ±4.00
Two	Forward	10.80 ±10.45
One and two	Forward	10.96 ±7.82
One	Back	9.75 ±6.70
Two	Back	15.00 ±8.25
One and two	Back	10.65 ±6.46

Table 9 details the mean number of minutes played per season, according to playing position and year of involvement in the study. A two-way ANOVA indicated no significant difference in the mean number of minutes played per season by forwards and backs ($F_{1, 47}$=1.54, *p*=0.22). Further, there was no significant difference in the mean number of minutes played per season according to the year of participation in the study ($F_{2, 47}$=0.06, *p*=0.94).

There was no significant interaction effect between playing position and year of participation in the study for number of minutes played per season ($F_{2, 47}$=0.42, *p*=0.66). Therefore, regardless of the year of participation in the study, forwards and backs did not differ significantly on the number of minutes played per season. A total of 2080 minutes of game time were played each season by the team. All participants played an average of 664.47 ±485.33 minutes per season.

Table 9

Mean ±SD number of minutes played per season according to playing position and year of involvement in study

Year	Position	Mean
One	Forward	550.83 ±191.35
Two	Forward	539.60 ±604.17
One and two	Forward	577.29 ±466.77
One	Back	688.75 ±493.61
Two	Back	1087.50 ±629.16
One and two	Back	701.77 ±482.02

Table 10 details the mean number of minutes played per game, according to playing position and year of involvement in the study. A two-way ANOVA indicated a significant difference for the mean number of minutes played per game for playing position ($F_{1, 47}$=16.78, p=0.00). The effect size of the difference (η^2=0.37) indicated that 37% of the variation in total minutes played per game can be explained by playing position. A power analysis indicated a large effect for both the variance explained and the power of the result (d=0.98) (Cohen, 1988).

Significant differences for the mean number of minutes played per game according to the year of participation in the study were not evident

($F_{2, 47}$=0.09, p=0.91). The interaction effect between playing position and year of participation in the study was not significant ($F_{2, 47}$=0.45, p=0.64).

A total of 80 minutes were played for each game. It is clear through examination of Figure 2 that forwards played fewer minutes than backs. Typically forwards played 46.59 ±12.21 minutes per game and backs played 61.54 ±15.37 minutes per game.

Table 10

Mean ±SD number of total minutes played per game according to playing position and year of involvement in study

Year	Position	Mean
One	Forward	48.69 ±20.01
Two	Forward	41.20 ±7.90
One and two	Forward	47.87 ±10.13
One	Back	66.90 ±7.93
Two	Back	71.50 ±6.47
One and two	Back	64.38 ±14.81

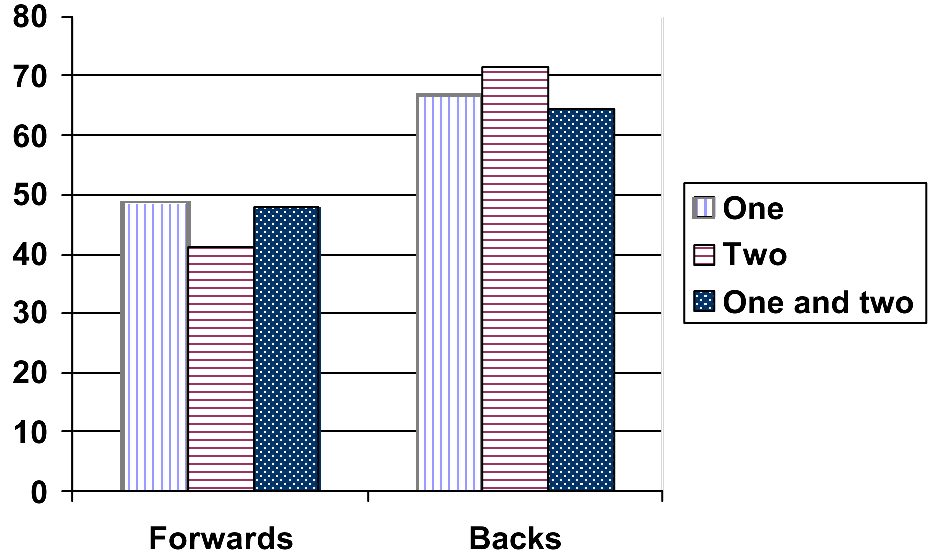


Figure 2 **Average minutes played per game according to playing position and year of involvement in the study**

Table 11 details the mean number of injuries sustained each season, according to playing position and year of involvement in the study. A two-way ANOVA indicated a significant difference in the mean number of injuries sustained for playing position ($F_{1, 47}$=4.21, p=0.04). The effect size of the difference (η^2=0.27) indicated that 27% of the variation in number of injuries sustained each season can be explained by playing position. A power analysis indicated a large effect for the variance explained, however the effect size of the power analysis was small (d=0.24) (Cohen, 1988).

The mean number of injuries sustained each year of participation in the study were not significantly different ($F_{2, 47}$=0.63, p=0.54). There was not a significant interaction effect between playing position and year of participation in the study ($F_{2, 47}$=1.30, p=0.28). Forwards sustained 2.16 ±1.12 injuries per season and backs sustained 0.94 ±1.01 injuries per season (see Figure 3).

Table 11

Mean ±SD number of total injuries sustained per season according to playing position and year of involvement in study

Year of involvement	Position	Mean
One	Forward	2.67 ±.57
Two	Forward	1.20 ±1.00
One and two	Forward	2.15 ±1.44
One	Back	0.95 ±0.84
Two	Back	0.75 ±1.5
One and two	Back	0.97 ±1.02

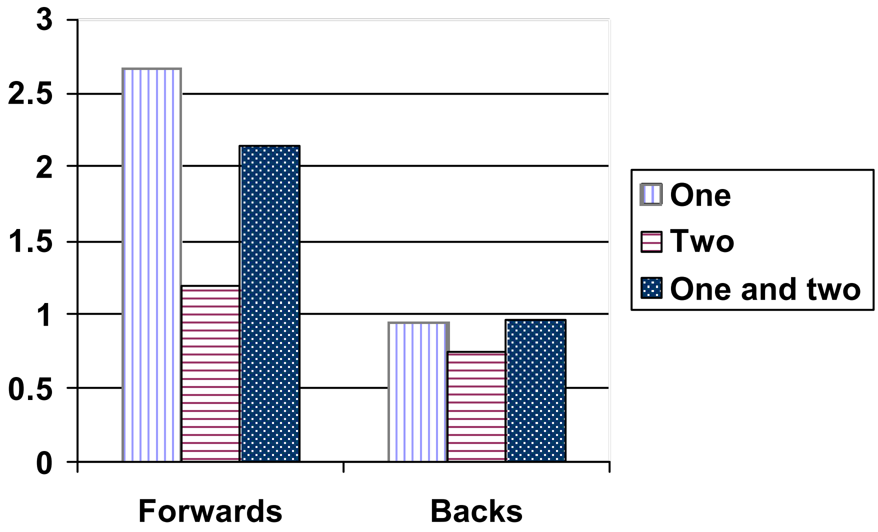


Figure 3 **Average number of injuries according to playing position and year of involvement in the study**

Injury incidence indicates the average number of new injuries sustained over a certain number of game hours (O'Connor, 2000). There was 1 player for each of the 6 forward and 7 back positions on the field at any one time for a period of 80 minutes (1.33 hours). The injury exposure for forwards over the 26 competition games each season for the 2 years was calculated as 415 player-position game hours (6 (forwards) x 1.33 (hours) x 26 (games) x 2 (years)). The injury exposure for backs over the 26 competition games each season for the 2 years was calculated as 484 player-position game hours (7 (forwards) x 1.33 (hours) x 26 (games) x 2(years)). The total number of injuries (N=46 for forwards and N=30 for backs) was then considered in relation to the number of player-position game hours. Forwards (110.84) had a higher overall rate of injury than backs (61.98) per 1000 playing hours.

Table 12 details the mean number of days missed per season through injury, according to playing position and year of involvement in the study. A two-way ANOVA indicated no significant difference in the mean number of days missed per injury by forwards and backs ($F_{1, 47}$=0.58, *p*=0.45). Further, there was no significant difference in the mean number of days missed per injury according to the year of participation in the study ($F_{2, 47}$=0.88, *p*=0.42). There was no significant interaction effect between playing position and year of participation in the study for number of days missed per injury ($F_{2, 47}$=0.29, *p*=0.75).

Therefore, regardless of year of participation in the study, forwards and backs did not differ on the mean number of days missed per season due to injury. All participants missed an average of 37.76±43.36 days per season due to injury. Despite forwards sustaining more injuries than backs, the number of days missed each season due to injury did not differ.

Table 12

Mean ±SD number of days missed per season through injury, according to playing position and year of involvement in study.

Year	Position	Mean
One	Forward	43.87 ±41.70
Two	Forward	46.11 ±49.37
One and two	Forward	46.23 ±48.71
One	Back	28.67 ±35.54
Two	Back	31.00 ±46.14
One and two	Back	32.45 ±38.71

Table 13 details the mean number of games missed per injury according to playing position and year of involvement in the study. A two-way ANOVA indicated no significant difference in the mean number of games missed per injury played by forwards and backs ($F_{1, 47}$=0.28, *p*=0.60). Further, there was no significant difference in the mean number of games missed per injury according to the year of participation in the study ($F_{2, 47}$=0.37, *p*=0.69). There was no significant interaction effect between playing position and year of participation in the studyfor the number of games missed per injury($F_{2, 47}$=0.85, *p*=0.43). Therefore, regardless of year of participation in the study, forwards and backs did not differ significantly on the number of games missed due to each injury sustained. The mean number of games missed for each injury for each season was 3.41 ±4.73.

Table 13

Mean ±SD number of games missed per injury according to playing position and year of involvement

Year	Position	Mean
One	Forward	5.82 ±8.94
Two	Forward	3.83 ±5.27
One and two	Forward	3.89 ±3.09
One	Back	1.86 ±1.82
Two	Back	3.03 ±4.26
One and two	Back	3.58 ±4.99

Table 14 details the mean number of games missed per season due to injury, according to playing position and year of involvement in the study. A two-way ANOVA indicated no significant difference in the mean number of games missed per season by forwards and backs ($F_{1, 47}=0.58$, $p=0.45$). Further, there was no significant difference in the mean number of games missed per season according to the year of participation in the study ($F_{2, 47}=0.88$, $p=0.42$). There was no significant interaction effect between playing position and year of participation in the study ($F_{2, 47}=0.29$,

p=0.75). Therefore, regardless of year of participation in the study, forwards and backs did not differ significantly on the number of games missed due to injury for each season. The mean number of games missed per season due to injury was 5.23 ±6.15.

Table 15 details the mean age of participants according to each level of injury severity. ANOVA revealed that age of participants did not vary according to injury severity ($F_{2, 47}$=1.06, p=0.36).

Table 14

Mean ±SD number of games missed per season through injury according to playing position and year of involvement

Year	Position	Mean
One	Forward	10.33 ±6.65
Two	Forward	3.60 ±4.15
One and two	Forward	6.54 ±6.75
One	Back	7.25 ±5.25
Two	Back	2.00 ±4.00
One and two	Back	4.17 ±6.02

Table 15

Mean ±SD age of participants according to level of injury severity

Injury severity	Mean age
Minor	24.54 ±3.23
Moderate	23.21 ±3.49
Severe	24.85 ±3.48

Table 16 details the mean number of physiotherapy treatments attended according to playing position and year of involvement in the study. A two-way ANOVA indicated a significant difference in the mean number of physiotherapy appointments attended by playing position ($F_{1, 47}$=7.90, p=0.00). Examination of Table 16 indicated that forwards attended more physiotherapy treatments than backs. The effect size of the difference ($\eta 2$=0.14) indicated that 14% of the variation in number of physiotherapy treatments can be explained by playing position. A power analysis indicated a medium effect for the variance explained and a large effect size for power (d=0.79) (Cohen, 1988).

There was no significant difference in the mean number of physiotherapy appointments attended by participants according to the year of participation in the study ($F_{2, 47}$=0.89, p=0.42). There was no significant interaction effect between playing position and year of participation in the study for the number of physiotherapy appointments attended ($F_{2, 47}$=1.26, p=0.29). The mean number of physiotherapy appointments attended was 41.95 ±15.54 and 26.41 ±15.99 visits for forwards and backs respectively.

Table 16

Mean ±SD number of physiotherapy treatments according to playing position and year of involvement

Year	Position	Mean
One	Forward	45.83 ±19.43
Two	Forward	27.25 ±16.88
One and two	Forward	44.08 ±13.31
One	Back	20.55 ±20.94
Two	Back	23.67 ±8.90
One and two	Back	30.95 ±18.13

As year of involvement did not result in significantly different numbers of physiotherapy treatments, the scores for this variable were combined. Table 17 details the mean number of physiotherapy treatments for each injury severity and playing position. A two-way ANOVA indicated significant differences in the mean number of physiotherapy appointments attended by participants according to their injury severity ($F_{2, 52}$=3.50, p=0.04). A Bonferroni post hoc test (α=0.05) indicated that participants with a minor injury had significantly fewer physiotherapy treatments than participants with moderate ($p<0.01$) or severe ($p<0.01$) injuries. The post hoc analysis indicated no significant difference between participants with moderate and severe ($p>0.05$) injury ratings. The relationship between playing position, injury severity and number of physiotherapy appointments is illustrated in Figure 4.

The effect size of the difference ($\eta^2=0.12$) indicated that 12% of the variation in number of physiotherapy treatments can be explained by injury severity. A power analysis indicated a medium effect ($d=0.63$) (Cohen, 1988).

Table 17

Mean ±SD number of physiotherapy treatments according to injury severity.

Injury severity	Playing position	Mean
Minor	Back	18.71 ±18.57
	Forward	42.50 ±17.99
Moderate	Back	32.83 ±19.54
	Forward	36.33 ±16.22
Severe	Back	31.50 ±15.45
	Forward	48.00 ±12.95

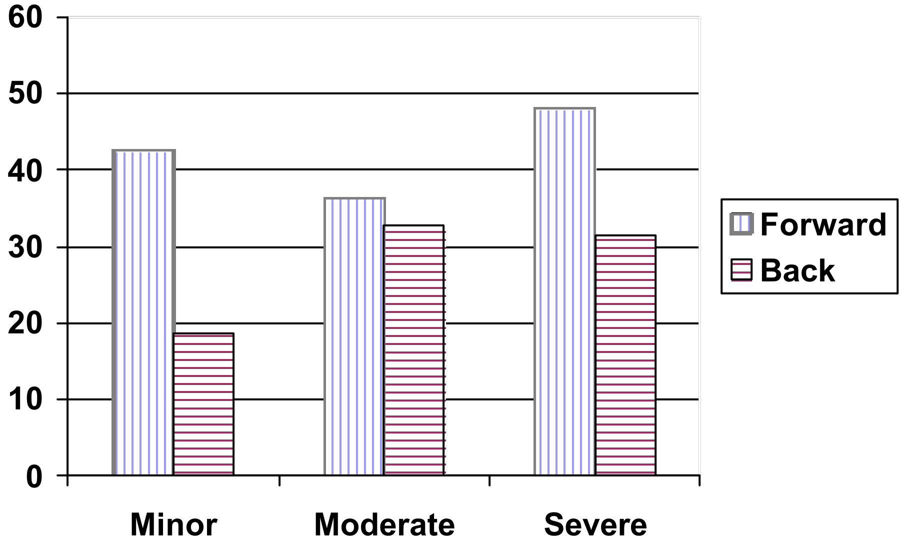


Figure 4 **Average number of physiotherapy treatments according to injury severity**

Table 18 indicates the frequency of injury severity according to year of participation in the study. A chi-square analysis indicated no significant difference for participants' injury severity when comparing the year of inclusion in the study (χ^2 (4, N=53)=3.58, p=0.47).

Table 18

Injury severity according to each year of participation.

		Severity of	injury	
Year	Minor	Moderate	Severe	Total
One	2	4	0	6
Two	4	6	5	15
One and two	12	11	9	32
Total	18	21	14	53

As injury severity did not vary according to the year of participation in the study, the responses were collated. Table 19 indicates the frequency of injury severity according to playing position. A chi-square analysis indicated no significant difference for participants according to playing position (χ^2 (2, N=53)=4.16, p=0.13).

The rating of injury severity percentage was similar to that reported by Gibbs (1993). The percentage of participants sustaining a severe injury was similar to that reported by Gabbett (2001). Gabbett (2001) does not report percentages for moderate or minor injury, preventing any further comparison. A comparison of these percentages is detailed in Table 20. Examination of the table suggested that the present sample shared similar injury characteristics to the professional rugby league players involved in earlier research (Gabbett, 2001; Gibbs, 1993). The percentages reported within the current study differ to that reported by Hodgson Phillips et al. (1998) who reported only 15.6% severe injuries in the British professional rugby league competition.

Table 19

Injury severity according to playing position

Injury severity	Playing position	Frequency
Minor	Back	14
	Forward	4
Moderate	Back	14
	Forward	9
Severe	Back	6
	Forward	8

Table 20

Injury severity comparing the present study with Gabbett (2001) and Gibbs (1993)

Injury severity	Study	Percentage
Minor	Current	34.0%
	Gabbett (2001)	not reported
	Gibbs (1993)	37.6%
Moderate	Current	39.6%
	Gabbett (2001)	not reported
	Gibbs (1993)	34.8%
Severe	Current	26.4%
	Gabbett (2001)	30.0%
	Gibbs (1993)	27.6%

The playing and injury variables were compared with spearman rank order correlation coefficients. Table 21 details significant correlations between playing and injury variables. The number of games played in the first year was positively correlated with the number of games played in the second year ($p<0.01$), number of minutes played (in years one and two) ($p<0.01$), and number of physiotherapy treatments ($p<0.01$) in the first year. Significant relationships were not evident between the number of injuries incurred with number of games played ($p>0.05$), minutes played

($p>0.05$), or total game minutes ($p>0.05$) for either the first or second year of data collection. Therefore, the number of injuries a player sustained was not significantly related to the number of games or number of minutes played. Number of injuries in years one and two were positively correlated ($p<0.05$), as were the number of games missed in years one and two ($p<0.01$).

Table 21

Pearson correlation coefficients for game and injury variables

	Number games yr 1	Number games yr 2	Number minutes yr 1	Number minutes yr2	Game minutes yr 1	Game minutes yr 2	Number Injuries yr 1	Number injuries yr 2	Games missed yr 1	Games missed yr 2	Percentage missed yr 1	Percentage missed yr 2	Physio yr 1	Physio yr 2
Number games yr 1	1.00													
Number games yr 2	0.58**	1.00												
Number minutes yr 1	0.95**	0.52**	1.00											
Number minutes yr 2	0.63**	0.95**	0.63**	1.00										
Game minutes yr 1	0.56**	0.23	0.74**	0.39*	1.00									
Game minutes yr 2	0.28	0.52**	0.38*	0.68**	0.39*	1.00								
Number injuries yr 1	0.25	0.20	0.16	0.17	0.06	-0.22	1.00							
Number injuries yr 2	-0.12	0.06	-0.19	-0.05	-0.23	-0.15	0.46*	1.00						
Games missed yr 1	-0.10	-0.08	-0.14	-0.10	-0.06	-0.27	0.68**	0.51**	1.00					
Games missed yr 2	0.10	-0.36*	0.05	-0.38*	0.01	-0.50**	0.46*	0.41*	0.54**	1.00				
Percentage missed yr 1	-0.15	-0.18	-0.17	-0.21	-0.05	-0.28	0.24	0.28	0.40*	0.52**	1.00			
Percentage missed yr 2	0.20	-0.45**	0.19	-0.42*	0.17	-0.53**	0.28	-0.35*	0.26	0.86**	0.41*	1.00		
Physio yr 1	0.51**	0.18	0.49**	0.26	0.41*	-0.01	0.51**	0.11	0.41*	0.35*	0.19	0.24	1.00	
Physio yr 2	0.21	0.16	0.17	0.17	0.04	-0.15	0.24	0.26	0.26	0.38*	0.21	0.25	0.35*	1.00

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

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

Analysis of TAIS data

The TAIS was included within the current research as the measure to determine attentional style of participants. Hypotheses tested in relation to this scale included the relationship (if any) between TAIS subscales and injury experience of participants. ANOVA was utilised to compare year of participation, playing position, and injury severity for each of the TAIS variables. Where appropriate, power and eta^2 of significant results will be reported. Test-retest reliability of the scale was assessed utilising the sign-test and the relationship between subscales was tested with spearman's rho.

ANOVA was utilised to compare the TAIS subscales according to year of participation in the study. Examination of the Levene statistic indicated homogeneity of variance ($p>0.05$) for the TAIS subscales, hence the appropriateness of parametric analysis. A summary of the ANOVA results are detailed in Table 22. Results indicated no significant differences between participants who participated in the first, second, or first and second year of the study. Therefore, the TAIS subscales were combined according to the year of inclusion.

Table 22

ANOVA results for TAIS subscales comparing year of participation

TAIS subscale	F	p	Levene statistic	p
BET	1.91	0.16	2.10	0.13
BIT	0.87	0.43	0.58	0.56
OET	1.38	0.26	0.05	0.95
OIT	0.69	0.51	0.24	0.80
OBS	0.48	0.62	0.34	0.71
IEX	1.87	0.17	0.91	0.41
NAE	0.77	0.47	0.55	0.58
PAE	2.63	0.08	0.78	0.46
INT	0.33	0.72	0.00	0.97
EXT	0.27	0.76	1.14	0.33
NAR	1.73	0.19	0.98	0.38
RED	0.16	0.85	0.76	0.47
INFP	0.39	0.68	0.88	0.42
BCON	0.51	0.60	0.86	0.43
CON	1.16	0.32	0.10	0.90
SES	1.01	0.37	0.29	0.75
PO	0.55	0.58	0.57	0.57

To examine playing position between the TAIS items,a one-way ANOVA was calculated. The ANOVA revealed no significant difference between TAIS scores for participants according to playing position. A summary of the results are detailed in Table 23. The hypothesis that playing position and TAIS subscale scores would be related was not supported. Heterogeneity of variance was evident for OIT (overload by internal information) ($p<0.05$). As this data was not normally distributed, a Kruskal-Wallis analysis was calculated. The result of the non-parametric analysis supported the result of the ANOVA. Scores on OIT did not significantly differ according to playing position of participants (H=0.23, p=0.63). As TAIS scores did not differ according to playing position of participants the subscale scores were combined and are summarised in Table 24.

Table 23

Summary statistics of ANOVAresults of TAIS subscales according to playing position

TAIS subscale	F	p	Levene statistic	p
BET	0.24	0.63	0.40	0.53
OET	2.10	0.15	4.15	0.05
BIT	0.05	0.83	1.43	0.24
OIT	1.91	0.17	7.41	0.01
NAR	0.00	0.99	0.00	0.96
RED	0.00	0.97	2.32	0.13
INFP	0.03	0.86	1.94	0.17
BCON	5.19	0.03	1.79	0.19
CON	0.67	0.42	0.53	0.47
SES	0.03	0.87	2.21	0.14
PO	0.12	0.74	0.26	0.61
OBS	0.00	1.00	1.21	0.27
EXT	2.02	0.16	0.92	0.34
INT	0.18	0.68	0.07	0.79
IEX	0.00	0.93	0.51	0.48
NAE	0.26	0.61	0.00	0.99
PAE	1.11	0.30	1.93	0.17

Table 24

Summary of TAIS variable demographics for all participants

TAIS subscale	Mean	Minimum	Maximum
BET	13.57 ±2.66	7	19
OET	18.41 ±4.97	8	31
BIT	18.29 ±3.76	6	29
OIT	15.27 ±4.52	7	31
NAR	23.97 ±4.86	13	34
RED	27.31 ±4.92	17	40
INFP	45.81 ±6.61	30	62
BCON	22.44 ±5.06	9	37
CON	47.12 ±6.35	36	65
SES	23.37 ±6.70	9	41
PO	20.35 ±3.21	12	28
OBS	15.89 ±3.86	9	32
INT	22.37 ±4.82	12	35
EXT	30.83 ±5.99	19	45
IEX	15.98 ±4.02	9	29
NAE	14.71 ±6.77	2	44
PAE	23.55 ±3.86	16	34

Consideration was then given to the representativeness of the sample to the larger population of elite athletes in Australia. Normative data for 1798 Australian athletes at the Australian Institute of Sport is provided (Bond & Nideffer, 1992). Table 25 details the data for the sample compared with the data for the elite male athletic population aged 18-24 years. As standard deviations were not reported by Bond and Nideffer (1992), comparison of the two groups of means was not possible. Non-random sampling precluded generalising beyond the current sample; however TAIS scores between the sample and the population of elite Australian athletes were similar. Therefore, it was assumed that results attained by the current sample were comparable with other elite athletes.

Table 25

Comparison of TAIS subscale results for the study sample and population (Bond & Nideffer, 1992)

TAIS subscale	Sample mean	Population mean
BET	13.57	14.70
OET	18.41	17.70
BIT	18.29	19.00
OIT	15.27	14.70
NAR	23.97	25.70
RED	27.31	27.00
INFP	45.81	43.90
BCON	22.44	21.70
CON	47.12	47.70
SES	23.37	21.50
PO	20.35	20.20
OBS	15.89	15.60
INT	22.37	28.90
EXT	30.83	28.90
IEX	15.98	22.20
NAE	14.71	14.00
PAE	23.55	20.40

To examine test-retest reliability of the TAIS on the two occasions of data collection, a sign test was calculated. The results are summarised in Table 26. Results indicated significant differences on the variables of obsessiveness ($p<0.05$), and positive expression of affect ($p<0.05$). OBS (obsessiveness) scores increased and PAE (positive expression of affect) decreased from year one to year two. Due to these differences, obsessiveness and positive expression of affect will be considered for both years one and two where appropriate. For the remainder of variables, results indicate stability in the scores over time.

Table 26

Significance values of the sign test for TAIS variables on test-retest from year one to year two

TAIS subscales	Z	p
BET year one - BET year two	0.44	0.07
BIT year one - BIT year two	0.40	0.12
OET year one - OET year two	0.38	0.50
OIT year one - OIT year two	0.72	0.06
OBS year one - OBS year two	0.59	0.03
IEX year one - IEX year two	0.30	0.50
NAE year one - NAE year two	0.43	0.75
PAE year one - PAE year two	0.27	0.01
INT year one - INT year two	0.68	1.00
EXT year one - EXT year two	0.32	0.50
NAR year one - NAR year two	0.59	0.45
RED year one - RED year two	0.35	0.50
INFP year one – INFP year two	0.28	0.50
BCON year one – BCON year two	0.60	1.00
SES year one - SES year two	0.67	0.75
PO year one - PO year two	0.68	0.50
CON year one – CON year two	0.72	0.18

The relationship between subscales on the TAIS was tested with spearman's rank order correlation. A summary of the correlation coefficients and significance values is detailed in Table 27. A degree of interscale correlation would be expected due to item overlap on some subscales. To account for this, Nideffer (1976) correlated the mean correlation (corrected for bias) between subscale items and the total subscale score. The percentage of non-subscale items that exceeded the mean item-scale were calculated with the highest percentage of overlap being only 2.2%. Due to multiple correlation comparisons, alpha was set at 0.01.

The relationship between age and TAIS subscale scores was examined with spearman rank order correlations. Table 28 details a summary of the results of this analysis. A significant positive correlation was found between age and participant's abilty to NAR (narrow) their focus (*rho*=0.36, *p*=0.02). Similarly, a significant positive correlation was evident between age and self-esteem (*rho*=0.75, *p*<0.01) supported results by Bond and Nideffer (1992).

Table 27
Spearman's rho correlations between TAIS variables

	BET	BIT	OET	OIT	OBS	IEX	NAE	PAE	INT	EXT	NAR	RED	INFP	BCON	CON	SES	PO
BET	1.00																
BIT	0.46	1.00															
OET	-0.10	-0.24	1.00														
OIT	-0.14	-0.02	0.54*	1.00													
OBS	-0.11	-0.22	0.38*	0.23	1.00												
IEX	0.29	0.49*	0.10	0.09	-0.14	1.00											
NAE	-0.17	0.14	0.21	0.30	0.06	0.27	1.00										
PAE	0.09	0.31	-0.06	-0.16	-0.22	0.33	0.09	1.00									
INT	0.05	0.11	0.11	0.39*	0.17	-0.15	0.14	-0.22	1.00								
EXT	0.39*	0.35*	0.15	0.11	-0.07	0.62[b]	0.24	0.46*	-0.07	1.00							
NAR	0.14	0.00	-38*	-0.12	0.06	-0.06	-0.34	0.07	0.13	-0.02	1.00						
RED	-0.13	-0.30	0.34	0.55*	0.59*	-0.17	0.19	-0.18	0.26	0.01	0.13	1.00					
INFP	0.64*	0.64*	-0.30	-0.36*	-0.36*	0.48*	-0.14	0.51*	-0.01	0.41*	0.14	-40*	1.00				
BCON	0.03	0.02	0.54*	0.40*	0.13	0.23	0.56*	0.00	0.04	0.26	-0.33	0.23	-0.06	1.00			
CON	0.49*	0.44*	0.08	0.03	-0.13	0.68*	0.24	0.44*	0.15	0.63*	0.14	-0.16	0.59*	0.13	1.00		
SES	0.49*	0.54*	-0.19	-0.19	-0.20	0.58*	-0.07	0.52*	-0.07	0.65*	0.32	-0.22	0.71*	-0.14	0.72*	1.00	
PO	0.38*	0.23	0.00	-0.09	-0.08	0.23	-0.17	0.44*	-0.03	0.52*	0.32	-0.07	0.49*	-0.08	0.61*	0.65*	1.00

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

Table 28

Spearman rank correlations for age and TAIS subscale scores

Variable	Spearman rank order correlation	p
BET	0.01	0.97
OET	-0.19	0.21
BIT	0.13	0.40
OIT	-0.08	0.62
NAR	0.35	0.02*
RED	-0.21	0.16
INFP	0.26	0.08
BCON	-0.08	0.59
CON	0.05	0.76
SES	0.75	0.00**
PO	0.05	0.76
OBS	-0.05	0.73
INT	0.15	0.34
EXT	-0.17	0.26
IEX	0.00	0.99
NAE	-0.24	0.11
PAE	0.17	0.26

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

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

The relationship between injury severity and TAIS subscale scores was examined by ANOVA. Homogeneity of variance for all variables was not significant (p>0.05), thus indicating the appropriateness of parametric analysis. Means and standard deviations of TAIS subscale scores for each injury severity are detailed in Table 29. A summary of the ANOVA analyses and Levene statistic are detailed in Table 30. Results indicated significant differences according to injury severity for the TAIS subscale scores of OIT (overloaded by internal information) ($F_{2, 47}$=3.30, *p=0.*04), SES (self-esteem) ($F_{2, 47}$=4.94, *p=0.*01), and PO (physical orientation) ($F_{2, 47}$=5.88, *p=0.*01). The hypothesis that injury severity and TAIS subscale scores would be related was partially supported.

A Bonferroni post hoc test (α=0.05) indicated that participants with a minor injury severity had a significantly lower mean OIT score (*M*=14.39 ±3.15) than those who had a severe injury severity (*M*=18.21 ±5.45). The effect size of the difference for the OIT subscale (η^2=0.12) indicated that 12% of the variation in OIT can be explained by severity of injury. A power analysis indicated a medium effect (d=0.60) (Cohen, 1988).

A Bonferroni post hoc test (α=0.05) indicated that participants with a minor injury severity had a significantly higher mean SES score (*M*=27.50 ±6.07) than those who had a severe injury severity (*M*=20.29 ±6.31). The effect size of the difference for the SES subscale (η^2=0.17) indicated that 17% of the variation in SES can be explained by severity of injury. A power analysis indicated a medium effect (d=0.79) (Cohen, 1988).

A Bonferroni post hoc test (α=0.05) indicated that participants with a minor injury severity had a significantly lower mean PO score (*M*=21.83 ±3.43) than those who had a severe injury severity (*M*=21.00 ±2.90). In addition, participants with a moderate injury severity had a significantly lower mean PO score (*M*=18.28 ±2.49) than those who had a severe injury severity (*M*=21.00 ± 2.90). The effect size of the difference for the PO subscale (η^2=0.19) indicated that 19% of the variation in injury severity can be explained by playing position. A power analysis indicated a small effect (d=0.19) (Cohen, 1988).

Table 29

Mean TAIS subscale scores according to injury severity

TAIS subscale	Minor	Moderate	Severe
BET	13.44 ±2.91	13.52 ±3.12	12.92 ±2.05
OET	16.56 ±4.57	19.62 ±4.27	19.29 ±5.11
BIT	19.39 ±2.20	17.81 ±3.88	17.86 ±4.85
OIT	14.39 ±3.15	14.95 ±4.67	18.21 ±5.45
NAR	25.61 ±4.92	23.38 ±4.18	23.29 ±5.89
RED	27.72 ±5.14	27.42 ±4.68	27.50 ±5.08
INFP	48.72 ±5.82	45.71 ±7.11	44.79 ±7.76
BCON	21.56 ±4.38	22.38 ±4.86	23.79 ±4.64
CON	49.06 ±6.78	48.33 ±7.38	44.79 ±5.00
SES	27.50 ±6.07	24.24 ±6.83	20.29 ±6.31
PO	21.83 ±3.43	21.00 ±2.90	18.28 ±2.49
OBS	14.11 ±2.89	15.61 ±2.69	15.79 ±3.04
INT	20.67 ±3.82	22.71 ±4.61	24.21 ±5.37
EXT	32.78 ±5.88	33.19 ±6.92	28.93 ±4.94
IEX	16.89 ±4.03	15.71 ±3.48	15.50 ±3.81
NAE	12.89 ±4.86	14.76 ±6.34	14.29 ±4.53
PAE	25.22 ±4.28	24.71 ±3.74	23.43 ±3.27

Table 30

ANOVA results for TAIS subscales according to injury severity

TAIS subscale	Levene statistic	p	F	P
BET	1.44	0.25	0.21	0.81
OET	0.79	0.46	2.4	0.10
BIT	2.39	0.10	1.05	0.36
OIT	1.78	0.18	3.30	0.04*
NAR	0.99	0.38	1.26	0.29
RED	0.15	0.86	0.02	0.98
INFP	0.89	0.42	1.51	0.23
BCON	1.05	0.36	0.91	0.41
CON	0.97	0.39	1.82	0.17
SES	0.18	0.84	4.94	0.01*
PO	1.69	0.19	5.88	0.01*
OBS	0.44	0.65	1.82	0.17
INT	2.05	0.14	2.44	0.10
EXT	1.08	0.35	2.32	0.11
IEX	0.38	0.68	0.68	0.51
NAE	1.70	0.19	0.60	0.55
PAE	0.21	0.81	0.90	0.41

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

Analysis of EASQ data

The EASQ was included within the current research as the measure of explanatory style of participants. Hypotheses tested in relation to this scale included the relationship (if any) between EASQ subscales and injury experience of participants. ANOVA was utilised to compare year of participation, playing position, and injury severity for each of the EASQ variables. Where appropriate, power and eta^2 of significant results will be reported. Test-retest reliability of the scale was assessed utilising the sign-test and the relationship between subscales was tested with spearman's rho.

To examine test-retest reliability of the EASQ questionnaires on the occasions of data collection, a Friedman test was calculated. The mean ranks for each occasion of testing are summarised in Table 31. This analysis indicated no significant differences between the subscales over time (χ^2 (3)=-2.69, p=0.44).

Table 31

Friedman test for reliability of EASQ subscales

Testing occasion	Mean rank
One	2.70
Two	2.85
Three	2.10
Four	2.35

To examine playing position between the EASQ items, a one way ANOVA was calculated for each subscale. The ANOVA revealed no significant difference between EASQ scores for participants according to playing position. A summary of the results are detailed in Table 32. The hypothesis that playing position and EASQ subscales would be related was not supported.

Table 32

Summary statistics of ANOVA results of EASQ subscales according to playing position

EASQ subscale	F	p	Levene statistic	p
Global	0.01	0.96	0.29	0.59
Stable	0.14	0.71	0.00	0.96
Internal	0.03	0.87	0.00	0.95

The relationship between the subscales on the EASQ was tested with spearman's rho. A summary of the correlation coefficients and significance values is detailed in Table 33. Significant relationships emerged between several of the variables. These included internal and stable ($p<0.05$) and global and stable ($p<0.01$).

Table 33

Spearman rank order correlation coefficient values between EASQ subscales

Variable	Internal	Global
Internal	1.00	
Global	0.25	1.00
Stable	.036*	0.67**

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

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

The relationship between age and EASQ subscale scores was examined with spearman rank order correlations. Table 34 details the results of this analysis. A significant correlation was found between age and the globality ($p<0.05$) and stability subscales ($p<0.01$). Therefore, older athletes reported less global and stable attributions to negative events.

Table 34

Spearman rank order correlation coefficient values between EASQ subscales and age

Subscale	ρ	p
Internal	0.12	0.44
Global	0.34	0.03
Stable	0.50	0.00

The relationship between injury severity and EASQ subscales scores was examined by ANOVA. Homogeneity of variance for all variables was not significant ($p>0.05$), thus indicating the appropriateness of parametric analysis. Means and standard deviations of EASQ subscale scores for injury severity are detailed in Table 35. A summary of the ANOVA analyses and Levene statistic are detailed in Table 36. Results indicated significant differences according to injury severity for the EASQ subscales of global ($F_{2, 53}$=5.91, p=0.00) and stable ($F_{2, 53}$=5.60, p=0.00). The hypothesis that injury severity and EASQ subscale scores would be related was partially supported.

A Bonferroni post hoc test (α=0.05) indicated that participants with a minor injury severity had a significantly higher mean global score (M=4.89 ±1.30) than those who had a moderate (M=3.79 ±1.33) or severe (M=3.52

±0.95) injury severity. The effect size of the global subscale (η^2=0.19) indicated that 19% of the variation in the global score can be explained by severity of injury. A power analysis indicated a large effect (d=0.86) (Cohen, 1988).

A Bonferroni post hoc test (α=0.05) indicated that participants with a minor injury severity had a significantly higher mean stable score (*M*=3.91 ±0.83) than those who had a moderate (*M*=3.08 ±0.84) injury severity. The effect size of the stable subscale (η^2=0.18) indicated that 18% of the variation in the stable score can be explained by severity of injury. A power analysis indicated a large effect (d=0.84) (Cohen, 1988).

Table 35

Mean EASQ subscale scores according to injury severity

EASQ subscale	Minor	Moderate	Severe
Internal	3.00 ±1.12	2.74 ±0.97	2.59 ±0.77
Global	4.89 ±1.30	3.79 ±1.33	3.52 ±0.95
Stable	3.91 ±0.83	3.08 ±0.84	3.20 ±0.87

Table 36

ANOVA results for EASQ subscales according to injury severity

EASQ subscale	Levene statistic	p	F	p
Internal	0.49	0.61	1.33	0.27
Global	1.64	0.20	5.91	0.00
Stable	0.13	0.88	5.60	0.00

Explanatory style is measured according to an individual's placing along a continuum from high to low scores. When the attribution to a bad event is explained as external, specific and short then 'optimism' is a reasonable descriptor (Peterson, 1991b). However, caution should be made in considering people as a typology and therefore, characterising them as 'optimistic' or 'pessimistic'. Whilst mindful of this, Peterson (1988) split his respondents at the 50th percentile and compared the responses according to those with higher and lower optimism.

To examine the relationship between injury severity and explanatory style, a chi-square analysis was conducted. Explanatory style was initially categorised across five categories of very pessimistic, pessimistic, average, optimistic, and very optimistic. Distribution of respondents across these categories resulted in insufficient numbers in 86.7% of cells when chi-square was calculated.

This violation of the assumption of chi-square resulted in distributing respondents across three categories including pessimistic, average, and optimistic. The very pessimistic and very optimistic participants were merged into the pessimistic and optimistic categories, respectively. The reduction of variables allowed data to be spread across fewer cells and to increase the expected frequencies within cells (Howell, 1999). The chi-square analysis between player injury rating and explanatory style was significant (χ^2 (4, N=53)=9.76, p=0.04). This result indicated associations between injury severity and a person's explanatory style. The effect size of this result was moderate (d=0.43, p=0.04). Table 37 details the frequency data for the injury severity and explanatory style of respondents. Examination of the table indicated that those participants with higher levels of pessimism had a higher proportion of severe ratings of injury.

Table 37

Frequency of explanatory style and injury severity

Severity	Explanatory Style			
	Pessimistic	Average	Optimistic	Total
Minor	5	4	9	18
Moderate	11	5	5	21
Severe	11	2	1	14
Total	27	11	15	53

The relationship between the subscales on the EASQ and TAIS questionnaires was examined by spearman's rank order correlations. The results of this analysis are detailed in Table 38. Due to the number of correlations between the subscales, alpha was set at 0.01.

The correlation coefficients were significant between several variables, and indicated the global subscale was positively correlated with BET (broad external focus), BIT (broad internal focus), INFP (information processing), and SES (self-esteem). Further, the global subscale was negatively correlated with OIT (overload by internal information). The stable subscale was positively correlated with BIT (broad internal focus), INFP (information processing), and SES (self-esteem). The stable subscale was negatively correlated with OET(overload by external information). The hypothesis that EASQ and TAIS subscale scores would be related was supported.

Table 38

Spearman rank order correlation values between EASQ subscales and TAIS subscales

TAIS subscale	Internality subscale	Globality subscale	Stability Subscale	Overall
BET	-0.03	0.47**	0.43*	0.28*
OET	0.24	-0.46*	-0.35**	-0.28*
BIT	0.15	0.42**	0.52**	0.32*
OIT	-0.06	-0.35**	-0.43*	-0.40**
NAR	0.06	0.27*	0.28*	0.22
RED	-0.12	-0.23	-0.28*	0.36**
INFP	0.22	0.53**	0.59**	0.58**
BCON	-0.12	-0.21	-0.26*	-0.15
CON	0.23	0.20	0.31*	0.32*
PO	0.13	0.27*	0.42*	0.42**
SES	0.20	0.48**	0.52**	0.52**
OBS	0.02	-0.13	-0.31*	-0.28*
EXT	0.05	0.15	0.14	0.04
INT	-0.03	-0.03	-0.18	-0.18
IEX	0.10	0.20	0.26*	0.24
NAE	-0.33*	-0.04	-0.15	0.25
PAE	0.17	-0.08	0.02	0.14

* correlation is significant at the 0.05 level (2 tailed).

** correlation is significant at the 0.01 level (2 tailed)

Discriminant function analysis

Discriminant function analysis is considered a highly robust statistical technique, able to withstand most minor violations of the assumptions underlying this procedure (Klecka, 1980). Nonetheless, assumptions of discriminant function analysis including linearity, multivariate normality, outliers, homogeneity of variance-covariance matrices, multicollinearity and singularity were assessed. Following screening, 53 cases remained for inclusion in the direct entry discriminant function analysis procedure. Independent variables for the analysis were mean scores of the subscales for the TAIS and EASQ. The dependent variable in the analysis was the injury severity for each of the participants.

The discriminant function analysis used the simultaneous estimation method for analysis. This method was chosen for two reasons. The first was to include all of the independent variables as their relationship with injury severity had not been previously explored. During step-wise method for analysis in discriminant function analysis, variables are eliminated as they are found to be irrelevant. Thus, as the sample size to independent variable ratio declines, the results become less stable and generalisable (Hair et al., 1989). The second reason for choosing the simultaneous estimation method was to avoid this problem.

The participants were divided into groups according to their injury status. These groups included those who experienced minor injury (n=18), moderate injury (n=21), and severe injury (n=14). When interpreting the results of this study, consideration should be given to the unequal size of these groups. However, the robust nature of discriminant function analysis allows for some deviation from the assumptions of normality (Klecka, 1980). Whilst this may result in some discrepancy in the accuracy of results, it is argued that significance tests remain useful in such circumstances, "… when the main interest is in a mathematical model that predicts well, or serves as a reasonable description of, the real world" (Smith & Spinks, 1995, p.384). When discrepancies in group size occur, Klecka (1980) recommended use of the percentage of correct classifications. In instances where these are high it may be assumed that any violation of normality assumptions is not problematic.

Opinions differ on guidelines for appropriate sample size for discriminant function analysis. These vary from the number of cases exceeding the number of variables by greater than two (Klecka, 1980) to each group including at least 20 observations per variable (Hair et al., 1988). Hair et al (1988) acknowledged that their recommendation is an ideal and, "… may be difficult to maintain in practice" (p. 258). Whilst an adequate sample size is an important consideration, the main assumptions of discriminant function analysis include normality, linearity, avoidance of multicollinearity between variables, and homogeneity of variance-covariance matrices.

Normality assumes that the predictor scores are normally distributed from the same randomly selected population (Tabachnik & Fidell, 1989). Normality was assessed via boxplot, outlier and normality tests for each of the predictor variables. Mahalanobis distances were calculated for each of the independent variables. Chi-square results revealed no multivariate outliers (see Appendix F).

To meet the assumption of linearity, all pairs of predictors should be best represented by a straight line. Matrix scatterplots should be utilised to determine that all relationships are linear through visual inspection of the graphs (Hair et al., 1989; Ntoumanis, 2001). Analysis of matrix scatterplots for the dataset indicated that the predictors had a linear relationship. With the derived data meeting assumptions of normality and linearity, the risk of Type II errors were reduced (Ntoumanis, 2001).

When variables are highly correlated they can be described as being multicollinear (Hair et al., 1988). Multicollinearity is problematic in discriminant function analysis as variables may be deemed redundant as they do not contribute any new information. The predictor variables should have correlation values of less than r=0.90. Examination of the pooled within-groups matrices indicated no multicollinearity between the variables (see Appendix G). This finding indicated the relative independence of the TAIS and EASQ variables measuring attentional and explanatory style, respectively. This correlation procedure assumed that participants were drawn either from the same population or from group populations with identical dispersion patterns and was a better estimate of the relationship between the variables than the total correlations. The correlation procedure encompassed the total range of participant data and was influenced by the differences in the group centroids (Klecka, 1980).

The Box's M test indicated whether homogeneity of variance-covariance can be assumed. Such an assumption indicates that homogeneity of variance existed between the variables, thus allowing the null hypothesis to be rejected with confidence (Tabachnick & Fidell, 1989). A violation of this assumption is likely to affect the classification analysis (Ntoumanis, 2001). Given the sensitivity of the test, significant results are often found (Hair et al., 1989). In the current study, a non significant value of 0.28 indicated that homogeneity of variance-covariance could be assumed.

The current research had a sample size of 53 participants; which was adequate for discriminant function analysis of the data (Klecka, 1980). The four underlying assumptions of normality, linearity, non-multicollinearity, and homogeneity of variance-covariance were all met. With these criteria satisfied, discriminant function analysis was applied to the data.

Table 39 shows the mean and standard deviation values for each of the independent variables categorised by the injury groups. The groups differed across independent variables including OIT, SES, PO, global, and stable. These differences were supported by significant ANOVA results (see Appendix H).

Table 39

Mean ±SD values for TAIS and EASQ subscale values forsporting injury severity

TAIS subscale	Minor injury	Moderate injury	Severe injury
BET	13.44 ±2.91	13.52 ±3.12	12.92 ±2.05
OET	16.55 ±4.56	19.61 ±4.27	19.28 ±5.10
BIT	19.38 ±2.20	17.80 ±3.88	17.85 ±4.84
OIT	14.38 ±3.14	14.92 ±4.67	18.21 ±5.45
NAR	25.61 ±4.92	23.38 ±4.17	23.28 ±5.89
RED	27.72 ±5.14	27.42 ±4.67	27.50 ±5.08
INFP	48.72 ±5.81	45.71 ±7.11	44.78 ±7.75
BCON	21.55 ±4.38	22.38 ±4.86	23.78 ±4.64
CON	49.05 ±6.77	48.33 ±7.38	44.78 ±4.99
SES	27.50 ±6.07	24.23 ±6.82	20.28 ±6.30
PO	21.83 ±3.43	21.00 ±2.89	18.28 ±2.49
OBS	14.11 ±2.89	15.61 ±2.69	15.78 ±3.04
EXT	32.78 ±5.87	33.19 ±6.91	28.92 ±4.93
INT	20.67 ±3.81	22.71 ±4.60	24.21 ±5.36
IEX	16.89 ±4.02	15.71 ±3.48	15.50 ±3.81
NAE	12.89 ±4.86	14.76 ±6.33	14.28 ±4.53

Table 39 continued

Mean ±SD values for TAIS and EASQ subscale values for sporting injury severity

TAIS subscale	Minor injury	Moderate injury	Severe injury
PAE	25.22 ±4.27	24.71 ±3.74	23.42 ±3.27
Internal	3.00 ±0.66	2.74 ±0.70	2.59 ±0.82
Global	4.89 ±1.29	3.79 ±1.33	3.52 ±0.95
Stable	3.90 ±0.82	3.08 ±0.83	3.20 ±0.73

Participants with minor injuries reported less likelihood of being overloaded by internal information, had higher self-esteem, higher physical orientation, higher global attributions, and more stable attributions. Tukey post-hoc tests indicated that the scores on these scales were highest for athletes with minor injuries, next highest were those with moderate injuries, and lowest were those with severe injuries.

Discriminant functions are a linear combination of the independent variables, in the case of the current research, TAIS and EASQ variables. The aim of discriminant functions is to maximise the separation between the groups (Klecka, 1980). This was derived from a canonical method, which identifies the first derived function as the one which best discriminates between the groups. The second derived function is the second best discriminator and so on. The maximum number of discriminant functions is the number of groups minus one. Two discriminant functions were identified in this study.

Following the derivation of the discriminant functions, they were tested for significance. Testing for significance of the functions is measured through eigenvalues, canonical correlations and Wilk's lambda. The values of the eigenvalues, percentage of variance explained and canonical correlations within this research are detailed in Table 40.

Table 40

Eigenvalues, percentage of variance and canonical correlations

Function	Eigenvalue	% of variance	Canonical correlations
1	2.86	80.40	0.86
2	0.70	100.00	0.64

Eigenvalues were calculated by dividing the between-groups sums of squares by the within-groups sums of squares. The larger an eigenvalue, the greater power the function has to discriminate between the groups (Klecka, 1980). Function one had the largest eigenvalue and therefore, was the most powerful discriminator. Function one was more than four times greater than function two. The relative percentage values indicated the amount of discriminating power held by each of the functions. The relative percentage is calculated by dividing the value of the eigenvalue into the sum total of all of the eigenvalues. The first function accounted for 80.4% of the variance between the groups while the second function contributed a further 19.6% of the variance between the groups.

Canonical correlations are a measure of association which are interpreted in similar fashion to a Pearson product-moment correlation (Klecka, 1980). The value of a canonical correlation coefficient is it's usefulness in determining the strength of the relationship between the groups and the function. Unlike the relative percentage of variance of the eigenvalue, the canonical correlation values for each function are not relative measures. Function one had a high canonical correlation which indicated a strong relationship with the injured participants. Whilst the relative percentage of variance for function two was relatively small, the canonical correlation is moderate to high. These results indicated that the two functions were meaningful in their ability to explain group differences.

Group differences in the discriminant variables were measured for each function by using the eigenvalues to calculate Wilks' lambda (?). Wilks' lambda varies in value between zero and one. A value of zero indicated the group centroids were greatly separated and high discrimination existed between the groups. A value approaching one suggests less discrimination between the groups. When Wilks' lambda equals one, the groups do not differ and the centroids are identical. Wilks' lambda for function one was low (0.15) which indicated separation between the group centroids. By converting Wilks' lambda to a chi-square approximation, function one was significant ($p<0.001$). A function which lacks significance is not considered to offer practical or theoretical importance (Klecka, 1980). Therefore, as function two was not significant, it did not warrant further interpretation. Values for Wilks' lambda, chi-square, degrees of freedom and significance are displayed in Table 41.

Table 41

Residual discrimination and tests of significance

Test of function(s)	Wilks' Lambda	Chi-square	Df	p
1	0.15	76.13	40	0.00
2	0.59	21.46	19	0.31

Having established the presence of two discriminant functions, the variables which contributed most to the functions were then identified. Standardised canonical discriminant function coefficients were used for this purpose with the larger absolute magnitude of the coefficient indicating a greater contribution to the function. Coefficient values above 0.30 were considered to be good predictors (Ntoumanis, 2001). The coefficient values are detailed in Table 42.

A low score on information processing (INFP) was the largest contributor to function one, followed by the global subscale and reduced attentional focusing (RED). Function two gave greater weight to lower levels of extroversion (EXT), lower scores on control (CON) and higher self-esteem (SES). Further interpretation of the discriminant function can be achieved by examining the structure coefficients. The structure coefficients are the correlation between the discriminating variables and the standardized canonical discriminant functions. High correlations indicate good predictive ability (Ntoumanis, 2001). The structure coefficients are detailed in Table 43.

Physical orientation (PO), self-esteem (SES), and overload by internal factors (OIT) were the important variables in function one. Therefore, it can be concluded that a higher physical orientation, higher self-esteem and lower overload by internal factors were the greatest predictor variables of the attentional and explanatory variables investigated in the study. These variables provided the greatest discrimination between the groups. Therefore, the hypothesis that attentional variables will discriminate between professional rugby league players with differing severity of injury ratings was partially supported. The EASQ subscales did not discriminate between professional rugby league players with differing severity of injury ratings, Therefore, that hypothesis was not supported.

Table 42

Standardised canonical discriminant function coefficients

Independent variable	Function one	Function two
INFP	-2.10	0.40
Global	1.75	-0.34
RED	1.53	0.72
OIT	-1.12	0.51
OBS	-1.03	-0.19
BIT	0.99	0.07
Stable	-0.80	0.65
EXT	0.76	-1.22
PO	0.75	0.18
NAR	-0.63	-0.16
SES	0.60	0.87
PAE	-0.58	0.16
CON	0.40	-0.96

Table 42 continued

Standardised canonical discriminant function coefficients

Independent variable	Function one	Function two
Internal	0.30	-0.12
IEX	-0.30	0.85
BCON	-0.25	0.73
NAE	0.21	-0.48
INT	-0.21	0.09
OET	-0.19	-0.74
BET	-0.03	-0.21

Table 43

Structure matrix

Predictor variable	Function one	Function two
PO	0.29*	-0.06
SES	0.26*	0.09
OIT	-0.21*	0.09
INT	-0.18*	-0.11
CON	0.16	-0.06
Internal	0.13*	0.10
BCON	-0.11*	-0.01

Table 43 continued

Structure matrix

Predictor variable	Function one	Function two
PAE	0.11*	-0.01
Stable	0.18	0.44*
Global	0.24	0.32*
OET	-0.12	-0.28*
OBS	-0.13	-0.20*
NAR	0.10	0.18*
BIT	0.09	0.17*
EXT	0.16	-0.16*
NAE	-0.05	-0.16*
INFP	0.13	0.15*
IEX	0.08	0.12*
BET	0.05	-0.05*
RED	0.01	0.03*

* Largest absolute correlation between each variable and any discriminant function.

A graphical representation of group discrimination canbe illustrated through a territorial map. The X axis is represented by function one and the Y axis by function two. The discriminant coefficients were used to compute the position of participant data in the discriminant space. Examination of the territorial map allowed a visual representation of group separation and determination of group territories. Clusters of cases that form on the map are referred to as centroids (Klecka, 1980). The mean position of each group's centroid was found by determining the average of the coordinates for all of the cases belonging to that centroid (Figure 5). The discriminant functions are mathematically derived to maximise the distance between the centroids. Figure 6 indicated that the three groups of injured participants were quite distinct as the group centroids were well separated with minimal overlap of individual participant data. Separate scatterplots of each injury group are presented in Figures 7 to 9.

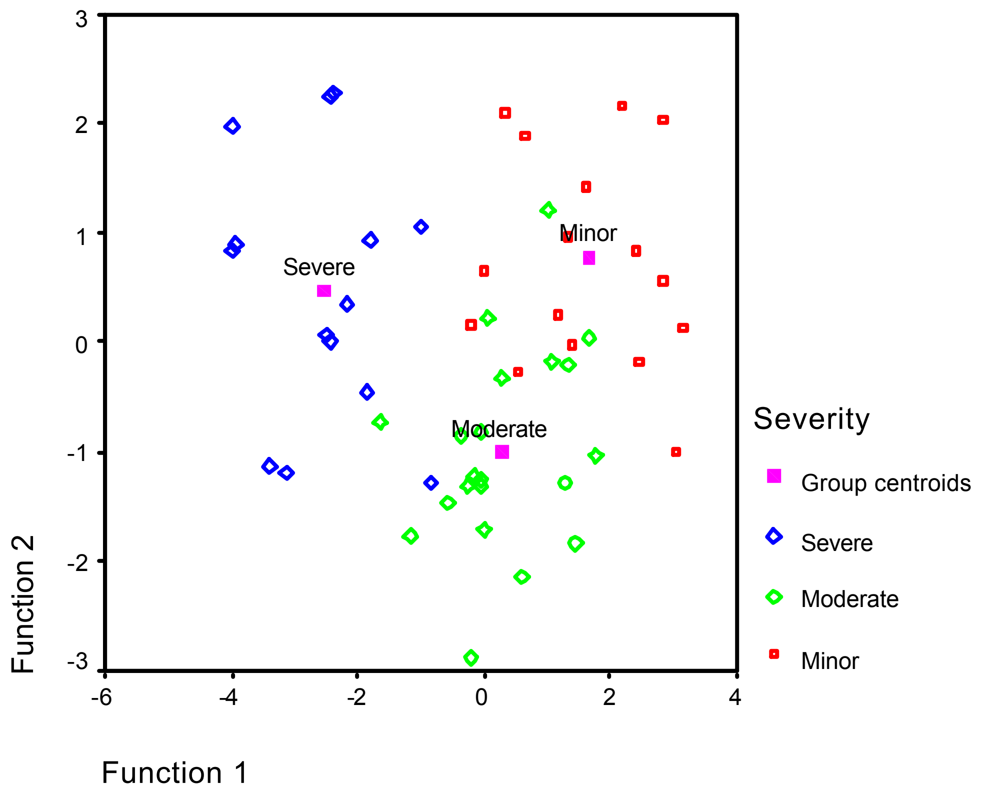
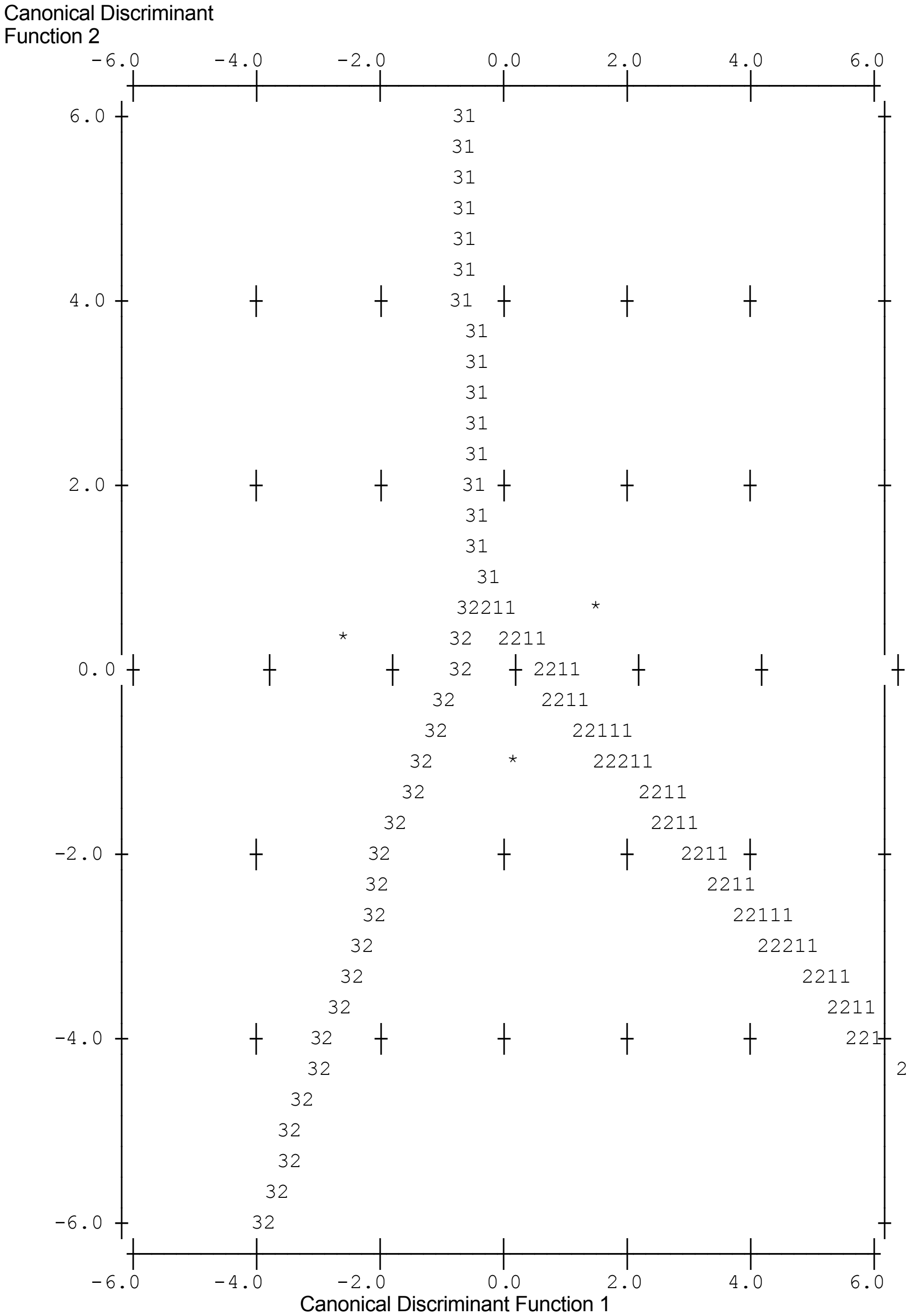


Figure 5 **Two function all-groups scatterplot**



Symbol	Group	Label
1	1	Minor
2	2	Moderate
3	3	Severe
*		Indicates a group centroid

Figure 6 **Territorial map**

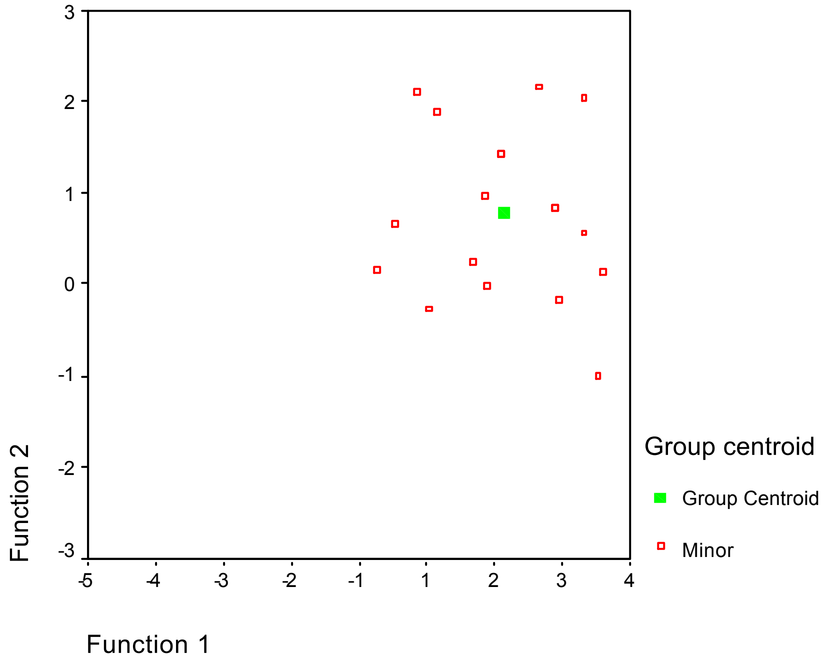


Figure 7 **Two function scatterplot for minor injury ratings**

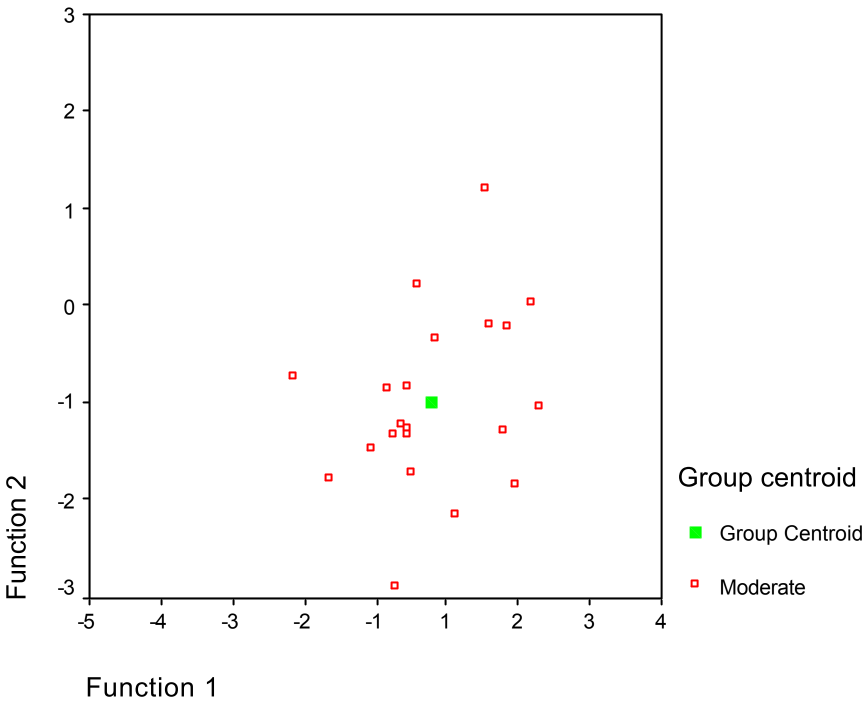


Figure 8 **Two function scatterplot for moderate injury ratings**

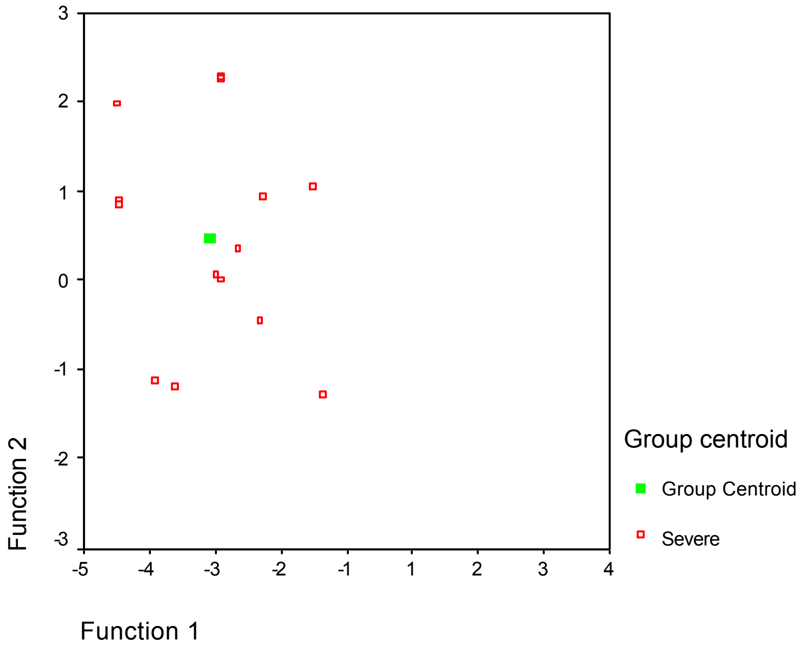


Figure 9 **Two function scatterplot for severe injury ratings**

Following interpretation of the discriminant functions, a classification procedure was used to determine to which group a participant most likely belonged. The process involved defining the 'distance' between each participant and each group centroid, with the participant being classified into the 'nearest' group.

The first step in the classification procedure involved using the discriminating variables to determine maximum group differences. These values, known as classification function coefficients are detailed in Table 44. The significance of these coefficients was not tested, their purpose being to allow calculation of the canonical discriminant functions (see Table 45) (Klecka, 1980).

To obtain a clearer picture of how the participants were classified, classification boundary lines from the territorial map (refer back to Figure 5, p. 190) were superimposed over the scatterplot for all groups of participants. The resulting territorial plot classification (see Figure 6) indicated the possible inclusion of an athlete with moderate injury in the severe injury group; an athlete with severe injury in the moderate injury group; and four to five athletes with moderate injuries in the minor injury group. One athlete with minor injuries may be classified into the moderate injury group.

Table 44

Classification function coefficients

		Severity	
Predictor	Minor	Moderate	Severe
BET	3.75	3.90	3.81
OET	1.26	0.86	0.13
BIT	0.62	0.96	0.84
OIT	-2.54	-2.40	-1.51

Table 44 continued

Classification function coefficients

		Severity	
Predictor	Minor	Moderate	Severe
NAR	1.25	1.48	1.80
RED	1.84	1.16	.49
INFP	5.48	5.21	3.78
BCON	-3.24	-4.68	-9.14
CON	4.86	4.79	8.80
SES	1.36	1.97	2.90
PO	7.81	7.51	8.08
OBS	-1.02	-.92	-1.15
EXT	4.31	4.44	4.93
INT	3.42	3.45	3.61
IEX	-2.53	-2.35	-3.00
NAE	-.46	-.14	.80
PAE	2.24	2.03	2.41
Internal	-2.97	-2.79	-3.18
Global	-1.44	-1.81	-1.88
Stable	3.74	3.29	2.66
Constant	155.0	152.82	168.29

Table 45

Canonical discriminant functions evaluated at group centroids

Predictor variable	Function one	Function two
Minor	1.66	0.78
Moderate	0.29	-0.99
Severe	-2.56	0.48

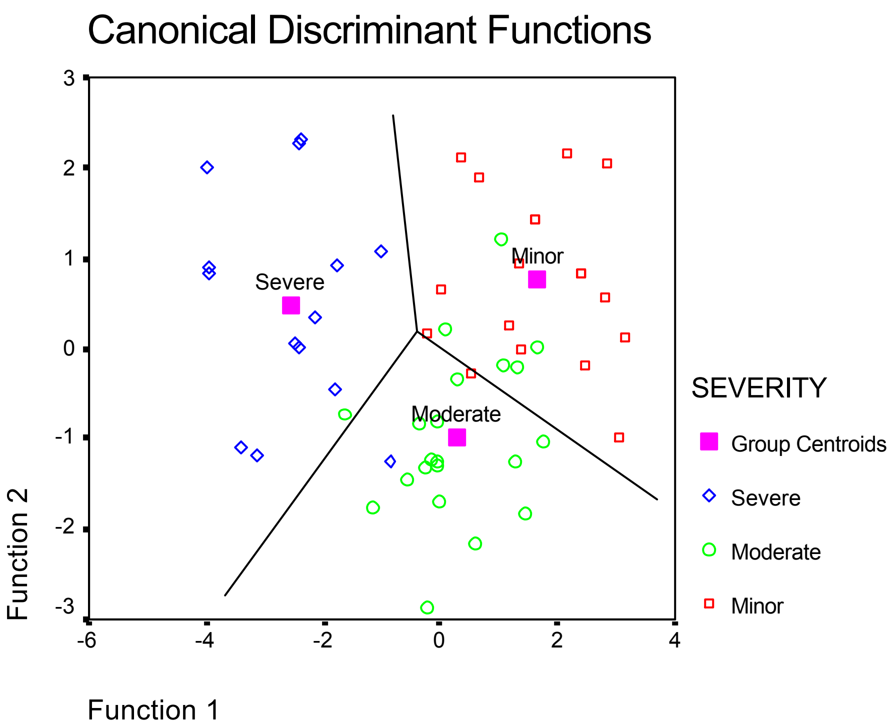


Figure 10 **Participant classification by territorial plot**

An additional measure of group differences was determined by deriving the percentage of known participants that were correctly classified. The extent to which the participants were correctly classified into their respective groups indicated the accuracy of the classification procedure and the degree of group separation.

The classification procedure correctly placed 88.9% of the minor injured group, 76.2% of the moderately injured group, and 92.9% of the severely injured group (see Table 46). Two moderately injured participants were classified as having minor injuries, of the moderately injured participants four were classified as having minor injuries and one was classified as having severe injuries. One severely injured participant was misclassified as having a moderate injury. A high percentage of the participants were correctly classified. This result permitted the conclusion that any violation of normality assumptions within the data was not problematic (Klecka, 1980).

Table 46

Classification matrix

Original group	Number of participants	Predicted group 1	2	3
Minor (1)	18	16 (88.9%)	2 (11.1%)	0 (0.0%)
Moderate (2)	21	4 (19%)	16 (76.2%)	1 (4.8%)
Severe (2)	14	0 (0.0%)	1 (7.1%)	13 (92.9%)

The original classification procedure derived the discriminant functions from all the available data cases, including the case to be classified. This may often result in an overly optimistic classification of the data cases (Hair et al., 1989). Therefore, a cross validation procedure was utilised to assess the consistency of the original classifications. In cross validation, each case is classified by the functions derived from all cases other than that case. The cross validation procedure often generates classifications that are lower than those of the original classifications (Tabachnick & Fidell, 1989). The results of the cross validation of the classification results are detailed in Table 47. This was the case in the current study where the cross validation procedure resulted in a decrease in the percentage of correct classifications to 54.7%. With three groups, 33.33% of correct predictions were possible with pure random assignment (Klecka, 1980). Those participants with minor injury (61.1%), moderate injury (42.9%) and severe injury (64.3%) all resulted in classification percentages greater than chance. Discriminant scores and classification information for each participant is presented in Table 48.

Table 47

Cross validated classification matrix

Original group	Number of participants	Predicted group 1	2	3
Minor (1)	18	11 (61.1%)	7 (38.9%)	0 (0.0%)
Moderate (2)	21	8 (38.1%)	9 (42.9%)	4 (19.0%)
Severe (2)	14	1 (7.1%)	4 (28.6%)	9 (64.3%)

Table 48

Participant discriminant scores and classification information

Participant	Actual group	Highest group	Probability P(X/G) P(G/X)		2nd highest group P(G/X)		Discriminant Scores	
1	1	1	0.08	0.78	2	0.21	3.05	-0.98
2	1	2	0.45	0.68	1	0.22	-0.22	0.17
3	1	1	0.75	0.97	2	0.02	2.41	0.84
4	1	1	0.75	0.97	2	0.02	2.41	0.84
5	2	2	0.47	0.63	1	0.32	0.07	0.21
6	2	2	0.82	0.96	1	0.02	-0.25	-1.31
7	2	2	0.91	0.95	1	0.03	-0.05	-1.25
8	2	1	0.76	0.91	2	0.08	1.04	1.20
9	2	2	0.81	0.78	1	0.20	0.30	-0.33
10	2	2	0.88	0.95	1	0.02	-0.16	-1.23
11	2	2	0.15	0.99	3	0.00	-0.21	-2.86
12	2	2	0.48	0.98	1	0.01	0.61	-2.15
13	2	2	0.74	0.98	1	0.01	0.00	-1.70
14	3	3	0.67	0.97	2	0.02	-1.79	0.92
15	3	3	0.89	0.98	2	0.01	-2.42	0.01
16	3	3	0.11	1.00	2	0.00	-3.99	1.99
17	3	3	0.35	1.00	2	0.00	-3.95	0.90

Table 48 continued

Participant discriminant scores and classification information

Participant	Actual group	Highest group	Probability P(X/G) P(G/X)		2nd highest group P(G/X)		Discriminant Scores	
18	3	3	0.36	1.00	2	0.00	-3.95	0.83
19	3	2	0.50	0.89	3	0.09	-0.86	-1.26
20	3	3	0.91	0.97	2	0.02	-2.16	0.34
21	3	3	0.92	0.98	2	0.01	-2.50	0.07
22	1	2	0.74	0.70	1	0.29	0.53	-0.26
23	1	1	0.78	0.71	2	0.28	1.18	0.26
24	1	1	0.22	0.99	2	0.00	2.83	2.05
25	1	1	0.27	0.96	2	0.03	3.13	0.13
26	1	1	0.71	0.67	2	0.32	1.39	-0.01
27	1	1	0.34	0.99	2	0.00	2.17	2.16
28	1	1	0.18	0.93	2	0.04	0.35	2.10
29	1	1	0.45	0.87	2	0.12	2.47	-0.18
30	1	1	0.26	0.48	2	0.45	0.01	0.66
31	1	1	0.50	0.97	2	0.02	2.82	0.56
32	1	1	0.33	0.95	2	0.04	0.67	1.90
33	1	1	0.94	0.91	2	0.08	1.35	0.95
34	1	1	0.81	0.97	2	0.02	1.62	1.42

Table 48 continued

Participant discriminant scores and classification information

Participant	Actual group	Highest group	Probability P(X/G) P(G/X)		2nd highest group P(G/X)		Discriminant Scores	
35	1	1	0.81	0.97	2	0.02	1.62	1.42
36	2	2	0.26	0.89	3	0.10	-1.16	-1.75
37	2	1	0.75	0.76	2	0.23	1.65	0.03
38	2	2	0.80	0.91	3	0.04	-0.36	-0.84
39	2	2	0.35	0.91	1	0.08	1.45	-1.83
40	2	2	0.93	0.91	1	0.06	-0.06	-0.81
41	2	2	0.89	0.96	1	0.02	-0.06	-1.31
42	2	1	0.58	0.57	2	0.42	1.32	-0.20
43	2	2	0.58	0.83	1	0.16	1.29	-1.26
44	2	1	0.53	0.50	2	0.49	1.08	-0.17
45	2	2	0.33	0.63	1	0.36	1.77	-1.03
46	2	3	0.31	0.67	2	0.32	-1.65	-0.73
47	2	2	0.63	0.96	3	0.03	-0.56	-1.45
48	3	3	0.26	0.77	2	0.15	-1.02	1.07
49	3	3	0.21	0.99	2	0.01	-3.14	-1.18
50	3	3	0.20	0.99	2	0.00	-2.41	2.26
51	3	3	0.19	0.99	2	0.00	-3.41	-1.11

Table 48 continued

Participant discriminant scores and classification information

Participant	Actual group	Highest group	Probability P(X/G)	P(G/X)	2^{nd} highest group	P(G/X)	Discriminant Scores	
52	3	3	0.50	0.84	2	0.15	-1.83	-0.44
53	3	3	0.19	0.99	2	0.00	-2.40	2.31

Dependent variables in discriminant function analysis need to be measured at a nominal or ordinal level. Playing position and level of playing ability were two nominal categories that were analysed in relation to the attentional and explanatory style subscales. Both analyses resulted in single discriminant functions. The values for Wilks' lambda, chi-square, degrees of freedom and significance are displayed in Table 49. As the Wilks' lambda results were not significant, it was concluded that theoretical or practical utility could not be assumed. Therefore, no further discriminant function analysis was considered for these categories.

Table 49

Residual discrimination and tests of significance for playing position and playing grade

Discriminating variables	Test of function(s)	Wilks' Lambda	Chi-square	Df	p
Grade	1	0.50	28.81	20	0.09
Position	1	0.51	27.67	20	0.12

Summary of results

Participants in the current research were involved in either the first, second, or first and second year of the study. Regardless of the year(s) involved, participants did not significantly differ in age, the number of years playing rugby league, playing position or the total number of rugby league games played. The participants had played for a similar number of years, and in a similar number of first grade games as the population of professional rugby league players in Australia. The mean age of the sample was significantly higher than the population of professional rugby league players in Australia.

Analysis of the playing and injury data resulted in a number of relevant findings. Forwards and backs did not significantly differ in the number of games or minutes played per season. Backs played significantly more minutes per game than forwards. Forwards sustained more injuries per season than backs. Despite the difference in the number of injuries sustained, forwards and backs missed a similar number of games and days per season due to injury. For all participants, the more severe the injury sustained, the more physiotherapy treatments attended. For each season of participation, the number of games and minutes played, and number of physiotherapy treatments attended was significantly positively correlated.

For all participants, year of inclusion in the study did not result in significantly different TAIS score results. Similarly, forwards and backs did not differ on TAIS score results. The TAIS scores by the sample were comparable with scores attained by a population of elite Australian athletes.

Test-retest reliability of the TAIS items was satisfactory. Relationships were evident between TAIS subscales. The findings relating to inter-scale correlations were logically and internally consistent. TAIS subscale scores differed according to injury severity for OIT (minor and severe), SES (minor and severe) and PO (minor and severe; moderate and severe).

For all participants, year of inclusion in the study did not result in significantly different EASQ score results. Similarly, forwards and backs did not differ on EASQ score results. Test-retest reliability of the EASQ items was satisfactory. Relationships were evident between EASQ subscales. The findings relating to inter-scale correlations were logically and internally consistent. Age was found to be positively correlated with globality and stability subscales. EASQ subscale scores differed according to injury severity for global (minor and severe; minor and moderate), stable (minor and severe).

An aim of this research was to assess the relationship between attentional and explanatory style, as measured by the TAIS and EASQ and the outcome measure of injury severity. It was hypothesized that minor, relative to moderate and severe injury severity would score higher on the BET, BIT, NAR, INFP, SES, PO scales, and lower on the OET, OIT, and RED scales. Hypotheses were not formed on the scores on BCON, CON, OBS, IEX, NAE and PAE however they would be examined for any possible relationships. Results from the ANOVA’s revealed significant differences for the OIT, SES, and PO subscales from the TAIS. Results from the ANOVA have revealed significant differences for the global and stable subscales on the EASQ.

The Discriminant Function Analysis revealed the presence of two discriminant functions, however only the first of these functions was found to be significant ($p<.001$). Scores on overload by internal information (OIT), self-esteem (SES), physical orientation (PO), global attributions and stable attributions had significantly different mean scores between the three injury groups. Physical orientation, self-esteem and a lowered tendency to become overloaded by internal information were found to be the major contributors to the only significant function and were therefore, the most significant predictor variables.

Of all 53 participants, 84.9% were correctly classified into their respective groups by the weighted discriminant scores. When compared with the Wilks' Lambda and the canonical correlations, the percentage of correct classifications was the most intuitive measure of the amount of discrimination contained in the attentional and explanatory style variables. The predictive accuracy of the psychological variables as measured directly by the percentage of participants correctly classified was 51.6% greater than the expected value if the participants had been randomly assigned to groups.

Consideration of other discriminating variables including playing grade and playing position did not reveal theoretically significant functions. Thus, attentional and explanatory style characteristics do not discriminate between the playing grade and playing position of professional rugby league players.

Chapter five

Discussion

Rugby league is a fast paced contact sport whereby players are at high risk of injury which has negative physical and psychological consequences. Despite the popularity of rugby league, research on the aspects of the psychological aspects of the sport is limited. Two areas where understanding of injury may be gained include attentional and explanatory style. The aim of this thesis was to understand the role of attentional and explanatory characteristics in injured professional rugby league players. Physical orientation (PO), self-esteem (SES) and overload by internal information (OIT) were identified as significant contributors for discriminating between minor, moderate and severe injury in professional rugby league players.

The aim of the following chapter is to consider the results of the study in relation to existing literature. This chapter will first consider the descriptive results for the demographic variables. The comparison of forwards and backs will be considered in relation to the injury data and psychological variables. The analysis of the psychological inventories will then be discussed. Finally, the Discriminant Function Analysis will be considered.

Rugby league involves a complex skill set requiring body transport, object manipulation, and regulatory conditions in motion with intertrial variability (Magill, 2004). For the 13 players on each team, the playing positions are broadly categorised as forwards and backs (Huxley, 1988). With the aim of the game being to score more points than the opposition team, each team is permitted six tackles whilst in possession of the ball before the ball is 'handed over' to the opposition team for six tackles. The same players hold both offensive and defensive roles, depending upon which team has the ball (Gibbs, 1993). High impact physical collisions and tackles are an inherent feature of the game (Gabbett, 2002).

Forwards and backs did not significantly differ on the number of games or minutes played each season. This finding was supportive of previous research indicating that playing time is generally evenly distributed amongst players (O'Connor, 1997). The even distribution of time is likely due to an unlimited interchange rule which was in place at the time of data collection. The interchange rule allows a coach to rotate players whenever they wish, thus allowing fatigued players an opportunity to rest (Sheens, 1998).

The mean number of minutes played by forwards and backs in each game significantly differed. The mean minutes played shown in Table 10 (refer back to p.131) indicated that backs spent more time on the field than forwards. The large effect of this difference and the power of the result indicate the difference is unlikely due to a type II error (Cohen, 1988). The differences in minutes played were indicative of the physical requirements of the two positions. Forwards are typically involved in a greater amount of full body contact than backs. Due to the physical cost of such activity, a forward is more likely than a back to be rested for a period of time on the interchange bench (O'Connor, 1997).

Forwards and backs differed significantly in the number of injuries sustained each season. The mean number of injuries sustained are detailed in Table 11 (refer back to p.133) and indicate that forwards sustained more injuries than backs. The effect of the variance explained was large and power was small. This suggests that whilst there is a large difference between forwards and backs in terms of the number of injuries sustained, there is potential that a type II error may have occurred (Cohen, 1988). This difference between the positions was further supported by the rate of injury incidence. Forwards (110.84) had a higher overall rate of injury than backs (61.98) per 1000 playing hours. These results were consistent with previous research indicating higher injury rates for forwards in rugby league due to greater body contact in defence and attack (Alexander, Kennedy, & Kennedy, 1979; Gibbs, 1993; Gissane et al., 1997; O'Connor, 1995; Orchard & Seward, 1994).

Whilst forwards and backs differed in the number of injuries, they did not differ according to the number of days missed per season due to injury, number of games missed per injury, number of games missed per season due to injury, or severity of injuries sustained (refer back to Tables 12, 13, 14, and 19, respectively, pp. 136-138, 144). Both positions require players to participate fully in defence and attack with a combination of speed, stamina, strength and agility required. Therefore, it should be expected that any position in the team will be exposed to injury.

The number of playing days missed due to injury did not differ significantly between forwards and backs. Despite forwards sustaining more injuries than backs, the number of days missed each season due to injury did not differ. Factors explaining the similarity between positions may include forwards undertaking more treatment to facilitate recovery. A further reason is a possible expectation by coaches and players for forwards to experience more body contact during a game, be more familiar with injury, and to return to play as quickly as possible (Murray, 2004; Sheens, 1998).

Comparison of results in Table 15 (refer back to p. 130) indicated injury severity did not differ according to the age of the participants. This finding is consistent with a 16 year study in a sports medicine outpatient clinic (Requa, McCormick, & Garrick, 1996). Across a total of 51953 injuries for participants aged 14-44 years, the authors concluded that there were few consistent patterns of injury across sports as age increased. Further, they argued that rather than age being the discriminating variable across injury patterns, the specific type of sporting activity itself was more relevant. It is relevant that the participants in the research were asymptomatic at the commencement of the study. Therefore, there is a bias within the sampling in relation to age.

The number of physiotherapy treatments attended by forwards and backs differed significantly. The mean number of injuries sustained are detailed in Table 16 (refer back to p.140) and indicate that forwards attended more physiotherapy appointments than backs. Two-way ANOVA indicated significant differences in the mean number of physiotherapy appointments attended by participants according to their injury severity. The medium-large effect for power indicated that the likelihood of a type II error is small, thus suggesting a real difference (Cohen, 1988). Participants with a minor injury had significantly fewer physiotherapy treatments than participants with moderate or severe injuries. No significant difference was evident between participants with moderate and severe injury ratings. This finding is supportive of the conclusion that forwards sought more treatment for injury than backs. It would be expected that more severe injuries might require more treatment (Cunningham, 2004).

The severity of injury percentage was compared with previous studies (Gabbett, 2001; Gibbs, 1993; Hodgson et al, 1998) with a comparison of the figures in Table 20 (refer back to p.145) showing similarities between the current research and the findings by Gibbs (1993) and Gabbett (2001). Therefore, the current study has similar injury percentages to other Australian studies. Hodgson et al. (1998) reported a lower percentage of British professional rugby league players with severe injuries. The difference between the figures for Australian and British players may be due to playing frequency (Estell et al., 1995), ground conditions (Hodgson Phillips et al., 1998) and differing styles of play or coaching (Estell et al., 1995).

The sample in the current study was comparable to the larger population of professional rugby league players on the number of first grade games played, and years of experience. The sample was significantly older than the population of professional rugby league players

($p<0.05$). This is most likely as a result of the club's policy of recruiting experienced players (Sheens, 1998).

TAIS subscale scores did not differ according to year of involvement in the study or playing position (refer back to Tables 22 and 23, respectively, pp. 149, 151). Therefore, the hypothesis that TAIS subscale scores and playing position are related was not supported. This finding contrasted with TAIS subscale score differences found for rugby union players (Maynard & Howe, 1989). Specifically, Maynard and Howe (1989) found that halfbacks scored significantly higher on the broad external focus (BET) and reduced attentional focus (RED) subscales than other participants.

The difference between the studies may be explained due to inclusion of athletes from different football codes. In addition, the studies differed in their conceptualisation of playing position. Maynard and Howe (1989) compared players according to four playing positions of tight five, back row, halfbacks, and outside backs. Further, their analysis was conducted utilising three two-way multivariate analysis of variance, thus increasing the risk of type II error. Whilst not reported by the authors, the power of their results was small ($d = 0.08$).

Had the current study adopted the same operationalisation, it would have suffered similar limitations. Rugby league does not typically categorise players into the same playing positions as rugby union. Further, participants in the current study did not hold the same position for every game. Some players were moved to different positions within and between games whilst remaining within the broader categories of forwards and backs. These changes occurred due to strategy and in response to injured players (Sheens, 1998).

The similarity in TAIS scores may also be understood through an underlying assumption of attention. Nideffer (1981; 1990) argued that most sports require the four combinations of attentional processing (ie. broad external, broad internal, narrow external, and narrow internal). Therefore, it would be reasonable to suggest that attentional scores may not differ according to playing position.

There are no other reported TAIS results for professional rugby league players. The TAIS subscale scores of the sample were similar to the scores of elite athletes tested by the AIS (refer back to Table 25, p.154) (Bond & Nideffer, 1992). The population included 1798 athletes participating in elite athletic programs at the AIS. The current sample was 53 rugby league players participating in the National Rugby League competition. Whilst the Bond and Nideffer (1992) participants did not include rugby league players, all were competing at the elite level in their respective sports.

Test-retest reliability of the TAIS subscale (refer back to Table 26, p.156) indicated that 15 of the 17 subscales did not significantly differ between the first and second year of testing. Obsessiveness (OBS) increased and positive expression of affect (PAE) decreased from year one to year two. In the original reporting of the TAIS scale, Nideffer (1976) identified the lowest test-retest reliability coefficient to be 0.60 on the OBS scale. Therefore, OBS may be the least stable of constructs within the TAIS. OBS measures the tendency of an individual to worry. Therefore, with time should a person experience negative events their tendency to worry may increase and thus be less stable (Ievleva & Orlick, 1999).

Lazarus and Folkman (1984) suggested that cognitive appraisal of a stressful event includes both the primary and secondary appraisal of an event. Primary appraisal is the initial assessment of a situation and its meaning for the individual (for example, ‘The injury will stop me from playing’). Secondary appraisal is the determination by the individual as to whether they have the resources to cope with the situation (for example, ‘What can I do about this?’). The appraisal process is a transaction between the individual and the environment (Evans & Hardy, 1999). Therefore, the process of appraisal, particularly in relation to obsessive thinking (OBS) will be adaptive and dynamic and likely to change over time.

For the remainder of variables, the results indicated reliability in the scores over time. This result lends support to the conclusion that the TAIS is a useful measure. This finding is supportive of literature indicating that attentional, control and interpersonal variables to be relatively stable constructs (DePalma & Nideffer, 1977; Nideffer, 1976, 1977b, 1987; Nideffer & Pratt, 1982; Salmela & Ndoye, 1986; Summers et al., 1991; Zaichkowky, 1984).

Nideffer (1976a) presented the interscale correlations for the subscales on the TAIS. Significant correlations should be anticipated due to the overlapping items on some of the scales and due to the relatedness between some of the scales (Nideffer, 1976a; Van Schoyck & Grasha, 1981). The inter-scale correlations between the TAIS subscales of the current research were logically and internally consistent. A summary of correlations between some of the attentional subscales will be discussed in the following paragraphs.

A significant positive relationship was evident between scores on BET with IEX, INFP, CON, SES, and PO (refer back to Table 27, p.158). Nideffer (1976) found similar results with all the above variables being significantly positively correlated except for BET with IEX. This result indicated that athletes with greater environmental awareness and assessment skills (BET) were more likely to process information well (INFP), would seek greater control in interpersonal situations (CON), have higher self-esteem (SES) and have greater enjoyment of competitive physical activities (PO). These findings (including the positive correlation between BET and IEX) are logical when considered in the context of athletic performance. It would be reasonable for an individual who is able to integrate numerous external stimuli at once to process information effectively and seek to control of their environment (Reed, 1988). It is also likely that such a person would have feelings of self-worth reflective of their ability and thus seek environments (eg. sport) which include high levels of external stimulation.

A significant positive relationship was evident between scores on BIT with IEX, PAE, EXT, INFP, CON, and SES (refer back to Table 27, p.158). This result indicated that athletes with greater analytical planning skills (BIT) were more likely to express thoughts and ideas in front of others (IEX), express support and encouragement to others (PAE), had a greater tendency to assume leadership in social situations (EXT), were more likely to process information well (INFP), seek greater control in interpersonal situations (CON), and have higher self-esteem (SES). A significant negative relationship was evident between scores on BIT with RED. Therefore, participants with greater analytical planning skills (BIT) were less likely to make mistakes due to an inability to shift focus from an external to internal focus. These results supported the previous research of Nideffer (1976).

A significant positive relationship was evident between scores on OET with OIT, OBS, RED, and BCON (refer back to Table 27, p.158). A significant negative relationship was evident between scores on OET with NAR. This result indicated that athletes who make errors due to inappropriately focussing on irrelevant external stimuli (OET) were more likely to make mistakes due to distractions from internal thoughts (OIT) and an inability to shift attention from an external to internal focus (RED). Participants high on OET were also more likely to worry in relation to decisions and mistakes (OBS), and act impulsively rather than adhere to the rules of others (BCON). This result supported Nideffer's findings (1976). Turner and Gilliand (1977) rejected the hypothesis that the overloaded and reduced attention subscales (OET, RED, and OIT) and the WAIS (Digit span and Block design tests) were significantly related. Whilst the authors were unable to find a relationship with the behavioural measure, the results provided further support for significant correlations between the overload variables.

A significant positive relationship was evident between scores on OIT with NAE, INT, RED, and BCON (refer back to Table 27, p.158). This result supported the same finding by Nideffer (1976). Further, Nideffer and Bond (1989) found OIT and RED to be intercorrelated. Such results indicate that people who become distracted by internal stimuli (OIT) are also likely to have difficulty in expressing negative emotions (NAE), have a greater need for personal space (INT), and are more likely to act impulsively and less likely to follow rules. Nideffer (1990) reported a positive correlation between OIT and OBS which was not replicated in the present analysis. A significant negative relationship was evident between scores on OIT with INFP. Whilst Nideffer (1976) did not report this result, it is likely that an individual who has a lower capacity to enjoy a diversity of activity (INFP) would be more likely to make errors due to being distracted by internal thoughts (OIT).

A significant positive relationship was evident between scores on RED with OBS (refer back to Table 27, p.158). This finding indicated that participants who tend to worry or ruminate about mistakes (OBS) are more likely to make mistakes due to a failure to appropriately shift attention from an external focus to an internal one (RED). This result was consistent with Nideffer's (1976) findings. A significant negative relationship was evident between scores on OBS with INFP. Therefore, participants who tend to worry about mistakes (OBS) are less likely to enjoy a diversity of activity (INFP). This result was also consistent with Nideffer (1976).

A significant positive relationship was evident between scores on IEX with NAE, PAE, EXT, INFP, CON, and SES (refer back to Table 27, p.158). This finding indicated that participants who are willing to express their ideas in front of others (IEX) are more likely to confront issues and express anger (NAE), express support and encouragement to others (PAE), take on leadership roles in social settings (EXT), enjoy a diversity of activity (INFP), need to be in control in interpersonal situations (CON), and have high feelings of self-worth (SES). Nideffer (1976) found similar results with all the above variables being significantly positively correlated except for IEX with NAE. The relationship between intellectual expression (IEX) and negative expression of affect (NAE) is not surprising given the sample used in this study. The tendency for athletes who play football to exhibit higher levels of aggression has been found previously (Simpson & Newby, 1994). It therefore, follows that an athlete who is prepared to speak in front of others may also be likely to express feelings of anger and frustration.

A significant positive relationship was evident between scores on NAR with SES and PO (refer back to Table 27, p.158). Nideffer (1976) found similar results with narrowing focus (NAR) being significantly positively correlated with self-esteem (SES). However, NAR was not correlated with physical orientation and competitiveness (PO). A significant negative relationship was evident between scores on narrowing focus (NAR) with behavioural control (BCON). This result supported the same finding by Nideffer (1976). Both of these findings are logical in their conceptualisation. Success at a performance skill (in this instance ability to narrow personal focus) is likely to be related to feelings of higher self-worth. The relationship between personal efficacy and self-esteem has been long established (Heatherton & Polivy, 1991). It would follow that narrowing focus (NAR) and behavioural control (BCON) are negatively correlated. Therefore, an individual who is able to narrow focus effectively is less likely to make impulsive decisions and actions (Reed, 1988).

A significant positive correlation was evident between age and self-esteem (refer back to Table 28, p.159). This supported the findings of Bond and Nideffer (1992) who found that self-esteem increases as an individual ages. In a meta-analysis of self-esteem research across the lifespan, Trzesniewski, Donnellan, and Robins (2003) concluded that self-esteem remained least stable in early childhood. However, from adolescence through the lifespan, self-esteem typically increases and then decreases in a curvilinear fashion (Trezesniewski et al., 2003). It is likely that the increase through early adulthood occurs as social roles become established and stabilises through middle-adulthood as choices surrounding career and relationship are maintained. The decrease in self-esteem in the latter part of the lifespan is likely to be due to a decline in personal health and adjustment to the notion of changes in personal circumstances and potential reduced feelings of autonomy and agency (Erikson, 1985). The age group of the participants in the current study ranged from 19 to 31 years. Therefore, a finding of self-esteem increasing with age is consistent with the findings of Trezesniewski et al. (2003).

A significant positive correlation was found between age and ability to narrow focus (NAR). Older participants had a greater ability to narrow their focus and block out irrelevant stimuli. Whilst it could be speculated that age is a reflection of the amount of playing experience, experience did not significantly correlate with NAR. The relationship between age and NAR is supportive of a similar finding with rugby union players (Maynard & Howe, 1989). It can be concluded that a learning component may exist within the attentional variables. This is supported by attentional control training (Nideffer, 1978) which offers strategies for improving attentional style.

In contrast to the current study, Bond and Nideffer (1992) found age differences on 15 of the 17 TAIS subscales. The difference in results is likely due to the difference in age ranges. Bond and Nideffer's (1992) participant's ages ranged 54 years, compared with the current study of 12 years. The Bond and Nideffer (1992) study also included male and female participants from a variety of sports (N=36) compared with male athletes from a single sport.

Many studies that have utilised the TAIS have reported a broad age range of participants (13-67 years) (Bond & Nideffer, 1992; Maynard & Howe, 1989; Summers & Maddocks, 1986; Summers et al., 1991; Van Schyock & Grasha, 1981). Despite this, only two studies considered the possible relationship between age and the TAIS subscales (Bond & Nideffer, 1992; Maynard & Howe, 1989). As evidenced by the findings of Maynard and Howe (1989) and Bond and Nideffer (1992) and the current study, age is a relevant variable for understanding NAR and SES and Therefore, should be considered in future research. The TAIS manual (Nideffer, 1977a) does not discuss the suitability of participants to complete the scale in terms of age and it does not present age-related norms.

Age was significantly correlated with globality and stability (refer back to Table 34, p. 167). Therefore, older athletes reported attributions to negative events which were less global and stable. Literature pertaining to explanatory style generally does not refer to age of participants, other than the development of the Children's Attributional Style Questionnaire (CASQ) (Kaslow, Tannenbaum, & Seligman, 1978) for children aged 8 to 14 years. Explanatory style is considered to be a stable trait, however it can be changed through cognitive interventions (Reivich & Gillam, 2003). Therefore, the explanatory style of older athletes may differ compared to younger athletes in their explanatory style due to more experience and maturity.

EASQ subscale scores did not differ according to playing position (refer back to Table 32, p. 165). A hypothesis predicting a relationship between EASQ and playing position was not formed due to an absence of previous literature. This finding is similar to the similarity between playing positions on the TAIS subscales. The results may be due to a real lack of difference between the positions. Alternatively, the conceptualisation of two broad positions in the game may not identify subtle differences between the 9 playing positions on the field. With a considerably larger sample size (N=360 for a power of 0.80 F=2.89 df= 8, 16) this could be tested (Lenth, 2004).

Test-retest reliability of the EASQ scale indicated no significant difference over time (refer back to Table 31, p.165). This finding is supportive of literature indicating that explanatory characteristics are stable over time (Grove & Heard, 1997; Peterson, 1991b; Reivich & Gillam, 2003; Scheier & Carver, 1993).

The relationship between the EASQ subscales indicated significant correlations between internality and stability and globality and stability ($p<0.01$) (refer back to Table 33, p. 166). Consistent with previous research, internality did not correlate significantly with the other two subscales (Peterson, 1986; Peterson & Villanova, 1988). Further the high correlation between globality and stability supported the argument of dependence between the subscales (Peterson & Villanova, 1988).

Significant correlations were evident between 14 of the 17 TAIS subscales with at least one of the EASQ subscales (refer back to Table 38, p.173). This provided support for the hypothesis that the TAIS and EASQ subscales are related.

Consistent with previous research, self-esteem (SES) was positively correlated with global, stable, and overall attributions (Felson, 1981; Reivich & Gillham, 2003; Tiggeman, Winefield, Goldney, & Winefield, 1992). This finding indicated that those participants with lower self-esteem were more likely to attribute negative events as being pervasive and permanent (for example, ‘I always get everything wrong, I’m hopeless’). This relationship has been explained by the influence of an individual’s expectations on their subsequent behaviour. Where positive expectations occur, improved behavioural and physical indicators are more likely, thus resulting in heightened self-esteem. Lowered self-esteem may be more likely to result in a sense of hopelessness in negative situations such as injury (Grove et al., 1993; Scheier & Carver, 1993; Scheier et al., 1989).

Participants scoring higher on obsessiveness (OBS) were significantly more likely to make stable attributions (for example, ‘I’m useless’) to negative events (refer back to Table 38, p.173). Therefore, those who are likely to worry about negative events are more likely to view negative events as being relatively permanent. Such attributions are more likely to result in diminished performance, presumably due to the distractive nature of such attributions (Martin-Krumm et al., 2003).

High scores on negative expression of affect (NAE) were significantly correlated with internal attributions to negative events (refer back to Table 38, p.173). Therefore, perceiving personal responsibility for a negative event was more likely in individuals who tend to express negative thoughts and feelings (Reivich & Gillham, 2003).

Those players more skilled at processing information (INFP) were more likely to attribute negative events to specific and unstable causes (for example, ‘I was unlucky today in defence’) ($p<0.01$) (refer back to Table 38, p. 173). Being overloaded by internal stimuli (OIT) was correlated with stable ($p<0.05$) and global ($p<0.01$) attributions (refer back to Table 38, p. 173). Therefore, those who tend to be distracted by thoughts are more likely to explain a negative event as having far reaching consequences and enduring with time (for example, ‘It’s always going to be this bad’). Both of these results lend support to the notion that a player who is less skilled at processing information and more likely to become overloaded by distracted thoughts is more likely to have an explanatory style which is negative.

More than a decade of research investigating links between explanatory style and physical health has supported a relationship between a pessimistic explanatory style and negative health consequences (Bennet & Elliott, 2002; Peterson, 1995; Scheier & Carver, 1993; Scheier et al., 1989). The relationship between global attributions and illness have been found to be mediated by depression, perceived stress, social support and poor health practices (Bennet & Elliott, 2002). The current research supports these findings for global and stable attributions.

ANOVA demonstrated significant differences between minor, moderate, and severely injured participants on global scales; and minor and moderately injured participants on stable scales (refer back to Table 35, p. 168). Further, when explanatory style was compared with severity of injury, participants with higher levels of pessimism had a higher proportion of severe injury ratings (refer back to Table 36, p. 169). The potential 'buffering' effect of an individual's cognitive state has been argued to reduce the impact of stress and therefore minimise the number of injuries sustained (Perna & McDowell, 1993; Williams & Anderson, 1998; Williams et al., 1993). Negative explanatory style and subsequent affective state is likely to inhibit performance and therefore increase possible injury (Lin & Peterson, 1990; Lynch, 1988).

A discriminant function analysis using simultaneous estimation method was utilised for analysis. Participants were considered according to their injury severity groups (minor n=18; moderate n=21; severe n=14).

The analysis found one significant function explaining 80.4% of the variance to discriminate psychological characteristics according to injury severity. The structure coefficients indicated the important variables on the function to be physical orientation (PO), self-esteem (SES) and overloaded by internal factors (OIT). Therefore, the hypothesis that attributional variables discriminate between professional rugby league players with differing severity of injury ratings was partially supported. EASQ variables did not discriminate between participants with differing severity of injury ratings; therefore, that hypothesis was not supported.

The territorial map (refer back to Figure 6, p.190) showed distinct separation of the three injury groups, with minimal overlap of individual subject data. Classification of the participant data resulted in 88.9% of the minor injury group, 76.2% of the moderately injured group, and 92.9% of the severely injured group being correctly classified. With cross-validation of the results, percentages for each group maintained values above the 33% that would be expected by chance. The difference was nearly twice what would be expected by chance for minor and severe injuries (refer back to Table 46, p.197).

Participants with minor injuries reported less likelihood of being overloaded by internal information (OIT), had higher self-esteem (SES), higher physical orientation (PO), higher global attributions, and more stable attributions (refer back to Table 39, pp. 179-180). Tukey post-hoc tests indicated that the scores on these scales were highest for athletes with minor injuries, next highest were those with moderate injuries, and lowest were those with severe injuries.

Given that professional rugby league players participate in a competitive sport requiring endurance, explosive power and strength it is not surprising that physical orientation and competitiveness (PO) was the most important discriminator between the groups of injured players. The PO subscale provides an indication of the level of interest in active and competitive sports. The higher the PO scores the greater the level of involvement (Nideffer, 1978). The results of the current study indicated that as the injury severity increased, the mean PO score decreased. Therefore, suggesting that those who were more physically oriented and competitive were less likely to incur more serious injuries.

Interestingly self-esteem was the next most useful measure to differentiate between the groups. This would suggest that feelings of self-worth are related to resulting injury. The relationship between self-worth and injury has been previously identified (Burckes, 1981; Rosenblum, 1979). The nature of the relationship between these variables has been described as negative self-image resulting in an athlete being more prone to injury. This research with professional rugby league players provides further support for such a conclusion.

The relationship between self-concept and injury in college female field hockey players was reported to be negatively related (Lamb, 1986). This finding is further supported in the current research when considering self-esteem. The results indicated that self-esteem scores decline for athletes as severity of injury increases. This finding is consistent with previous research that demonstrated injury negatively impacts upon self-esteem (Bramwell, Masuda, Wagner, & Holmes, 1975; Chan & Grossman, 1988; Leddy, Lambert, & Ogles, 1994). The current research demonstrated that lower self-esteem prior to the commencement of the playing season is related to incidence of more severe injury. This finding is consistent with the finding that individuals with high self-esteem are more likely to outperform others (Tuckman & Sexton, 1992).

In addition to the relationship between self-image and injury, Burckes (1981) identified athletes who have difficulty concentrating to be more likely to incur injury. The finding of higher scores on the OIT subscale as injuries were rated more severe is useful (refer back to Table 29 & 30, pp. 162-163). The higher the OIT score, the greater tendency of the athlete to make mistakes due to confusion caused by thinking about too many things. In a comparison of uninjured, uninjured but not disabled, and disabled American Football players, lowered ability to visually isolate an object was found to increase the risk of sustaining an injury (Dahlhauser & Thomas, 1979; Pargman, 1976). Thus, the preoccupied athlete may be less perceptive to environmental cues and more likely to sustain injury.

The OIT subscale reflects the tendency of an individual to become distracted by thoughts. It is therefore reasonable to assume that an individual who is distracted in such a way would be more vulnerable to the risk of injury. A relationship between narrowing attention and risk of athletic injury was hypothesized by Bergandi and Witting (1988). A small sample across a large number of sports resulting in low statistical power led the authors to conclude that the limitations of their research prevented a conclusion on whether narrowing attention would increase risk of injury. Results of the current research indicate the utility of the OIT subscale in discriminating between levels of athletic injuries. Those players with reported higher scores on OIT were those players with severe injuries. Therefore, those players who were more disturbed by internal thoughts were more likely to experience a severe injury. It has further been suggested that an inappropriate focus on internal cues may make an athlete more vulnerable to apply excessive force resulting in injury caused by muscle strain (Bergandi & Witting, 1988; McMaster, 1982).

The relationship between OIT and injury may also be explained through cue utilisation. A range of physical, environmental and internal cues are available to an athlete during competition. As individual arousal levels increase, attention will narrow to exclude irrelevant stimuli. In the event of high arousal, attention may overly narrow resulting in heightened distractibility (Easterbrook, 1959). Ability to avoid distracting stimuli was positively correlated with greater accuracy in a competitive situation (Wilson & Kerr, 1991). Thus, when individual arousal levels are inappropriately matched to the attentional focus, a negative impact is more likely to result (Nideffer, 1981). In the current research, participants with high scores on OIT were more likely to experience severe injury.

Evidence of psychological variables which predispose an athlete to injury has been presented by a number of authors (Bergandi, 1985; Jackson et al, 1978; Valiant, 1981). This study demonstrates that psychological variables continue to offer a source of explanation for the injury experiences of athletes. In identifying the role of overload of internal information (OIT), physical orientation and competitiveness (PO) and self-esteem (SES) in explaining injury severity, further research should consider the underlying mechanisms of these variables.

Summary

This study was a prospective, longitudinal study. The recommendation for a prospective study was argued by Gabbett (2001). The collection of the TAIS and EASQ data over a two year period enabled an understanding of the consistency of the measures. Utilising a prospective research design meant that responses were not limited by an inability of participants to correctly recall all injuries sustained during a competitive season. Retrospective studies are often criticized as they are open to attribution and memory bias effects (Brewer et al, 1991; Evans & Hardy, 1995).

The participants in this study were not randomly selected. Despite this, the findings from the present study indicated that the sample shared similar characteristics (specifically years playing professionally and number of first grade games) with the comparative population of national rugby league players (National Rugby League, 2000). Whilst the sampling method adopted precludes the generalisation of findings from this research to the larger population, it is reassuring to note that the sample utilised shared these characteristics. Research with elite athletes often precludes use of large non-random samples.

An important consideration in any research is the adequacy of sample size to justify the conclusions made. Whilst it is desirable to have as large a sample as possible, size may be limited according to financial, methodological, or time constraints. Debate exists in the literature on the minimum case numbers required within discriminant function analysis. Guidelines vary between 2-20 cases per variable. This research had a ratio of 2.8:1 cases:variable. Whilst a larger sample may be appropriate for future research, the current sample size is considered appropriate, as it meets the basic assumptions presented by Klecka (1980). The study had a sample size enabling good statistical power for analysis.

Forwards and backs played equivalent numbers of games, total game minutes, total season minutes, and had equivalent numbers of days missed per injury. Forwards and backs did not differ on the TAIS or EASQ subscale scores. Forwards and backs did differ however, on the number of injuries sustained per season. Specifically, forwards incurred significantly more injuries than backs. This finding is consistent with results from previous research and is most likely attributable to the greater physical involvement required of forwards over backs in both attack and defence (Gissane et al, 1997, Gabbett, 1999).

Interestingly, whilst forwards and backs differed according to the total number of injuries sustained, they did not differ according to the number of games missed per injury, the number of days missed per injury, nor the number of games played per season. This result indicates that forwards (who sustained more injuries) played an equivalent number of games during the season. This suggests that forwards either had a shorter recovery time from injury, or played whilst injured to some degree. Given the contrasting physiological attributes required of forwards and backs there may be differing expectations for the two roles. Forwards generally have greater involvement of increased body contact throughout the game (Gibbs, 1993). Therefore, an expectation may exist for forwards to be better able to rehabilitate from injury, or play whilst partly injured. To date, research has not been published to consider this issue. The results of this research demonstrated argument for continued comparisons between the positions of forwards and backs.

Participants involved in the second year of data collection missed significantly more games per injury than those who participated in the first year of the study. This finding raised the question as to whether injuries sustained in the second year were more serious in nature, thus necessitating respondents taking longer rehabilitating. Injury severity did not differ according to the year of study, despite the time taken to recover from injury increasing from year one to year two. This difference must be accounted for by factors other than injury severity. A number of possible explanations may account for this finding. Variables that may impact on the incidence and recovery from injury include variability in coaching techniques, equipment utilised in training and games, physiological characteristics of players, and the players varying levels of stress and anxiety through the duration of the season (Bergandi, 1985). These factors may have some influence on the incidence and recovery from injury. Equipment utilised in training and games remained consistent between years one and two. The other variables listed above were not included in the present study, however could be considered in future research.

A further possibility to explain the difference in the two years of results could be in considering the literature on the ‘injury-prone’ personality (Burckes, 1981; Ogilvie, 1966; Sanderson, 1977). This conceptualisation of the injury-prone athlete suggests that certain psychological factors may contribute to how injury is manifested.

A major contribution of the present research has been in the study of the interrelatedness of personality characteristics with injury variables. Determination of a relationship between personality variables and injury severity provides further support for a credulous position in approaching personality research. Therefore, the assumption that personality variables have a useful contribution to injury research is supported by the results of the current research.

The TAIS appears to be a useful measure as a descriptive tool of the psychological characteristics of elite athletes. The TAIS has been suggested as a potential screening device for injury (Bergandi & Witting, 1988). This recommendation was made with limited findings reaching statistical significance. As identified by Zaichowsky, et al. (1982), the TAIS also offers potential as a diagnostic aid. The current research lends support to the recommendation, with OIT, SES and PO all discriminating athletes with minor, moderate and severe severity of injury ratings.

Internality continued to be a variable which correlated lower with the other two subscales on the EASQ. This finding may indicate that internal and external explanatory style is a multidimensional variable (Peterson & Villanova, 1988; Tiggeman et al., 1992). Further, the high correlation between globality and stability lends support to the dependence between the variables. Peterson and Villanova (1988) suggested that such a relationship may together reflect a dimension of hopelessness, catastrophising or pessimism.

This study has shown that consideration of attentional characteristics may allow identification of those psychological variables which contribute to physical injury. This finding may assist coaches and athletes to recognise the variables involved in the determination of minimising risk to physical injury. In conclusion, it is clear that further research is needed to provide greater insight into the domain of athletic injury experiences. With the vast number of people engaging in athletic activity, the role of personality characteristics and attributional style needs to be better understood. The findings of the current research could be incorporated into the development of intervention programs with the aim to assist injured athletes and minimise the impact of the athletic injury experience.

The study appears to be the first of its kind to examine the interrelatedness between attentional and attributional style with athletic injury. As such, this study is a significant contribution to the literature and the information will assist coaches, athletes, and medical personnel to gain a clearer understanding of the injury recovery process. The TAIS “makes intuitive sense to coaches and athletes” (Bond & Sargent, 1995, p. 394). Therefore, results supporting the utility of the measure lend further support to its use. The amount of physiological data on rugby league players and the sport of rugby league continue to grow with scope for future research in this area (Brewer & Davis, 1995).

Chapter six

Summary, conclusions, and recommendations

This thesis draws on personality literature and contributes to the body of research on the experiences of injured athletes. Research in this area is fragmented and limited in terms of scope. This thesis considered the interrelationship between attentional and attributional characteristics and the influence of these variables on the injury experience of professional rugby league players. This chapter details the general conclusions that are made from the findings of the research. Further, the chapter will describe the relationship between personality variables and injury experience for the participants in this study. Suggestions for future research are offered.

Injury is of high prevalence in rugby league and has negative physical and psychological consequences for the players that experience them. Rugby league requires players to execute a range of skills including kicking, jumping, passing, catching, and tackling. These skills require a combination of speed, agility, strength, anaerobic and aerobic power. Played by a large number of Australian male athletes, around 30% of injuries incurred playing rugby league are classified as major. It is generally considered that insufficient information is available on football injuries and that professional athletes should be considered separately to the general population. Psychological research of injury in rugby league is limited and psychological characteristics measured in prospective studies of rugby league injury have not been considered prior to this study.

Athletic injury is generally considered to be any physical or medical condition that results in at least one day of practice, training or competition being missed. For the purpose of this research injury was recorded when players were prevented from playing their sport for 1-7 days (minor), 7-28 days (moderate), or more than 28 days (severe).

Personality is the culmination of individual and common characteristics shared amongst people. Views vary as to whether personality characteristics are biologically determined or evolve through social learning. The credulous position maintains that personality characteristics are useful in the prediction of behaviour. Whilst debate continues between the sceptical and credulous views, the current research assumes that personality characteristics are worthy of exploration in understanding the injury experience in professional male rugby league players. In particular, the research was based upon trait theory which assumes a predisposition by individuals to respond to situations in a consistent manner.

Understanding of how attentional focus operates is well placed within the trait perspective. Nideffer has presented an extensive body of literature to argue that individuals hold a relatively consistent style in attending to environmental and interpersonal stimuli. Further, Nideffer has argued that most individuals can adequately attend to most situations; however when placed under perceived stress will defer to a preferred attentional style that may or may not suit the situation. Attentional style is broadly compared along the two continuums of broad-narrow and internal-external.

The TAIS is a psychometric instrument which measures attentional style, control and interpersonal variables. Test-retest reliability of the scale is good. With 30 years of prior research it has been employed in many sporting environments. Arguments have been made for the inclusion of the TAIS in research with injured athletes.

Attributions are generally considered to be those internal-external and stable-unstable explanations that people give to explain their circumstances. Explanatory style is a personality variable which reflects the causal explanations of bad events in people's lives. Explanatory style is measured by the EASQ. Explanatory style has been explored in sport research and suggests that a positive explanatory style is associated with better well-being and improved health.

Many previous injury studies have been subject to methodological criticisms. Recommendations for injury research include adopting a prospective design to avoid reliance on participant recall. Further, studies benefit from utilising a longitudinal design, consistently applied variables, and control of variables such as gender, type of sport, competitive level and playing status.

A prospective longitudinal exploration of psychological characteristics and their influence on injury experiences of rugby league players has not previously been considered. The aims of this research were twofold, namely to consider the relationship between attributional and attentional style for injured professional rugby league players. Secondly, the study aimed to identify the personality variables which are discriminated by injury severity of professional rugby league players.

Male professional rugby league players competing in the NRL (N=53) participated in the study. Players ranged in age from 19-31 years

(M=24.39 $\pm$2.69 years) and had been playing professional rugby league between 1 and 11 years. Participants completed the TAIS and EASQ over a two year period whilst their injury experiences were recorded. Univariate and multivariate tests were used to analyse the data, including Discriminant Function Analysis to determine whether injury severity differentiated between the psychological variables.

Playing statistics and injury experiences were compared for the sample according to whether participants played in the positions of forwards or backs. The interchange rule present at the time of data collection is considered to explain forwards and backs playing a similar number of games and minutes each season. Forwards and backs did however differ in the number of minutes played in each game, with backs spending more time on the field. This was explained by the difference in amount of full body contact sustained by forwards in a typical game. Forwards had a higher overall rate of injury incidence however were not absent for more games per injury or over the entire season. The possibility of different expectations of forwards and backs to recover by coaching staff was raised.

Overall, forwards attended more physiotherapy sessions than backs. As would be expected, those players with more severe injuries attended more physiotherapy sessions. The number of injuries and their severity in this study was similar to those attained in other Australian studies.

In contrast to the hypothesis, TAIS scores did not differ according to playing position. This finding contradicted previous results from a study with rugby union players. It was suggested that for the studies to be comparable, a larger sample of rugby league players is required to compare the nine positions on the field, rather than the broad comparison of forwards and backs. The theory of attention underlying the thesis argues that players require the four combinations of attentional processing, hence the lack of difference between the positions.

The TAIS proved reliable over the two years with the least stable measure being a person's tendency to worry (OBS). The variability of a person's tendency to worry was explained by cognitive appraisal of stressful events which may be dynamic and subject to change over time. Inter-item correlations were logically and internally consistent. Descriptions of some of the significant correlations were offered.

Age was found to be significantly correlated to self-esteem. This finding was supported by previous research which indicated that self-esteem typically increases post-adolescence and then declines in later part of the lifespan. Age was also found to correlate with an athlete's ability to narrow their focus. This finding was supportive of Nideffer's arguments that attentional style can be modified and improved. The current study is one of the few to consider age in relation to the TAIS. In relation to the EASQ, older players responded to negative events with less stable and global attributions. Little previous literature exists to assist in understanding this finding.

Similar to the TAIS, EASQ subscale scores did not differ according to playing position. With a larger sample, potential differences between the nine playing positions could be examined. The EASQ demonstrated good test-retest reliability, supporting the stability of explanatory style. The inter-subscale correlations within the EASQ produced results supported by previous research.

Significant relationships were found between the TAIS and EASQ scales. Players with lower self-esteem were more likely to perceive negative events as being pervasive and permanent. This finding was supported by the body of literature which identifies lowered self-esteem resulting in a sense of hopelessness in negative situations. Players with an increased tendency to worry were more likely to make stable attributions and consider them to be more permanent.

Injury severity was related to scores on the EASQ. Specifically, injuries of a higher severity were experienced by athletes who could be described as being more pessimistic. A negative explanatory style and the resultant affective state were argued to inhibit performance and thus make an athlete more vulnerable to injury.

Discriminant Function Analysis found 80.4% of the variance of psychological characteristics explained injury severity. The variables of importance were physical orientation (PO), self-esteem (SES), and tendency to become overloaded by internal factors (OIT). Therefore those players who were more competitive, had higher self-esteem, and were less likely to be distracted by overwhelming thoughts experienced lower levels of injury.

A competitive orientation is indicative of higher involvement in physical activity. Therefore, those players with lowered involvement were more at risk of sustaining serious injury. There is a body of literature to support the relationship between self-concept and athletic injury. Lowered self-esteem is correlated to poorer performance, thus supporting a relationship between self-esteem and increased risk of injury. It is logical that a player who is distracted by internal thoughts would be more vulnerable to the risk of injury. A range of cues are available within a sporting environment, therefore the athlete who is preoccupied with their own thoughts may be more likely to miss important physical, environmental and internal cues. This misdirection of thinking would explain an increased vulnerability for injury.

The study clearly demonstrated that psychological variables continue to offer an important explanation for the injury experiences of athletes. Further evidence for the credulous view of personality variables contributing to the understanding of athletic injury is presented. The possibility of an injury-prone personality can be argued and the importance of further research within this area is warranted.

Conclusions

Within the limitations of this study, the following conclusions seem justified:

1. Playing position and TAIS subscale scores were not significantly related.
2. Injury severity differed according on three TAIS subscales. Injury of greater severity was associated with higher overloaded by internal

stimuli (OIT) and lower physical orientation (PO) and self-esteem (SES).

3. EASQ and TAIS subscale scores were related.
4. Playing position was not related to days missed through injury. Participants with more severe injuries missed more days due to injury.
5. Attentional variables overloaded by internal stimuli (OIT), self-esteem (SES), and physical orientation (PO) together discriminated between levels of severity of injuries suffered by professional rugby league players.
6. Attentional variable did not discriminate between professional rugby league player’s injury levels.

Recommendations

It is recommended that further study consider:

1. The extent to which attributional explanatory style explain the willingness of rugby league players (eg. forwards) to play with some degree of injury.
2. Compare the EASQ and TAIS subscales according to each playing position.

3. Further consider the relationship between the EASQ and TAIS scales.
4. Consider the extent to which variables such as level of athlete (elite, sub-elite, recreational), age of athlete (junior, open, mature), and type of sport related to psychological variables and injury experience.
5. Determination of the causal relationship between personality characteristics and athletic injury.

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Appendix A

Gentile's taxonomy (2000).

	Action Function			
	Body stability		Body transport	
Environmental context	No object manipulation	Object manipulation	No object manipulation	Object manipulation
Stationary regulatory conditions and no intertrial variability	1A Standing alone in a room	1B Brushing teeth standing alone	1C Climbing stairs	1D Climbing stairs while holding a book
Stationary regulatory conditions and intertrial variability	2A Standing on different surfaces	1B Standing on different surfaces holding a bag	2C Walking on different surfaces	2D Walking on different surfaces holding a bag
In-Motion regulatory conditions and no intertrial variability	3A Sitting in a wheelchair being pushed along a hallway	3B Wheeling a wheelchair along an empty hallway	3C Walking on a treadmill at a constant speed	3D Walking on a treadmill at a constant speed holding a cup of water
In-Motion regulatory conditions and intertrial variability	4A Sitting in a moving car	4B Sitting in a moving car holding a baby	4C Walking in a crowed mall	4D Walking in a crowded mall carrying a baby

Appendix B

Informed consent form

INFORMED CONSENT FORM

SCHOOL : *PSYCHOLOGY*

PROJECT: *ATTRIBUTIONAL AND EXPLANATORY STYLE OF PROFESSIONAL RUGBY LEAGUE PLAYERS*

CHIEF INVESTIGATOR: *JOANN LUKINS*

CONTACT DETAIL: *(07) 47814770 Email: Joann.Lukins@jcu.edu.au*

DESCRIPTION:
The aim of this project is to gain a clearer insight into the attributional and attentional style of elite rugby league players. It is hoped that with a better understanding of the profile of current players, such information can be utilised in the injury experience of future players.

CONSENT

The aims of this study have been clearly explained to me and I understand what is wanted of me. I know that taking part in this study is voluntary and I am aware that I can stop taking part in it at any time and may refuse to answer any questions.

I understand that any information I give will be kept strictly confidential and that no names will be used to identify me with this study without my approval.

Name: *(printed)*	
Signature:	**Date:**

SIGNED BY RESEARCHER OBTAINING CONSENT

Name: *(printed)*	
Signature: *(Principal Investigator)*	**Date:**

Appendix C

Skewness and kurtosis values for ratio level variables.

Variable	Skewness	Kurtosis
Age	0.30	-0.99
Average minutes, year two	-0.30	-0.30
Average minutes, year one	-0.17	-0.78
Number of days injured, year two	1.64	1.89
Number of days injured, year one	1.00	-0.01
Year playing professional football	0.59	-0.92
Total number of games played, career	1.14	0.20
Number of games played, year one	-0.06	-1.20
Number of games played, year two	0.26	-1.31
Number of injuries, year one	0.49	-0.85
Number of injuries, year two	0.67	-0.08
Number of minutes played, year one	0.22	-0.69
Number of minutes played, year two	0.39	-1.04
Number of games missed, year one	0.22	-0.69
Number of games missed, year two	1.64	1.89
Number of games missed per injury, year one	2.76**	10.30*
Number of games missed per injury, year two	2.10**	4.25*
Number of physiotherapy appointments, year one	0.15	-.71

Number of physiotherapy appointments, year two	0.29	-.16

** Skewness which exceeds 2.00

* Kurtosis which exceeds 3.00

Appendix D

Minimum and maximum Z scores of variables

Name of variable	Min z score	Max z score
Demographic variables		
Age	-1.77	1.96
Total number of games played	-0.93	2.57
Total number of years played	-1.12	1.92
Game variables		
Average minutes played in first year of study	-2.19	1.67
Average minutes played in second year of study	-2.71	1.49
Number of games played in first year of study	-1.55	1.77
Number of games played in second year of study	-1.28	1.75
Total number of minutes in first year of study	-1.44	2.28
Total number of minutes in second year of study	-1.24	2.34
Injury variables		
Number of days missed through injury in first year of study	-0.91	2.37
Number of days missed through injury in second year of study	-0.79	2.88
Number of games missed through injury in second year of study	-0.79	2.88

Number of injuries sustained in first year of study	-1.07	2.31
Number of injuries sustained in second year of study	-1.03	2.01
Number of physiotherapy appointments in first year of study	-1.46	1.92
Number of physiotherapy appointments in second year of study	-1.46	2.85
Percentage of games missed in year one	-0.74	4.41
Percentage of games missed in year two	-0.70	3.28
TAIS subscales		
BCON	-2.05	3.07
BET	-2.41	2.08
BIT	-2.07	2.81
CON	-1.70	2.65
IEX	-1.77	2.23
INFP	-2.36	2.34
INT	-2.15	2.64
NAE	-2.18	1.95
NAR	-2.25	2.07
OBS	-1.92	2.70
OIT	-1.77	2.24
PAE	-2.21	2.64
PO	-2.62	2.39

RED	-2.13	2.53
SES	-1.76	2.57
OET	-1.85	2.59
EXT	-2.06	2.25

Appendix E

Kolmogorov-Smirnov test results for ordinal and interval variables

Name of variable	Kolmogorov-Smirnov Z	p
Stability	1.21	0.10
Globality	1.03	0.23
Internality	0.96	0.31
Overall EASQ	0.84	0.47
BET	0.73	0.64
BIT	0.92	0.36
OET	0.75	0.62
OIT	1.10	0.17
OBS	0.81	0.52
IEX	1.18	0.12
NAE	0.58	0.88
PAE	0.71	0.68
INT	0.92	0.36
EXT	0.62	0.83
NAR	0.69	0.72
RED	0.54	0.93
INFP	0.53	0.93
BCON	0.52	0.94

CON	0.72	0.67
SESDEP	0.66	0.77
PO	0.87	0.43

Appendix F

Squared Mahalanobis distance to centroid for each participant

Case Number	df	D^2	Case Number	df	D^2
1	2	0.50	30	2	0.13
2	2	1.43	31	2	3.44
3	2	1.43	32	2	1.60
4	2	0.17	33	2	6.86
5	2	2.62	34	2	0.13
6	2	0.50	35	2	0.15
7	2	3.69	36	2	3.92
8	2	2.65	37	2	0.36
9	2	2.65	38	2	0.11
10	2	1.79	39	2	0.53
11	2	0.35	40	2	0.06
12	2	0.24	41	2	1.97
13	2	0.16	42	2	1.39
14	2	0.39	43	2	1.12
15	2	2.69	44	2	1.48
16	2	0.15	45	2	0.84
17	2	0.18	46	2	0.34

18	2	0.79	47	2	0.07
19	2	0.63	48	2	0.56
20	2	1.77	49	2	1.40
21	2	0.01	50	2	1.67
22	2	0.64	51	2	2.87
23	2	1.63	52	2	0.45
24	2	0.22	53	2	0.54
25	2	0.64			
26	2	4.76			
27	2	0.44			
28	2	0.63			
29	2	0.05			

Appendix G

Pooled within-groups matrices for discriminant function analysis

Predictor	BET	BIT	OET	OIT	NAR	RED	INTERNA_	GLOBAL	STABLE	OBS	IEX	NAE	PAE	INT	EXT	INFP	BCON	CON	SES	PO
BET																				
BIT	.45																			
OET	-.18	-.13																		
OIT	-.14	-.03	.67																	
NAR	.11	-.03	-.38	-.19																
RED	-.19	-.31	.47	.57	.13															
Internal	-.013	.06	.16	.02	-.01	.02														
Global	.13	.21	-.32	-.29	.21	-.45	.16													
Stable	.14	.23	-.30	-.34	.25	-.31	.31	.59												
OBS	-.20	-.09	.34	.30	.12	.67	-.07	-.24	-.25											
IEX	.20	.51	.10	.20	-.19	-.22	.04	.08	.11	-.17										
NAE	-.15	.14	.22	.28	-.30	.26	-.13	-.23	-.18	.19	.31									
PAE	.09	.21	-.08	-.18	.18	-.14	.15	.22	.26	-.12	.27	.13								
INT	12	.09	.05	.31	.13	.24	-.19	.01	-.11	.23	-.06	.16	-.24							
EXT	.34	.31	.14	.17	.02	.04	-.02	-.14	.02	-.03	.57	.22	.55	.11						

Appendix G continued

Pooled within-groups matrices for discriminant function analysis

Predictor	BET	BIT	OET	OIT	NAR	RED	INTERNA	GLOBAL	STABLE	OBS	IEX	NAE	PAE	INT	EXT	INFP	BCON	CON	SES	PO
INFP	.63	.66	-.32	-.34	.15	-.42	.16	.49	.41	-.34	.42	-.04	.50	.12	.45					
BCON	-.04	.04	.52	.49	-.31	.26	.03	-.17	-.15	.09	.16	.57	.09	.07	.34	-.11				
CON	.43	.56	.03	.06	.16	-.10	.14	.09	.31	-.02	.68	.26	.44	.22	.59	.60	.09			
SES	.38	.49	-.19	-.19	.33	-.23	.05	.16	.25	-.10	.53	-.05	.56	.06	.67	.72	-.14	.73		
PO	.30	.16	.01	-.09	.43	-.01	.09	.09	.34	-.01	.12	-.14	.51	.07	.50	.47	-.10	.56	.61	

Appendix H

Test of equality of group means

Independent variable	Wilks Lambda	F	df1	df2	P
BET	0.91	2.12	2	50	0.13
BIT	0.95	1.19	2	50	0.31
OET	0.96	0.84	2	50	0.43
OIT	0.96	0.94	2	50	0.39
NAR	0.96	1.06	2	50	0.35
RED	0.92	1.77	2	50	0.18
Internal	0.94	1.51	2	50	0.23
Global	0.98	0.47	2	50	0.63
Stable	0.93	1.70	2	50	0.19
OBS	0.99	0.03	2	50	0.97
IEX	0.99	0.04	2	50	0.96
NAE	0.83	4.64	2	50	0.02
PAE	0.96	0.89	2	50	0.41
INT	0.86	3.67	2	50	0.03
EXT	0.95	1.16	2	50	0.32
INFP	0.93	1.74	2	50	0.18
BCON	0.94	1.36	2	50	0.27

CON	0.98	0.27	2	50	0.76
SES	0.96	0.75	2	50	0.48
PO	0.99	0.21	2	50	0.81