Adaptive Perfectionism, Maladaptive Perfectionism, Perceived Stress and Risk of Concussion in Varsity Athletes

by

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Graduate Department of Exercise Science
University of Toronto

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Abstract

Introduction: Psychological variables such as personality, perceived stress and mood have been proposed as antecedents to musculoskeletal injury. Furthermore, a positive relationship between life stress and athletic injury has been reported in the literature. However, these variables have not yet been examined with respect to sport concussion. Purpose and Method: Baseline measures of perfectionism and perceived stress (PS) were examined as potential risk factors for concussion. Specifically, adaptive perfectionism (AP), maladaptive perfectionism (MP), and PS were investigated as predictors of concussion. Mood states were hypothesized to mediate these relationships. A total of 828 varsity athletes completed the Frost Multidimensional Perfectionism Scale, Perceived Stress Scale, and Profile of Mood States (POMS). Results: Significant correlations were found between AP, MP, PS, and the POMS. Based on logistic regression analysis, AP, MP, and PS did not predict concussion occurrence. Conclusion: Risk of concussion is not associated with perfectionism or perceived stress.
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See you next season.
# Table of Contents

Acknowledgments ........................................................................................................................................... iii

Table of Contents........................................................................................................................................ iv

List of Tables .................................................................................................................................................. v

List of Figures ............................................................................................................................................... vi

List of Appendices ....................................................................................................................................... vii

Chapter 1: Introduction ................................................................................................................................. 1

Chapter 2: Literature Review ....................................................................................................................... 6

Chapter 3: Method ......................................................................................................................................... 36

Chapter 4: Results ......................................................................................................................................... 43

Chapter 5: Discussion ................................................................................................................................... 55

References ...................................................................................................................................................... 69
List of Tables

1. Number of concussions by sport
2. Descriptive statistics for the FMPS
3. Descriptive Statistics for the PSS and the POMS
4. Correlations examining the FMPS, PSS, POMS and concussion: Total sample
5. Pearson correlations examining the FMPS, PSS and POMS: Concussed and non concussed sample
6. Step 1 of the logistic regression with three predictor variables (AP, MP, PS) controlling for sex and age
7. Step 2 of the logistic regression with three predictor variables (AP, MP, PS) controlling for sex and age
8. Correlation analyses between predictor variables and proposed mediators in figure 1
9. Logistic regression examining the relationship between the POMS and concussion occurrence
10. Step 1 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for maladaptive perfectionism
11. Step 2 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for maladaptive perfectionism
12. Step 1 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for adaptive perfectionism
13. Step 2 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for adaptive perfectionism
14. Step 1 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for perceived stress
15. Step 2 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for perceived stress
List of Figures

1. An illustration of the relationships between predictor variables (perfectionism/perceived stress), mediators (mood states) and the outcome variable (concussion occurrence)

2. A modified version of the Integrated Model of Psychological Response to the Sport Concussion Injury and Rehabilitation Process (Wiese-Bjornstal et al., 2015) identifying significant associations between the FMPS, PSS and POMS.
List of Appendices

Appendix A - Consent Form ................................................................. 95
Appendix B - FMPS Questionnaire ...................................................... 96
Appendix C - Perceived Stress Scale .................................................. 98
Appendix D - POMS questionnaire .................................................... 99
Appendix E - Information Sheet .......................................................... 100
Appendix F - Supplementary Tables .................................................. 101
Appendix G – Abbreviations of Key Terms ........................................ 105
Appendix H - Ethics Certificate ........................................................... 106
Appendix I - Integrated Model of Psychological Response to Sport Concussion .... 107
Chapter 1

Introduction

Sport-related concussions present a prominent risk for athletes in all physical sports (Webbe, 2011). Each year, 10% of all adult participants in formal athletics are expected to sustain a concussion (Cable, 2001). Further, the rate of concussion in high school and collegiate athletes is on the rise (Gessel et al., 2007; Hootman, Dick, & Agel, 2007). As of 2014, the number of collegiate athletes reporting at least one concussion over their athletic careers is 38% (Kerr et al., 2014).

A concussion, or a mild traumatic brain injury (mTBI), can be defined as a transient, biomechanically induced injury to the brain resulting in several neurological dysfunctions (Kutcher, 2010; Terrell et al., 2014). Often referred to as the invisible injury, concussion shows no structural damage through traditional investigative imaging; only signs of functional impairment are present (Hutchison, Mainwaring, Comper, Richards, & Bisschop, 2009). Proper management of a single concussion should result in minimal neurological deficits (McClincy et al., 2006). However, the cumulative effects of multiple concussions may result in long term consequences for athletes (Covassin et al., 2003). These consequences include deficits in cognitive functions such as memory (Iverson et al., 2012), emotional control (Kerr et al., 2014), and lingering physical symptoms such as headaches and dizziness (Mannix et al., 2014).

To facilitate an understanding of sport concussion risk factors, two sport injury models based on the stress-injury literature were used as the guiding theoretical framework: The Integrated Model of Psychological Response to Sport Injury (Wiese-Bjornstal et al., 1998) and the Integrated Model of Psychological Response to the Sport Concussion Injury and Rehabilitation Process (Wiese-Bjornstal et al., 2015). The more recent Integrated Model (Wiese-Bjornstal et al., 2015), which was adapted from the author's original Integrated Model of Psychological Response to Sport Injury (Wiese-Bjornstal et al., 1998), provides an evidence based framework for understanding the pre-injury psychological risk factors involved in concussion. These pre-injury variables (personality, history of stressors, coping
resources, and interventions) have the potential to influence an athlete's vulnerability to injury by affecting the stress response (Wiese-Bjornstal et al., 1998; Wiese-Bjornstal et al., 2015). The athlete stress response is often characterized by changes in cognitive appraisal as well as physiological (e.g., tension) and attentional (e.g., tunnel vision) changes which influence concussion risk (Wiese-Bjornstal et al., 2015). Individual differences in athlete personality such as competitive trait anxiety, achievement motivation, impulsivity, sensation seeking and negative affectivity are reflected in the cognitive, emotional and behavioural responses to stress which may affect concussion risk (Wiese-Bjornstal et al., 2015). Although no research has shown personality types to directly result in concussions, several constructs of personality have shown positive relationships with musculoskeletal injuries when investigated as a pre-injury component of the Integrated Model. A review by Williams and Andersen (1998) found several studies linking competitive trait anxiety, aggression and anger to increased injury risk (Fields, Delaney & Hinkle, 1990; Petrie, 1993; Thompson & Morris, 1994). Another pre-injury risk factor is an athlete's history of stressors, which includes the athlete's levels of life event stress, daily hassles and previous injuries (Wiese-Bjornstal et al., 2015). Research testing the Stress and Injury model (Andersen & Williams, 1988) has shown relationships between life event stress, daily hassles and athletic injury (Ivarsson et al., 2013). Pre-injury life stress also appears to be a risk factor for the occurrence of mild traumatic brain injury, although this relationship was found in non-athletes (Fenton et al., 1993).

The original Integrated Model of Sport Injury developed by Wiese-Bjornstal et al. (1998) identifies constructs such as negative affect, competitive trait anxiety and achievement motivation to be common pre-injury variables associated with the risk of sport injury. One personality trait associated with all of these constructs is multidimensional perfectionism, as research has found relationships between perfectionism and negative affect (Dunn et al., 2006; Erozkan et al., 2011), competitive trait anxiety (Martinent et al., 2007), and different achievement motives (Stoeber & Becker, 2008). Athletes' perfectionism levels have also been related to variations in sport performance (Stoeber, 2012) and personality characteristics (Stoeber & Otto, 2006). Variations in personality characteristics may result from the multidimensional nature of perfectionism, consisting of adaptive and maladaptive dimensions (Frost et al., 1990). Adaptive perfectionists are described as people who set high
standards yet feel free to be less precise as the situation permits (Frost et al., 1990; Hamachek, 1978). In contrast, maladaptive perfectionists are defined by the setting of high standards while leaving little to no room to make mistakes; leaving maladaptive perfectionists feeling as if nothing is ever done well enough (Hamachek, 1978). Maladaptive perfectionists may also base their feelings of self worth on the outcome of their endeavours (Hall, 2006). In addition, differences in the levels of adaptive and maladaptive perfectionism have been associated with musculoskeletal injuries: Levels of adaptive and maladaptive perfectionism were correlated with the total number of days lost due to injury (Winter & Greenlees, 2005), and specific maladaptive perfectionist traits (see Chapter 2) were found to be correlated with the total number of injuries in gymnasts and dancers (Krasnow et al., 1999).

Highly critical maladaptive perfectionists are susceptible to increased levels of perceived stress, anger, feelings of worry, fear of failure, and an inability to cope with stress (Dunkley et al., 2003; Dunn et al., 2006; Rice & Van Arsdale, 2010). In situations where athletes experience perceived criticism from others, maladaptive perfectionists are especially vulnerable to failure and a loss of control (Dunkley et al., 2003). Perfectionist athletes experiencing these negative feelings may attempt to alleviate them by over-training to prepare for their next performance or by ignoring medical advice in order to continue training (Hall, 2006). Attentional changes such as over-training and loss of control are comparable to the negative stress response described by Wiese-Bjornstal et al. (2015) that has been proposed as a precursor for the occurrence of concussion.

As a result of increased levels of perfectionism, athletes may experience increased levels of perceived stress (Dunkley et al., 2003; Rice & Van Arsdale, 2010). Levels of perceived stress due to perfectionism can be considered a risk factor for sport concussion under the Integrated Model's "History of Stressors" component (Wiese-Bjornstal et al., 2015). Increases in athletic injuries have been linked to increases in perceived stress due to daily hassles (Ivarsson & Johnson, 2010). The same study also found that injured athletes reported higher levels of stress susceptibility than non-injured athletes. Similar to perfectionists, athletes with increased levels of perceived stress experienced higher levels of negative emotions such as irritability, which was shown to account for 11% of the variability in injury occurrence.
These athletes had a tendency to approach stressful situations with more anger and hostility, subsequently increasing their injury risk by putting themselves into more dangerous situations. This tendency towards anger and hostility is akin to the tunnel vision described by Wiese-Bjornstal et al. (2015) as part of the stress response that may result in the occurrence of sport concussion.

Athletes exhibiting high levels of perfectionism and perceived stress may be susceptible to an increased negative stress response as a result of the pre-injury factors mentioned above (i.e., perfectionism, perceived stress). One possible manifestation of this negative stress response is an increase in negative moods, such as depression (Erozkan et al., 2011; Hammen, 2005), fatigue, (Hockey, 1983; Magnusson et al., 1996) and anger (Dunn et al., 2006; Ivarsson et al., 2013). Behaviours resulting from these mood states may result in increased injury risk. Decreased peripheral ability due to anger and irritability may result in athletes putting themselves in more dangerous situations, increasing risk of injury as a result. Further, athletes experiencing increased levels of fatigue may be at higher risk for injury, as their ability to make quick decisions and adjust their posture is diminished (Murgia, 2013). Fatigue due to physical exhaustion was also found to be a significant risk factor for concussion, possibly due to decreased reaction time (Finnoff, Jelsing & Smith, 2011; Stevens et al., 2008). Similarly, changes in muscle tension and fatigue may be linked to depression, which has been positively related to injury rate in rugby players (Lavallée & Flint, 1996).

In sum, perfectionism seems to be a common trait among elite athletes (Hardy, Jones & Gould, 1996) that may put them at risk for negative behavioural outcomes (Hall, 2006). Due to its prevalence among athletes and its apparent influence on mood and behaviour, it is important to examine the effect of perfectionism on concussion risk. This information may contribute to improving athlete awareness and decreasing concussion risk. To date, no studies have examined perfectionism as a risk factor for sport concussion, although research has linked increased levels of perfectionism and perceived stress to increases in negative moods. Thus, using the Integrated model of Psychological Response to the Sport Concussion (Wiese-Bjornstal et al., 2015) as the guiding theory, this study examined the effects of perfectionism and perceived stress on concussion risk.
1.1 Purpose

The purpose of this study was to investigate the predictive ability of multidimensional perfectionism and perceived stress on the occurrence of concussion and whether negative mood mediated those relationships. The two Integrated models developed by Wiese-Bjornstal et al. (1998, 2015) have previously shown that personality traits and history of stressors influence sport injury and concussion occurrence. This study used these models to examine perfectionism, perceived stress and mood states and their effects on the occurrence of concussion.

The following chapter provides a review of the literature concerning the dimensions and measurement of perfectionism, perfectionism in sport, and a review of the relationship between perfectionist traits, perceived stress and athlete's emotions and personality.
Chapter 2
Literature Review

2.1 Theoretical Model of Injury and Rehabilitation

Several theoretical models have been developed in an attempt to explain the relationship between an athlete's physical, psychological, behavioural and emotional tendencies and how they can influence the incidence of injury and the effectiveness of rehabilitation. One of the first of these models is the Stress and Injury Model developed by Andersen & Williams (1998). This model outlines several pre-injury psychological factors that impact the likelihood of injury onset. The Stress-Injury model was the basis for the development of two integrated models of sport injury developed by Wiese-Bjornstal and colleagues (1998, 2015). These psychological models have provided useful frameworks for investigating and describing the impact of psychological factors involved in sport injury.


Wiese-Bjornstal et al. (1998) developed The Integrated Model of Psychological Response to Sport Injury and Rehabilitation Process. This model examines both pre and post injury factors as in regards to sport injury. The Integrated Model emphasizes the pre-injury factors: 1) History of Stressors, 2) Coping Resources and, 3) Personality and, 4) Interventions. These risk factors were originally outlined by Andersen and Williams (1988) in the Stress and Injury Model, who cited them as key psychological variables that effect an athlete's response to stress, which in turn would impact the likelihood of injury onset. Wiese-Bjornstal et al. (1998) extended the Stress and Injury Model to include the post injury response to the stressor, which is mediated by the athletes cognitive appraisals. The two post injury factors included were: 1) personal factors and 2) situational factors. Personal factors include motivational orientation, athletic identity and injury severity. Situational factors include social support, level of competition and access to rehabilitation.
Recently, Wiese-Bjornstal and colleagues (2015) developed The Integrated Model of Psychological Response to Sport Concussion Injury and Rehabilitation Process. As this model was developed from their original Integrated model (Wiese-Bjornstal et al., 1998) it is presented with the same structure and considers the same four pre-injury factors as possible precursors to sport concussion. The Integrated Model of Sport Concussion was developed to synthesize the existing literature on the psychological, psychiatric, and psychosocial aspects of sport concussion as a guideline for kinesiologists and sports medicine practitioners working with athletes (Wiese-Bjornstal et al., 2015). According to the model, the influence that the pre-injury factors have on the stress response can impact the likelihood of an athlete suffering a concussion through their appraisal of these stressors and any possible behavioural changes (Wiese-Bjornstal et al., 2015). The interaction of pre and post injury factors also results in an athlete specific cognitive appraisal of the concussion (Wiese-Bjornstal et al., 2015). These appraisals subsequently affect an athlete’s emotional (e.g., anxiety, anger, fear) and behavioural response (e.g., adherence to rehabilitation guidelines) which will consequently alter recovery outcomes.

The present study uses the Wiese-Bjornstal et al. (2015) Integrated Model of Sport Concussion to examine the effect of personality variables and history of stressors on concussion risk. Although the integrated model accounts for the pre-injury psychological variables being examined, as currently constructed, it does not account for other factors that previous research has indicated to have an effect on concussions such as sex (Scopaz et al., 2013) and age (Abrahams et al., 2014). However, the present study controls for both sex and age in order to more accurately represent the factors identified in the Integrated Model of Sport Concussion (Wiese-Bjornstal et al., 2015). Both pre-injury factors and aspects of the stress response was accounted for in regards to risk of concussion.

### 2.2 Factors affecting the Risk of Concussion

Research examining the risk factors for concussion has shown mixed results in regards to what constitutes a significant risk factor. As expected, previous research examining type of sport has found that athletes participating in high collision sports such as hockey (Koh et al., 2003; Hootman, 2007), football (Lincoln et al., 2011; Marar et al., 2012) and rugby (Koh et al., 2003) have increased concussion risk. A recent systematic review conducted by
Abrahams et al. (2014) investigated age and sex in addition to several other possible concussion risk factors. Mixed evidence in this area of research does not provide any certainty for age as being a risk factor. The influence of age on concussion risk may also be influenced due to rule changes in sports such as hockey, in which body checking is not allowed in younger age groups (Emery & Meeuwisse, 2006).

A review of sex as a risk factor for concussion has also yielded mixed results. While several studies have found that females have increased risk of concussion compared to males (Finnoff et al., 2011; Scopaz et al., 2013) the review by Abrahams et al. (2014) suggests that the findings in this area remains equivocal. Another risk factor for concussion is physical exhaustion, possibly due to decreased reaction time and dehydration (Finoff et al., 2011).

Abrahams et al. (2014) concluded with certainty, that history of concussion is a significant risk for suffering further concussions in any future sport participation. Athletes who have previously suffered one or more concussions have a significantly increased risk of suffering another one (Abrahams et al., 2014). This finding is consistent through several sports, including hockey (Schneider et al., 2013), rugby (Hollis et al., 2009) and football (Guskiewicz et al., 2003). No studies have reported a decreased risk accompanying a history of concussion.

2.3 Multidimensional Perfectionism

Although a singular, formal definition of perfectionism has not been accepted, perfectionism is most often defined as a trait in which the subject sets excessively high standards in pursuit of personally important goals (Burns, 1980; Hamachek, 1978; Hewitt and Flett, 1993). As the setting of high standards is not pathological itself, further research specified that these high personal standards are accompanied by tendencies for overly critical evaluations of one's own behaviour as well as criticisms of the outcomes of these behaviours (Frost, Marten, Lahart, & Rosenblate, 1990). Perfectionism has long been recognized as a personality trait that can affect an athlete's cognitive, affective and behavioural functioning across several sport settings (Gotwals, Stoeber, Dunn, & Stoll, 2012). Whereas certain levels of perfectionism can aid in motivating and guiding athletes (Stoll, Lau, & Stoeber, 2008;
Stoeber, Uphill, & Hotham, 2009), the tendency to be overly critical of one's performance can be psychologically debilitating (Hall, 2006).

Early conceptualizations of perfectionism have framed the trait as a unidimensional construct that is detrimental to all who possess the trait (Burns, 1980). Hamachek (1978) introduced the notion that two types of perfectionism exist - normal perfectionism (adaptive perfectionism) and neurotic perfectionism (maladaptive perfectionism). This view of two opposing types of perfectionism was reiterated by Stoeber (2011) with the analogous concepts of perfectionist strivings and perfectionist concerns. Whereas the central concept of high standards is common to both conceptualizations, there are several traits that differentiate adaptive from maladaptive perfectionists. Adaptive perfectionists set high standards for themselves, but feel the freedom to be less than exact when completing tasks (Frost et al, 1990). They are realistic in their self expectations and are aware of their own strengths and limitations. Adaptive perfectionists also realize that performances that include mistakes can be seen as successful, allowing them to experience a sense of satisfaction from the performances, even if they were not flawless (Hamachek, 1978; Vallence, 2006).

In contrast, maladaptive perfectionists are inflexible in their evaluation criteria, as their goals to achieve high standards leave no room for errors (Hall, 2006; Slade & Owens, 1998). Whereas adaptive perfectionists are motivated by the pursuit of excellence and pleasure in goal achievement (Burns, 1980), maladaptive perfectionists are more motivated by fears and anxiety over the implications of a non-successful performance (Hamachek, 1978; Hall, 2006). Maladaptive perfectionists perceive minor mistakes as being disastrous and consistently perceive their efforts as failures, leading to a high likelihood of negative affect (Frost et al., 1990; Hamachek, 1978; Hewitt & Flett, 1991; Stoeber, 2012). As a result, maladaptive perfectionists rarely feel as if they have met their high standards, and experience minimal enjoyment and satisfaction from their performances. Maladaptive perfectionists also have a tendency to base their self-worth on the successes and failures of their endeavours, with successful performances increasing self-worth and poor performances decreasing self-worth (Hall, 2006). These perceived failures can lead to feelings of anger and despair that can be catastrophic in athletic situations, including over-training, unhealthy nutritional habits and an inability to heed medical advice (Hall, 2006).
Beginning in 1978 with the work conducted by Hamachek, numerous scales were developed to measure perfectionism. Over time, these scales grew to become more multidimensional, encompassing a greater range of interpersonal factors, while also becoming more specific for use within the realm of sport.

### 2.4 Multidimensional Perfectionism Scales

Early tools used to quantify perfectionism were uni-dimensional, as all questions were directed to the negative aspects of perfectionism (Burns, 1980). These early perfectionism scales focused on the dysfunctional attitudes and irrational beliefs of the subjects as the sole contributor to perfectionism. The next generation of perfectionism scales were multidimensional, encompassing both the self and others in determining a person's level of perfectionism. Frost et al. (1990) developed a six factor, 35 item inventory known as the Frost Multidimensional Perfectionism Scale (FMPS), which focused on the intrapersonal factors of both the adaptive and maladaptive dimensions of perfectionism. The first factor of the scale, **Concern over Mistakes** (CM) contains nine items describing the degree to which a person reacts negatively to mistakes and their tendency to perceive these mistakes as a failure to complete a certain task, resulting in the belief that they have lost the respect of others in their lives (Frost, 1990; Lee, 2000). CM reflects a personal disposition as well as concern over the social component of their lives, in which goal striving is based on fear of failure rather than the need for achievement. The higher one scores on CM, the more likely it is that mistakes will be viewed as important and more reprehensible. The second factor of the MPS, **Personal Standards** (PSta), contains seven items outlining a person's tendency to set extremely high personal standards and place importance on achieving these standards for self-evaluation (Frost et al., 1990). Scoring high in this dimension has been associated with positive achievement striving, positive affect and feelings of self-efficacy (Flett, Sawatzkty, et al., 1995; Frost, Heimberg, Holt, Mattia & Neubauer, 1993; Frost et al., 1990). The third dimension, **Parental Expectations** (PE), contains five items that measure the belief that a subject's parents set very high goals for them. People scoring high in this dimension believe that they must perform at increasingly high standards in order to gain love and approval from an environment in which these are perceived as conditional (Frost et al., 1990). Self-evaluation of performance is strongly tied to assumptions and evaluations from parents. The
fourth factor, Parental Criticism (PC), contains four items that reflect the individual's perception that their parents are overly critical of their performance. PE and PC outline the parental connection and influence as being central to the aetiology of perfectionist performance (Burns, 1980; Hamachek, 1978; Pacht, 1984). Additionally, these two dimensions give more information on the sources of perfectionism, rather than the behavioural dimensions (Antony & Swinson, 1998; Lee, 2000). The fifth factor of perfectionism, Doubts over Actions (DA), contains four items that outline an individual's insecurity and feelings of uncertainty regarding their personal performance behaviours (Frost et al., 1990). Individuals high in DA have a tendency towards inaction and procrastination, as DA is significantly related to fear of failure and task aversiveness (Magnusson, Bias, & White, 1996). The sixth and final dimension of the FMPS is Organization (OG). OG is a six item factor that measures the extent to which people are neat and prefers planning and rigidity in their daily lives (Frost et al., 1990). Each item is scored on a five point Likert scale and summed into a total score for each of the six factors. Factor scores are then added together to create a Total Perfectionism score (TP) (Frost et al., 1990). Organization is excluded from this calculation as those subscales scores were the least correlated with the other subscales of the FMPS and of other perfectionism scales (Burns, 1980; Frost et al., 1990). Conversely, CM was significantly correlated with all of the other FMPS subscales.

Factor analysis revealed the relative contributions of each of the subscales towards the total perfectionism score (Frost et al., 1990): Concern over Mistakes: 25% variance in TP, Organization: 15.7%, Parental Criticism: 8.6%, Personal Standards: 7.1%, Doubts about Actions: 4.6%, Parental Expectations: 3.5%. In response to these results, Frost et al.(1990) suggested that a high CM orientation is the distinguishing criterion of the maladaptive perfectionist, whereas PSta represents the major component of adaptive perfectionism (Gotwals et al., 2010).

2.4.1 Hewitt & Flett MPS Conceptualization

Since the creation of the FMPS, several other perfectionism scales have been developed. The first of these, developed just after the FMPS, is the Hewitt Multidimensional Perfectionism Scale (Hewitt-MPS) (Hewitt & Flett, 1991). In contrast to the FMPS, the Hewitt-MPS contains only 3 dimensions of perfectionism, although it still is modeled according to how
perfectionism is related to the self and others. The first of these dimensions is labeled **Self Oriented Perfectionism** (SOP), containing 15 items that focus on the degree to which individuals strive for perfection in their own endeavours (Vallence, 2002). Three defining characteristics of SOP include the following: setting high personal standards, striving to achieve these high standards and being overly self-critical (Hewitt & Flett, 1991). The first trait, setting high standards, is conceptualized similarly to PSTa in the FMPS, but leans more towards the maladaptive side of the scale, in which the goals are manifested in an "all or nothing" attitude towards performance (Lee, 2000). The second feature of SOP, striving towards these goals, demonstrates a perfectionist's optimal effort and motivation (Hewitt & Flett, 1991). The final trait of SOP is the tendency to be overly self-critical. This trait suggests that perfectionists will place their value of self-worth on the achievement of their standards, and will perceive failure if any mistakes occur. The second dimension of the Hewitt-MPS is **Other Oriented Perfectionism** (OOP), which refers to the demands one has for others to meet their own high standards. Other oriented perfectionists have similar traits to SOP but project these feelings and characteristics onto others instead of themselves (Flett, Hewitt, Blankstein, & Koledin, 1991). However, these traits may be associated with the leadership and motivational ability common in elite athletes (Hewitt & Flett, 1991). The final dimension of the Hewitt-MPS is **Socially Prescribed Perfectionism** (SPP), which describes the expectations of perfectionism placed on individuals by significant others (Flett, Hewitt, Blankstein, Solnik & Brunschot, 1996; Hewitt and Flett, 1991). These perfectionists are motivated by the approval they would receive from others by meeting the standards placed on them that are out of their control (Flett et al., 1996). Although this model is useful in identifying the sources and targets of one's perfectionism, it cannot identify the behaviours and cognitions of perfectionists that differentiate them from non perfectionists (Flett et al., 1996).

### 2.4.2 Sport Multidimensional Perfectionism Scale

Prior to 2002, the FMPS was the perfectionism scale used almost exclusively in the sport psychology literature (Gotwals & Dunn, 2009). Although the FMPS was found to be a very reliable and valid measure of global perfectionism (Enns & Cox, 2002), Dunn and colleagues believed a more domain specific measure was needed. The **Sport Multidimensional**
Perfectionism Scale (Sport-MPS) was created as a result (Dunn, Causgrove Dunn, & Syrotuik, 2002). Based off the FMPS, the Sport-MPS contains four subscales: PSta, CM, Perceived Parental Pressure (PPP) and Perceived coach pressure (PCP). PSta and CM measure the same dimensions as in the FMPS, while PPP is an aggregate dimension of the PC and PE subscales from the FMPS. The PCP subscale is used to represent athletes tendencies to perceive their coaches as a central source of pressure to be perfect (Anshel & Eom, 2003).

An updated version of the Sport-MPS was created in 2009 by Gotwals & Dunn, which added domain specific versions of Doubts about Actions (DA-Sport) and Organization (OG-sport). The initial validity and reliability of these two new subscales were established by Gotwals & Dunn (2009). Acceptable internal consistency levels of $\alpha \geq .74$ were found across all subscales.

2.4.3 Relation between Scales

As research in perfectionism becomes more prominent, there are an increasing number of studies that use one of the three mentioned MPS scales. To consolidate the results of these studies, it was first necessary to ensure that the factors of the FMPS are adequately represented by factors in both the Hewitt MPS and the Sport-MPS-2 (Enns & Cox, 2002).

Several studies have compared the factors of the FMPS to those of the Hewitt-MPS. The first of these studies was conducted by Frost et al. (1993). Total Perfectionism score from the FMPS was significantly correlated with all three of the SPP, OOP and SOP subscales in the Hewitt-MPS. The PSta scale of the FMPS was found to be most closely related to SOP. This seems to reflect the common emphasis on self-standards and high expectations that perfectionists place on themselves. Replicating this finding, a large significant correlation between Personal Standards and Self-Oriented-Perfectionism was also found by Enns & Cox (2002). Additionally, the CM, PE and PC scales were significantly correlated with SPP when SOP and OOP were controlled, suggesting that the three FMPS scales account for separate amounts of variance in SPP and that SPP scores reflect the perceptions of those three dimensions from the FMPS (Frost et al., 1993). This finding supported results found by Flett and Sawatzky et al. (1995). The correlation between CM and SPP demonstrates that making
mistakes and the negative reactions to those mistakes are conceptually tied to social concerns (Lee, 2000). All correlations were similar across gender, allowing all results to be combined for analysis. Overall, it was concluded that the Frost-MPS and Hewitt-MPS were closely related, allowing studies using either version to be compared under the assumption that the scales are measuring the same constructs (Frost et al., 1993).

More recently, one of the creators of the Sport-MPS conducted a study to establish the validity of the Sport-MPS compared to the Frost-MPS (Gotwals et al., 2010). It was hypothesized that there would be strong positive correlations between the conceptually similar subscales of the two scales (i.e., PSta-Sport and PSta-Frost). As expected, Pearson correlations revealed moderate to strong positive validity coefficients between each of the subscales: $r_{PS} = .58$, $p < .001$; $r_{CM} = .75$, $p < .001$; $r_{PPP-PE} = .68$, $p < .68$; $r_{PPP-PC} = .62$, $p < .001$; $r_{DA} = .043$, $P < .001$ and $r_{OG} = .20$, $p < .001$ (Gotwals et al., 2010). These significant correlations indicate that the Sport-MPS-2 subscales are validated to measure sport specific perfectionism, and that the constructs are related closely enough to the FMPS that they can be adequately compared to contribute to the enhanced understanding of perfectionism (Gotwals et al., 2010).

2.5 Healthy vs. Unhealthy Perfectionism

As described earlier, perfectionism has been conceptualized into two separate types: Healthy (adaptive) perfectionism in which realistic goals are set and strived towards with personal limitations in mind, and unhealthy (maladaptive) perfectionism, in which the goals are rigid and any accomplishment perceived as less than perfect is seen as a failure (Hamachek, 1978). With this dichotomous model of perfectionism in mind, the Frost-MPS and Hewitt-MPS have been compared and applied to both undergraduate and psychiatric populations (Frost et al., 1993; Flett et al., 1995). Factor analysis conducted in these studies have shown that the subscales of each MPS provides support for the distinction between adaptive and maladaptive perfectionism. Adaptive perfectionism (also known as perfectionist strivings) was found to be composed of Personal Standards (PSta) and Organization (OG) from the Frost-MPS, and the Self-Oriented (SOP) and Other-Oriented (OOP) subscales of the Hewitt-MPS. Maladaptive perfectionism (also known as evaluative concerns) was composed of Concern over Mistakes (CM), Parental Expectations (PE), Parental criticisms (PC), and
Doubts over Actions (DA) of the Frost MPS. The Hewitt-MPS subscale of Socially-Prescribed Perfectionism (SPP) also contributed to maladaptive perfectionism. This factor analysis by Frost et al. (1993) revealed a correlation of \( r = .28 \) between the adaptive and maladaptive factors. Several reviews have looked at the correlations between adaptive and maladaptive perfectionism. A more recent review of 31 studies found a mean correlation of \( r = .43 \) between adaptive and maladaptive perfectionism (Gotwals et al., 2012). An earlier review by Stoeber and Otto (2006) grouped the reviewed studies into two categories: 1) those that found perfectionist strivings maladaptive, mixed or undifferentiated from perfectionist concerns and 2) those that found perfectionist strivings adaptive. The first category of studies revealed correlations between strivings and concerns to be between \( .45 < r_s < .70 \), while the second category of studies yielded a much lower correlation, which fell between \( .10 < r_s < .28 \).

As the MPS is a multidimensional model it is important that the results are interpreted by the pattern of the overall scores. Parker (1997) used the FMPS to highlight this approach in a study examining perfectionist orientations among talented school children. Using cluster analysis, it was found that children who scored moderate on PSta, low on CM, low on PC and low in DA were adaptive perfectionists who were conscientious, predictable, could adjust well to different situations and achievement oriented. In contrast, children with high PSta, CM, PC, PE, and DA scores demonstrated the highest maladaptive perfectionism, as they tended to be socially detached, moody, highly neurotic and overly competitive (Parker, 1997). Dunn et al. (2002) replicated these finding in a sport specific context as it was found that athletes low in PC, PE and CM and high in PSta were deemed to have an adaptive style of perfectionism in that they had task goal orientations. It was also discovered that athletes who were mainly ego-oriented tended to have a maladaptive style of perfectionism. These athletes had the same MPS profile as the maladaptive children described by Parker (1997).

Early models of perfectionism (Burns, 1980; Hamachek, 1978) posited that setting and striving to attain high personal standards are inherently pathological traits. Frost et al. (1990) and Hewitt and Flett (1991) challenged and changed the view of perfectionism from a unidimensional concept to one of multiple dimensions and outcomes. As such, Frost et al. (1990) stated that in the right circumstances, the setting of high personal standards can reflect
a positive self-concept, healthy experience and a positive goal orientation. This point was alluded to above, as it was shown that children and athletes high on PSta and low on the other subscales of the FMPS were healthy perfectionists and experienced healthy outcomes (Parker, 1997; Dunn et al., 2002; Gotwals et al., 2012).

As suggested by the results of the factor analysis on the FMPS, Frost et al. (1990) considered CM orientation as the major component of maladaptive perfectionists. This relationship is further suggested as the characteristics of those high in CM (negative reaction to mistakes, fear of failure) match the traits of negative perfectionism, such as avoidance of failure/disapproval and dissatisfaction with performance (Slade and Owens, 1998). The power that CM has over perfectionism is also exhibited in Parker (1997) and Dunn et al. (2002). Both studies found that even in adaptive perfectionists with high levels of PSta, high scores on the CM subscale result in thoughts and actions becoming maladaptive (Frost et al., 1991; Gaudreau & Thompson, 2010). It has been suggested that self-oriented perfectionists (Hewitt-SOP, highly correlated with PSta) may have dysfunctional affective reactions to situations they perceive as threatening, which will negatively affect their ability to handle less than optimal performances (Hewitt & Flett, 2005).

A review by Stoeber & Otto (2006) further found that adaptive perfectionism does not necessarily create a positive perfectionist. In over 15 studies, perfectionist strivings showed a mixed pattern of outcomes, with both positive and negative correlations to adaptive (goal satisfaction, self-acceptance, positive affect) and maladaptive characteristics (burnout, ego orientation, competitive anxiety). Similar to the studies by Parker (1997) and Dunn et al. (2002), nine studies in the review that found maladaptive outcomes from perfectionist strivings, reporting a high correlation between strivings and perfectionist concerns (.45 ≤ rs ≤ .70). In contrast, the studies finding perfectionist strivings as adaptive reported smaller correlations between perfectionist strivings and concerns (.10 ≤ rs ≤ .28). This overlap between strivings and concerns was hypothesized to be the reason for the correlation between perfectionist strivings and maladaptive characteristics (Stoeber & Otto, 2006). Partial correlations suggested this theory was correct, as perfectionist strivings were found to be only positively correlated with adaptive characteristics when controlling for negative influence of perfectionist concerns (Stoeber & Otto, 2006).
A study by Terry-Short et al. (1995) revealed significant differences in the levels of positive and negative perfectionism between clinical and non-clinical groups. Specifically, athletes display significantly higher levels of adaptive perfectionism compared to maladaptive perfectionism. Additionally, the analysis of variance showed that athletes had significantly higher levels of adaptive perfectionism, than both a control group and a depressed group. Conversely, research on judo athletes found no significant differences in perfectionism between male and female judo athletes and the non-athlete controls. (Rouveix et al., 2007).

Although the subscales of adaptive and maladaptive perfectionism may have overlapping effects, several studies have concluded that they are two separate dimensions. The first of these studies by Frost et al. (1993) conducted a factor analysis on the FMPS and found two distinct loadings for adaptive and maladaptive perfectionism within the subscales of the MPS. Similar factor analyses were conducted by Terry-Short et al. (1995) and Slaney et al. (1995) who also found distinct loading of subscales into two factors. Specifically, it was found that all but two items loaded into the "negative" factor were negative subscales, while all of the items loaded into the "positive" factor were considered positive subscales (Terry-Short et al., 1995). Stumpf and Parker (2000) found similar evidence for the notion that adaptive and maladaptive perfectionism were separate constructs, as it was found that by allowing commonly grouped subscales of the FMPS to be intercorrelated, two broad factors emerge on a higher level that are similar to the overall constructs of "healthy" and "unhealthy" perfectionism as described by the developers of the multidimensional concept.

2.6 Perfectionism and General Health

The literature on the effects of perfectionism on general health has yielded several significant associations. The most common health-related correlate of perfectionism is depression. Using their own version of the MPS, Hewitt and Flett found a relationship between depression and perfectionism across several studies. The first of these studies examined the relationship between perfectionism, social support, coping and depressive symptoms in adolescents (Flett et al., 2012). It was found that socially prescribed perfectionism (SPP) has a direct, significant correlation with depressive symptoms. Self-Oriented Perfectionism (SOP) was found to be indirectly related to depression through the mediating factors of avoidant coping, internal coping resources and low support seeking. SOP was also found to
have a significant relationship with these factors, which were found to be correlated with the presence of depressive symptoms (Flett et al., 2012). In addition to depression, the presence of avoidant coping led to higher reported levels of distress in the study sample. Hewitt and Flett’s second study looked at the relationship between perfectionism, rumination, worry and depressive symptoms in early adolescents (Flett et al., 2011). These results differed slightly as both SOP and SPP were found to be significantly correlated with the presence of depressive symptoms. These findings consolidated results found by Costigan et al. (2010) who found that any exposure, perceived or actual, to unrealistic standards and expectancies imposed on the self from others can contribute to a significant increase in distress. Additionally, all three of dimensions of the Hewitt MPS were significantly correlated with levels of uncontrollable worry regarding things that have yet to happen. These worries are a reflection of the fear of failure and anticipation of mistakes that many perfectionists have (Flett et al., 2011).

An earlier study by Magnusson et al. (1996) discovered connections between perfectionism and health issues using the Frost version of the MPS. Doubts about actions (DA) was strongly associated with mental fatigue whereas high scores of parental expectations (PE) were significantly associated with increased physical fatigue. Consistent with the Frost et al’s. (1993) view of healthy vs. unhealthy perfectionism, personal standards (PSta), an adaptive subscale of the MPS, was found to be inversely correlated with both mental and physical fatigue (Magnusson et al., 1996). A multiple regression revealed that overall, maladaptive perfectionism is associated with the presence of chronic fatigue. One possible explanation of this association is that perfectionists become highly stressed when attempting to meet extremely high standards. This may lead to a vicious cycle in which self-doubting individuals become progressively more fatigued while continually striving for, but failing to achieve their goals (Magnusson et al., 1996).

A review by Shafran and Mansell (2001) examined multiple articles that studied the association between perfectionism and several clinical psychological disorders. In terms of depression, the findings were consistent with the later studies by Hewitt & Flett (2011, 2012) in that both SPP and SOP were significantly related to depression. SOP was most strongly associated with depression in the context of achievement stress. Symptoms of low self-
esteem were found to be common in perfectionists, showing a mild correlation with SPP. For perfectionists with low self-esteem, any negative comments, even mild ones can be seen as catastrophic failures. This constant negative thinking is thought to be a major reason for low self-esteem being a major mediator of the relationship between perfectionism and depression (Preusser et al., 1994). Another study found that SPP was moderately correlated with the development and maintenance of social anxiety (Saboonchi & Lundh, 1997). The review also found that obsessive compulsive disorder (OCD) was closely associated with perfectionism and that those who suffer from OCD exhibit the same preoccupation with orderliness as perfectionists with high organization ratings on the FMPS and display the same rigidity, stubbornness and lack of flexibility seen in maladaptive perfectionists. Similar to findings from the Magnusson et al. (1996) study, this review found that higher levels of maladaptive perfectionism were related to chronic fatigue and headaches in mothers, as well as in workers who described themselves as having a high level of involvement but a low level of enjoyment in their jobs. Similarly, type A behaviour, which is highly correlated with perfectionism, has been implicated in health complaints such as cardiac disease and hypertension. A study of medical outpatients has suggested that these physical symptoms may be reported more in subjects with high perfectionism levels when they experience a high number of events that threaten their sense of accomplishment (Organista & Miranda, 1991).

### 2.7 Perfectionism in Sport

Anecdotal evidence has documented the salience of the perfectionist personality and its influence on elite athletes. Hardy, Jones and Gould (1996) stated that "Many of the most effective world class athletes are perfectionist in their orientations ... they have learned to deal with their perfectionism in a positive manner, allowing these tendencies to facilitate, as opposed to inhibit, their development" (p. 243). Conversely, while "perfection" is a common term used to describe the quality of elite athletics, the idea that an athlete must be perfect during each and every competition may adversely affect their ability to stay focused on the task in pursuit of their goals (Zinsser & Bunker, 2001).

Empirical research into competitive sport and elite athletes examining the functions and consequences of perfectionism has indicated that perfectionism plays a prominent role in influencing an individual's cognitions, behaviours and emotions. The first direct examination
of perfectionism in sport came from Frost and Henderson (1991), when they assessed female athletes with the FMPS in relation to other psychological inventories (i.e., Reactions to Mistakes during Competition Scale; Sport Competition Anxiety Test). Results yielded a number of significant correlations between several MPS subscales and psychological tendencies. First, CM was found to be positively correlated with competitive trait anxiety, a tendency to focus on failure, disappointment with the self, feelings of letting the team down, pressure to make up for a mistake, focusing on a mistake, and imagining a mistake throughout competition. CM was found to be negatively correlated with competitive sport confidence. This pattern of correlations seems to suggest that athletes high in CM are in a constant state of worry about a previous mistake they have made or a mistake they are concerned they will make. This pattern of failure centered thinking has been shown to predict lower sport performance in athletes with high levels of perfectionist strivings due to possible "cognitive interference" affecting their task relevant thoughts (Anshel & Mansouri, 2005; Sarason, Pierce, & Sarason, 1996).

A recent review conducted by Gotwals et al. (2012) found results similar to those of Stoeber and Otto (2006), in that the majority (54.8%) of the 31 studies presented mixed evidence of the adaptive characteristics of perfectionist strivings. A significant, positive correlation between perfectionistic strivings and concerns (r = .43) was again found in the review studies, showing considerable overlap between the two dimensions. Hill et al. (2010) conducted a similar correlation study, controlling for overlap with characteristics of Stoeber's perfectionistic concerns. As expected, the study found that perfectionist strivings were strongly correlated with adaptive characteristics and negatively correlated with maladaptive characteristics. However, in some instances there was evidence that perfectionist strivings were neutral or maladaptive. Overall, the results of these two studies suggest that the components of perfectionist strivings that overlap with perfectionist concerns cause an increase in the significance of the relationship between perfectionist strivings and the expression of maladaptive characteristics (Hill et al., 2010). These results can be applied to a study conducted by Gould et al. (2002), which found that a sample of Olympic champions had high scores on the personal standards subscale of the FMPS and low scores on the concern over mistakes subscale of the FMPS, suggesting that the success of the elite athletes
is predicated on the abundance of adaptive characteristics and the absence of maladaptive characteristics.

Four other studies have investigated the relationship between perfectionism and sport-related performance. Of these four, three have found that perfectionist strivings predict higher performance (Stoeber et al., 2009; Stoll et al., 2008), and one has found perfectionist strivings to predict lower performance after failure (Anshel & Mansouri, 2005). As stated earlier, the study by Anshel and Mansouri (2005) found that perfectionist strivings and concerns were unrelated to performance when no feedback was provided. However, when provided with negative feedback regarding their performance, athletes high in perfectionist strivings and perfectionist concerns performed significantly worse on a body balance task. This suggests that perfectionism can undermine sport performance if the athletes perceives their performance as a "failure".

Stoll et al. (2008) examined the effect of perfectionist strivings on training performance and discovered that athletes with higher levels of perfectionist strivings performed at a higher level across four trials. It was also found that the interaction between perfectionist strivings and concerns predicted performance increments between trials, as athletes who were high in both types of perfectionism showed larger increments between performances. The reason for these increments between performances may have been due to the negative emotional reactions to perceived imperfect training sessions (Stoeber, 2012). Athletes with high perfectionist concerns were more motivated to improve their performance to match their high personal standards.

Stoeber et al. (2009) conducted two studies on the correlation between perfectionist strivings, perfectionist concerns and triathlon performance. In both studies, only perfectionist strivings predicted athletic performance, with perfectionist concerns being unrelated. Similar to Dunn et al. (2002), athletes with high levels of perfectionist strivings adopted more approach-oriented goal setting styles. The difference in goal styles mediated the effect of perfectionist strivings on race performance, with better race performance belonging to athletes with a larger difference between their approach (task) and avoidance (ego) goal setting styles.
There has long been a divide in the sport psychology literature regarding the inherent effects of perfectionism on sport performance. Some researchers have found that perfectionism is a key characteristic of achieving elite performance in sport (Gould et al., 2002; Stoeber et al., 2009; Stoll et al., 2008) whereas others see perfectionism as a maladaptive characteristic that can undermine athletic performance, rather than help it (Anshel & Mansouri, 2005; Flett & Hewitt, 2005; Hall, 2006). Recent review studies have lent merit to both views as perfectionism has been shown to have both adaptive and maladaptive effects on the cognitions and behaviours of athletes, which in turn can affect their level of performance in training or competition (Gotwals et al., 2012; Stoeber & Otto, 2006).

2.8 Effects of Perfectionism on the Incidence of Injury

Research into the effects of perfectionism on sport performance has yielded mixed results. The one constant finding is that athletes who scored high on maladaptive subscales of the FMPS (particularly CM) showed a much higher level of negative behavioural and emotional consequences (Gotwals et al., 2012; Stoeber & Otto, 2006). The topic of perfectionism’s direct effects on the incidence of athletic injury has been scarcely researched. However, the studies examining this topic have found results suggesting that perfectionism may have a negative impact on athletic injuries.

The first of these studies examined the relationship between perfectionism, psychological stress and injuries in three groups of elite young dancers using the FMPS (Krasnow, Mainwaring & Kerr, 1999). Pearson correlations showed significant relationships between CM, total stress in modern dancers and negative stress in artistic dancers. A significant relationship between two maladaptive subscales of perfectionism and injury were found as the Parental Expectations subscale was positively correlated with the number of injuries in modern dancers. The CM subscale was also found to be significantly correlated with injury in artistic gymnasts. Total Perfectionism was not correlated with injury. Perfectionism also showed a significant positive relationship with stress as measures of total and negative stress were correlated with CM in both modern dancers and artistic gymnasts. DA was found to be correlated with only negative stress in modern dancers, while PE and total stress were correlated in ballet dancers (Krasnow et al., 1999). This proposed link between negative stress and athletic injuries was strengthened with work by Ivarsson et al. (2013), who found
that levels of negative life event stress leading to daily hassles in professional soccer players has an indirect effect on the frequency of injury. This finding adds to the literature implicating negative stress in increasing injury frequency (Steffen et al., 2009). Daily hassles were found to have a moderate positive relationship with injury occurrence, suggesting that the burden placed on athletes as a result of life stresses or chronic daily hassles may increase their vulnerability to injury (Ivarsson et al., 2013). Ivarsson et al. (2013) found results similar to those by Dunkley et al. (2000), in which hassles were found to be a unique mediator that explained the relationship between maladaptive perfectionism and stress. The relationship between daily hassles and stress levels may be especially pronounced in maladaptive perfectionists, as these people tend to focus on the negative aspects of everyday occurrences, causing ordinary events to be interpreted as stressful (Hewitt & Flett, 1993).

A systematic review of 32 studies on the epidemiology, treatment and prevention of musculoskeletal injuries in dancers yielded one study that found perfectionism to be a risk factor for injury (Hincapie, Morton & Cassidy, 2008). A separate study by Liederbach & Compagno (2001) found that perfectionism in university level and professional dancers was associated with a higher incidence of injury.

A third study considered the levels of adaptive vs. maladaptive perfectionism using the FMPS in female artistic gymnasts aged 13.14 ± 2.68 years (Winter & Greenlees, 2005). Injury data was reported 6 months after administration of the FMPS for the following variables: number, type (non, acute, chronic) and severity of injury measured by days lost. Pearson correlations indicated that maladaptive perfectionism was significantly and positively correlated with total days lost due to injury and days lost due to chronic injuries. Regression analysis revealed that neurotic perfectionism accounted for 47.3% of the variance in the number of training days lost due to injury, while normal perfectionism only accounted for 7.6% of the variance in days lost due to injury (Winter & Greenlees, 2005). Similarly, neurotic perfectionism accounted for 42.9% of the variance in the number of training days lost due to chronic injury while normal perfectionism only accounted for 7.6% of the variance. These results suggest two things. First, adaptive perfectionists showed flexibility and restraint to take time off recover after being injured, resulting in fewer days lost due to injury. This contrasts maladaptive perfectionists, who would display more destructive
tendencies and negative emotions (Gotwals et al., 2012; Hall et al., 2006). Second, the more severe injuries and longer recovery times seen in maladaptive perfectionists (Winter & Greenlees, 2005) may be a result of anxiety and stress arising from perfectionist personality traits (Dunkley et al., 2003; Flett & Hewitt, 2005; Frost & Henderson, 1991; Hall, 1998; Hall, 2006; Koivula et al., 2002; Wimberley & Stasio, 2013) as a result of a failure to minimize the discrepancy between actual performance and achievement standards (Winter & Greenlees, 2005).

2.9 Emotional and Cognitive Correlates of Perfectionism

The literature on perfectionism's effects on sport performance and personality has stated, almost universally, that maladaptive perfectionism can lead to negative emotions, thoughts and coping styles, that potentially contribute to an athlete's response to a stressor, such as a perceived failure or an athletic injury (Gotwals et al., 2012; Hall, 2006). The existing literature on perfectionism has suggested that it can negatively influence an individual's level of stress, affect, and mood states such as depression, anger and anxiety (Dunn et al., 2006; Erozkan et al., 2011; Frost et al., 1993).

2.9.1 The Influence of Perfectionism on Athlete Affect and Distress

Frost et al. (1993) analyzed the correlations between the measures of positive and negative affect and the subscales of both the FMPS and Hewitt-MPS. The FMPS subscales CM, PC, and DA were significantly and positively correlated with the Beck Depression Inventory (BDI) in a group of 553 undergraduate students. Total Perfectionism also showed a positive significant correlation with scores of the BDI. Significant correlations on the Positive-Affect-Negative Affect Scale (PANAS) were also found for these subscales (Frost et al., 1993). Similar to the correlations with the BDI, feelings of negative affect (NA - fear, anger, guilt) were positively correlated with CM, PC, DA and Total Perfectionism. None of these subscales were associated with positive affect (PA) on the PANAS which includes feelings of energy, enthusiasm and activity. In contrast, the adaptive FMPS subscales of Personal Standards and Organization were positively correlated with PA, sharing no correlations with NA. Similar relationships between maladaptive perfectionism and depression as well as between PSta and positive affect were found in more recent studies (Chang et al., 2008;
DiBartolo, Li & Frost, 2008; Flett et al., 2002). Consistent with previous research, the BDI was positively correlated with NA and negatively correlated with PA (Watson, Clark & Tellegen, 1988). The Hewitt MPS measure of SOP was not significantly correlated to either NA or the BDI but showed significant association with PA. This correlation may represent the variance that SOP shares with the PSta subscale of the FMPS. SPP showed a significant correlation with both the BDI and NA scales. OOP was not correlated with any affect measure (Frost et al., 1993).

A study examining the relationship between dispositional perfectionism and its influence on stress and coping found further evidence that maladaptive perfectionism can be a precursor to increased stress levels (Dunkley et al., 2003). Specifically, it was found that highly self-critical perfectionists may be prone to feelings of guilt, sadness, hopelessness, feelings of fear, worry, nervousness and an inability to cope with stress. It was also found that highly self-critical perfectionists experienced increased severity of daily hassles, perceived criticism and high levels of negative stress during events in which they experienced perceived criticism from others and low levels of confidence in their ability to cope (Dunkley et al., 2003). Based on these data, the researchers have suggested that highly self-critical perfectionists are especially vulnerable to failure and a loss of control compared to perfectionists who are not highly self-critical (i.e., adaptive perfectionists). Rice and Van Arsdale (2010) examined the association between perfectionism and perceived stress. Post-hoc tests revealed that subjects classified as maladaptive perfectionists have significantly higher perceived stress levels than adaptive perfectionists and non-perfectionists, with non-perfectionists having higher stress levels than adaptive perfectionists (Rice & Van Arsdale, 2010).

2.9.2 Perfectionism and Fatigue

Early studies on the association between multidimensional perfectionism and fatigue conducted by Magnusson et al. (1996) showed that the subscales of the FMPS have significant effects on fatigue levels. Participants rated their state fatigue as the amount of tiredness experienced over the past week, while trait fatigue was measured through repeated administering of these tests. A significant correlation was found between maladaptive perfectionism and trait fatigue (Magnusson et al., 1996). Specifically, PE was strongly
correlated with physical fatigue, while DA showed a statistically significant relationship with mental fatigue. Conversely, the positive subscale PSta, showed trends towards being inversely related to fatigue. The completely different effects that positive and negative perfectionism have on fatigue demonstrated evidence that the two dimensions of perfectionism are separate from one another. Regression analysis confirmed the results of the correlation analysis that showed the effect of negative perfectionism on trait fatigue (Magnusson et al., 1996).

Kempke et al. (2011) investigated the roles of adaptive and maladaptive perfectionism on the presence of fatigue. CM and DA were significantly correlated with increased fatigue. Conversely, adaptive perfectionism was not significantly correlated with fatigue. Overall, the subscales of the maladaptive dimension of perfectionism, but not adaptive perfectionism, were significantly and positively related to the severity of fatigue.

Chronic fatigue syndrome (CFS) is characterized by severe, prolonged fatigue along with muscle pains, headaches and post-exertional malaise (Kempke et al., 2011). Studies comparing fatigue with the MPS showed several significant findings. First, subscales of maladaptive perfectionism (CM, DA, PC) were significantly correlated with CFS, whereas adaptive perfectionist traits (PSta) were not as highly correlated (Deary & Chalder, 2010). Overall, the fatigued group’s levels of adaptive perfectionism were matched by the levels of maladaptive perfectionism. Therefore, it may not be either trait itself that causes fatigue, but the interaction of having to maintain high standards in the face of worry and self doubt may be a predisposing factor for fatigue (Deary & Chalder, 2010). Ware and Kleinman (1992) have found that CFS patients report themselves as having excessively high standards, and work hard to achieve these standards. Perfectionist personality traits such as self doubt, self criticism and all or nothing thinking have been associated with anxiety, depression and general distress. In turn, there affects have been associated with increased levels of fatigue (Arpin-Cribbie & Cribbie, 2007).

CFS resulting from excess perfectionist strivings (Deary & Chalder, 2010) may be a possible precursor to the incidence of injury due to decreased physical ability to perform necessary physical adjustments to avoid these injuries (Murgia, 2013). Overall, it was concluded that
the physiological arousal, emotional distress and cognitive activation that arise from high levels of maladaptive perfectionism could lead to physiological burnout in situations where the process continues for long periods of time.

Additionally, increased fatigue has been found to be one of key precursors to injury occurrence (Johnson, 2011) and a significant risk factor for concussion occurrence (Finnoff et al., 2011). Maladaptive perfectionism seems to play an important role in the maintenance of CFS through a subject's level of depression (Van Houdenhove et al., 2010).

2.9.3 Perfectionism and Depression

Perfectionism has long been recognized as a predisposing factor for depression in cognitive and psychoanalytic research (Beck, 1967). In the years since the development of the MPS, there has been considerable growth in this view (Hewitt & Flett, 1991), with two central mechanisms that have been used to explain this relationship (Hewitt & Flett, 1993). First, perfectionist behaviour has been shown to generate negative stress, originating from a tendency to focus on the negative aspects of performance, with little room for error. Second, perfectionism can enhance avoidance of a healthy stress response. These responses stem from a maladaptive perfectionists inclination to interpret their performances in relation to their own feelings of self-worth (Hewitt & Flett, 1993).

A recent study (Erozkan et al., 2011) examining the relationship between perfectionism and depression in high school students confirmed the early results found by Frost et al. (1993). As expected, it was found that students scoring high on the CM subscale of the FMPS had higher levels of depression than those scoring higher on the other subscales, when measured using the BDI. Other subscales of the FMPS correlated with depression (Erozkan et al., 2011). In descending order, the subscales are as follows: PSta, PE, PC, DA, OG. Even though PSta is a trait of adaptive perfectionism, it has been suggested in these and previously mentioned results (Parker, 1997; Dunn et al., 2002; Hewitt & Flett, 2005) that maladaptive characteristics and affects are common in athletes who are concerned about their mistakes while attempting to achieve their self-prescribed high standards. However, if the overlapping effects of CM are controlled for, PSta no longer shows a positive correlation with depression (Wimberly & Stasio, 2013) Depression appeared to differ between sex as high school
females had higher depression levels than high school males (Erozkan et al., 2011). Overall, it was found that the subscales of the FMPS contributed a great deal to depression, explaining 14.4% of the total variance in BDI scores. Enns et al. (2002) conducted a study to determine the relationship between parenting experiences, perfectionism orientation and proneness to depression. It was found that maladaptive perfectionism was correlated with increased proneness to depression. Similar to other studies, Enns et al. (2002), found that maladaptive perfectionism was comprised of the following MPS subscales: CM, DA and SPP. This study concluded that harsh parenting (PC) and perfectionistic parenting (PE) was significantly correlated to the presence of maladaptive perfectionism (Enns et al., 2002). Perfectionistic parenting on its own was found to be positively correlated to adaptive perfectionism and negatively correlated to depression proneness.

Associations between perfectionism and depression have been found recently through use of the Profile of Mood States scale (POMS), as opposed to the BDI. In a study of elite and recreational athletes, Kerr and Sterling (2006) found that depression-dejection was significantly associated with Parental Expectations and expectations of the coaching staff. Similarly, Wimberly and Stasion (2013) found that maladaptive perfectionist dimensions as a whole was also associated with depression-dejection.

2.9.4 Perfectionism and Anger

Anger is one the most common and influential performance-related emotions in sport (Lazarus, 2000). It has been also been linked to perfectionism in non sport settings (Frost & Henderson, 1991, Gotwals et al., 2012; Hall, 2006). Hamachek (1978) first suggested anger as an emotional correlate of perfectionism as those with high perfectionism scores believe: 1) They should do better and 2) No mistakes should have been made. A study by Dunn et al. (2006) found significant relationships between perfectionism and two different anger scales: 1) Reactions-to-Mistakes Anger (RMA), which contains three subscales, and 2) Trait Anger (TA), which contains two subscales. There were significant correlations found between CM and PCP to RMA and TA. Overall, Dunn et al. (2006) concluded that as scores on the maladaptive scales of the MPS increased, dispositional tendencies towards anger increased. Both trait anger and reaction to mistakes anger were also found to increase with increases in the maladaptive perfectionist subscales. Athlete disposition to anger was also found to
increase when a high CM was combined with a high PSta. Interestingly, perceived parental pressure was not significantly correlated with any of the anger dimensions while perceived coach pressure was. This may be because the athletes in this study felt that their coaches were a more important authority figure in guiding their goals (Dunn et al., 2006).

A study on the perfectionism-anger relationship in youth ice hockey yielded similar results (Vallence, 2002). Bivariate correlations indicate that CM had significant positive correlations with both trait anger subscales: Anger-Temperament, Anger-Reaction, and all three state anger subscales; Feeling angry, Feel like expressing anger verbally and Feel like expressing anger physically. Similar to Dunn et al. (2006), perceived coach pressure of the Sport-MPS had significant positive correlations with all trait and state anger scales, with the exception of feeling angry in highly critical situations. These correlations indicate that players higher in CM, PPP and PCP are more likely to experience angry emotions without any provocation and are more likely to get angry out of frustration in sport settings (Vallence et al., 2006). Using the POMS, similar associations between perfectionism dimensions and anger have been found. With the exception of self oriented perfectionism, all dimensions of the MPS (TP, PC, PCP, PSta) were significantly correlated with anger-hostility on the POMS (Kerr & Stirling, 2006).

2.9.5 Perfectionism and Anxiety

Reviews have suggested that the presence of perfectionism plays a key role in the mediation of various anxiety disorders (Egan, Wade & Shafran, 2011; Gotwals et al., 2012). State anxiety, felt during time of perceived stress, and trait anxiety, which is experienced across typical situations on a daily basis (Spielbeger & Sydeman, 1994), have both been associated with perfectionism within and outside of sport situations. Perfectionism research in sport has consistently revealed that high scores in both adaptive and maladaptive perfectionism can lead to increased anxiety before and during competition (Flett & Hewitt, 2005; Frost & Henderson, 1991; Hall, 1998; Hall, 2006; Koivula et al., 2002; Wimberley & Stasio, 2013). Universally, the CM subscale of the FMPS has demonstrated strong positive correlations with both somatic and cognitive anxiety (Gnilka et al., 2012; Hall et al., 1998, Martinent & Ferrand, 2007; Stoeber et al., 2007; Stoeber, 2012). High anxiety individuals were also found to have scored higher on the socially prescribed perfectionism subscale of the Hewitt MPS.
than those in a less anxious control group (Kerr & Stirling, 2006). Maladaptive perfectionists have been found to have significantly higher levels of anxiety than both adaptive perfectionists and non perfectionists (Gnilka et al., 2012). A recent study by Handley et al. (2014) has found that both CM and PSta are significant positive predictors of pathological worry in a clinical sample after controlling for gender and depression. This relationship between PSta and negative outcomes lends more evidence to the suggestion that, although PSta is a positive component of perfectionism, it can lead to debilitating outcomes when combined with CM (Hall, 2006). These results provide some rationale for perfectionism to be a target of therapies when attempting to reduce anxiety levels.

The degree to which athletes demonstrate CM has been shown to influence their interpretation of anxiety. Martinent & Ferrand (2007) have identified several clusters in which athletes differ based on their level of perfectionism. The first of these clusters are the anxious debilitators, who exhibited significantly higher intensity of cognitive and somatic anxiety than other groups and perceived it as a definite negative to their performance. On the MPS, these athletes responded with the highest scores on the CM and PSta subscales. Handley et al. (2014) have also demonstrated the correlation of high anxiety to CM and PSta, whereas Wimberly & Stasio (2013) found that PSta, after controlling for other subscales, is negatively correlated to anxiety. Anxious facilitators, who interpreted their higher levels of anxiety as helpful, also scored high on PSta, but showed lower levels of CM, general worry and perceived pressure from parents and coaches.

2.9.6 Perfectionism and Self-Esteem

Perfectionism has also been demonstrated to influence how individuals view themselves, which can effect anxiety levels and interpretation of anxiety in athletes. In particular, self-confidence and self-esteem have been at the forefront of this research. A characteristic of the anxious facilitators cluster was their significantly higher self confidence levels compared to other athlete clusters (Martinent & Ferrand, 2007). Having high levels of self confidence allowed athletes to slightly lower their overall anxiety levels, as well as offset the negative effects through a more facilitative appraisal of how the anxiety would affect them. Further, athletes exhibiting high levels of self confidence, showed lower levels of competitive state anxiety (Stoeber et al., 2007). Much like anxiety itself, self confidence increases with high
levels of PSta (Hall, 1998; Stoeber, 2007) and decreases when maladaptive perfectionist traits such as CM and DA increase (Koivula et al., 2002). Self-esteem is a variable that has also shown to influence anxiety, as mediated by perfectionism (Koivula et al., 2007). Defined as a dispositional evaluative attitude people have towards themselves, self-esteem was found to change as a result of perfectionist traits (Gotwals & Dunn, 2003). Similar to other personality traits, self-esteem is determined by the balance between adaptive and maladaptive perfectionism. Koivula et al. (2002) showed that elite athletes high in DA, moderate to high in CM and low in PSta show low self-esteem and significantly higher levels of competitive anxiety than those with high self-esteem. Similar results were found by Doebler et al. (2010) and Gotwals & Dunn, (2003). The self-esteem of athletes high in maladaptive perfectionist traits was altered in response to performance feedback regarding the successes for failures of the task (Koivula et al., 2002).

2.10 Emotional and Cognitive Correlates of Perceived Stress

For the purposes of this study, perceived stress was construed as a pre-injury psychological factor which can produce a negative stress response, leading to injury. Previous studies have shown associations between perceived stress and several negative mood states (measured by the POMS) such as depression, anger and fatigue.

Several studies examining the association between perceived stress and depression have demonstrated several significant results. Early studies found associations between life stress and several psychological disorders, including depression (Paykel & Dowlatshahi, 1988; Levenstein et al., 1993). To investigate the predictive abilities of the Perceived Stress Scale, Hewitt et al. (1992) explored the relationship between perceived stress and depressive symptomatology in a clinical sample. Results yielded significant positive correlations between PS and scores on the Beck Depression Inventory. Martin et al. (1995) studied correlations in adolescents. Analysis revealed similar significant correlations between Perceived Stress and the Children's Depression Inventory (CDI), a version of the BDI used with children and adolescents. These correlations were found in both males and females. In addition, PS scores accounted for independent variance in CDI scores, suggesting that perceived stress levels may play a more important role in depression onset than major life events (Martin et al., 1995). A study on the subject done by Begdahl and Bergdahl (2002)
also found an overall significant association between PS and the BDI. However, the magnitude of the association between stress and depression differed between subjects who reported low, moderate and high levels of stress. The high stress group was found to have stronger associations with the BDI, while low to moderately stressed groups, showed stronger associations with state and trait anxiety. A more recent study conducted by Lee and Kim (2006) investigated depression levels in relation to perceived stress in clinical nurses, where a significant positive correlation between depression and perceived stress was found. Additionally, perceived stress was found to be one of the significant predictors of depression, along with mental fatigue and anger, that explained 32.7% of the variance in depression levels.

Several studies have also suggested an association between perceived stress and fatigue. In a study evaluating patients with chronic fatigue syndrome, it was found that reporting increased levels of stress was correlated with increased levels of fatigue (Taylor et al., 2006). A study on the relationship between stress, fatigue and cognitive functioning in college students found similar significant and positive correlations between stress and fatigue levels (Palmer et al., 2013). Both of these studies found that the combination of stress and fatigue resulted in detriments to neuro-cognitive functioning. Similar detriments in neuro-cognitive functioning have been previously linked to musculoskeletal injuries (Murgia, 2013). Other studies have also found correlations between stress and fatigue levels (Elavski & Gold, 2009; Maghout-Juralti et al., 2010). Maghout-Juralti et al. (2010) specifically found that fatigue fully mediated the relationship between stress and poor health outcomes, when stress is significant enough to drain stress resiliency and manifest as fatigue.

Finally, several studies have implicated stress as a precursor to increased levels of anger. An early study by Thomas and Williams (1991) found that perceived stress is related to trait anger and four different modes of anger expression: Anger-in, anger-out, anger-symptoms and anger-discussion. All of the relationships were positive with the exception of the healthy expression mode of anger-discussion, in which anger is openly discussed outwardly in a healthy manner. Most notably, Perceived Stress was strongly related to trait anger-symptoms, in which suppressed anger is manifested somatically in the form of physical symptoms such as headaches. Subsequent studies by Lee (2003) and Lee et al. (2005) have found similar
association between anger and Perceived Stress. The earlier of these studies concluded that trait anger is significantly correlated with increased levels of perceived stress (Lee, 2003). This result was also found by Maan Diong et al. (2005). The later study by Lee et al. (2005) found that subjects with higher levels of Perceived Stress are significantly more likely to be high in both the anger-in and anger-out modes of anger expression. Finally, Hampel and Petermann (2006) found that perceived interpersonal stress is related to anger control problems and emotional distress.

2.11 The Effects of Stress, Emotions, and Mood on the Occurrence of Injury

Previous to his work with perceived stress and daily hassles (Ivarsson et al., 2013), Ivarsson investigated a variety of other psychological factors as predictors of injury among soccer players in competitive leagues (Ivarsson & Johnson, 2010). Athletes with a higher risk of injury had significantly different levels of several different psychological variables. First, injured athletes had significantly higher levels of somatic and trait anxiety compared to non-injured players. Ivarsson and Johnson (2010) suggested that these athletes would perceive certain situations as more stressful compared to low anxiety counterparts, decreasing their "peripheral ability", leading to tunnel vision and increased injury risk. In that same light, injured athletes reported higher levels of stress susceptibility than non-injured players. Ivarsson et al. (2013) reported increased perceptions of stress resulting in an increase in daily hassles and increased injury risk. Increased levels of irritability were also found in injured athletes, accounting for 11% of the variability in injury occurrence. These athletes were seen to approach difficult situations with more anger and hostility, putting themselves in more dangerous situations and increasing subsequent injury risk. Additionally, athletes who used negative coping strategies such as self-blame had a higher injury rate. These negative coping strategies accounted for 14.6% of the variance in injury occurrence.

In a qualitative study, Johnson (2011), identified four core themes while interviewing athletes with an increased injury frequency. The first of these themes was an increased number of negative life stressors such as a turbulent life and work/school related stressors. As mentioned, negative stressors are seen to play a large role in the incidence of injury, with research by Rogers & Landers (2005) suggesting that negative life stressors were the
The strongest predictor of injury incidence among athletes. The second core theme found were the athlete's personal factors, the most salient of which was seen to be performance anxiety. The third core theme was increased fatigue levels. As explored in research by Magnusson et al. (1996), fatigue is a salient feature of maladaptive perfectionists as it becomes exhausting attempting to meet expectations. This physical exhaustion may lead to decreased awareness and higher stress, which has been shown to increase injury occurrence. The final core theme was the ineffective coping methods used in response to the criticism received from coaches, parents and peers. Excessive self-blame and avoidance strategies, commonly found in perfectionists (Gnilka et al., 2012) were often precursors to restricted health and decreased well being in non sport settings (Johnson, 2011).

The qualitative study by Johnson and Ivarsson (2011) served to reinforce findings from their previous studies; injured high school soccer players had significantly higher levels of somatic trait anxiety than non-injured athletes (Johnson & Ivarsson, 2011). Overall, somatic trait anxiety accounted for 11% of the total variance in injury occurrence. Additionally, the presence of high levels of negative life stress was a significant predictor of injury occurrence, accounting for 7% of the total injuries in the study. The modest 7% variability may be explained by negative life stressors, which have been found to influence other predictors that increase injury frequency, such as daily hassles (Ivarsson et al., 2013) and fatigue (Johnson, 2011). All together, negative life stress, somatic trait anxiety, negative coping strategies and stress susceptibility explained 23% of the total variance in injury incidence in junior soccer players.

2.12 Conclusion

As the number of concussions in organized sport is increasing rapidly (Gessel et al., 2007), knowledge of which factors influence risk, and knowing how to reduce the impact of these factors is an important step in proactively reducing concussions in the future. History of concussion (Abrahams et al., 2014) and sport (Hootman, 2007) are the only risk factors that have shown a high level of certainty of predicting concussion risk. Previous studies show that athlete behaviour provides a low level of certainty in regards to risk of concussion (Abrahams et al., 2014). However, perfectionism has yet to be examined as a concussion risk factor. As perfectionism has been found to be a salient personality trait in elite athletes
(Gould et al., 2002), it is worth investigating how an athlete's levels of perfectionism, perceived stress and mood states may affect risk of concussion. Following the path of the Integrated Model of Sport Concussion (Wiese-Bjornstal et al., 2015), concussions may be influenced by perfectionism and perceived stress through their effects on an athlete's stress response. Negative personality variables and a history of stressors can influence the athlete's stress response by increasing negative moods. This increase in negative moods may lead to decreased peripheral ability and increased injury risk (Andersen & Williams, 1999). Previous findings based on this pathway between stress response and injury have shown significant and positive relationships between athlete anxiety and musculoskeletal injury (Ivarsson & Johnson, 2010). As this pathway has been found to accurately depict athlete risk of musculoskeletal injury, it is the aim of this study to determine if the pre-injury factor stress response pathway could also predict an athlete's risk of suffering a concussion.

Therefore, this study explored how multidimensional perfectionism, perceived stress and mood states affect the risk of concussion in varsity athletes, with a goal to identify risk factors of sport concussion. It is the hope of this study that this knowledge may eventually be applied to the creation or modification of a psychological intervention program that aims to reduce the number of injuries in varsity athletes. The effectiveness of such programs has been examined by Noh et al. (2007), who found that an intervention targeting the improvement of broad based coping skills, such as managing peaking under pressure, self-confidence, coping with adversity and concentration, was effective in reducing injury frequency and duration on ballet dancers. These results support the suggestion by Williams and Andersen's (1998) stress injury model (on which the Wiese-Bjornstal Integrated Model was formed) that interventions reducing stress or increasing coping resources will reduce the likelihood of injury (Noh et al., 2007). The techniques used in this successful intervention (positive self-talk and imagery) focused on situations in which perfectionists perceive the highest amount of stress, such as handling coach criticism, the pressure associated with performance and the tension of competing against others.

The following chapter will outline the method used to examine multidimensional perfectionism, perceived stress, mood states and the purpose, hypotheses and procedures of the study.
Chapter 3

Method

3.1 Research Questions

The purpose of this study was to investigate the predictive ability of multidimensional perfectionism and perceived stress on the occurrence of concussion and whether or not negative mood states played a role in the mediation of those relationships. To this end, the following research questions were examined:

1. What is the association between adaptive perfectionism and risk of concussion?
2. What is the association between maladaptive perfectionism and risk of concussion?
3. What is the association between perceived stress and risk of concussion?
4. Does fatigue mediate the relationship between perfectionism (AP and MP), perceived stress and concussion?
5. Does anger mediate the relationship between perfectionism (AP and MP), perceived stress and concussion?
6. Does depression mediate the relationship between perfectionism (AP and MP), perceived stress and concussion?

3.2 Hypotheses

1. High levels of adaptive perfectionism will predict increased risk of concussion.
2. High levels of maladaptive perfectionism will predict increased risk of concussion.
3. High levels of perceived stress will predict increased risk of concussion.
4. Fatigue will mediate the relationship between perfectionism (AP and MP), perceived stress and concussion.
5. Anger will mediate the relationship between perfectionism (AP and MP), perceived stress and concussion.
6. Depression will mediate the relationship between perfectionism (AP and MP), perceived stress and concussion.

3.3 Participants
Archived data, originally collected between 2000 and 2005, from male (n = 521) and female (n = 307) varsity athletes (n=828) from the University of Toronto were included as participants in this study. Of these, a total of 68 athletes completed all of the prerequisite psychological forms prior to suffering a concussion at some point during their varsity career. Those concussions were sustained by the athletes between 2000 and 2008. The athletes played for the following male and female teams (excluding football [male only] and field hockey [female only]) (16 in total): hockey, basketball, volleyball, lacrosse, soccer, rugby, mountain bike, football and field hockey. The athletes in the original study were recruited in their rookie year and asked to complete a battery of psychological tests as pre injury baselines in order to compare them to post injury results, should a concussion occur.

3.4 Privacy and Confidentiality
To maintain athlete confidentiality, participants were assigned a participant number to be used for identification and data entry for the duration of the study. These participant numbers were accessible only to the student investigator and the faculty supervisor.

3.5 Data
All data used for this study were previously collected from athletes who played at the University of Toronto from 2000-2005 as part of the larger study. The results from the test battery are stored in a large archived database, to which access is restricted to the primary investigators. The goal of the initial large scale study was to examine (neuro) psychological impact and recovery processes after concussion, and to develop better clinical techniques for the assessment and treatment of concussions in order to facilitate the recovery process. The archived data from that study were examined and participant data relevant to this study were extracted. Permission was obtained following ethical approval of the study to extract the
required data from the database. Injury information was gathered from archived records contained on the restricted Graduate Department of Exercise Science server at the University of Toronto that contains the concussion history of the athletes tested during the data collection.

3.6 Measures

3.6.1 Perfectionism

Perfectionism is a trait that most prominently involves the setting of excessively high goals (Burns, 1980; Hamachek, 1978) accompanied by a tendency for overly critical evaluations of one’s own behaviour and/or performance (Frost et al., 1990). Perfectionism was measured using the Multidimensional Perfectionism scale (MPS) (Frost et al., 1990) which is used to assess global levels of perfectionism (Gotwals et al., 2010). The Frost version of the MPS was used in data collection, and is the most commonly used measure of perfectionism in general and sport psychological literature (Enns & Cox, 2002; Gotwals et al., 2003). The FMPS is a 35-item scale that measures six related but independent dimensions of perfectionism on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) (Frost et al., 1990):

1. Concern over Mistakes (CM; 9 items)
2. Personal Standards (PSta; 7 items)
3. Parental Expectations (PE; 5 items)
4. Parental Criticism (PC; 4 items)
5. Doubts about Actions (DA; 4 items)
6. Organisation (OG; 6 items)

Dimensions 1-5 are summed to create a total perfectionism score, considered to be a measure of one’s overall levels of perfectionism. Organization is excluded from this total as it was the least correlated with the other subscales of the FMPS and the total perfectionism score (Frost et al., 1990). Adaptive perfectionism is measured using the PSta and OG subscales, while maladaptive perfectionism is measured by combining the scores of the CM, PE, PC and DA subscales.
Factor analysis conducted by Frost et al. (1993), Terry-Short et al. (1995), and Slaney et al. (1995) revealed two distinct loadings for the subscales of the FMPS. Specifically, the subscales could be loaded into distinct "negative" and "positive" factors. Lee (2000) conducted bivariate correlations between the dimensions of perfectionism, (with the exception of OG) indicating an absence of multicollinearity, confirming Frost et al.'s (1990) statement that the dimensions of the MPS are distinct from one another. The FMPS has a high level of internal consistency, with Cronbach's alphas ranging from .87 to .91 (Stöber, 2000). Previous analysis has shown each subscale to have good internal consistency with Cronbach's alphas of 0.78 (PSta), .87 (CM), .88 (PE), .81 (PC), .73 (D) and .86 (O) (Stöber, 1998). Enns & Cox (2002) have found compelling evidence of the construct, concurrent and discriminant validity of the FMPS. This evidence includes results from Frost et al.'s original report (1990) which found the MPS to be related to several psychological symptoms hypothesized to be associated with perfectionism. Specifically, the FMPS has strong relationship with self-criticism as measured by the Depressive Experiences Questionnaire. The of TP, CM and DA subscales have moderate to high levels of correlations to guilt and obsessive compulsive symptoms. Similar results were found in a study conducted by Clavin, Clavin, Gayton and Broida (1996).

Although previous studies have suggested that high level athletes no longer consider their parents an influence on their athletic endeavours (Dunn et al., 2006), early research conducted on perfectionism in athletic situations used a population of division III varsity athletes (Frost & Henderson, 1991). The studies confirming the validity and reliability of the FMPS subscales were conducted in a population with a mean age of 20.3 years, similar to the expected mean age of the population in the current study.

3.6.2 Perceived Stress.

Athletes' levels of perceived stress were measured using the Perceived Stress Scale developed by Cohen et al. (1983). The PSS is a 14-item Likert scale (rated 1-5) that retrospectively measures the extent to which participants find their lives to be uncontrollable, unpredictable, and overloaded (Cohen et al., 1995). As some questions on the Perceived Stress Scale are positively framed (4,5,6,7,9,10,13), the responses from these questions are reverse coded and subtracted from the total perceived stress score as opposed to added. The
version used in the present study asked the athletes to report feelings of stress over the last month. Higher scores on the PSS indicate increases in perceived stress levels. Like the other measures used in the study, the PSS was administered prior to the beginning of the athletes' sporting seasons. Cohen et al. (1983) reported an internal consistency of .84 in a college freshman sample and .85 in a psychology student sample. It was also found to be a better predictor of health outcomes than the life events scale (Cohen et al., 1983).

3.6.3 Mood States.

To measure mood states, a shortened version of the POMS (Grove & Prapavessis, 1992) was used to minimize the time commitments needed from the participants. The POMS has been the most frequently used measure of mood states, and has been shown to be a good measure of athlete mood (Kerr & Stirling, 2006). This version of the POMS consists of 40 adjectives organized into seven categories: Tension, Depression, Anger, Vigor, Fatigue, Confusion and Self-Esteem.

Athletes are asked to rate their moods on a 5-point Likert scale from 0 (not at all) to 4 (extremely), describing how they are feeling at that moment. A Total Mood Disturbance score is determined by subtracting the positive mood scores from negative mood scores and adding a constant of 100 (Grove & Prapavessis, 1992). Self-Esteem was not included in the calculations due to insufficient reliability (Grove & Prapavessis, 1992). Previous studies used this version of the POMS (Hutchison et al., 2009; Mainwaring et al., 2010) and confirmed its reliability and validity in the same varsity athlete population, reporting Cronbach's alphas from 0.66-0.95 with a mean of 0.79. Scores from all mood subscales were collected for the purposes of descriptive statistics and correlation analysis.

3.7 Procedure

As part of a larger scale study (2000-2005) at the University of Toronto, incoming rookies to the previously mentioned 16 varsity teams were asked to complete a battery of psychological evaluations prior to the season. Included in the battery was the Frost-Multidimensional Perfectionism scale, the Profile of Mood States, the Perceived Stress Scale and a general demographic form that included age, height, weight, sport and injury history. Responses
from the archived FMPS, PSS and POMS questionnaires were transposed into separate Excel data sheets and analyzed. Concussion history of the athletes was determined through concussion records archived in the restricted Exercise Science server at the University of Toronto.

3.8 Data Analysis

SPSS 20 was used to analyze all data. Descriptive statistics were calculated for each variable. Variables were transformed if these variables fell outside the range of ± 2 for skewness and ± 7 for kurtosis (Tabachnick & Fidell, 2003). Cronbach's alphas were calculated to determine the scale reliability of the MPS and PSS as they had not been previously calculated for this population. Cronbach's alphas in similar samples were calculated for the POMS (Hutchison et al., 2009; Mainwaring et al., 2010). Values of skewness and kurtosis were also examined. Missing data for partially complete questionnaires was imputed using Expectation Maximization to account for the missing data points. Although previous research has created a 2x2 model to classify perfectionists based on their subscale scores (Gaudreau & Verner-Filion, 2012) the current study will not classify athletes on their FMPS scores and will measure associations based solely on the relative scores on the AP and MP subscales.

Pearson correlations examined the relationship between the 6 subscales of perfectionism, the Perceived Stress Scale, and the Profile of Mood States. If the constructs of adaptive and maladaptive perfectionism were too highly correlated, the singular measure of total perfectionism was to be used instead. This cut off point for the correlation between the dimensions of perfectionism was set at r = .70, as this was the highest correlation between the two dimensions found in a review of literature by Stoeber and Otto (2006) while being examined as separate constructs.

As concussion occurrence is a dichotomous variable, non-parametric Spearman's correlations were also conducted to determine the relationship between multidimensional perfectionism, perceived stress, the POMS and the concussion occurrence.

A logistic regression was conducted to determine the degree to which the outcome variable (incidence of a concussion) could be predicted by two personality variables (Adaptive
perfectionism and Maladaptive perfectionism), and one affective predictor (Perceived Stress). Logistic regression was used as the outcome variable was binary - occurrence of concussion and the absence of concussion. The sex and age of the athletes were controlled, as they may have effects on both the predictor and outcome variables in the model. The following statistical variables were assessed in the logistic regression models; the significance of the Wald statistic indicated whether that variable can significantly predict concussion. In addition, beta values indicated changes in the concussion risk with changes in the predictor variable. The significance of the full model against a constant only model indicated whether the predictors reliably predict concussion occurrence. The fit of the overall model was examined with the log likelihood statistic, in which large values indicate poor fitting models. Cox and Snell values were examined to indicate how much of the variation in concussion occurrence is accounted for by the logistic model. The Nagelkerke measure was examined to determine the relationship between the predictors in this model and the occurrence of concussion. Odds ratios were examined to determine the change in odds of suffering a concussion, given a unit change in the predictor variables.

Through a series of regressions, analysis for partial mediation was conducted to determine the effects of several mood states on the pre injury factor-concussion relationship. The first regression in the mediation analysis examined the relationship between adaptive perfectionism (predictor variable) and the occurrence of concussion (outcome variable). The second regression was to test for the mediation effects of certain mood states by regressing the mood in question onto the predictor variable. In the third regression, concussion occurrence was to be regressed on both the predictor variable and the potential mediator at the same time. Significant relationships between the predictor variable, outcome variable and potential mediator were to be used to determine if the mood state acts as a mediator. This series of regressions was to be carried out multiple times, one for each predictor variable (adaptive perfectionism, maladaptive perfectionism and perceived stress) along with separate tests for each of the mood states under investigation (fatigue, depression and anger).
Chapter 4

Results

4.1 Descriptive Statistics

The purpose of this study was to investigate the predictive ability of multidimensional perfectionism and perceived stress on the occurrence of concussion and whether negative mood mediated those relationships. Due to reasons outlined in Chapter 4.3, the mediating effect of negative mood was not examined. Three out of the original six hypotheses were examined:

1. High levels of adaptive perfectionism predict increased risk of concussion
2. High levels of maladaptive perfectionism predict increased risk of concussion
3. High levels of perceived stress predict increased risk of concussion

A total of 828 varsity athletes from the University of Toronto completed at least some portion of the various psychological constructs relevant to this study, and were included in analysis. There were a number of participants who completed some of the baseline questionnaires, but did not complete the full battery. This missing data was random \( \chi^2(152) = 147.89, p = .58 \) as some participants may have forgotten to answer a single question or did not feel comfortable with that question. As a result, data was imputed using Expectation Maximization to consolidate this missing data.

The mean age of the athletes was 20.93 years ranging from 17-37 years, (Males: \( M = 21.0 \pm 0.13 \), SD: 2.91; Females: \( M = 20.8 \pm 0.18 \), SD: 3.16). The age of the athletes was not normally distributed as the Shapiro-Wilk test was significant (\( p < .05 \)). This is due to most of the participants being approximately 19-20 years old. This is shown with a median of 20 years of age and a mode of 19. The majority of the athletes participated in rugby (20.5%) and football (19.1%). The remaining sports were represented as follows: Mountain Bike (11.5%), soccer (11.4%), lacrosse (10.7%), hockey (10.5%), volleyball (6.4%), basketball (5.9%) and field hockey (4.0%). The number of concussions suffered by athletes in each sport can be seen in Table 1.
Table 1
Number of concussions by sport

<table>
<thead>
<tr>
<th>Sport</th>
<th>Total Athletes</th>
<th>Number of Concussions</th>
<th>% of Total Concussions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basketball</td>
<td>49</td>
<td>6</td>
<td>8.82%</td>
</tr>
<tr>
<td>Field Hockey</td>
<td>33</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Football</td>
<td>158</td>
<td>8</td>
<td>11.76%</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>89</td>
<td>5</td>
<td>7.35%</td>
</tr>
<tr>
<td>Hockey</td>
<td>87</td>
<td>20</td>
<td>29.41%</td>
</tr>
<tr>
<td>Soccer</td>
<td>94</td>
<td>6</td>
<td>8.82%</td>
</tr>
<tr>
<td>Rugby</td>
<td>170</td>
<td>17</td>
<td>25.00%</td>
</tr>
<tr>
<td>Volleyball</td>
<td>53</td>
<td>4</td>
<td>5.88%</td>
</tr>
<tr>
<td>Mountain Bike</td>
<td>95</td>
<td>2</td>
<td>2.94%</td>
</tr>
</tbody>
</table>

Of the 828 participants, 68 (8.1%) (36M, 32F) athletes suffered concussions at some point after completing their baseline testing. The mean number of days between baseline testing and concussion was 476.37 days (SE = 56.26) with a median of 381.00 and a range of 0-1642 days. The interquartile ranges for the time between baseline and concussion were as follows: 0 - 66.5, 66.5 - 381.00, 381-751.50, 751-1642. Concussions were evenly distributed between the quartiles as 16 concussions were suffered in all time periods with the exception of between 66.5-381.00 days, where 17 concussions were suffered. A concussion rate of 8% is relatively low compared to a recent finding that 38% of athletes report at least one concussion over their athletic careers (Kerr et al., 2014).

Descriptive statistics for each of the psychological variables are reported in Tables 2-3. Examination of the POMS revealed positive skew in anger and depression. Log transformations were conducted for these variables in an attempt to normalize the distribution of these responses. These transformations resulted in more normalized data for each of the variables involved (Table 3). Cronbach's alphas were calculated for the FMPS and the PSS. Cronbach's alphas for the POMS were previously calculated for the same sample of athletes (Hutchison et al., 2009). All were between or exceeded the generally accepted values of 0.7- 0.8 (Kline, 1999) and are listed Tables 2 and 3.
Table 2  
*Descriptive statistics for the FMPS*

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*Note:* CM: Concern over mistakes, PE: Parental Expectations, PC: Parental Concerns, DA: Doubts about Actions, PSta: Personal Standards, OG: Organization
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*Note: TMD: Total Mood Disturbance*
4.2 Correlation Analysis

Pearson correlation analyses were conducted to determine any existing relationships between baseline levels of perfectionism, perceived stress and subscales of the POMS. The first set of analyses were conducted on the entire sample, including both non-concussed and concussed participants. The analysis revealed several significant correlations between total perfectionism, maladaptive perfectionism, perceived stress and negative subscales of the POMS. Adaptive perfectionism was significantly correlated with the vigor subscale of the POMS. See Table 4 for correlation results of the entire sample. As stated in Chapter 3, the constructs of adaptive and maladaptive perfectionism were analyzed separately, on the condition that the correlation between the two variables was lower than or equal to \( r = .70 \). Correlation analysis revealed the relationship between adaptive and maladaptive perfectionism to be \( [r(828) = .31, p \leq .01] \). As a result, AP and MP were considered separate constructs and subsequently analyzed as separate variables. Based on a sample of 828 participants, an effect size of 0.1, and an \( \alpha \) coefficient of .05, the calculated power for this study was 0.89. Two subsequent analyses were conducted on the concussed and non concussed participants (Table 5) separately to examine if relationships remained significant in different participant conditions.

Tables 4 and 5 illustrate several differences in the correlations involving AP and perceived stress. These Tables also illustrate that the only psychological variable significantly correlated with adaptive perfectionism was vigor, a subscale of the POMS. The significance of this relationship differed, as the correlation remained significant in the non concussed group but was not significant in the concussed group. Finally, the correlations between perceived stress, PE and vigor also differed between the total sample, concussed and non concussed groups. Specifically, the concussed group did not show significant correlations between perceived stress and vigor and perceived stress and PE, whereas these associations were significant in the total and non-concussed samples. Associations between the subscales of the POMS and concussion were not significant.
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Correlations examining the FMPS, PSS, POMS and concussion: Total Sample [N = 828]

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*p < .05, **p < .01; + Spearman correlations; Note: Concussed athletes have an N of 68§ Ten-Concussion: 95% CI [-.09, .05]
Table 5
Pearson correlations examining the FMPS, PSS and POMS: \([N = 828]\)

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<td>.11</td>
<td>-.05</td>
<td>-.10</td>
<td>-.08</td>
<td>-.05</td>
<td>-.06</td>
<td>-.08</td>
<td>-.08</td>
<td>-.06</td>
<td>.12</td>
<td>.09</td>
<td>-.09</td>
<td>.02</td>
<td>.09</td>
<td>.32</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; Concussed sample above diagonal; Non concussed sample below diagonal; Note: AP: Adaptive Perfectionism; MP: Maladaptive Perfectionism; Dep: Depression; Ten: Tension; Ang: Anger; Vig: Vigor; Fat: Fatigue; Conf: Confusion; CM: Concern over mistakes, PE: Parental Expectations, PC: Parental Concerns, DA: Doubts about Actions, PSta: Personal Standards, OG: Organization; 1 95% CI [-.02, .42]; 2 95% CI [-.02, .45]; 3 95% CI [-.43, .05]; 4 95% CI [0.05, .50]; 5 95% CI [-.40, .07]; 6 95% CI [-.47, .13]; 7 95% CI [-.03, .40]; 8 95% CI [-.44, -.01]; 9 95% CI [-.46, -.12]; 10 95% CI [.04, .44]; 11 95% CI [.03, .44]; 12 95% CI [.02, .40]; 13 95% CI [.06, .35]; 14 95% CI [-.47, .06]; 15 95% CI [-.03, .12]; 16
95% CI [-.35, .10]; \textsuperscript{17} 95% CI [.01, .46; \textsuperscript{18} 95% CI [-.43, .06].
Non parametric analysis revealed no significant correlations between concussions and any of the psychological variables. Results of these analyses can be seen in Table 4. Results of the correlation analysis in Table 4 indicate lack of significance in two relationships essential to carrying out mediation analysis. First, there was no significant correlation between the hypothesized predictors and concussion. Second, there was no significant correlation between the hypothesized mood states and concussion.

4.3 Logistic Regression Analysis

To determine the predictive ability of perfectionism and perceived stress on the occurrence of concussion, a logistic regression was conducted, controlling for sex and age of the athletes. The predictor variables in this model were AP, MP and PS. The results of the logistic regression with these models can be seen in Tables 6 and 7. Significance will be designated as follows: *p < .05, **p < .01,

Table 6
Step 1 of the logistic regression with three predictor variables (AP, MP, PS) controlling for sex and age

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald Statistic</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>95% CI for Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.60(1.04)</td>
<td>2.39</td>
<td>.12</td>
<td>.20</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>.47 (.26)</td>
<td>3.18</td>
<td>.07</td>
<td>1.60</td>
<td>.97</td>
</tr>
<tr>
<td>Age at Baseline</td>
<td>-.07 (.047)</td>
<td>2.29</td>
<td>.13</td>
<td>.93</td>
<td>.85</td>
</tr>
</tbody>
</table>

Note: $R^2 = .007$ (Cox and Snell), .017(Nagelkerke); -2LL = 454.51
Table 7  
Step 2 of the logistic regression with three predictor variables (AP, MP, PS) controlling for sex and age

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald Statistic</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.06 (1.31)</td>
<td>2.45</td>
<td>.12</td>
<td>.128</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>.46 (.26)</td>
<td>3.18</td>
<td>.07</td>
<td>1.59</td>
<td>.96</td>
<td>2.65</td>
</tr>
<tr>
<td>Age at Baseline</td>
<td>-.07 (.05)</td>
<td>2.29</td>
<td>.13</td>
<td>.93</td>
<td>.85</td>
<td>1.02</td>
</tr>
<tr>
<td>Adaptive Perfectionism</td>
<td>.01 (.02)</td>
<td>.16</td>
<td>.69</td>
<td>1.01</td>
<td>.98</td>
<td>1.04</td>
</tr>
<tr>
<td>Maladaptive Perfectionism</td>
<td>.00 (.01)</td>
<td>.02</td>
<td>.88</td>
<td>1.00</td>
<td>.98</td>
<td>1.02</td>
</tr>
<tr>
<td>Perceived Stress</td>
<td>.00 (.02)</td>
<td>.05</td>
<td>.83</td>
<td>1.00</td>
<td>.97</td>
<td>1.04</td>
</tr>
</tbody>
</table>

Note: R² = .008 (Cox and Snell), .018 (Nagelkerke); -2LL = 454.18

The intended mediation analysis for this study (Hypotheses 4-6) was not conducted due to non-significance in the predictor-outcome relationship (Figure 1-relationship 1) and the mediator-outcome relationship (Figure 1-relationship 3). This analysis was to be run to determine the effects of several mood states on the pre-injury factor-concussion relationship. However, several conditions for stepwise mediation were not met. First, there must be a significant association between the predictor variable and the outcome variable (Baron & Kenny, 1986). Second, the association between the predictor variable and the mediator (mood state) must be significant. Third, it must be shown that the mediator affects the outcome variable. In this study, only one of the essential relationships (condition 2) was significant, whereas the relationships for conditions 1 and 3 were not met. The necessity of condition one in order to carry out mediation analysis has come into question (Preacher & Hayes, 2004). As a result, many contemporary researchers believe that condition 1 is not required and the essential conditions to establish mediation are conditions 2 and 3 (Kenny, 2015). Recent research advocating the testing of indirect effects with an insignificant
predictor-outcome relationship have been accompanied by a significant relationship between the proposed mediator and the outcome (Hayes, 2009). Although contemporary methods suggest carrying out the mediation without a significant association in step 1 (Hayes, 2009), the significance of steps 2 and 3 are essential (Kenny, 2015). Mediation analysis was not conducted because analysis showed non-significant relationships in the predictor-outcome relationship and the mediator-outcome relationship. These relationships are illustrated in Figure 1 below. The results of the correlation analysis between perfectionism, perceived stress, the POMS and concussion can be seen in Table 8. The results of the logistic regression between perfectionism, perceived stress and concussion can be seen in Table 7. The results of the logistic regression examining depression, anger and fatigue as predictors of concussion can be seen in Appendix F, Tables.

Figure 1: An illustration of the proposed relationships between predictor variables (perfectionism/perceived stress), mediators (mood states) and the outcome variable (concussion occurrence)

* The relationships between predictor variables and multiple mediators were the only significant relationships in the proposed mediation pathway (Table 8)
Table 8  
*Correlation analyses between predictor variables and proposed mediators in Figure 1*

<table>
<thead>
<tr>
<th></th>
<th>AP</th>
<th>MP</th>
<th>PS</th>
<th>Dep.</th>
<th>Ang.</th>
<th>Fat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MP</td>
<td>--</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dep.</td>
<td>-.02</td>
<td>.29**</td>
<td>.45**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ang.</td>
<td>.01</td>
<td>.24**</td>
<td>.32**</td>
<td>--</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Fat.</td>
<td>-.01</td>
<td>.15**</td>
<td>.33**</td>
<td>--</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>Conc.</td>
<td>.03†</td>
<td>.00†</td>
<td>.01†</td>
<td>-.01‡</td>
<td>.00‡</td>
<td>.02‡</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01  
† = Denotes non-significant relationship between predictors and concussion occurrence  
‡ = Denotes non-significant relationship between mediators and concussion occurrence
Chapter 5
Discussion

The purpose of this study was to investigate whether multidimensional perfectionism and perceived stress influenced the risk of sustaining a concussion and whether mood states played a role in the mediation of those relationships. The findings suggest that adaptive perfectionism, maladaptive perfectionism, and perceived stress do not have any predictive ability on the occurrence of concussion.

5.1 Multidimensional Perfectionism and Perceived Stress as Possible Predictors of Concussion Occurrence

**Multidimensional Perfectionism.** Counter to hypotheses 1 and 2, adaptive and maladaptive perfectionism did not predict risk of concussion across all sports and sexes. Neither correlation nor logistic regression analysis revealed significant relationships between adaptive perfectionism, maladaptive perfectionism, and the occurrence of concussion. This result is supported by a study that found no relationship between injured athletes and their levels of perfectionism (Bringer, 1998). The lack of significant relationship found in the current study between perfectionism, a personality trait, and injury is further supported by evidence found in a review by Junge (2000), which examined pre-injury factors based on the stress theory adapted from Andersen and Williams (1988). Junge (2000) reviewed the effects of situation-independent traits and concluded that no characteristic personality profile exists for injury prone athletes. Several of the studies reviewed in this thesis revealed mixed results for the presence of risk-taking behaviours in injured athletes. For example, Lysens et al. (1989) and Taimela et al. (1990) found risk-tasking behaviours present in injured athletes. Two additional studies reported a link between sensation seeking and injury in skiers (Bouter et al., 1988; Cherpitel et al., 1998). Recently, Osborn et al. (2008) investigated the role of individual personality differences in predicting athletic injury in professional hockey players, and found increased risk of injury in athletes who reported higher levels of sensation seeking in more stimulating environments. In contrast, Schwebel et al. (2007) and Smith et al. (1992) found no relationship between the athlete's sensation seeking and injury incidence. Overall, a relatively small amount of research has been conducted to examine the relationship between
individual personality differences and athletic injury. The studies that have been published suggest that personality may not predict athletic injury risk in adults (Osborn et al., 2008). The results from the current study support these findings, as no relationship was found between perfectionism and the risk of concussion.

Previous work by Krasnow et al. (1999) found significant correlations between specific perfectionism subscales (PE, CM) and the number of injuries suffered. The reason for the lack of significance in the current study may be the differences in the sports examined. Whereas the current study examined "contact" varsity sports such as hockey, football, rugby and basketball (a complete list can be seen in Chapter 3), the study by Krasnow et al. (1999) focused on the more "aesthetic" sports of dancing and gymnastics. Thus, differences in the nature of aesthetic sports and the contact/collision sports of this study may have led to differences in findings. As aesthetic performances depend on the evaluation of others (Eunasio, Thomson, & Jaque, 2014), the drive to achieve a perfect performance becomes even more stressful, as perfectionist performers with low levels of perceived personal control experience greater levels of debilitating anxiety (Mor et al., 1995). In contrast, the varsity sports examined in this study are judged solely on objective markers of performance (e.g., points, wins), as opposed to the subjective judgment of others. The increased stress resulting from subjective evaluation of performance (Eunasio, Thomson & Jaque, 2014) and physical appearance (Claessens et al., 1999) may have been one factor leading to an increased number of injuries suffered by the gymnasts and dancers, compared to the contact sport athletes from the current study.

One other study found a significant, positive relationship between perfectionism and injury (Winter & Greenlees, 2005). That study found both adaptive and maladaptive perfectionism to be related to total days lost due to injury. Additionally, adaptive perfectionism was positively correlated to the number of days lost due to acute injuries. However, this study cannot be accurately compared with the current study, as Winter and Greenlees (2005) examined injury severity in the form of days lost, while the current study examined injury occurrence.
In fact, comparing current results to previous studies may also be difficult due to the different contexts surrounding musculoskeletal injuries vs. those surrounding concussion. The onset of concussion is normally suffered due to a blow to the head or neck. These events are often random in nature. However, the occurrence of musculoskeletal injuries can occur in a variety of ways, including overtraining and an inability to heed medical advice (Hall, 2006), impairments in posture due to fatigue (Murgia, 2013), and changes in muscle tension (Lavallee & Flint, 1996). As a result of these different contexts, the direct comparison of the same pre-injury variables on the occurrence of concussion vs. musculoskeletal injury is difficult, as those factors differently influence the behaviours that may result in the different injuries.

Although significant associations were found between perfectionism and injury in previous studies, neither adaptive nor maladaptive perfectionism was found to be significantly related to concussion in this study. The current results provide some evidence that coaches and athletes do not need to be concerned over baseline perfectionism levels directly increasing risk of concussion. However, examining the results of this thesis research in light of previous studies indicates that, as Bringer (1998) suggests, the relationship between specific personality traits and their effect on injury may be more complex than can be represented through the "stress-injury" model.

**Perceived Stress.** Counter to hypothesis 3, perceived stress was not found to be a significant predictor of concussion risk. Neither correlation nor logistic regression analysis revealed a significant relationship between PS and the occurrence of concussion. This finding does not support previous literature finding PS to be a risk factor for athletic injury (Galambos et al., 2005; Johnson, 2011; Rogers & Landers, 2005) and concussion (Fenton et al., 1993).

One possible reason for the lack of a significant relationship between PS and concussion is the different levels of stress an athlete may experience between baseline testing and the performance in which they suffered a concussion. Specifically, the levels of stress athletes perceived at the time of baseline testing may be lower than the stress they experienced during the athletic seasons. For example, Filaire et al. (2001) found stress levels to be significantly higher on competition days when compared to resting values before competition. If this was
the case for the athletes in the current study, their levels of stress at the time of injury may have been higher than the baseline scores recorded.

Another possible reason for the difference in findings may be the different population of athletes being examined in the current study from those in previous literature. The current study examined a sample of mainly university-aged varsity athletes, whereas recent research linking stress with injury was conducted on groups of professional athletes (Ivarsson & Johnson, 2010; Ivarsson et al., 2013). While these athletes experience many similar sources of stress (e.g., fear of injury, pressure to perform), the environments in which they perform are very different (Kimball & Freysinger, 2003; Noblet & Gifford, 2002). These different situations must be taken into account when considering the stressors that influence the athletic experience. Many varsity-aged athletes experience stress as a result of balancing student and athletic careers. Research has indicated that varsity level athletes report increased stress levels as a result of exclusion from non-athletic activities, lack of social support for non-athletic endeavors, and feelings of isolation in situations away from the support of their team (Kimball & Freysinger, 2003). University level athletes also reported social isolation, as others did not take the time to see them as "people" outside of their athletic participation. In a number of these cases, the athletes in question felt disrespected as students and grew frustrated as a result (Kimball & Freysinger, 2003). The lack of social support networks may stem from the strict schedules varsity athletes must adhere to in order to balance athletic and academic careers. Professional athletes also suffer from high levels of stress but the circumstances of these stressors may be different. In contrast to varsity athletes, professional athletes identified the adjustment to independent living away from family and friends as a significant stressor (Noblet & Gifford, 2002). Additionally, professional athletes identified the media, constant public scrutiny, and making the transition from underage to elite competition as significant sources of stress (Noblet & Gifford, 2002). These different environments experienced by varsity and professional athletes may have led these athletes to experience stress or seek social support in different ways. Therefore, the sources and experience of stress between the varsity athletes and professional athletes may have resulted in the difference in the relationship between PS and athletic injury.
The different scales used to measure the concept of stress may also have resulted in the current findings not supporting the previous stress-injury literature. While the current study and previous studies both measured stress, the current study measured stress with the PSS (see Chapter 3), whereas several studies linking stress and athletic injury used the Swedish universities Scales of Personality (SSP; Ivarsson & Johnson, 2010; Ivarsson & Johnson 2011; Ivarsson et al., 2013). There are several differences between these scales. First, while the SSP does measure stress, it does not measure the exact concept of "perceived stress", as measured by the PSS. Second, the SSP asks subjects about their stable personality traits, whereas the PSS is concerned with how subjects perceived their stress levels over the last month. Both the current study and the studies by Ivarsson and colleagues listed above were designed with the "stress-injury" theory (Andersen & Williams, 1988) in mind. Thus, the different concepts of stress may have differing effects on the athlete stress response, resulting in different injury outcomes.

Based on the results of the current and past studies, it appears that perceived stress is significantly associated to the occurrence of musculoskeletal injuries but not concussion. However, methodological differences between the current study and past studies make it difficult to conclude that perceived stress affects risk of musculoskeletal injury in all athletes but not risk of concussion. Instead, findings from the present study suggest that, in a sample of varsity athletes, increased levels of pre-season perceived stress do not increase concussion risk.

5.2 Mood States as Mediators of the Relationship between Perfectionism, Perceived Stress and Concussion

Hypotheses 4-6 were not analyzed due to a lack of significant associations in the following two key relationships: 1) the relationship between the pre-injury risk factors and concussion and, 2) the relationship between the potential mediators (depression, anger and fatigue) and concussion. Although previous research has shown that emotions such as anger and irritability (Ivarsson et al., 2013), anxiety (Ivarsson & Johnson, 2010), fatigue, (Rogers & Landers, 2005), and depression (Galambos et al., 2005) are associated with increased injury risk, these moods were not found to be associated with concussion risk in the current study. This lack of association between mood and concussion is consistent with the literature, as
Harmon et al. (2013) point to a lack of evidence that pre-existing mood disorders pre-dispose athletes to concussion.

### 5.3 Pre-Injury Risk Factors as a Model for Concussion Occurrence

The theoretical framework for this study was based on the Integrated Model of Psychological Response to the Sport Concussion Injury and Rehabilitation Process (Wiese-Bjornstal et al., 2015). The Integrated Model examines psychological variables and their effect on the stress response, which in turn influence risk of concussion. Using this model, it was inferred that AP, MP and PS would act as pre-injury factors that were associated with negative mood states in athletes. These mood states were hypothesized to mediate the predictor-concussion relationship. As age and sex are not factors accounted for in the Integrated Model, they were controlled for prior to analysis of the variables that are part of the original Wiese-Bjornstal et al. (1998) Integrated Model. Correlation analysis revealed that AP, MP and PS are all significantly associated with one or more subscales of the POMS. However, no significant associations were found between any mood states and concussion occurrence. Therefore, the proposed association between pre-injury factors and the stress response on concussion occurrence was not significant. This relationship is modeled in Figure 2. The original design of the Integrated Model has been modified slightly in three ways for the purposes of this study: 1) AP, MP and PS are shown at the top of the model as personality factors and history of stressors that can affect the stress response; 2) the stress response section was separated into distinct variables to clearly illustrate the inclusion of the POMS subscales as a part of the athlete stress response; and 3) the correlation between each pre-injury variable and stress response variable is shown individually. Analysis from this study has shown that each of these factors is correlated with one or more mood states of the POMS. These significant relationships are depicted by the design of the lines connected to the mood state in question. The strength and direction of these correlations can be seen in Chapter 4. However, no significant associations were found between any mood state and concussion occurrence.

Compared to a previous study examining perfectionism levels in college students (Enns & Cox, 2002), the mean scores on the subscales of perfectionism (Table 2) differ as follows: lower CM (23.01 ± 7.03), similar PSta (23.77 ± 5.24), lower DA (10.93 ± 3.29), similar OG (21.92 ± 5.56) levels. When compared to a separate study examining competitive adolescent...
athletes, levels of total perfectionism (Table 2) were lower than both injured (76.57 ± 15.80) and uninjured (80.50 ± 17.19) athletes (Bringer, 1998). Additionally, the mean PS value in the current study (Table 3) is lower than an average found in division I NCAA football athletes (24.6) and non-football athletes (23.8) (Hendrix, Acevedo & Hebert, 2000). The lower levels of perfectionism and PS seen in the current athletes may have been related to a more positive response to stress, which may have been linked with the lack of significant concussion risk associated with the examined variables.

Therefore, based on this study, perfectionism, perceived stress and mood states do not influence concussion occurrence in the manner inferred by the Integrated Model. Although results suggests that perfectionism and perceived stress are significantly associated with mood states, the behavioural outcomes of these moods are not related to athlete risk of concussion.

Further correlation analyses were conducted in order to determine the differences in moods and perceived stress between concussed and non-concussed athletes at baseline. All significant correlations found between MP, PS and the negative subscales of the POMS in the total sample remained significant in both concussed and non-concussed athletes. In addition, all correlations between MP, PS and the POMS were stronger in concussed cases when compared to non-concussed cases. This suggests that concussed athletes' maladaptive perfectionist tendencies and high stress levels are more strongly correlated with their levels of negative mood. The significant relationship between AP and vigor was no longer significant when concussed participants were analyzed as a group. This may suggest that concussed athletes levels of adaptive perfectionism are not associated with their mood states. Based on these results, perfectionism, perceived stress, and mood states are related; however, the consequences of these relationships do not influence concussion occurrence.
Pre Injury Factors†

Figure 2: The FMPS, PSS, POMS and the occurrence of concussion represented in relation to The Integrated Model of Psychological Response to the Sport Concussion Injury and Rehabilitation Process (Wiese-Bjornstal et al.,2015) ¤For the purposes of this study, PS was examined as a pre-injury factor effecting ones "History of Stress"
†Sex and age were two variables controlled for, prior to the analysis of AP, MP and PS.
5.4 Practical Implications

Although this study's hypotheses were not supported, the results provide valuable information for athletes. First, the inability of perfectionism to predict concussions provides some evidence that athletes and coaches do not need to be concerned with driven and obsessive behaviours (Hill et al., 2015) increasing risk of concussion. However, significant correlations between the FMPS, and POMS suggest that the practice of pre-season psychological testing is still useful for tracking which athletes may be predisposed to exhibiting certain mood states. Results also show that testing for baseline levels of perceived stress is not useful in assessing concussion risk, due to the non-significant relationship found in the logistic regression between the variables. Instead, significant correlations between perceived stress and the POMS indicate that recording these baseline scores may be useful in assessing an athlete's tendency to exhibit negative mood states. This is important as negative moods have been suggested as risk factors for musculoskeletal injuries (Hollis et al., 2009; Ivarsson & Johnson, 2010; Magnusson et al., 1996).

This study has provided further evidence that maladaptive and adaptive constructs are separate dimensions of perfectionism. Significant and positive correlations were found between maladaptive perfectionism, perceived stress and all subscales of the POMS, with the exception of vigor, whereas adaptive perfectionism was significantly correlated only with vigor. These results seemingly distinguish adaptive and maladaptive perfectionism as two distinct constructs, in which the presence of the respective trait may have significantly different effects on an athlete's mood state. This is important as it gives athletes the knowledge that certain perfectionist behaviours are not associated with negative emotions and burnout, and that remaining flexible and realistic in their goals may reduce stress and negative mood resulting from perfectionist traits. However, it is important to note that although perfectionism can be considered two separate constructs, the components of perfectionism are not completely independent of one another, as the adaptive subscale of personal standards was found to be significantly correlated with depression and the negative
subscales of the FMPS. As a result, it is important for athletes to understand that although adaptive perfectionism may aid in sport performance (Stoll et al., 2008), high levels of PSta combined with high levels of maladaptive characteristics may be associated with negative thoughts and actions (Frost et al., 1991; Gaudreau & Thompson; 2010; Stoeber & Otto; 2006).

Although the facets of perfectionism measured by the FMPS show a distinction between adaptive and maladaptive perfectionism, it is difficult to inherently label their consequences as "healthy" or "unhealthy". As it is unlikely that any personality dimension will be universally related to certain outcomes. To address this in regards to perfectionism, Gaudreau and Verner-Filion (2012) have proposed a 2 x 2 model of perfectionism in which broader health outcomes are explored through four different combinations of the Hewitt-MPS constructs of SOP and SPP. Contrary to previous research (Hamachek, 1978, Stoeber & Otto, 2006), findings from Gaudreau and Verner-Filion (2012) found that "mixed" perfectionism is not the most unhealthy subtype of perfectionism and that the more "positive" effects of SOP may buffer the negative effects of perceived pressure to strive towards perfection.

The lack of significant relationship between perfectionism and concussion risk in this study supports evidence that situation-independent personality traits do not influence injury risk, and that there may be no "injury-prone" athlete personality profile (Junge, 2000). Instead, other factors such as history of concussion and type of sport (Marar et al., 2012) may be the largest factors that modify concussion risk.

5.5 Limitations

As with all research, there were limitations to this study. Given the retrospective design, the materials and baseline tests available for use were limited to what was used in the original concussion protocols. Use of the Sport-MPS (Dunn, Dunn, & Syrotuik, 2002), as opposed to the FMPS, may be beneficial for future studies as it measures more specific subscales within the sport domain. This would have allowed athletes to answer questions regarding their coaches as opposed to their parents, who may not be significant influences at this stage of
their athletic careers. As the FMPS was not a sport specific questionnaire, some of the questions may not have been relevant for a number of athletes, as there were several instances where questions regarding organization and parental influence were left blank. However, any difference in results created by use of the more global FMPS (Enns & Cox, 2002) should not have created a significant change in results, as the FMPS and Sport-MPS are related closely enough that the separate constructs can be adequately compared (Gotwals et al., 2010).

Participants were required to complete these pre-injury tests once at baseline. However, the accuracy of the responses on the PSS or POMS may not be a precise depiction of the athletes' stress levels and mood states at the time of injury, as mood states have been shown to fluctuate differently within individuals (Berger & Motl, 2000). Further, the accuracy of the questionnaires (FMPS, PSS, POMS) used in this study relies on the self-reporting of the participants. Participants were urged to be completely honest, as the results of these questionnaires were anonymous; however, the possibility of participants responding dishonestly remains (Brener et al., 2003).

Although the PSS retrospectively measures athletes' perceptions of stress, the variable does not measure "History of Stressors" exactly as conceptualized by the Integrated Model (Wiese-Bjornstal et al., 1998) as it was meant to measure variables such as life stress and previous injuries. Additionally, although altered mood states are common responses to stressors, they has not been evidence to indicate they are a mode of stress response as defined by the Integrated model. Although the measures of PS and the POMS measure similar constructs to those described in the Integrated Model, other, more empirically tested variables for the Stress-Response theory may be more appropriate.

5.6 Future Directions

Correlation analysis in this study revealed several significant differences in the relationships between perfectionism and moods between concussed and non-concussed athletes. Future research in this area should further investigate the relationship between perfectionism, stress
and mood in order to determine the degree to which perfectionism can predict athlete stress levels and mood states. In addition, research can be conducted to investigate whether the relationship between perfectionism and mood can lead to behavioural changes such as risk taking. Identification of these behaviours may assist coaches in determining which athletes may have a higher risk of injury.

Further work on the relationships between stress and injury may be conducted by examining athletes' stress levels intermittently throughout the season, as opposed to one baseline measurement. This would provide a more accurate depiction of athletes' stress levels as they fluctuate due to academic and athletic stressors. Testing more frequently over the course of the season would allow researchers to have a more recent psychological profile of athletes at the time of injury.

Future research would also benefit from comparing perfectionism levels in a concussed group, a musculoskeletal injury group and a control group in order to determine if levels of perfectionism have an effect on the type of injury suffered by athletes.

Future research would benefit from investigating the possible effects of perfectionism on the length of rehabilitation post-concussion. Qualitative analysis has previously identified perfectionism as a pre-existing personality variable which can complicate recovery from concussions (Ruff, Camenzuli, & Mueller, 1996). Although Ruff and colleagues did not investigate length of recovery time in relation to perfectionism, they stated that perfectionist individuals are frequently overcome by the stressors of an MTBI, as perfectionists demonstrated a dysfunctional loop between perfectionist tendencies and heightened levels of stress. With the knowledge that perfectionism can have an effect on stress levels and concussion recovery, it would be beneficial to conduct a study investigating the relationship between perfectionism, stress, mood states, and return to play time after suffering a concussion. Additionally, higher levels of perfectionism seem to be associated with more days lost due to musculoskeletal injury in performing artists (Winter & Greenlees, 2005).
Thus, it is worth investigating if high levels of perfectionism would have the same influence on an athlete's rehabilitation from concussion.

Future research in this area should examine co-morbid musculoskeletal injuries as covariates in order to control for their effects. As previous injuries have been identified as a history of stressor (Wiese-Bjornstal et al., 2015), any injuries suffered between baseline testing and time of concussion may alter levels of perceived stress and the ways in which athletes respond to stress compared their response at the time baseline testing was administered.

5.7 Conclusion

The purpose of this study was to examine baseline perfectionism, perceived stress, and mood states in athletes to determine if pre-injury levels of those variables acted as risk factors for sport concussion. Overall, the study resulted in three main findings: 1) Baseline measures of adaptive perfectionism, maladaptive perfectionism, and perceived stress did not predict risk of concussion, 2) Correlations between perfectionism, perceived stress and mood states reveal that athlete stress and mood states may be significantly affected by their perfectionism levels, and 3) Perfectionism is a multidimensional trait that can result in different emotions and reactions to stress, depending on the nature of one's perfectionist traits.

Findings 1 and 2 demonstrate that although perfectionism and perceived stress influenced athletes' stress responses in the form of altered mood states, any behavioural changes related to these moods were not associated with concussion risk. Thus, baseline testing for perfectionism and perceived stress did not aid in directly assessing concussion risk in varsity athletes. However, as correlations between perfectionism, perceived stress, and mood states show, the practice of baseline testing for these constructs is still useful in determining which athletes may be predisposed to certain negative mood states.

Finding 3 supports evidence (Frost et al., 1993; Stoeber & Otto, 2006; Stumpf & Parker, 2000; Terry-Short et al., 1995) that perfectionism is a multidimensional trait. The exclusive
relationship between adaptive perfectionism and vigor, and the association between maladaptive perfectionism, perceived stress and negative mood suggest that adaptive and maladaptive perfectionism are two different personality traits that result in different emotional manifestations.

Overall, perfectionism and perceived stress do not act as significant pre-injury risk factors for concussion as outlined by the framework of the Integrated Model for Sport Concussion (Wiese-Bjornstal et al., 2015). However, significant correlations between perfectionism, perceived stress and subscales of the POMS indicate that those pre-injury variables can influence mood states. Therefore, the recording of these variables is useful for determining the mood states athletes may experience. To further investigate any proposed relationship between personality, mood states and injury, there is a need to assess these factors more consistently throughout an athletic season in order to have a more accurate representation of the athlete's psychological state closer to the time of injury.
References


Winter, S., & Greenlees, I. (2005). Female gymnast predisposition to injury based on the personality trait of perfectionism., 23(11-12), 1277-1278.


Appendix A

UNIVERSITY OF TORONTO / TORONTO REHABILITATION INSTITUTE

VAR SY ATHLETE CONCUSSION RESEARCH PROJECT

Information Sheet

A group of scientists at the University of Toronto and Toronto Rehab are conducting a study on concussion/mild traumatic brain injury in varsity athletes. The purpose of the study is to examine the (neuro)psychological impact and recovery process after concussion. Our ultimate aim is to facilitate the recovery process. In order to do this, we are seeking your participation in this study as indicated in the Information sheet you have read.

I hereby consent to the use of my baseline neuropsychological testing to be used for research purposes. All identifying information will be removed.

5.8 Name: __________________________________________

Signature_________________________________ Date_________

Witness name:

Signature_________________________________ Date_________

Dr. Paul Comper, Dr. Robin Green, Dr. Lynda Mainwaring Dr. Doug Richards
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Toronto Rehabilitation Institute, Assistant Professor, University of Toronto
FPEH, U of T, Assistant Professor, FPEH, University of Toronto
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Appendix B

MPS Self-Evaluation Questionnaire

Please circle the number that best corresponds to your agreement with each statement below. Use this rating system:

Strongly disagree  1  2  3  4  5 Strongly agree

1. My parents set very high standards for me.  1 2 3 4 5
2. Organization is very important to me.  1 2 3 4 5
3. As a child, I was punished for doing things less than perfectly.  1 2 3 4 5
4. If I do not set the highest standards for myself, I am likely to end up as a second rate person  1 2 3 4 5
5. My parent never tried to understand my mistakes.  1 2 3 4 5
6. It is important to me to be thoroughly competent in everything I do.  1 2 3 4 5
7. I am neat person.  1 2 3 4 5
8. I try to be an organized person.  1 2 3 4 5
9. If I fail at work/school, I am a failure as a person.  1 2 3 4 5
10. I should be upset if I make a mistake.  1 2 3 4 5
11. My parents wanted me to be the best at everything.  1 2 3 4 5
12. I set higher goals than most people.  1 2 3 4 5
13. If someone does a task at work/school better than I, then I feel like I failed the whole task.  1 2 3 4 5
14. If I fail partly, it is as bad as being a complete failure.  1 2 3 4 5
15. Only outstanding performance is good enough for my family.  1 2 3 4 5
16. I am very good at focusing my efforts on attaining a goal. 1 2 3 4 5
17. Even when I do something very carefully, I often feel that it is not quite right. 1 2 3 4 5
18. I hate being less than best at things. 1 2 3 4 5
19. I have extremely high goals. 1 2 3 4 5
20. My parents have expected excellence from me. 1 2 3 4 5

21. People will think less of me if I make a mistake. 1 2 3 4 5
22. I never felt like I could meet my parents' expectations. 1 2 3 4 5
23. If I do not do as well as other people, it means I am an inferior human being. 1 2 3 4 5

24. Other people seems to accept lower standards from themselves than I do. 1 2 3 4 5
25. If I do not do well all the time, people will not respect me. 1 2 3 4 5
26. My parents have always had higher expectations for my future than I have. 1 2 3 4 5

27. I try to be a neat person. 1 2 3 4 5
28. I usually have doubts about the simple everyday things I do. 1 2 3 4 5
29. Neatness is very important to me. 1 2 3 4 5
30. I expect higher performance in my daily tasks than most people. 1 2 3 4 5
31. I am an organized person. 1 2 3 4 5
32. I tend to get behind in my work because I repeat things over and over. 1 2 3 4 5

33. It takes me a long time to do something "right". 1 2 3 4 5
34. The fewer mistakes I make, the more people will like me. 1 2 3 4 5
35. I never felt like I could meet my parents' standards. 1 2 3 4 5
Appendix C

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts. In each case, you will be asked to indicate your response by placing an “X” over the circle representing HOW OFTEN you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don’t try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Almost</th>
<th>Sometimes</th>
<th>Fairly Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How often have you been upset because of something that happened unexpectedly?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. How often have you felt that you were unable to control the important things in your life?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3. How often have you felt nervous and “stressed” in the last few days?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>4. How often have you dealt successfully with day to day problems and annoyances in the last few days?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5. How often have you felt that you were effectively coping with important changes that were occurring in your life?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6. How often have you felt confident about your ability to handle your personal problems?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7. How often have you felt that things were going your way?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8. How often have you found that you could not cope with all the things that you had to do?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>9. In the last month, how often have you been able to control irritations in your life?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>10. How often have you felt that you were on top of things?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>11. How often have you been angered because of things that happened that were outside of your control?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>12. How often have you found yourself thinking about things that you have to accomplish?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>13. How often have you been able to control the way you spend your time?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>14. How often have you felt difficulties were piling up so high that you could not overcome them in the last few days?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Appendix D

POMS QUESTIONNAIRE  MALE / FEMALE (Please circle one)

Respond to the following questions based on how you are feeling **RIGHT NOW**. These boxes refer to these phrases:

<table>
<thead>
<tr>
<th>Feeling</th>
<th>0= Not at all</th>
<th>1= A little</th>
<th>2= Moderately</th>
<th>3= Quite a bit</th>
<th>4= Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worn out</td>
<td>0 1 2 3 4</td>
<td>Confused</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peeved</td>
<td>0 1 2 3 4</td>
<td>Sad</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheerful</td>
<td>0 1 2 3 4</td>
<td>Fatigued</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restless</td>
<td>0 1 2 3 4</td>
<td>Grouchy</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embarrassed</td>
<td>0 1 2 3 4</td>
<td>Active</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bewildered</td>
<td>0 1 2 3 4</td>
<td>Tense</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hopeless</td>
<td>0 1 2 3 4</td>
<td>Confident</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weary</td>
<td>0 1 2 3 4</td>
<td>Unable to concentrate</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitter</td>
<td>0 1 2 3 4</td>
<td>Worthless</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vigorous</td>
<td>0 1 2 3 4</td>
<td>Exhausted</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nervous</td>
<td>0 1 2 3 4</td>
<td>Angry</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ashamed</td>
<td>0 1 2 3 4</td>
<td>Energetic</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forgetful</td>
<td>0 1 2 3 4</td>
<td>Uneasy</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>0 1 2 3 4</td>
<td>Satisfied</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bushed</td>
<td>0 1 2 3 4</td>
<td>Uncertain about thing</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resentful</td>
<td>0 1 2 3 4</td>
<td>Unhappy</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full of pep</td>
<td>0 1 2 3 4</td>
<td>Furious</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-edge</td>
<td>0 1 2 3 4</td>
<td>Lively</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annoyed</td>
<td>0 1 2 3 4</td>
<td>Anxious</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proud</td>
<td>0 1 2 3 4</td>
<td>Discouraged</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix E

UNIVERSITY OF TORONTO / TORONTO REHABILITATION INSTITUTE
VARSITY ATHLETE CONCUSSION RESEARCH PROJECT

INFORMATION SHEET

A group of scientists at the University of Toronto and Toronto Rehab are conducting a study on concussion/mild traumatic brain injury in varsity athletes. The purpose of the study is to examine the (neuro)psychological impact and recovery process after concussion. Our ultimate aim is to facilitate the recovery process. In order to do this, we are seeking your participation in this study.

There are two levels of participation:
Level 1: Providing permission to use the data collected during the baseline mandatory neuropsychological testing as well as the information from your health questionnaires for research purposes. Any information that identifies you personally will be removed from the data prior to public dissemination.
Level 2: This level of participation can occur only if you sustain a concussion or knee injury. In this case, within 72 hours of sustaining a concussion or knee-injury, you would be re-administered the baseline neuropsychological testing battery. This will be repeated again approximately four days later, and then weekly for either three weeks or until performance returns to pre-injury level (in the case of significant concussions). Again, any information that identifies you personally will be removed from the data prior to public dissemination.

Your participation in this study is voluntary and confidential. Team coaches will not know which athletes chose to participate and your academic and athletic career will not be affected whether you participate or not. All information obtained will be kept confidential and stored in locked filing cabinets. Only the researchers will have access to the information. Your privacy and anonymity will be protected.

There are no anticipated risks associated with participation in the study. Your participation may enhance the medical, psychological, and social support you would receive if injured during the season.

If you are interested in participating, you will be asked to sign Consent forms when you have completed your baseline testing. If you have any questions or would like more information, please contact one of the researchers listed below.

Thank you for taking the time to consider this request.

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Toronto Rehabilitation Institute; Assistant Professor, U of T
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Dr. Doug Richards
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### Appendix F

#### Table 9
*Logistic regression examining the relationship between the POMS and concussion occurrence*

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.24 (.33)</td>
<td>46.31</td>
<td>.00</td>
<td>.11</td>
<td>.9</td>
<td>1.11</td>
</tr>
<tr>
<td>Depression</td>
<td>-.03 (.07)</td>
<td>.23</td>
<td>.63</td>
<td>.97</td>
<td>.84</td>
<td>1.11</td>
</tr>
<tr>
<td>Anger</td>
<td>.002 (.05)</td>
<td>.001</td>
<td>.97</td>
<td>1.00</td>
<td>.91</td>
<td>1.10</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.002 (.04)</td>
<td>.002</td>
<td>.96</td>
<td>1.00</td>
<td>.94</td>
<td>1.10</td>
</tr>
</tbody>
</table>

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

Note: $R^2 = .00$ (Cox and Snell), .00 (Nagelkerke); -2LL = 466.37

#### Table 10
*Step 1 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for maladaptive perfectionism*

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.5 (.52)</td>
<td>22.81</td>
<td>.00</td>
<td>.09</td>
<td>.09</td>
<td>1.02</td>
</tr>
<tr>
<td>Maladaptive</td>
<td>.00 (.01)</td>
<td>.23</td>
<td>.88</td>
<td>.98</td>
<td>.89</td>
<td>1.02</td>
</tr>
</tbody>
</table>

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

Note: $R^2 = .00$ (Cox and Snell), .00 (Nagelkerke); -2LL = 467.05
Table 11
Step 2 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for maladaptive perfectionism

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.53 (.53)</td>
<td>22.35</td>
<td>.00</td>
<td>.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maladaptive Perfectionism</td>
<td>.00 (.01)</td>
<td>.01</td>
<td>.69</td>
<td>1.00</td>
<td>.98</td>
<td>1.02</td>
</tr>
<tr>
<td>Depression</td>
<td>-.03 (.07)</td>
<td>.27</td>
<td>.61</td>
<td>.97</td>
<td>.85</td>
<td>1.09</td>
</tr>
<tr>
<td>Anger</td>
<td>.00 (.05)</td>
<td>.01</td>
<td>.94</td>
<td>1.00</td>
<td>.92</td>
<td>1.09</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.01 (.03)</td>
<td>.04</td>
<td>.83</td>
<td>1.00</td>
<td>.95</td>
<td>1.07</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01
Note: R² = .000 (Cox and Snell), .001 (Nagelkerke); -2LL = 466.73

Table 12
Step 1 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for adaptive perfectionism

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.92 (.72)</td>
<td>16.68</td>
<td>.00</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptive Perfectionism</td>
<td>.01 (.02)</td>
<td>.574</td>
<td>.45</td>
<td>1.01</td>
<td>.98</td>
<td>1.04</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01
Note: R² = .001 (Cox and Snell), .002 (Nagelkerke); -2LL = 466.49
Table 13
*Step 2 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for adaptive perfectionism*

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
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<td>15.90</td>
<td>.00</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptive</td>
<td>.01 (.02)</td>
<td>.57</td>
<td>.45</td>
<td>1.01</td>
<td>.98</td>
<td>1.04</td>
</tr>
<tr>
<td>Perfectionism</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>-.03 (.06)</td>
<td>.22</td>
<td>.64</td>
<td>.97</td>
<td>.86</td>
<td>1.10</td>
</tr>
<tr>
<td>Anger</td>
<td>.00 (.05)</td>
<td>.00</td>
<td>.95</td>
<td>1.00</td>
<td>.92</td>
<td>1.09</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.01 (.03)</td>
<td>.04</td>
<td>.83</td>
<td>1.00</td>
<td>.95</td>
<td>1.07</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01
Note: R² = .00 (Cox and Snell), .00 (Nagelkerke); -2LL = 466.22

Table 14
*Step 1 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for perceived stress*

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.50 (.38)</td>
<td>43.79</td>
<td>.00</td>
<td>.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Stress</td>
<td>.006 (.018)</td>
<td>.08</td>
<td>.76</td>
<td>1.01</td>
<td>.97</td>
<td>1.04</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01
Note: R² = .00 (Cox and Snell), .00 (Nagelkerke); -2LL = 460.62
Table 15
Step 2 of the logistic regression examining the relationship between the POMS and concussion occurrence, controlling for perceived stress

<table>
<thead>
<tr>
<th></th>
<th>B (SE)</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
<th>Lower</th>
<th>Upper</th>
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</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.579 (.40)</td>
<td>41.18</td>
<td>.000</td>
<td>.076</td>
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<td></td>
</tr>
<tr>
<td>Perceived Stress</td>
<td>.009 (.021)</td>
<td>.20</td>
<td>.66</td>
<td>1.01</td>
<td>.97</td>
<td>1.05</td>
</tr>
<tr>
<td>Depression</td>
<td>-.034 (.067)</td>
<td>.26</td>
<td>.61</td>
<td>.97</td>
<td>.85</td>
<td>1.10</td>
</tr>
<tr>
<td>Anger</td>
<td>.001 (.046)</td>
<td>.000</td>
<td>.99</td>
<td>.99</td>
<td>.91</td>
<td>1.09</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.009 (.033)</td>
<td>.082</td>
<td>.77</td>
<td>1.00</td>
<td>.95</td>
<td>1.08</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01
Note: R² = .001 (Cox and Snell), .001 (Nagelkerke); -2LL = 4660.255
## Appendix G

**Table 12: Abbreviations of Key Terms**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Term</th>
<th>Abbreviation</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>Adaptive Perfectionism</td>
<td>Fat.</td>
<td>Fatigue</td>
</tr>
<tr>
<td>MP</td>
<td>Maladaptive Perfectionism</td>
<td>Conf.</td>
<td>Confusion</td>
</tr>
<tr>
<td>TP</td>
<td>Total Perfectionism</td>
<td>CM</td>
<td>Concern over Mistakes</td>
</tr>
<tr>
<td>PS</td>
<td>Perceived Stress</td>
<td>PE</td>
<td>Parental Expectations</td>
</tr>
<tr>
<td>TMD</td>
<td>Total Mood Disturbance</td>
<td>PC</td>
<td>Parental Criticism</td>
</tr>
<tr>
<td>Dep.</td>
<td>Depression</td>
<td>DA</td>
<td>Doubts about Actions</td>
</tr>
<tr>
<td>Ten.</td>
<td>Tension</td>
<td>PSta</td>
<td>Personal Standards</td>
</tr>
<tr>
<td>Ang.</td>
<td>Anger</td>
<td>OG</td>
<td>Organization</td>
</tr>
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<td>Vig.</td>
<td>Vigor</td>
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<td></td>
</tr>
</tbody>
</table>
Appendix H

PROTOCOL REFERENCE # 31434

April 21, 2015

Dr. Lynda Mainwaring
FACULTY OF KINESIOLOGY AND PHYSICAL EDUCATION

Mr. Jonathan Chan
FACULTY OF KINESIOLOGY AND PHYSICAL EDUCATION

Dear Dr. Mainwaring and Mr. Jonathan Chan,

Re: Your research protocol entitled, "Investigating the association between multidimensional perfectionism, perceived stress, mood states and concussion in varsity athletes"

ETHICS APPROVAL

Original Approval Date: April 21, 2015
Expiry Date: April 20, 2016
Continuing Review Level: 1

We are writing to advise you that the Health Sciences Research Ethics Board (REB) has granted approval to the above-named research protocol under the REB's delegated review process. Your protocol has been approved for a period of one year and ongoing research under this protocol must be renewed prior to the expiry date.

Any changes to the approved protocol or consent materials must be reviewed and approved through the amendment process prior to its implementation. Any adverse or unanticipated events in the research should be reported to the Office of Research Ethics as soon as possible.

Please ensure that you submit an Annual Renewal Form or a Study Completion Report 15 to 30 days prior to the expiry date of your current ethics approval. Note that annual renewals for studies cannot be accepted more than 30 days prior to the date of expiry.

If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your research.

Yours sincerely,

[Signature]

OFFICE OF RESEARCH ETHICS
McMorris Building, 12 Queen's Park Crescent West, 2nd Floor, Toronto, ON M5G 1J4 Canada
Tel: +1 416 946-3751 • Fax: +1 416 946-3781 • ethics.research@utoronto.ca • http://www.research.utoronto.ca/research-ethics
Appendix I

Pre-injury Psychological Risk Factors
- Personality
- History of Stressors
- Stress Response
  - Cognitive appraisals
  - Physiological and attentional changes
- Coping Resources
- Interventions
  - Coping style
  - Social support
  - Sport concussion education

Sport Concussion Injury

Post-injury Psychological Response and Rehabilitation Process

Personal Factors
- Injury Characteristics
  - History previous TBI, headache
  - Severity: mild, moderate, complex
  - Symptoms: high symptom report, headache
  - Perceived cause: preventable, accidental, intentional
  - Recovery status: time-limited or protracted
  - Comorbid injuries: skull fracture, whiplash neck injury, chronic pain, inner ear
- Individual Differences
  - Psychological:
    - personality: ADHD, explanatory style, hardness, optimism
    - history of stressors: PTSD, other life stresses
    - mood states: depression, anxiety, panic disorder
  - Demographic:
    - gender: female
    - age: older and younger
    - role: student or career
  - Physical/Behavioral:
    - substance use
    - physical health status

Situational Factors
- Sport
  - Type: contact/collision, high risk
  - Level of play
  - Time in season
  - Playing status: starter
  - Practice vs. competition
  - Scholarship status: fear of losing

- Social
  - Teammate influences: invisible injury
  - Coach influences: pressure
  - Family dynamics: understanding
  - Sports medicine team: empathy
  - Social support: satisfaction with
  - Sport ethic: report or hide injury or symptoms

- Environmental
  - Rehabilitation environment: required reporting or untrained supervision
  - Evaluation: assessment providers
  - Accessibility to rehabilitation: youth, high school, college, elite, recreational
  - Insurance: coverage or lack of
  - Litigation: pending litigation
  - School demands: pressure to perform

Post-injury Psychological Care

Behavioral Symptoms & Responses
- Sleep-wake disturbances, lethargy
- Poor social functioning, social isolation
- Communication difficulties
- Behavioral disinhibition
- Avoidant coping
- Aggression, verbal outbursts
- Illness behavior
- Substance abuse
- Suicide

Psychological Outcomes
- Reduced quality of life or life satisfaction
- Disability
- Delayed return to sport
- Suboptimal sport performance
- Delayed return to school
- Reduced academic performance
- Post-concussion syndrome

Affective Symptoms & Responses
- Fatigue, lack of vigor, apathy
- Nervousness, anxiety, stress, worry, panic
- Irritability
- Emotional instability
- Frustration
- Post-traumatic stress disorder: hyperarousal
- Depressive symptoms or depression
- Hypochondriasis, symptom preoccupation
- Passive, emotion-focused coping

Assessments
- Behavioral
- Cognitive
- Affective
- Physiological

Providers
- Neuropsychologists
- Psychiatrists
- Psychologists – counseling and clinical
- School psychologists
- Sport psychologists

Interventions
- Education
- Rest, graduated exercise
- Social support
- Cognitive behavior therapy
- Goal setting

Kinesiology Review. 4(2), 169-189.