Predicting Concussion Reporting using the Theory of Planned Behaviour and a Stress-Response Framework among Junior University Athletes

By

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Abstract

Concussion in sports has become one of the main concerns for the health of athletes (McCrory et al., 2017). In response, preventative initiatives have been put in place to educate the public about concussion management (Mrazik, Dennison, Brooks, Yeates, Babul, & Naidu, 2015). Despite attempts to further the public's knowledge of concussion, research reveals that athletes often fail to report concussions to authority figures (Delaney, Caron, Correa, & Bloom, 2018; Williamson & Goodman, 2006). Therefore, my study builds on existing research examining psychological factors relevant to athletes reporting concussions.

Current Study: The purpose of this study was to examine concussion reporting intention from the theory of planned behaviour and a stress-response to injury framework. Constructs from these theories were used in predicting intentions, delay, and the actual behaviour of reporting concussion symptoms.

Methods: In this cross-sectional quantitative design, data was collected via convenience-sampling methods from 113 junior varsity athletes playing team sports at the University of Alberta. Inferential statistics included multiple regression models predicting both an athlete's reporting intention and the anticipated delay of reporting. Subsequent analyses included logistic regression models in predicting the actual occurrence of athletes' reporting their concussion.

Findings: Results provide support for my proposed models using constructs from the theory of planned behaviour and the stress-response to injury model to predict reporting intention ($F(5,102)= 7.01$, $p < .001$, $R^2 = .26$) and an anticipated reporting delay ($F(5,103)= 10.35$, $p < .001$, $R^2 = .33$). Perceived control in reporting concussions and emotional help seeking coping were found to have significant associations with greater intentions for reporting and lower delays in anticipated reporting times. Logistic regression analyses reveal that reporting intentions and

perceived control in reporting were significantly predictive of an athlete reporting they had a "bell ringer" in the previous season (χ^2 (2) = 6.04, $p < .05$). Implications, limitations and directions for future research are discussed in relation to the existing literature.

Preface

This thesis is an original work by Adam McCaffrey. No part of this thesis has been previously published. The research project of which this thesis is a part of received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Exploring Perceptions on Concussion Education" No. Pro 00058122.

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Chapter I

Introduction

Concussion in Sports

Concussion in sports has been viewed as a significant health problem within our population. For example, Statistics Canada (2011) estimated that youth aged 12 to 19 years old reported approximately 30,000 concussions annually, and 66% of these concussions were related to sport activities. The three sports with the highest incidence rates of concussions were rugby, hockey, and football (Hootman et al., 2007; Pfister et al., 2016). One of the issues with concussion management has been that a concussion can be difficult to treat, as each concussion can display a variety of symptoms (McCrory et al., 2013). For example, one concussion may cause an athlete to be forgetful and anxious, whereas another concussion can cause dizziness and nausea. Despite these varying symptoms, significant progress has been made in developing an agreed-upon definition of a concussion, based on a pattern of common symptoms. Knowing the symptomology of a concussion can help coaches and athletes determine when to seek medical treatment. Therefore, the medical and scientific communities have stressed the importance of dispelling commonly-held beliefs regarding a concussion to help the public understand what to do when a concussion occurs (McCrory et al., 2013). Nonetheless, there remains a paucity of research that investigates an athlete's reporting behaviour at the time of injury. At present, there is limited scientific research that has evaluated variables that explain why some athletes are more likely to report their injury and seek medical help.

The Hidden Problem of Non-Reporting

There is evidence that a large proportion of concussions in sports go unseen, unreported, and therefore not treated (Williamson & Goodman, 2006). Estimations of non-reporting show

that approximately half of all potential concussions are not being reported (Fraas, Coughlan, Hart, & McCarthy, 2013; Kroshus, Baugh, Daneshvar, Nowinski, & Cantu, 2015; McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004; Wallace, Covassin, Nogle, Gould & Kovan, 2017). For example, McCrea et al. (2004) found that about 52.7% of concussions in high school football leagues were not reported by athletes, whereas Fraas et al. (2013) found that 46.6% of professional rugby players did not report symptoms of concussion when they were aware of symptoms. This underreporting is part of the reason why concussions are often labeled as the invisible injury (Enchemendia, 2012). Thus, underreporting of concussion in sports can be viewed as one of the principal barriers to players receiving appropriate treatment (Williamson & Goodman, 2006).

Responsibility of Reporting from a Developmental Lens

This study focused on university-level athletes, specifically junior varsity athletes (ages 17 to 21) in the intercollegiate sports environment. Developmentally, this period marks a time when individuals enter adulthood and experience a greater responsibility to make decisions about their health and well-being (Arnett, 2006, 2015). During this phase of life, an individual develops their identity, self-consciousness, and cognitive reasoning skills that influence how decisions are made about important issues (Arnett, 2015; Rutter & Rutter, 1993). In fact, this developmental period has been recently re-examined within a modern context and has been referred to as a stage of emerging adulthood (Arnett, 2015; Lenz, 2001). Before attending university, the health and well-being of adolescent athletes are primarily managed by parents and coaches. The transition from adolescence to young adulthood means increased personal responsibility about decisions about their health and well-being. This study examined a sample of athletes who had recently undertaken the transition into university.

Theoretical Frameworks for Understanding Concussion Reporting

The theory of planned behaviour is one of the more practical theories relating to health behaviours, as it provides a framework to explain how one forms an intention for a behaviour. Ajzen (1991) postulated that the attitudes and beliefs one develops in relation to a behaviour would predict the occurrence of that behaviour. That is, there is a cognitive summation prior to a behaviour that informs and drives a behaviour. Ajzen proposed that an individual's attitudes towards an outcome of the behaviour and the perceived social norm around that behaviour were the two most important beliefs that guide the actual occurrence of that behaviour. Ajzen (1991) went on to include beliefs that centre on the perceived controllability of performing the intended behaviour. He stated that these factors, in relation to each other, are the principal components that make up an individual's intentions to engage in that specific behaviour (Ajzen, 1991). Furthermore, intention is the closest link to the occurrence of the actual behaviour. While the theory of planned behaviour has been helpful across many areas of psychology, one potential limitation as applied to research examining concussion reporting behaviour, is that it currently does not account for understanding concussion as an injury that is related to a stress response (Wiese-Bjornstal, 1998, 2010).

The stress-response to injury model conceptualizes an athlete's response to an injury as a stressor and proposes that there are many factors that affect one's ability to cope afterwards (Anderson & Williams, 1988; Wiese-Bjornstal, et al., 1998, 2010). An athlete does not simply engage in examining their attitudes or thoughts when forming an intention; they are also influenced by their established methods of coping and seeking help for their injuries. Within the sports performance literature, how an athlete deals with the stressor of an injury is based on personal coping styles as well as the resources available to them (Anderson & Williams, 1988;

Wiese-Bjornstal, et al., 1998, 2010). Therefore, any model that considers a response to an injury should consider an athlete's coping tendencies.

The purpose of this study was to examine concussion reporting intention from the theory of planned behaviour and a stress-response to injury framework. Previous research has identified the value that the theory of planned behaviour has in predicting reporting behaviours. This study extends previous research in examining whether the addition of constructs from a stress-response to injury model can further contribute to predictive models of concussion reporting. My study also looks at extending the understanding of concussion reporting as a delay in reporting.

Chapter II

Literature Review

This chapter begins with a definitional overview of sports-related concussion as well as the prevalence and outcomes of concussion in sports. In addition, this chapter reviews past research on concussion reporting and the prevalence and potential problems that develop from non-reporting. The chapter then reviews and elaborates on the two main theories of this research: The theory of planned behaviour and the stress-response to injury model. It concludes with the proposed hypotheses for the current study.

Defining a Concussion

Definitions of sports related concussion (SRC) have advanced over the years with the current consensus describing a sports related concussion as "a traumatic brain injury induced by biomechanical forces" (McCrory et al., 2017, p. 839). McCrory et al. (2017) have outlined four common features that may be useful in the definition of concussion:

(1) SRC may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head.

(2) SRC typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over a number of minutes to hours.

(3) SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.

> (4) SRC results in a range of clinical signs and symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged (p. 839).

The evolving definition of a concussion has come to focus more on alteration in consciousness as opposed to a loss of consciousness (Barr & McCrea, 2010). This change was a result of understanding that a concussion can happen regardless of an athlete losing consciousness. Furthermore, concussions are considered a subset of traumatic brain injuries that are classified on a spectrum based upon severity (Iverson & Lange, 2011). The term "mild traumatic brain injury (MTBI)" has been used interchangeably with "concussion" in the literature. However, a MTBI is defined by a short-term neurologic dysfunction due to physical head trauma, while a concussion is viewed as a milder subset of MTBI, as typically a concussion does not result in pathological changes (Echemendia, 2012; Vos et al., 2012). This paper will use the term concussion exclusively, to maintain consistency and to focus my research on concussions in sports.

Research on understanding the dangers of concussions in sports has improved greatly over the past two decades (Bloom, Loughead, Shapcott, Johnston, & Delaney, 2008; Cantu & Gean, 2010; DeKosky et al., 2010; McCrory et al., 2017). Much of the research has focused on determining the incidence rates of concussions for different sports and assessing the common ways that athletes become concussed (Covassin, Swanik, & Sachs, 2003; Guskiewicz, Weaver, Padua, & Garrett, 2000; Hootman, Dick, & Agel, 2007; Iverson & Lange, 2011; Kaut, DePompei, Kerr, & Congeni, 2003). However, in the early to mid 2000's, researchers proposed that there exists a gap in understanding why some athlete do not report their concussion symptoms (Kerr et al., 2014; Kroshus, Daneshvar, Baugh, Nowinski & Cantu, 2014; Provvidenza et al., 2013). Recently there has been an increase in research investigating the

various factors that relate to disclosure of concussion symptoms (Kerr et al., 2014; Kroshus, Baugh, Daneshvar, Nowinski, & Cantu, 2015; Kroshus, et al., 2014). For example, Kerr et al. (2014) found 30 peer reviewed studies addressing athletes' disclosure of concussion symptoms, while a current search on Pubmed, SPORT Discus and PsycINFO shows more than twice as many studies from the time of that study. A current strength of the literature is that there are a wide range of cross-sectional studies looking at different demographic (e.g., age, gender, sport etc.) and attitudinal factors related to concussion disclosure. Despite this, a potential weakness of the current literature is the absence of a theoretical and conceptual model taking into account the factors for why athletes do or do not disclose concussion symptoms (Delaney et al., 2018; Kerr et al. 2014; Kroshus, et al., 2015). Therefore, current research directions are examining the evolution and etiology of why athletes do not report (Register-Mihalik, Valovich McLeod, Linnan, Guskiewicz, & Marshall, 2017).

The Prevalence of Concussion in Sports

Concussion is a major health concern in the school-aged population, with two-thirds of all injuries among those aged 12 to 19 due to involvement in sports (Statistics Canada, 2011). For example, over 40% of all brain injuries among Canadian youth that are treated in an emergency room are due to injuries from sports (Statistics Canada, 2011). It is no surprise then that concussions are one of the most frequent causes of neurological disorders, with the highest rates among those aged 15 to 24 years old (Hirtz, Thurman, Gwinn-Hardy, Mohamed, Chaudhuri, & Zalutsky, 2007; Pfister et al., 2016; Vos et al., 2012). Overall, concussions occur in 5% to 18% of all injuries in sports (Covassin, et al., 2003; Gessel, Fields, Collins, Dick, & Comstock 2007; Guskiewicz, Weaver, Padua, & Garret, 2000; Hootman, Dick, & Agel, 2007; Powell & Barber-Foss, 1999). In fact, ice hockey, football, soccer, rugby, and basketball have

shown some of the highest occurrences of concussions (Hootman et al., 2007; Pfister et al., 2016). For example, research indicates rates of 0.72 to 21.52, 0.22 to 18.8, and 0.37 to 35.0 concussions per 1000 athlete exposure hours for hockey, football, and soccer respectively (Covassin et al., 2003; Guskiewicz et al., 2000; Hootman et al., 2007; Pfister et al., 2016; Powell & Barber-Foss, 1999). Considering the number of hours athletes spend engaging in their sport, many athletes will be at high risk for concussions (Hootman et al., 2007; Powell & Barber-Foss, 1999).

Assessment of the Symptomology

A challenge with diagnosing concussions is that each concussion is unique in its presentation and athletes can manifest a wide range of signs and symptoms (McCrory et al., 2013). Most often, the typical immediate result of a concussion is that an athlete will experience some confusion and disorientation (Putukian & Echemendia, 2003). This temporary state is commonly followed by an array of symptoms such as headaches, fatigue, concentration problems, and balance troubles. However, some symptoms, such as depression and anxiety, do not emerge until hours or even days after a concussion (Echemendia, 2012). Some symptoms of a concussion may be observable, such as a loss of consciousness (LOC) or trouble speaking (Putukian & Echemendia, 2003), while other symptoms may not be as noticeable, such as headaches, fatigue, concentration troubles, and psychological symptoms (e.g., depression). Due to the many symptoms related to concussions, the current consensus calls for a multi-dimensional assessment (McCrory et al., 2013). Specifically, a concussion can be suspected under one or more of the following signs: (1) Symptoms and somatic concerns (such as headaches and emotional changes); (2) Physical signs (such as a loss of consciousness or amnesia); (3) Behavioural changes (such as irritability); (4) Cognitive impairments (such as

slowed reaction times and memory disturbances); and (5) Sleep disturbances. Fortunately, research has suggested that the majority of concussions resolve themselves within a 10-day period with little to no long-term consequences (McCrory et al., 2013, 2017). However, the recovery time varies across age, with children and adolescents usually requiring longer recovery periods. This 10-day period marks the process of the brain healing itself through the restoration of neuro-metabolic functioning (Blennow, Hardy, & Zetterberg, 2012; Giza & Hovda, 2001). Therefore, rest is prescribed as the main treatment for a concussion, and it represents the time when an athlete allows for this recovery process to happen (Schneider, Iverson, Emery, McCrory, Herring, & Meeuwisse, 2013).

The treatment of rest is followed by a recommended graduated "return-to-play protocol" that involves six stages: (1) no activity, (2) light aerobic exercise, (3) sport-specific exercise, (4) non-contact training drills, (5) full-contact practice, and (6) return to play (Johnston et al., 2004). Athletes must progress from stage to stage based on being asymptomatic, and it is suggested that each stage should take around 24 hours. An athlete would normally progress to the final stage after one week (McCrory et al., 2013). If symptoms reappear during the graduated process and persist longer than 24 hours then an athlete can be placed at a lower stage of activity. A sub group of athletes (about 1.6% to 3.1%) experience symptoms beyond this 10-day recovery period despite the use of rest as an intervention (Makdissi, Cantu, Johnston, McCrory, & Meeuwisse, 2013; McCrea et al., 2013; Pfister et al., 2016). Athletes who do not follow this guided recovery procedure are putting themselves at a higher risk for re-injury and possibly long-term health consequences.

Problematic Outcomes of Poorly Managed Concussions

Athletes who fail to report concussion symptoms and who do not take a rest period for recovery are putting themselves at a heightened level of risk for more significant outcomes. One of the main concerns is the possibility of athletes suffering from second impact syndrome (Cantu, 1998; Kelly, Nicholos, Filley, Lillehei, Rubinstein, & Kleinschmidt-DeMasters, 1991; Saunders & Harbaugh, 1984). Second impact syndrome occurs when an athlete suffers from a second concussion while they are still recovering from a previous concussion (Cantu & Gean, 2010; Saunders & Harbaugh, 1984). This second impact can cause the progression of a rapid neurologic deterioration marked by irreversible damage and permanent disability or even death (Cantu & Gean, 2010). The majority of second impact syndrome cases have been documented in athletes who did not report their injuries, delayed reporting, or were improperly assessed to return to their sport (Cantu, 1998; Kelly et al., 1991). Additionally, other concerns center on the fact that negative outcomes of multiple concussions may not emerge until later in an athlete's life and can potentially correlate with degenerative brain disease (DeKosky, Milos, Ikonomovic, & Gandy, 2010). Concussions have also been linked to many other negative outcomes if not treated such as increased anxiety, sleep disturbances, mood disturbances, depression, and persistent headaches (Covassin, Elbin, Beifler, LaFevor, & Kontos, 2017; Eckner, Seifert, Pescovitz, Zeiger, & Kuther, 2017).

The prevalence of non-reporting.

While studies have suggested that concussions in sports are decreasing overall due to policy changes and better safety equipment, some researchers claim that these estimates of concussions in sports are underestimations due to the increasing numbers of athletes who do not report their injuries (Gerberich et al., 1983; Guskiewicz et al., 2000; Powell et al., 1999;

Williamson & Goodman, 2006). Studies have estimated that around 50% of potential concussions are not reported and are therefore not treated (Broglio, Vagnozzi, Sabin, Signoretti, Tavazzi, & Lazzarino, 2010; Delaney, et al., 2018; McCrea et al., 2004; Wallace, Covassin, Nogle, Gould and Kovan, 2017; Williamson & Goodman, 2006). This statistic is best understood through Williamson and Goodman's (2006) study, which used converging reports on concussions to test whether coaches and athletic trainers were able to spot potential concussions. Their study used official injury reports and direct observations and compared these reports of concussions to self-report from youth ice hockey athletes. Their results found that the official injury reports showed 0.25 to 0.61 concussions per 1000 player game hours (PGH), while the direct observation from athletic staff reports found a 4.44 to 7.94 per 1000 PGH. What was most surprising was that athlete self-reported estimates were 6.65 to 8.32 per 1000 PGH and up to 9.72 to 24.30 per 1000 PGH for elite athletes. These numbers stress that a significant percentage of potential concussions were not overtly observable to coaches. These findings are consistent across many sports, including soccer (Broglio et al., 2010), rugby (Sye, Sullivan, & McCrory, 2006), and football (McCrea et al., 2004; Sallis & Jones, 2000). Evidence of non-reporting and delayed reporting has also been found in data from emergency departments (Bakhos, Lockhart, Myers, & Linakis, 2010). Thus, attempts to measure the actual rate of concussions are difficult due to non-reporting. The reasons for non-reporting behaviour could be explained by the unique culture of each sport, athlete variables (e.g. confidence, awareness), external pressure on athletes to perform, available supports to athletes, and the organizational policies that may differ depending on the geographic region (Kerr, Register-Mihalik, Marshall, Evenson, Mihalik, & Guskiewicz, 2014).

Awareness as the Primary Prevention for Athlete Reporting

Awareness of the symptoms of concussion has been the primary focus for lowering the rates of non-reporting. Raising awareness directly addresses the problem of some athletes not recognizing symptoms and therefore not knowing when to report a potential concussion. For example, Bloom et al. (2008) found that most of the concussions from the previous season went unrecognized due to a failure to identify common concussion symptoms. Bloom et al.'s (2008) study, using a sample of university-age athletes across a variety of team sports, found that many athletes claimed that they had no concussion from the past season but had reported that they did have symptoms related to a concussion after an impact (i.e., the athletes said that they felt dizziness or confused after an impact in the previous season but reported that they had no concussions). The incongruity between athletes having concussion symptoms but not realizing they may have a concussion reflects a lack of understanding of the nature of a concussion. These discrepancies have been seen in other research studies (see Delaney, Lacroix, Leclerc, & Johnston, 2002; Delaney et al., 2000; Llewellyn, Burdette, Joyner, & Buckley, 2014; Valovich, McLeod, Bay, & Heil, 2008), which may indicate that many athletes do not believe they have a concussion unless the symptoms are extreme (e.g., being knocked unconscious). Valovich, Mcleod, Schwartz, and Bay (2007) found that 42% of youth athlete coaches believed that a loss of consciousness (LOC) was the primary symptom of a concussion, with 26% believing that it is okay for an athlete to continue playing when they displayed other concussion symptoms such as headaches. While a loss of consciousness is the most commonly mentioned symptom, studies show that this symptom only accounts for approximately 10% concussions (Guskiewicz et al., 2000). Chrisman, Quitiquit, and Rivara (2013) observed that there was often a lack of knowledge among high school aged athletes in identifying the various symptoms associated with

concussion, and these athletes often missed the milder symptoms (i.e., confusion, headaches, and dizziness). Additionally, Register-Mihalik et al. (2013) found that many high school-aged athletes (ages 14–17) were not able to identify some of the less common symptoms of concussion such as amnesia and nausea. Another finding suggests that one fourth to one half of athletes are not able to name more than one concussion symptom (Cusimano, Chipman, Donnelly, & Hutchison 2009). Several studies have expanded terms that athletes are more likely to associate with concussion (e.g., bell ringer) to assess whether athletes had a concussion but did not label it as one. Register-Mihalik et al. (2013) explained that a large proportion of reported "bell ringers" are not viewed as concussions, highlighting a misunderstanding by athletes on what constitutes a concussion. Guskiewicz et al. (2004) proposes that the term "bell ringer" should be used with caution for clinical and educational purposes, as the term may minimize an athlete's view of a mild concussion, instead labeling it with the softer term of "bell ringer."

To address this lack of knowledge about concussions, there has been a movement towards improved concussion education (Kroshus et al., 2014) and there are a growing number of programs that promote concussion education awareness. Yet only a minority of studies have evaluated the consistency and effectiveness of these programs (Mrazik et al., 2015). For example, Bagley et al. (2012) reviewed one youth concussion program, which involved providing education through interactive demonstrations, discussions, and case studies. This study found that students' scores improved from the pre-quiz (34% correct) to post-quiz (80% correct). Females and older individuals usually scored higher than younger males. A study by Cusimano et al. (2014) showed one group of minor hockey players (ages 10 and 14 years) an educational video on concussions and offered another group (as a control group) no video intervention. Participants in the video group had significantly higher knowledge of concussions immediately

after the video compared to the no-video group; however, in a two-month follow-up, they discovered that there were no differences in knowledge gained. Findings also showed that there was no difference between the groups in their attitudes and behaviours towards being aggressive in sports. Correspondingly, Bramley, Patrick, Lehman, and Silvis (2012) found that 72% of the athletes that had some previous education on concussions would report their concussions, while only 36% would report if they had no education. This suggests that those with concussion education are more likely to report symptoms. This finding is contrasted with other studies that discovered surprising outcomes. For instance, Kroshus (2014) used randomized controlled designs with late adolescent male hockey athletes to assess three publically accessible concussion education materials involving two informational videos and one informational handout. This study found that none of the interventions caused significant changes in the athlete's knowledge or reporting behaviours except for an increase in perceived norms on concussions (athletes believing that it was normal to have concussions in sports). This showed a possible harmful effect of the interventions in that concussions may be normalized and not taken as a serious injury. The authors argued that the video intervention may have increased the perceptions that most athletes engage in unsafe reporting behaviours and therefore the participants in this study may have normalized this behaviour.

Evaluations of the effectiveness of concussion educational programs show mixed results. Although some studies show that athletes gain knowledge about concussions, other studies demonstrate small gains or even negative subjective normalizing effects (Mrazik et al., 2015). It is a concern that educational programs appear to show no evidence of actually lowering concussion risk behaviours such as non-reporting. These challenges highlight that while knowledge of concussions is important, ultimately the behaviour of reporting is dependent on

much more than awareness: “While knowledge is a necessary first step, it is not sufficient to tip the scales to behaviour change” (Corace, 2014, p. 2624). This concept reflects findings from Mrazik, Perra, Brooks, and Naidu’s (2014) study, which showed that young athletes, for the most part, knew what a concussion was and how to deal with one in an ideal manner, but that many of the young athletes reported they would not engage in these ideal behaviours. Accordingly, this study suggested that motivational and perceptual factors of reporting were important to consider in predicting the reporting behaviour of the athletes. Kroshus et al.’s (2014) study, titled “NCAA Concussion Education in Ice Hockey: An Ineffective Mandate,” highlighted the issue that governmental policies on providing education for concussions are a necessary first step, but they stated that current programs do little to increase reporting intentions and do not demonstrate significant increases in athlete knowledge on concussions. These results indicate that researchers need to study how to best implement programs, and that any program must consider the complex socio-ecological issues in which this behaviour is embedded.

The Socio-Ecological Issues in Non-reporting

Kerr et al. (2014) identifies that non-reporting behaviours related to concussions can be organized into four levels as based on a socio-ecological model:

(1) intrapersonal factors (e.g., knowledge, internal pressures, gender, concussion history);

(2) interpersonal factors (e.g., teammates’ attitudes, external pressure, external supports);

(3) environment (e.g., access to concussion education, team culture, sports culture); and

(4) policy (e.g., legislation, rules). These areas specifically and the socio-ecological model in general are helpful in understanding that an individual is part of a larger environment of potential influences, and that effective concussion reporting interventions depends on looking at the many factors that influence reporting.

Intrapersonal factors are the internal and demographic aspects that relate to concussion reporting. A history of previous concussions is the most commonly identified variable related to concussion reporting. Torres et al. (2013) found that athletes who reported one or more concussions in their past were more likely to not report their symptoms to their coach. They also found that males with a history of concussions were least likely to report. In a similar study, Register-Mihalik, et al. (2017) found that a greater number of previous concussions experienced was related to negative attitudes to concussion reporting and an actual lower intention to report among high school athletes.

Interpersonal factors represent the immediate environment that can affect an athlete; these include attitudes of teammates and external social pressures. McCrea et al. (2004) assessed attitudes in sports and found that over half (53%) of high school athletes who had a concussion did not report their symptoms because they did not believe the injury was serious enough (63%), had a fear of leaving the game (41%), or that they did not know they even had a concussion (36%). In a similar study, Broglio et al. (2010) found that of those who sustained a concussion, 94% claimed they did not report because they did not believe the injury was serious enough. Other reasons endorsed were that concussions were "just a part of the game," that they did not know "what a concussion was," that they "did not want to be removed from the game," and that they "did not want to let their team down" (Broglio et al., 2010). Delaney, et al. (2018) found that 82.1% of professional Football athletes from their study did not report at least one concussion during the past season with the most commonly listed reason being that they did not feel the injury was severe enough and that they could continue playing with little danger. External pressures are also associated with non-reporting behaviours (Bloodgood et al., 2013; Broglio et al., 2010; Chrisman et al., 2013). For example, Sye et al. (2006) found that 32% of the

athletes from their sample believed that they are pressured to continue to play while having a concussion in order to win. Other athletes have reported that they received negative evaluations from reporting their concussions (Chrisman et al., 2013). Broglio et al. (2010) found that many coaches did not know they were influencing their athletes into these non-reporting behaviours.

Less research has investigated environmental and policy factors in relation to reporting behaviours. Sawyer et al. (2010) found that athletes from rural areas had restricted access to concussion information material and were least likely to have access to concussion management and prevention programs. Tomei, Doe, Prestigiacomo, and Gandhi (2012) found that in the 43 states that have legislation requiring concussion education, only 48% of coaches received formal training and the legislation did not require any athlete to undergo any formal training on concussion management.

Positioning Reporting Behaviours within a Motivational Framework

The socio-ecological model helps researchers look at external factors, however in this study I focussed on intra and interpersonal variables. Reporting behaviour in athletes is similar to other issues in motivational psychology research. For example, motivational psychology has been looking at how to change, on a larger group level, people's actions towards health behaviours such as smoking cessation, promoting physical activity, healthy eating, and regular doctor check-ups (Davis, Campbell, Hildon, Hobbs, & Michie, 2014; WHO, 2005, 2009). Most of these social behaviours requires individuals to have some basic understanding of the problem and education around available choices. Despite availability of information, the same problem arises: it is challenging to change human behaviour.

Motivational psychology proposes several theories to describe behaviour that could apply to the concussion reporting in athletes: social cognitive theory (Bandura, 2001), stages of change

(Prochaska, DeClemente, & Norcross, 1992), the health belief model (Rosenstock, 1974), and the theory of planned behaviour (Ajzen, 1985). I chose the theory of planned behaviour because it specifically tries to link the intentions one has for a behaviour to the actual behaviour and has been used already to help explain concussion reporting (Register-Mihalik et al., 2013). Additionally, the theory allows researchers to understand better how an athlete may have high or low intentions to engage in concussion reporting behaviours, thus allowing for a measure that relates to later actual behaviour.

Theoretical Basis of the Theory of Planned Behaviour in Concussion Reporting

Ajzen (1991) claimed that general dispositions and personality traits are poor predictors of specific behaviours. Psychological constructs are best conceptualized when they are based on specific behaviours rather than in broad and global dispositions. This is the case with Bandura's concept of self-efficacy, which is best measured to the precise behaviour of interest (Bandura, 2001). Ajzen (1991) has postulated that specific behaviours are based on "the influence of various other factors unique to the particular occasion, situation, and action being observed" (Ajzen, 1991, p. 180). Along with that, behaviours are the function of the expectancies one has towards the outcome and the value attached to completing that behaviour. Therefore, the theory of planned behaviour is described as a value expectancy theory in which the individual must weigh the value of the behaviour outcome, which in this case is the value attached to reporting versus continuing to play (Ajzen, 1985). The theory of planned behaviour postulates that the intention one has towards a behaviour is the most proximal factor to predicting the actual occurrence of that behaviour. An intention, defined as a cognitive representation of readiness for a person to engage in a given behaviour, acts as the most proximal factor to predicting the actual behaviour (Ajzen, 1985). Furthermore, a person first has an intention for a planned behaviour

before the behaviour is initiated. Three factors have been determined to influence this intention: (1) the attitudes one has towards a specific behaviour; (2) the subjective norms one has of that behaviour; and (3) the perceived control one feels they have over that behaviour (Ajzen, 1991). Of these factors, attitudes towards the behaviour have been seen as the strongest predictor of intention across a wide range of health behaviours, whereas subjective norms have been seen as the weakest (Armitage & Conner, 2001). The theory of planned behaviour has been applied to various areas and outcomes, such that the sequence of belief-intention-behaviour has been widely supported (Armitage & Conner, 2001; Cristea, Paran, & Delhommme, 2013; Pineles & Parente, 2013**)**. Within behavioural change research, the theory of planned behaviour is one of the most cited theories and one of the most influential models for the prediction of behaviours across a wide range of populations (Armitage & Conner, 2001). Across a wide array of studies, the factors of one's attitudes, subjective norms, and perceived behavioural control together account for 39% of intentions and 27% of behaviours (Armitage & Conner, 2001), suggesting that a further look at these factors is important to understanding any behaviour.

The construct of attitude towards a behaviour is defined as the positive or negative evaluations an individual gives to the performance of that behaviour (Ajzen, 1991). In other words, thinking about the consequences of the behaviour and giving the behaviour a positive or negative value may increase or decrease the probability of the behaviour. The list of possible outcomes can be numerous, so the strongest and most frequent consequences are the ones most likely to impact an athlete's attitude. For example, looking at an interpersonal level in concussion reporting, a belief could be that reporting will hurt their team's performance, that teammates will think less of them, that they will lose their spot in the line-up and that they will be removed from the game (Broglio et al., 2010; Delaney, et al., 2018).

Subjective normative beliefs are considered the normative social pressures an individual feels to remain with the status quo (Ajzen, 1991). These pressures include an individual's perceptions of the particular behaviour and how these perceptions are influenced by the judgment of others (e.g., significant others). Subjective norms represent the social aspect and the social pressure one feels to maintain the status quo. For example, common beliefs pertaining to concussion reporting may be with the athlete believing that his teammates would not report the same concussion, or that it is expected that they continue to play and not disrupt the status quo of their play in the game. In addition, it has been shown that the normative beliefs of coaches can influence athletes' perceptions about reporting (Broglio et al., 2010).

Perceived control beliefs were added later to the theory of reasoned behaviour model and were influenced by Bandura's self-efficacy theory (Ajzen, 1991). Ajzen (1991) felt that perceived control explained a further element of control expectancy towards the goal. That is, if a goal does not seem achievable, then one's attitudes and subjective norms have less influence on the occurrence of the actual behaviour. For example, an individual attempting to quit smoking may feel a lack of control due to their addiction. People are less likely to quit smoking if they feel they have little control over their addiction in spite of having a positive attitude about quitting and experiencing normative pressure to quit. These beliefs are seen as the individual's perceived ease in performing the behaviour. Applied to reporting a sport concussion, if an athlete perceives that they have little control of positive outcomes (e.g., due to fears of losing their starting spot on the team, not knowing how the coach will respond, not having the time to speak to the coach, or having no formal plan for reporting symptoms) the athlete may be less likely to perform the behaviour.

While attitudes, subjective norms, and perceived control are seen as important to understanding behaviour, the primary outcome of interest within the theory of planned behaviour is behavioural intentions and their link to actual behaviour. A behavioural intention (BI) is defined as an indication that a person is prepared and willing to engage in the planned behaviour (Ajzen, 1985). Simply put, it is the plan one makes to engage in a behaviour based on their beliefs about that behaviour. This plan is one that is both forecasted into the future and is something that an individual is motivated to carry out. This model is demonstrated in the following equation: BI = a + *b*1 (Attitudes) + *b*2 (Subjective Norms) + *b*3 (Perceived Control). This equation outlines that behavioural intention is a summation of one's attitudes towards the behaviour, the subjective norms that surround the behaviour, and the perceived control one feels towards successfully completing the behaviour. The BI equation suggests that each factor has a unique valance. An attitude towards a behaviour (*b*1) and the subjective norms of behaviour (*b*2) are under volitional control but perceived control (*b*3) includes beliefs about one's ability to control variables that may be outside of one's direct control. This is why Ajzen (1991) emphasizes that perceived control plays a significant role in not only behavioural intention but also in the enactment of the behaviour itself because perceived control includes the degree to which the person actually believes they can control an outcome in spite of their attitudes and the presiding normative behaviour. The combination of these factors can lead to a wide range of behavioural outcomes as reflected in Ajzen's statement (1991): "The relative importance of attitude, subjective norm, and perceived control in the prediction of intention is expected to vary across behaviours and situations" (p. 188). For the purposes of the current research, the addition of perceived control is an important addition because it is possible that, in spite of having a positive attitude about reporting and believing that other teammates would report, an athlete's

perceived control may not only impact their behavioural intention, but also their actual behaviour.

The theory of planned behaviour and concussion reporting intentions.

A few recent studies have applied the theory of planned behaviour to sports concussion reporting. For instance, Register-Mihalik et al. (2013) used the factors from the model of the theory of planned behaviour to predict concussion reporting intentions. Their study used a cross-sectional design that sampled high school students and found that the model could explain 58% of the variance for a student's intention to report a concussion if they sustained one. Interestingly, their analysis also showed that intention was not significantly associated with the actual reporting behaviour. However, an increased intention was associated with a decrease in the number of athletes who reported continuing to play while experiencing symptoms. Therefore, the athletes in this study did not report their concussions but possibly delayed reporting to see if their symptoms resolved by themselves. Register-Mihalik et al. (2013) extended this study's analysis and used binomial regression modeling to estimate the prevalence ratios for the reporting outcomes. In addition, results showed that the level of knowledge an athlete had of concussions did not predict a reporting outcome, while the attitude an athlete has towards concussion reporting showed a decrease in athletes participating while symptomatic. My study intends to build on of these findings by including coping strategies taken from a stress-response theory of injuries. Including factors related to coping could help to explain further why athletes seek help or not. Furthermore, I chose to include not only reporting intention, but also how athletes may delay reporting based on different concussion symptoms they are experiencing. Register-Mihalik et al. (2013) found that athletes continued to participate in their sport despite experiencing mild concussion symptoms. Thus, there is evidence to support expanding research

to include not only whether an athlete has an intention to report, but also if they choose to report their symptoms, and how long they tend to wait until they judge the symptoms to be severe enough to report.

In another study, Kroshus et al. (2015) hypothesized that the measure of intention was the most important metric to evaluate concussion education. Their study looked at university-aged athletes' preseason concussion knowledge and reporting intentions exclusively in predicting in-season concussion reporting behaviours. This study found that preseason concussion knowledge was not significantly related to in-season reporting behaviours, while preseason reporting intentions were a significant predictor. Specifically using multi-variable logistic regression analysis, they found that for 1-unit change in the intention measure, the athletes had a 1.63 times greater chance of reporting their concussion symptoms (however, the variance accounted for was only 6% based on this model, indicating that very little variance in the reporting behaviour was accounted for by intention). Kroshus et al. (2014) also looked at assessing whether the variables of attitudes, subjective norms, and perceived control could show a good fit within a structural equation model predicting intentions and reporting behaviours from the past season. Their findings showed that the data fit the TPB-based model in all of the hypothesized pathways. Along with their findings, results revealed that intentions and perceived control were among the highest predictors of the actual behaviour and that knowledge only related to an athlete's attitudes towards concussion reporting. Their results revealed that the model explained 22% of the variance for intentions and 10.5% for reporting behaviours based upon retrospective athlete. Using retrospective self-reports is beneficial in attempting to tap into the private experience of non-reporting and requires a level of reflection and honesty from an athlete. Each of these studies showed promising results that the theory of planned behaviour can predict, to some extent,

reporting intentions and behaviours. The theory of planned behaviour framework, however, has not factored in other influences seen from the socio-ecological model. An area missing from current research is conceptualizing concussion reporting behaviors in the context understanding that injuries in sports have been viewed as a stress event that elicits a coping style (Andersen et al., 1988).

Understanding Concussions within the Stress-Response to Injury Model

Concussion is defined fundamentally as a complex physical injury (Echemendia, 2012). Although it leads to direct pathophysiological changes in the brain (McCrory et al., 2017), like other injuries, it results in damage to a person. The most important piece, from a psychological standpoint, is that physical injuries are perceived as a stressor by the individual and elicits an emotional and behavioural response to recovery. It is important to understand that any response to a concussion includes a response based on the stress caused by the concussion. The theoretical model of stress from an athletic injury is not new to the field of sports psychology, with one of the first frameworks looking at the prediction and prevention of injuries as based on the stressors an athlete has in their life (Andersen et al., 1988). The stress-related theories on injuries include the various cognitive, physiological, behavioural, attentional, social, intrapersonal, and stress history factors and grew out of the synthesis of the stress-illness, stress-accident, and stress-injury research. The stress-response theory states that many factors can contribute the perceptions one has of their injury and how they cope once they have an injury (Andersen & Williams, 1988). For example, one athlete may cope by ignoring an injury while another athlete may give the injury considerable time and attention. Thus the impetus of seeking help for their injuries will also reflect their patterns of coping.

The stress-response of sports injuries.

The foundation of the stress-response models comes from Hans Selye's (1976) stress-health model, and later from Richard Lazarus and Susan Folkman's (1984) transactional model of stress and coping. Selye was one of the first to conceptualize the stress-health model within psychological terms. He suggested that stress is the "nonspecific result of any demand upon the body" (Seyle, 1993, p. 7), and his definition focused on the introduction of a demand on the individual. The stress response is conceptualized as a universal response one has to a perceived threat. A perceived threat places a demand on the person and is responded to in varying ways dependent upon the individual's interpretation of the stressor. While Seyle's research was important in defining stress and how one deals with it psychologically, he did not offer a complete definition of the cognitive appraisals and coping strategies people use. Lazarus and Folkman's (1984) transactional model of stress and coping extended Seyle's theory by conceptualizing stressors as being internal or external demands that upset the balance of physical and psychological well-being, which requires an action to restore the balance. Central to this theory is the concept that how one deals with stressors is dependent on their own perceptions of the stressors (and so each individual cope differently).

The transactional model of stress and coping is the basis of the larger contextual models proposed within sports psychology to understand injuries. Out of this literature there are several models that conceptualize the stress-response theory of sports injuries and may be applied to concussion. One of the first and most influential models was proposed by Anderson and Williams (1988). This theory looked at the factors associated with risk vulnerability an athlete has to injury. These factors included the athlete's personality, history of stressors, and coping resources (Anderson & Williams, 1988). One of the most consistent findings was that a greater

number of stressors in an athlete's life puts them at a risk for injury in sports (Williams & Anderson, 1998). Furthermore, athletes who report fewer coping skills, or lack the social resources to deal with their stress, in turn have worse outcomes. Wiese-Bjornstal et al. (1998, 2010) expanded upon the risk factors that can lead an athlete to adaptive or maladaptive appraisals of their injuries. These risk factors relate to how an athlete can compromise their health behaviours by not seeking help for their injuries and therefore not coping adaptively. Adaptive coping on the other hand includes a willingness to seek help and follow up with the recommended treatments (Wiese-Bjornstal et al., 1998). Wiese-Bjornstal et al. (1998) proposed a process that an athlete goes through when they sustain an injury: first the athlete makes an appraisal of the injury, then the athlete feels the emotional effect, and then the athlete engages in a behaviour to deal with the injury and the stress caused by the injury. At the root of all these conceptualizations of "what an injury is" there is a focus on injuries, at an interpersonal level, as stressors that an athlete perceives as events that should or should not be taken seriously. As well, how an athlete deals with the stressors in their sport, such as when injuries happen, can lead them to either to internalize their feelings and not report, or conversely to externalize and feel comfortable seeking help as a means of coping (Wiese-Bjornstal, et al. 1998, 2010).

In terms of concussion, the act of seeking help involves seeking social and medical resources to help deal with symptoms. Craver, Scheier, and Weintraub (1989) proposed that the way people usually respond to stress through coping could be assessed in a multidimensional inventory. From this inventory scale, they articulated two main conceptually distinct coping styles: problem-focused coping and emotion-focused coping. From these categorizations two styles relate most to a help seeking behaviour: "seeking of instrumental social support" from the problem-focused copings scale, and "seeking of emotional social support" from the emotion-

focused coping scale. These two types of coping may both relate to concussion help seeking tendencies in that they both measure whether a person normally seeks help from a significant other, and whether they tend to do so in an instrumental or emotional manner, both of which may be important for understanding a reporting behaviour.

An instrumental coping response to a concussion reflects an athlete's response that aligns with them seeking concrete advice or problem-solving actions from and within their support systems (Craver, Scheier, & Weintraub, 1989). For example, an athlete going to their coach and asking them if they think they have a concussion and what they should do about it represents an instrumental seeking of advice. This response reflects an action focus to dealing with the concussion. On the other hand, the emotional coping response is one in which an athlete would seek emotional support for their injury (Craver, Scheier, & Weintraub, 1989). For example, an athlete expressing that they feel dizzy and sick to their coach as a means of seeking empathy represents an expression of emotion-focused coping. Both coping styles are adaptive in that they bridge the experience of the injury from the athlete to the support system that can help them.

The Development of this Study's Hypotheses

The theory of planned behaviour has helped to explain how one forms beliefs that contribute to the formation of an intention to report. This study builds on the previous findings that the theory of planned behaviour is associated with an athlete's intention to report concussions. However, this study looks further in contributing to the research by including constructs associated with how an athlete deals with a concussion as based from the stress-response theories. Stress-response theories propose the importance of athletes seeking help to deal with their injuries through both instrumental and emotional coping methods. This study attempts to replicate previous findings that the theory of planned behaviour is important in an

athlete forming an intention to report. However, I attempt to test whether adding variables from a stress-response to injury model can add to explaining how athletes form intentions to report and whether there is a decrease in the delay to report beyond the theory of planned behaviour. To test this model, I conducted two multi-regression analyses and a logistic regression analysis. The specific hypotheses are presented below.

Hypotheses of the Study

Hypothesis I:

My model, using constructs from the theory of planned behaviour and the stress-response to injury theory, predicts an athlete's reporting intention. Specifically, entering the variables of attitudes, subjective norms, perceived control, instrumental and emotional coping into a regression model will account for a statistically significant portion of the total variance in predicting a reporting intention. The null hypothesis is that this regression model will not account for a statistically significant portion of the total variance in predicting a reporting intention.

Hypothesis II:

My model, using constructs from the theory of planned behaviour and the stress-response to injury theory, predicts an athlete's anticipated reporting delay. Specifically, entering the variables of attitudes, subjective norms, perceived control, instrumental and emotional coping into a regression model will account for a statistically significant portion of the total variance in predicting an anticipated reporting delay. The null hypothesis is that this regression model will not account for a statistically significant portion of the total variance in predicting an anticipated reporting delay.

Hypothesis III:

Using logistic regression analysis, an athlete's reporting intention and perceived control will significantly predict whether an athlete reported a concussion from the past season. The null hypothesis is reporting intention and perceived control will not predict whether an athlete reported from the past season.

Chapter III

Methodology

Recruitment Procedures and Participants

Participants were male and female varsity athletes from the University of Alberta in their first 2 years of university (henceforth described as "junior" level athletes). I sampled junior level athletes to examine the specific developmental time when athletes are given more responsibility to make their own medical decisions. Junior level athletes typically enter into their chosen sport from high school at the ages of 17 or 18, and then continue in their sport at the junior level for the first 2 years. Athletes who played ice hockey, football, soccer, basketball and volleyball were included as these sports involve a social dynamic as a team sport, which contributes to social norms created about concussions. Athletes were recruited using a convenience sampling method.

The preseason medical testing at the University of Alberta was used as an opportunity to gather data from athletes. As part of the preseason medical testing, athletes completed a baseline concussion assessment and then had the opportunity to participate in this study. Before the baseline concussion testing, athletes were briefed on the study and were told that they could volunteer to participate in the study if they desired. The athletes were told that they could decline their involvement and that by doing so would not influence them in their testing or sport. Athletes received a survey package that included the study's information page (see Appendix A) and consent form (see Appendix B). Before filing out the survey measures, the athletes had the opportunity to ask questions from the investigator (Adam McCaffrey) and/or the study's supervisor (Dr. Martin Mrazik). Once the athletes had completed the survey, they returned it to the examiner at the pre-season medicals along with the signed consent form. Across all sports, a total of 113 athletes filled out the survey.

Measures

Demographic information measure. Demographic and background information was gathered based on previous studies suggestions of important factors to consider (Torres et al., 2013). This study gathered information on the athlete's age, sport type, year of playing, previous methods of learning about what a concussion is and number of previous diagnosed concussions.

Attitudes about the outcomes of concussions. This measure was created from Rosenbaum and Arnett's Concussion Attitude Inventory but modified by Kroshus et al. (2014) to fit within the outcomes of concussion reporting. An expert panel initially evaluated the scale and the scale focused on the perceived consequences and benefits of athletes reporting (or not) their concussion symptoms. The scale asked participants to report their agreement with eight statements about potential positive or negative outcomes of concussion reporting. The scale was modified slightly to pertain to all team sports rather than just ice hockey. For example, the scale asked questions such as "If I report what I suspect might be a concussion..." and had questions such as "I will hurt my team's performance" or "I will lose my spot in the lineup." Unless otherwise stated, items were rated on a 7-point scale from 1 = strongly disagree to 7 = strongly agree with the statements. Rosenbaum & Arnett, (2010) reported a $\alpha = .59$ to .72 for internal consistency. Kroshus et al. (2014) reported $\alpha = .62$. In the present work, I calculated $\alpha = .65$.

Subjective reporting norms. This scale was created by Rosenbaum and Arnett's Concussion Attitude Inventory (2010) to assess the attitudes athletes have towards subjective norms of concussion in sports. This scale was meant to capture how athletes perceive social norms surrounding concussion reporting. Athletes were asked to report on how strongly they agreed to twelve hypothetical statements about either their teammates or what most athletes would do. A higher score reflected a more negative belief around concussion reporting. This

scale was slightly modified from using hypothetical situations that used the terms "athlete x, athlete y" to names such as "Alex and Morgan." Kroshus et al. (2014) reported a coefficient alpha of .74. In this study, the coefficient alpha was .86.

Perceived control. This scale measured an athlete's level of confidence reporting concussion symptoms under challenging conditions. The challenging conditions were reporting symptoms when "they really want to continue playing", or are "under pressure from their teammates." Previous studies have reported strong internal consistency coefficient alpha of .91 (Kroshus et al., 2014; 2015). In the present work, I calculated α =.89.

Coping styles. The measure of coping style was adapted from a Stadden (2007) modification of the Cope Inventory (Carver et al., 1989) to relate to concussion events. The COPE Inventory was developed to assess how people deal with general stress, however for this study it was modified for use with concussion in sports. From the COPE Inventory two main categories of coping were determined: 1) The use of problem-focused coping and 2) The use of emotion-focused coping. The two types of coping chosen for this study were the scale of Instrumental Social Support (COPE ISS) and Emotional Social Support (COPE ESS). While other coping scales could have been included, this study emphasized help seeking tendencies that align with an athlete seeking aid from their coaches and/or athletic trainers. Craver et al., (1989) reported α = .75 and .85 for COPE ISS and COPE ESS, respectively. They also found that the correlation between these two constructs was .69. Stadden (2007) reported α = .86 for the COPE ISS scale, and .79 for the COPE ESS scale. In the present work, I calculated α = .80 for emotional coping and .87 for instrumental coping.

Concussion knowledge. This 13-item measure was based on Rosenbaum and Arnett's (2010) 25-item Concussion Knowledge Index. This scale was modified by Kroshus et al. (2014)

to a 7-point scale ranging from “Strongly Disagree” to “Strongly Agree,” in contrast to the previous binary True/False scale (see Table 1). Kroshus et al. (2014) also modified the previous scale to focus on concussion symptoms, concussion recovery, and concussion symptom recognition. Responses to statements that were false were reverse coded so that higher average scores represented more correct responses from the concussion-related knowledge questionnaire. In the present work, I calculated $\alpha = .461$, lower than expected. The poor reliability was potentially due to the level of varying difficulty and that each question looked at a different area of knowledge about concussions (Rosenbaum & Arnett, 2010). Despite this, the measure was created using expert review to encompass many areas of concussion knowledge and has been used in similar studies (Kroshus et al., 2013, 2014) which do not report the internal consistency, but instead rely on the concept that higher scores are still representing higher knowledge of concussions. Given these limitations, I used the concussion knowledge items within the preliminary demographic analysis but not the main inferential analysis.

Symptom reporting behaviours. This questionnaire was based on Kaut et al. (2003)’s study and reports on the common symptoms of head injuries. Previous studies indicate the most common symptoms of concussions are first the symptom of confusion, then followed by headaches, dizziness and blurred vision (Delaney, Lacroix, Leclerc, & Johnson, 2000). The questionnaire asked athletes to think back on the previous season and to determine if they had experienced any of the common concussion symptoms and whether they reported this to their coach. Meehan, Mannix, O’Brien, & Collins, (2013) used a similar method whereby athletes completed a self-report on the common concussion symptoms and reported if they had previously had any undiagnosed concussions based on a review of these symptoms. For the current study’s analysis, two criterion variables were created from this questionnaire. One

involved selecting the athletes that reported having any concussion symptoms during the past season. This group was then split into those who reported that they told their coach or the athletic staff about these symptoms and those who did not, creating a dichotomous variable. Within this variable, the number of athletes who reported having any symptom due to an impact in their sport in the past season totalled 70 participants. Of this total, 32 participants reported their symptoms to their coach or medical professional, while 38 did not report. The sample from this variable was used in the first analysis of hypothesis III. The second criterion variable created involved simply whether the athlete had experienced a "bell ringer*"* from the previous season and whether they told their coach or professional about this, creating a dichotomous variable. The number of athletes who reported having experienced a "bell ringer" in the past season from an impact totalled 53 athletes. Of this total, 30 participants reported to their coach, and 23 did not. The sample from this variable was used in the second analysis of hypothesis III. With the complexity of gathering information on potential concussions from the past season, both variables were viewed as adding uniquely to exploring this phenomenon.

Intention to report. Kroshus et al., (2014) created the Intention to Report scale based on the 8 common concussion symptoms, e.g., "In the upcoming season, I would stop playing and report my symptoms if I sustained an impact that caused me to." Participants answered the previous statement in regards to a list of common symptoms (see Table 1). The items demonstrated high internal consistency, $\alpha = .82$.

Delay of reporting. A scale was created by the investigator (Adam McCaffrey) to assess the degree to which athletes delay reporting symptoms to a coach. Scale items were taken from the Intentions to Report Scale, and participants were asked hypothetically how long they would delay if they were to experience concussion symptoms in the future. This scale was developed

based on the theoretical work of a tendency to delay health-related behaviour (Steel, 2007, 2010). It used a 7-point scale that ranged from 1 "would report right away" to 7 "would wait a couple of weeks" before reporting persisting symptoms to a coach. The scale anchors are based on 1) the moment an athlete realizes they have symptoms to 2) research suggesting that symptoms will dissipate normally within 10-days (Gusckiewicz et al., 2004; McCrory et al., 2017). The items demonstrated high internal consistency, $\alpha = .82$.

Table 1

Range of Responses for Main Variables

Scales	Range of Responses						
	Strongly Disagree						Strongly Agree
Attitudes to Report Sample Item: If I report what I suspect to be a concussion, I will hurt my team's performance	1	2	3	4	5	6	7
Subject Reporting Norms Sample Item: Pat experienced a concussion during the first game. My teammates would feel that he should have returned to play	1	2	3	4	5	6	7
Perceived Control Sample Item: I am confident in my ability to recognize when I have symptoms of a concussion	1	2	3	4	5	6	7
Coping Styles Emotional Coping Sample Item: I discuss my feelings with my Coach/Athletic Trainer. Instrumental Coping Sample Item: I try to get advice from my Coach/Athletic Trainer about what to do about the symptoms.	1	2	3	4	5	6	7
Knowledge of Concussions Sample Item: People who have had a concussion are more likely to have another concussion	1	2	3	4	5	6	7
Intention to Report Sample Item: In the upcoming season, I would stop playing and report my symptoms if I sustained an impact that caused me to have a headache.	1	2	3	4	5	6	7

Data Cleaning and Statistical Examination of Assumptions

Survey information was entered into an SPSS database. The database was double checked for consistency and missing responses. For the 5 item scores missing, participant means for each construct was used (Tabachnick & Fidell, 1996). I created construct average scores as oppose to summed composite scores so that interpretations from the analysis could be best understood within the same metric that comes from the surveys (Tabachnick & Fidell, 1996). Within regression analysis, outliers were assessed as based on the extremeness found on each predictor to criterion variable. Univariate outliers were found by assessing the distribution of the single construct measures. Outliers were determined as any score that deviated more than 3 standard deviations from the mean of each construct (Tabachnick & Fidell, 1996). It was determined that 1 outlier was found for the construct of Concussion Knowledge, 2 for Attitudes, 1 for Perceived Control and 2 for Reporting Intentions. These outliers were removed from the analysis.

Multicollinearity was assessed as based on the variance inflation factor test within SPSS and no issues were seen throughout the analysis (Field, 2013). I assessed normality, linearity and homoscedasticity within the regression analyses by looking at the residual scatterplots of the predicted criterion variable scores and the errors of the predictions. The errors of the obtained scores were normally distributed along the predicted criterion variable scores such that when looking at the scatterplots the residuals showed generally a horizontal straight-line relation. Normality (univariate and bivariate) was assessed using individual histograms of the constructs and looking at skewness and kurtosis, as well as within examining the multivariate scatterplots of the observed residuals to the predicted residuals (Tabachnick & Fidell, 1996). Table 2 provides

an overview of a descriptive of the main variables within the study. Overall, there were no issues with skewness or kurtosis (see Table 2).

Table 2

Psychometric Properties of Main Variables

Variable	# of Items	M	SD	Range	Skew	Kurtosis	N
Attitudes	8	2.84	.69	3.25	.19	-.30	111
Subject Norm	12	2.69	.90	3.92	.08	-.84	113
Perceived Control	5	5.16	1.07	4.60	-.16	-.47	112
Emo. Coping	4	4.10	1.42	6.00	-.05	-.36	112
Instru. Coping	4	4.86	1.41	6.00	-.63	-.12	112
Knowledge	13	5.84	.61	2.89	-.41	.06	113
Intentions	8	5.82	.80	3.25	-.26	-.79	111
Delay of Reporting	8	2.25	.93	3.88	.70	-.07	113

Note: All variables in table were on a 1-7 scale.

A-Priori Power Analysis

An a-priori power analysis was completed by using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007). For the first two multiple regression models, the effect size estimates were determined based on prior literature in the area in which the reported an adjusted R^2 ranging from 0.20 to 0.50 for the criterion variable of reporting intentions (Kroshus et al., 2013, 2014). This study used the more conservative estimate of 0.20 as the effect size. Because this study performed two multiple regressions, the more conservative alpha level of 0.01 and a power level of 0.80 was chosen. For the main analysis using 6-7 predictor variables, (with $\alpha = 0.05$, $(1 - \beta) = 0.80$, and $R^2 = .020$), G* Power software suggested a minimum sample size of 103. Another method offered by Tabachnick & Fidell (1996) was to use the formula of $N \geq 50 + 8m$ (where m

is the number of predictor variables) for multiple regression and $N \geq 104 + m$ for testing the individual predictors within the equation. This simple rule of thumb applies to medium-sized relationships between the predictor and the criterion variables (beta = .20). Using Tabachnick & Fidell (1996) simplistic formula, with 6 predictor variables specified in the model, a minimum sample of 98 for multiple regression analysis and 111 for testing the individual predictors with the equation was suggested. Considering both power analysis methods, it was considered that the sample size of 113 was sufficient for the analyses purposed.

Chapter IV

Results

Procedure of Analysis

This study involved a number of statistical analyses to examine the theory-based hypotheses proposed in Chapter II. The analyses were broken down into three main steps:

1) A preliminary descriptive analysis of the sample. This descriptive analysis included correlations between the number of previous concussions with the variables from the theory of planned behaviour and the stress-response theory. I also examined questions related to athlete knowledge of concussion including sources of information. Finally, I conducted correlational analysis for the variables of the theory of planned behaviour to the variables from the stress response to injury.
2) Two multiple regression analyses examined the relationship between the predictor variables to the criterion variables. My regression models included predictor variables from the theory of planned behaviour (attitudes, subjective norms, and perceived control) and the stress-response coping (instrumental and emotional coping) in predicting both an athlete's intentions to report and the anticipated reporting delay.
3) A logistic regression analysis to assess whether reporting intention and perceived control significantly predicted whether an athlete reported their concussion symptoms during the past season.

Sample Demographic

The sample had a mean age of 18.52 and standard deviation of 1.18. The majority of the sample was male (74.3%) and consisted of athletes from a variety of team sports such as those from Football (54 athletes), Hockey (14 athletes), Basketball (11 athletes), Soccer (27 athletes) and Volleyball (7 athletes). Within the sample, 50.4 % of the athletes had never had a previously diagnosed concussion before, followed by 23.9% of athletes who had just one diagnosed concussion (see Table 3). Approximately half of the athletes had at least one diagnosed concussion with some having had 4 or more. However, this measure only included formally diagnosed concussions and therefore was not a measure of the potential non-reported concussions.

Table 3

Frequency of Previous Concussions Formally Reported

	No Prior Formal Concussions	1 Prior Formal Concussion	2 Prior Formal Concussions	3 Prior Formal Concussions	4 + Prior Formal Concussions
# of Athletes	57 (50.4%)	27 (23.9%)	17 (15%)	6 (5.3%)	4 (3.5%)

Associations between the number of previous diagnosed concussions and the main variables of the study were assessed (Table 4). The only significant correlation found was with the number of previous diagnosed concussions with emotional coping, $r(108) = -.24$, $p < .05$. This suggests that the greater the number of previous diagnosed concussions experienced by an athlete, the less likely the athlete is to seek emotional support if they experience concussion symptoms again.

Table 4

Association between Frequency of Previous Concussions to Main Variables

	Att.	Sub	Per Con.	Know	Instr. Coping	Emo. Coping	Intentions to Report	Delay of Reporting
# of Prev. Concussion	.06 (109)	.04 (111)	.02 (111)	-.03 (111)	-.18 (110)	-.24* (110)	-.01 (109)	.12 (111)

Note: Att = Attitudes Towards Reporting, Sub = Subject Norms of Reporting, Per Con = Perceived Control of Reporting, Know =Knowledge of Concussions, Instr Coping = Instrumental Coping, Emo Coping = Emotional Coping. *p<.05.

Our questionnaire included true/false statements from Rosenbaum and Arnett's (2010) Concussion Knowledge Index and attempted to examine an athlete's ability to correctly agree or disagree to these statements. For example, an athlete that strongly agrees to the statement "People who have had a concussion are more likely to have another concussion" was rated as being correct. Additionally, an athlete that disagrees with the statement "A concussion cannot cause brain damage unless the person has been knocked unconscious" would also be rated as correct in disagreeing to a false statement. Based from Kroshus et al., (2014)'s study, athletes that chose 6 and above on the 1 to 7 scale were seen as correct, with reversed items reverse-coded. Table 5 shows the statements and the percentages of those athletes that correctly agreed or disagreed with the true/false statements.

Table 5

Knowledge Item Statements and Scores

Knowledge Item	% Correct
1. People who have had a concussion are more likely to have another concussion.	60.2%
2. There is a possible risk of death if a second concussion occurs before the first one has healed.	26.5%
3. A concussion cannot cause brain damage unless the person has been knocked unconscious. (R)	82.3%
4. The brain never fully heals after a concussion. (R)	22.1%
5. It is easy to tell if a person has a concussion by the way the person looks or acts. (R)	35.4%
6. Symptoms of a concussion can last for several weeks.	74.3%
7. Resting your brain by avoiding things such as playing video games, texting, and doing schoolwork is important for concussion recovery.	78.8%
8. After a concussion occurs, brain imaging (e.g. computer assisted tomography scan, magnetic resonance imaging, X- ray, etc.) typically shows visible physical damage to the brain (e.g., bruise, blood clot). (R)	7.1%
9. A concussion may cause an athlete to feel depressed or sad.	59.3%
10. Once an athlete feels "back to normal," the recovery process is complete. (R)	63.7%
11. Even if a player is experiencing the effects of a concussion, performance will be the same as it would be had the player not experienced a concussion. (R)	74.3%
12. Concussions pose a risk to an athlete's long-term health and well-being.	76.1%
13. A concussion can only occur if there is a direct hit to the head. (R)	69.0%

"Correct" indicates an answer of $\geq$ 6 on a 1-7 scale. R = Item has been reversed.

The questionnaire included a checklist of the different methods that athletes learned about what a concussion was and concussion related issues in sports. The majority of the athletes reported that they learned about what a concussion was through discussions with their athletic staff or coaches (80.5%), discussions with other teammates (66.4%) and/or discussions with their parents (54.9%). Athletes reported learning less about what a concussion was through methods of an educational workshop (18.6%), educational printed material handed to them (27.4%) or

online material provided (45.1%). Therefore, participants reported learning what a concussion was mostly by informal discussions with their coaches, family and peer groups rather than from structured formal workshops or educational methods.

Correlations of the Main Variables

The magnitude of the correlations was interpreted according to Cohen (1988), which suggests coefficients ranging from .01 to .29 as small, .30 to .49 as medium and .50 or larger as large. Correlations among the variables from the theory of planned behaviour and the stress-response to injury theory were assessed (See Table 6). As expected, the variables within the theory of planned behaviour (TPB) (attitudes, subjective norms and perceived control) correlated with each other at a medium magnitude in the expected directions (see Table 6). The variables of instrumental coping had a weak to medium relation with attitudes ($r(108) = -.24$, $p < .050$), subjective norms ($r(110) = -.32$, $p < .01$) and perceived control ($r(109) = .42$, $p < .01$). Similar significant relations were found for emotional coping, but the variable of attitudes did not correlate significantly. All of the main variables significantly correlated with reporting intention and an anticipated reporting delay.

Table 6

Correlations between Main Variables

	1	2	3	4	5	6	7
1. Att.	__						
2. Sub.	.43* (111)	__					
3. PerCon.	-.30* (110)	-.33* (112)	__				
4. Instr. Coping	-.24* (110)	-.32* (112)	.42* (111)	__			
5. Emo. Coping	-.17 (110)	-.20* (112)	.31* (111)	.69* (112)	__		
6. Intent	-.28* (110)	-.27* (111)	.32* (110)	.29* (110)	.36* (110)	__	
7. Delay	.22* (111)	.25* (113)	-.42* (112)	-.32* (112)	-.48* (112)	-.65* (111)	__

Note: Att = Attitudes Towards Reporting, Sub = Subject Norms of Reporting, Per Con = Perceived Control of Reporting, Instr Coping = Instrumental Coping, Emo Coping = Emotional Coping, Intent = Intentions to Report, Delay= Delay in Reporting. *p<.05.

Inferential Statistics

Hypothesis I. I used multiple regression procedures to test my model using variables from the theory of planned behaviour and the stress-response to injury theory in predicting a reporting intention. Both standardized and unstandardized betas were reported in the tables, however, unstandardized betas were used to determine the change on the construct scales. Specific variables entered were attitudes towards reporting, subjective norms of reporting, perceived control, instrumental and emotional coping. A significant regression equation was found ($F(5,102)= 7.01$, $p < .001$) with an R^2 of .26. Table 7 provides an overview of the unstandardized and standardized coefficients for each of the variables entered. The only significant variables in predicting an intention to report were perceived control (B = .20, $p <$. 01) and emotional coping (B = .17, $p < .05$). Other variables in the model were not significant. The

predicted difference in an athlete's intentions to report increased on average by .20 for a 1-unit difference in perceived control, and .17 for a 1-unit difference in emotional coping, holding all other variables in the model constant.

Table 7

Regression Analysis Predicting Intention to Report Concussion

Predictor	B	SE B	B
Intercept	4.77*	.63	-
Attitudes Towards Reporting	-.15	.12	-.12
Subjective Norm of Reporting	-.07	.09	-.08
Perceived Control of Reporting	.20*	.08	.25**
Instrumental Coping	-.01	.07	.02
Emotional Coping	.17*	.07	.29*

Note: *p <. 05, ** p < .01.

We completed a follow-up multiple regression analysis that used a parsimonious model including only the significant variables (i.e., perceived control and emotional coping). This was to reduce potential inflation of variance in the full model that included non-significant variables. The results of the regression indicated the two predictors explained 21.6% of the variance (R^2 = .22, F(2,106) = 7.42, p <. 001). Perceived control significantly predicted reporting intentions (B = 0.23, SE B = .07, p <. 01), as did emotional coping (B = 0.16, SE B = .05, p < .01). These results provide partial support for the first hypothesis; the model including both variables from the theory of planned behaviour and the stress-response to injury theory showed the highest significant variance accounted for in predicting reporting intentions. Furthermore, what mattered most in predicting reporting intention was whether the athlete felt they had the control to report (perceived control) and whether they felt that they could approach their coach for emotional

support such as seeking empathy (emotional coping). Interestingly, attitudes and subjective norms on concussion reporting were not significant predictors within the model.

Hypothesis II. I used multiple regression procedures to test my model using variables from the theory of planned behaviour and the stress-response to injury theory in predicting an anticipated reporting delay. The variables were entered into the regression model the same as from Hypothesis I. A significant regression equation was found ($F(5,103)= 10.35$, $p < .001$) with an R^2 of .33. Table 8 provides an overview of the unstandardized and standardized coefficients for each variable entered. In this model, perceived control (B = -.28, $p < .001$) and an emotional coping (B = -.32, $p < .001$) were statistically significant. Other variables in the model were not significant. The predicted difference in an athlete's delay to report decreased on average by .28 for a 1-unit difference in perceived control, and .32 for a 1-unit difference in emotional coping, holding all other variables in the model constant.

Table 8

Regression Analysis Predicting Delay of Reporting Concussion

Predictor	B	SE B	β
Intercept	4.14*	.68	-
Attitudes Towards Reporting	-.02	.12	-.02
Subjective Norm of Reporting	.12	.10	.12
Perceived Control of Reporting	-.28*	.08	-.31**
Instrumental Coping	.11	.08	.17
Emotional Coping	-.32*	.07	-.48**

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

I completed a follow-up multiple regression analysis that used a parsimonious model including only the significant variables (i.e. perceived control and emotional coping). This was to reduce potential inflation of variance in the full model that included non-significant variables.

The results of the regression indicated the two predictors explained 32.7% of the variance (R^2 = .33, $F(2,108) = 26.23$, $p < .001$). Perceived control significantly predicted reporting intentions (B = -0.26, SE B = .07, $p < .001$), as did emotional coping (B = -0.25, SE B = .05, $p < .001$). These results provide support for Hypothesis II; the model including both variables from the theory of planned behaviour and the stress-response to injury theory showed the highest significant variance accounted for in predicting the anticipated reporting delay. The two variables that found a significant result were whether the athlete felt they had the ability and control to report (perceived control) and whether they feel that they could approach their coach for emotional support such as seeking empathy.

Hypothesis III. To test my hypothesis that an athlete's reporting intention and perceived control will significantly predict whether an athlete reported as concussion from the past season, the two criterion variables from the Symptom Reporting Behaviours scale were used (see methods on how these variables were created). In the first analysis, the number of athletes who reported having any symptom due to an impact in their sport in the past season totalled 70. Of this total, 32 reported their symptoms to their coach or medical professional, while 38 did not report. Logistic regression analysis was conducted to predict this criterion variable using reporting intentions and perceived control as predictors. A test of the full model against a constant only model was not found to be statistically significant, indicating that the predictors could not distinguish between those who reported and not χ^2 (2) = 4.75, p = .09. Therefore, when considering the complete set of potential symptoms (i.e. dizziness, seeing stars, vomiting, confusion, nausea, headaches, light and noise sensitivities, and feeling like they are in a fog), this model could not predict whether they reported these symptoms or not. To simplify the dependent

variable, the question of whether they had their "bell rung" in the past season was used in a follow-up analysis.

In the second analysis, the number of athletes who reported having experienced a "bell ringer" in the past season from an impact totalled at 53 athletes. Of this total 30 reported to their coach, and 23 did not. Logistic regression analysis was conducted to predict this criterion variable using reporting intentions and perceived control as predictors. A test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between those who reported and those who did not, χ^2 (2) = 6.04, $p < .05$. Nagelkerke's R^2 of .14 indicated a weak relationship between the prediction and grouping, indicating that my model accounted for 14.4% greater variance explained in predicting whether an athlete reported or not. Prediction success overall was 67.9% (83.3% for reporting and 47.8% for not reporting). The Wald criterion demonstrated that only reporting intentions made a significant contribution to prediction ($p = .023$), whereas perceived control was not a significant predictor. The Exp(B) value indicated that when intentions were raised by one unit, the odds ratio was 2.65 times larger and therefore reporting behaviours were 2.65 times more likely happen. These results provide support for Hypothesis III; predicting an athlete's reporting behaviour includes at first a formed intention.

Chapter V

Discussion

In recent years, studies have found that many athletes do not report their concussion symptoms. The label of "the invisible injury" to describe concussion is fitting, as coaches and athletic staff may not know that an athlete has sustained a potential concussion. Many symptoms are not overtly observable, placing the responsibility on the individual athlete to recognize the symptoms and report them. Despite efforts to inform the public about concussions, a large proportion of these injuries remain unreported by athletes. This problem of non-reporting is viewed as more complicated than simply having the athlete educated about concussions. Indeed, one can understand why even athletes who know how to identify a concussion choose not to report, or at least delay reporting. Athletes are strongly pressured to compete, and ignoring a headache following a contact may be a more desirable outcome for an athlete than speaking with the coach, which may result in being taken out of play for an indeterminate time. Thus, future models must be based on psychological theories that can account for the complex socio-ecological factors that may influence reporting behaviours. In this dissertation, I built on the existing literature and explored the behaviour of concussion reporting through the framework of the theory of planned behaviour (Ajzen, 1991) and a stress-response to injury theory (Wiese-Bjornstal et al., 1998). Hypotheses from this dissertation were based on these theories in an attempt to predict the following: reporting intention, an anticipated reporting delay, and the actual reporting behaviour. Findings from this study lend partial support to the hypotheses set forth, and discussed in this section is how these hypotheses fit within the existing literature. I will discuss the main findings first, looking at constructs from the theory of planned behaviour in

predicting reporting intentions and delay. I will then discuss the stress-response to injury model and whether my model could predict actual reporting behaviours.

The Theory of Planned Behaviour and Concussion Reporting

Ajzen (1991) postulated that specific behaviours are based on the expectancies that one has towards the outcome and the value attached to completing that behaviour. These expectancies form the beliefs that a person has towards a specific behaviour and whether they engage in it. Ajzen (1991) stated that the prediction of an actual behaviour is complex, as there are a number of factors to consider. With this in mind, the theory of planned behaviour (TPB) postulates that the intention one has towards a behaviour is the most proximal factor in predicting the actual occurrence of that behaviour. Therefore, the variation within one's intentions to report could be seen as an important proximal metric to predicting the actual reporting behaviour. The current study found overall that the model from the TPB (attitudes, subjective norms and perceived control) and stress-response (instrumental and emotional coping) significantly predicted a concussion reporting intention. In addition, this model significantly predicted an anticipated reporting delay. These results are slightly different from previous studies (Kroshus et al., 2015; Register-Mihalik et al., 2013) in that the current study found that only perceived control was seen as significantly contributing to intentions. For instance, Kroshus et al. (2014) found that all of the variables from the theory of planned behaviour were associated with intentions to report, with perceived control having the strongest association. Furthermore, they found that the only items associated with reporting intentions were, "I will hurt my teams performance," My teammate will think less of me," "I'll be back to full strength sooner," and "My teammates will think I made the right decision." Register-Mihalik et al. (2013) found that attitudes towards reporting was associated with a decrease in athletes participating in games and

practices while symptomatic, but not associated with reporting of recalled concussion events during games. This could suggest that athletes understand the dangers of concussions to their health and performance but instead of reporting, they engage in removing themselves from the game.

My results showed that attitudes towards reporting and subjective norms were significantly correlated with intentions, but in the multiple regression models, these same variables did not uniquely contribute to predicting intentions. These results may reflect Ajzen's (1985) research, stating that each factor has a unique valance on forming an intention that is different for each situation and sample. My sample included those who were junior level athletes within the first few years of playing at university, and during this time perceived control may be a bigger factor than attitudes towards reporting. That is, the athletes may determine the degree to which they can report concussion symptoms based on the team environment created by the behaviours and expectations of coaches and teammates. Another explanation of the results may be that attitudes to report and subjective norms contribute to an athlete's level of perceived control which then predicts intentions to report. For example, if an athlete believes that their teammates will think less of them in a game if they reported, they will feel less likely to report due to these pressures of perceived negative outcomes. Therefore, negative attitudes and subjective norms may act as barriers to an athlete feeling they have control of the reporting behaviour.

Ajzen (1991) believes that perceived control explains the control expectancy one has towards the goal. That is, if a goal does not seem attainable or possible, then one's attitudes and subjective norms would have less of an influence one's intention to engage in that behaviour. Namely, an athlete will have a greater intention to report if they believe that reporting will

actually result in a positive outcome such as being understood by their coach, which would lead to successful management of concussion symptoms and the opportunity to get back into the game with a full recovery. Barriers reducing perceived control could be that athletes may not believe that reporting will result in these positive outcomes. This finding is not uncommon in psychological research that focuses on how control beliefs affect behaviour (Bandura, 2001). These findings suggest that beliefs on controllability and similar potential constructs such as self-efficacy could be applied to understanding the preventative programs aimed at lowering concussion non-reporting.

It is important to understand that the perceived control variable in this study measured a range of different aspects of control for reporting. For instance, one item stated, "I am confident in my ability to recognize when I have symptoms of a concussion," whereas another item stated, "I am confident in my ability to report symptoms of a concussion even when I think my teammates want me to play." Thus, the variable of perceived control captured a number of domains of control, some of which may be overlapping with attitudes and subjective norms. An athlete who has as good knowledge base about concussion symptoms and understands the appropriate steps to take if they suspect a concussion tends to have higher confidence in reporting despite other teammates placing pressure to not report. Therefore, the most significant determination of their reporting behavior may be the perception of outcomes in spite of negative attitudes towards reporting and subjective norms. Future research may investigate how beliefs of control are influenced by the different levels of the socioecological model. An athlete may feel a lack of control due to factors from teammates, coaches, parents, understanding of symptoms, ability to reach out, and/or policies put in place that either increase or decrease reporting behaviours.

Strategies for increasing an athlete's perceived control may center on removing any obstacles to an athlete feeling less control over their decisions to report. Such strategies may be in making clear procedures for reporting, explaining how it can be beneficial to their health and future athletic performance, and indicating that their concerns are important and will not be ignored. Other strategies could center on coaches asking athletes in a consistent and expected manner about their well-being, reinforcing that their coach and athletic staff are there to help them with their health and performance goals. These strategies can strengthen an athlete's control beliefs; that is, reporting concussion symptoms would result in a positive outcome which would address their own goals. These methods all center on fostering, at the interpersonal level, a relationship with the athlete, thereby removing the barriers to seeking help and fostering an environment for disclosing injuries. These suggestions relate to Broglio et al.'s (2010) findings that the pressures placed on an athlete may not be obvious to coaches; however, these pressures may influence athletes not to report their concussion symptoms. Furthermore, recent research has looked at how concussion reporting is related to the relationship for help seeking between the athlete and the coach with results suggesting that the better the relationship, the more they disclose to the coach (Kroshus et al., 2017).

Stress-Response to Injury and Intention Formation

Stress response theories place significance on how an athlete is able to cope with injuries by conceptualizing injury as a stressor (Anderson & Williams, 1988). Wiese-Bjornstal et al. (1998, 2010) showed that certain styles of coping could prevent athlete risk factors during recovery. These risk factors relate to how an athlete can compromise their health behaviours by not seeking help for their injuries. From this, each athlete displays varying coping styles for an injury stressor. One potential coping strategy important to the injury of concussion was coping

via seeking help. From this research, the two styles of coping were assessed: instrumental and emotional help-seeking. My study found that including emotional coping styles significantly contributed the model's predictive validity in both reporting intentions and an anticipated reporting delay. Within my models, it was found that perceived control and emotional help seeking coping had the only significant associations with reporting intentions and reporting delay.

In considering that perceived control and emotional coping had the greatest association on reporting intentions, these findings fit well with Lazarus's theory on stress coping and that concussions can be conceptualized as stressors (Lazarus & Folkman, 1984). Lazarus and Folkman (1984) defined "coping" as "constantly changing cognitive and behavioural efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of that person" (p. 141). An intention to report may be closely associated with an athlete seeking external resources to cope with their injury. Lazarus's theory on stress coping was the foundation from which the stress-response theory to injuries was developed and postulates that an individual goes through a process of appraising the stressor as positive or negative. The individual then goes through a secondary process of assessing if they have the resources available to deal with the stressor. If the individual believes that they have the resources to deal with the stressor at hand, then that individual copes with the stressor in an adaptive way. Furthermore, if the stressor is perceived to be greater than their resources available to the individual, then that individual will experience anxiety and will not adapt positively to the stressor. In the case of an athlete experiencing an injury as a stressor, they may look to their ability to deal with the stressor (perceived control) and then assess their available resources to deal with it (emotional coping supports). In this sense, how an athlete comes to the decision of

reporting may be best understood through models that focus on beliefs of controllability and the tendencies an athlete has to emotionally connect with their coach or others in a position to help them. These findings fit well with the stress-response theories in that a lack of support resources (social or medical supports) can exacerbate the risks of how an athlete deals with their current injury (Anderson & Williams, 1988; Wiese-Bjornstal et al., 1998). An athlete may already have limited resources and supports, and the addition of an injury further effects how they cope. This also fits with how these theories view injuries as stressors that causes an emotional response requiring an action.

Concussions produce emotional, cognitive, and somatic symptoms. Understanding the decision-making process of athletes after a concussion should be grounded in conceptual models that consider cognitive, emotional, and somatic variables. An athlete's emotional coping in the context of understanding the injury as a stress-response may explain why an athlete is less reliant on the cognitive part of forming attitudes of concussion reporting (i.e., whether they think it is a good or bad idea to report), and instead more reliant on relational factors (i.e., the ease at which they can talk to their coach about it). Research has established a link between emotional disturbances such as anxiety, fear, anger, and depression after injury (Mainwaring, Hutchison, Comper, & Richards, 2012). The theory of planned behaviour may not take into account the emotional coping aspects of concussion reporting and may need to further include factors that can account for this dimension. How an athlete seeks emotional support may be one of the most important links to understanding their reporting behavior. This in turn could educate coaches and facilitate improved communication between athletes and coaches.

A potential strategy for facilitating better engagement with coaches and staff may be to consider the "embeddedness" of help-seeking behaviours in the sports environment (Booth-

Butterfield, 2003). Namely, health behaviours are not easy to isolate and are a part of a complex system that reinforces and exemplifies why an athlete engages in such behaviours. This, once again, places importance on examining the implicit pressures that athletes feel with reporting their concussion symptoms and the expected outcomes (Broglio, et al., 2010). This relates to research finding that maintaining an open and ongoing dialogue about concussion safety with athletes increased opportunities for disclosure from athletes about their health (Kroshus, et al., 2017).

Prediction of Concussion Symptom Reporting

In my final analysis, I found that approximately 46% of the athletes who reported having had at least one symptom from a head impact (dizziness, confusion, light headedness, headaches etc.) reported it to their coach or athletic professional, while the remaining sample did not report. Of the athletes who reported having a "bell-ringer" in the previous season, only 57% reported this to their coach or athletic professional. Interestingly, the increase in reporting rates may be the result that a "bell-ringer" signifies a more descriptive account of sustaining a concussion with a greater level of severity than simply a checklist of potential symptoms athletes sustained due to an impact. These rates of under-reporting are in line with previous research rates that center around 50% reporting, and represents a barrier to concussion management (Fraas, Coughlan, Hart, & McCarthy, 2013; Kroshus et al., 2015; McCrea et al., 2004). Research identifies that the methods in which researchers ask athletes to report previous concussions is vitally important and may reveal changes to rates of non-reporting. For example, one study asked if athletes intentionally hid their concussion symptoms, which is quite different from asking if athletes whether or not they reported symptoms in the previous season (Delaney et al., 2018). It is

encouraging that researchers use a variety of questions that can collect and assess any non-reporting or delays in reporting concussion symptoms.

The final hypothesis was that an athlete's level of intention to report and their perceived control in reporting would be predictive of whether the athletes reported a concussion symptom or not. This study did not find significant results when considering all of the potential symptoms combined. There was a significant result when the analysis focused, rather, on whether the athletes said they had a "bell-ringer." Specifically, this study found a 67.9% overall prediction rate and that for a 1-unit change in the intention measure, the athletes had a 2.65 times greater odds of reporting. These results are congruent with Kroshus et al. (2015)'s finding, using multi-variable logistic regression analysis, that for a 1-unit change in their intention measure, athletes had a 1.63 times greater odds of reporting their concussion symptoms. Along with their findings, they revealed that intentions and perceived control were of the highest predictors of the actual behaviour and that knowledge only related to an athlete's attitudes towards concussion reporting. Conversely, Register-Mihalik et al. (2013) showed that reporting intentions were not significantly associated with the actual reporting behaviour. However, they found that using the term "bell-ringer" was important to assess how athletes described their concussion events separate from a concussion definition. They found that concussion knowledge and attitudes were associated with reporting bell-ringer only events due to the increase in prevalence of these events versus athletes who recalled concussion events. This result fits well with previous research findings that many athletes claimed that they had no concussions from the past season but also reported that they did have symptoms related to a concussion after an impact (Bloom et al., 2008). This inconsistency of athletes reporting that they had symptoms associated with a concussion but not believing they had a concussion reflects that they may have difficulties

knowing to the extent that they have a mild concussion or not and would tend to delay reporting to do a self-assessment. This difference has been seen in other research studies (see Llewellyn, Burdette, Joyner, & Buckley, 2014; Delaney, Lacroix, Leclerc, & Johnston, 2002; Delaney et al., 2000; Valovich, McLeod, Bay, & Heil, 2008). These findings also suggest that, separate from my measures of concussion knowledge, athletes' may misdiagnosis their own concussion and ultimately reflects a lack of practical understanding on what a concussion is when they have symptoms. These findings also highlight that while intention to report is conceptualized as the most proximal factor to reporting, it only accounts for predicting a small variance of the actual behaviour. Future research should consider optimal methods to better measure the link between a reporting intention and the reporting behaviour, which may help better elucidate the barrier to reporting.

Implications and Limitations

Implications to Theory and Research

The current study provides partial support that research can expand beyond the use of constructs from the theory of planned behaviour in understanding why an athlete would have an intention to report or have a delay. It is the current study's findings that constructs from the stress-response the injury can be added to understanding concussion reporting and why athletes' delay reporting. Future research could look further within the stress-response adding measures on the history of stressors the athlete is experiencing (ex. daily hassle journals) and personality characteristics seen to exacerbate the stress-response. Similarly, future research could explore how a concussion influences an athlete to cognitive appraise the situational demands from the injury, and how they engage in an emotional response to deal with the injury.

This study sought to expand upon how I can measure the potential delay athletes have in reporting, rather than just whether they report or not. The time from when an athlete has sustained a concussion to when they actually report can be seen as the time when they are vulnerable to second impact syndrome and other negative outcomes. This finding is important because it taps into how some athletes ignore and wait to see if their symptoms persist before seeking helping. It might be that some athletes will report their injuries, but tend to delay this reporting behaviour to self-assess their symptoms. Furthermore, they might intend to report but that they are not as comfortable with doing so and delay. Future research should look at not only the decision athletes make to report concussion symptoms but why they delay taking action on this intention. Furthermore, future research could expand upon operationally defining the action and behaviour of an athlete not reporting more concretely such that some athletes might report their concussions in varying ways. Future research could draw upon athletes talking about times when they reported or not and this qualitative information can further inform what is actually happened beyond my quantitative measures.

Future research can address how various symptoms affect different behavioural responses for seeking help. That is, it could be that some concussion symptoms signal to an athlete that they have a serious injury, whereas other symptoms lend themselves to confusion on whether to report or not. In a follow-up analysis, the variable of if they had their “bell rung” in the past season could be predicted from the model. This could be due to the term “bell rung” conforming better to an athlete’s interpretation of having a concussion and potentially one that was less ambiguous than simply experiencing a symptom. Other areas of further research suggested is that qualitative methods can explore the concept of emotional coping and how athletes develop this type of coping with their coaches. Such qualitative methods could provide specific examples of

how some athletes have a healthy relationship with their coach and how others may feel they are under pressure to not-report. Of importance, results from this study found that the more concussions an athlete sustained in the past inversely relates to the tendency to use emotional coping. Previous research has also found that a greater history of prior concussion was associated with poorer attitudes towards concussion reporting (Register-Mihalik, et al., 2017). Future research should examine why athletes tend to develop worse attitudes and seek less emotional support when they have a history of multiple concussions. Longitudinal designs could look at how athletes overtime develop or change their coping styles and at different levels of competitiveness or different teams. These longitudinal designs could be used to further expand how an athlete embeds and adopts health based decisions within their sporting careers as postulated within developmental theories (Arnett, 2015; Booth-Butterfield, 2003).

Future studies could base theoretical models on the socioecological framework in assessing how the various levels influence each other. For example, a large-scale cross sectional study could look at the various intrapersonal factors (i.e., number of previous concussions, gender, age, etc.), and assess how they relate to the interpersonal factors (i.e., attitudes and subjective norms). Furthermore, future studies could investigate how the environmental and policy factors (based on the socioecological model) influence athletes at the interpersonal and intrapersonal levels. Studies could continue to assess how different state educational policies affect athlete perceptions of concussions and reporting. The sociological model should also be examined from a developmental lens. For example, it may be that younger athletes are more influenced by intrapersonal and interpersonal levels of exposure, whereas older athletes are more exposed to greater levels of influence due to having been on more sports teams, having had more coaches, and having experienced greater education opportunities. It is also possible that older

athletes have greater concussion knowledge and/or willingness to report based due to having greater autonomy over their decisions. More studies incorporating these factors could help better explain socioecological factors relating to concussion reporting.

Results from this study found that measuring athletes' concussion knowledge was not a simple matter. My study did not include the construct of concussion knowledge due to difficulties with the psychometric properties of measuring an athlete's knowledge of concussions. It has not been determined as of yet in research what information and knowledge an athlete needs to appreciate the impact of a concussion (i.e. what is a concussion, symptoms of a concussion, management of concussions, myths of concussion). On top of this, it is still yet to be determined what are the best methods to assessing knowledge. A disparity exists in how researchers measure concussion knowledge. Some studies have used checklists of symptoms to determine if an athlete can differentiate between concussion and non-concussion symptoms (Goodman et al., 2000; Kurowski, et al., 2014). Other methods have included multiple choice questions, true/false questions, open-ended short answer questions, free recall of symptoms, and case scenarios (Cournoyer & Tripp, 2014; Cusimano et al., 2015; Lin et al., 2015; Register-Mihalik et al., 2013; Sye, Sullivan, & McCrory, 2013; Torres et al., 2013; Weber & Edwards, 2012). Rosenbaum and Arnett's (2010) study attempted to create a psychometrically sound measure called the Concussion Knowledge Index (CKI). Rosenbaum and Arnett (2010) found the test-retest reliability for the CKI was approaching an appropriate level of reliability and stated that it was an acceptable measure of concussion knowledge. Many questionnaires have been created based on the knowledge items and questions of Rosenbaum and Arnett's (2010) study. To date there remains no clear consensus on how to measure concussion knowledge, with each study using varying methods and questionnaires but centered on the same basic topics of

concussion general knowledge. Creating a reliable and valid measure of concussion knowledge and having research conform to these standards in future research I believe is an important next step. The poor reliability in this study, and in past studies, relates to Rosenbaum and Arnett (2010)'s findings that concussion knowledge is a complex construct along a wide range of concussion topics and levels of knowledge difficulty. An important addition to concussion knowledge may involve athletes speaking to their past on concussion and "bell ringers" they have sustained and therefore creating a more dynamic and personal measure of how an athlete interprets their own experience with potential concussion events.

Implications to Practice/Application

Practical implications from this research centres on the findings that athletes have a greater intention to report if they feel they have control on the behaviour (less barriers to performing the action) and whether they feel they can seek emotional support from their athletic staff. Practically speaking, reducing barriers so athletes feel more control can come from formalizing reporting actions and making it clear on how an athlete would report. Another method would be to model and show the process of reporting and removing the uncertainty and fear associated it the task. These practices would allow the athletes to see that reporting will be taken seriously and is a part of them showing responsibility for their own health. Strategies for promoting emotional support could come in the practice of coaches promoting more informal discussions with their athletes centred on how they are feeling, how are their stress levels and fostering active listening skills. These practices may relate to coaches taking on more of an empathetic leadership role.

Limitations of the Study

This section outlines a number of limitations that give caution to any interpretations of the results and the subsequent explanations made from the results. First of all, my measure for the level of knowledge an athlete had about concussions was not found to have an acceptable level of internal reliability. Instead athletes were asked to what extent they agreed with true and false statements about concussions with the intent that athletes who had a greater knowledge would tend to agree and disagree in concordance with the statements. As an example, an athlete reading the statement "people who have had a concussion are more likely to have another concussion" would tend to agree more with the statement the greater they understood that this statement was true. One limitation was that although athletes may understand that the statement is true, they may not agree to the statements based on their own attitudes and opinions on the matter and separate from having received information about this. Interestingly, the majority of the statements from the knowledge scale were answered correctly, suggesting that the athletes from my sample had a good knowledge of how to answer the statements I provided.

Second, I chose a cross-sectional design, which has the benefits of taking a snapshot across a wide range of variables at a single point without the fear of drop-outs. A limitation of cross sectional designs is of not being able to provide evidence of a cause-and-effect relationship. Another limitation is that this study used a convenience sampling method which has the benefits in this study of collecting from a sample that was readily available, cost effective and time efficient. Therefore, there is caution used when generalizing to the wider population. It is fair to suggest that the sample collected from this study represents a unique sample that is focused on young adult athletes in the first years of their competitive university careers at the University of Alberta. Yet caution is taken when the results are suggestive to other universities,

other locations, and to a wider population. Additionally, a weakness may exist in that this study used self-reporting from athletes, and may be confounded by self-reporter bias. Self-report studies inherently have the disadvantage that respondents may answer in certain ways that was biased such as exaggerating their responses, minimizing or concealing their personal details, or reporting in a socially desirable way. There is also the concern that athletes may not remember certain information such as how many possible concussion symptoms they had from the previous season. Given these possible limitations, using a self-report is still beneficial in attempting to tap into the private experience of non-reporting. That is, this study is looking at a phenomenon that is hidden and private and not easily measured through other observers such that the self-report represents one way to assess this.

Another limitation of this study is that the gender of the athlete was not addressed in my analyses. Gender has been seen as another important factor that may be associated with reporting behaviours. For example, Torres et al. (2013) and Wallace, Covassin and Beidler (2017) found that female athletes were more likely to report their concussions, while Llewellyn et al. (2014) found no gender differences. Anderson and Kian (2012) suggested that competitiveness paired with a highly masculine identity could lead to increased risk-taking behaviours like not reporting concussion symptoms. However, Chrisman et al.'s (2012) qualitative study showed that both males and females endorsed similar thought patterns. A recent study discovered that gender-based behaviour and the conformity to risk-taking norms was associated with athletes continuing to play while asymptomatic (Kroshus, Baugh, Stein, Austin, & Calzo, 2017). This research is suggesting that gendered behaviour, rather than sex differences, is associated with risky play. The implications of these findings are that stronger masculine attitudes may cause more aggressive play within sports and reduce the likelihood of an athlete reporting.

Conclusion

Concussion in sports has been viewed as a significant health problem, and has been compounded by the rates of under-reporting among the public. This study attempted to take into account a more thorough understanding on the psychological underpinnings of why athletes report through the framework of the theory of planned behaviour and a stress-response to injury model. Results from this study provided partial support for the hypotheses proposed, and included unforeseen findings on the key factors of perceived control and emotional coping. Future research can take these findings further in exploring how healthy coaching styles base themselves in resourceful and empathic preventative methods.

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Appendix A: Study Information Page

Information Letter and Consent Form

Exploring Perceptions on Concussion Education- Preseason

Principle Investigators: Adam McCaffrey, PhD Student & Dr. Martin Mrazik

Background:

- You are being asked to be a part of this study. Your participation has been requested because you are a competitive athlete at the University/college level. The results of this study will be used to support a dissertation study created by the principle investigator Adam McCaffrey.

Purpose:

- Concussions in sports have become one of the biggest concerns for athletes. To address this there has been a recent push to create concussion education programs. Our study aims to look at how an athlete's knowledge about concussions relates to possible barriers they face to seek help. This study looks to add to sports psychology literature in concussion management.

What We Are Asking You To Do?

- This study involves a preseason survey that takes approximately **10 minutes to fill out**. Data from the surveys will be stored in a data file and assessed.

Confidentiality and Anonymity:

- No identifiers will be asked of you besides for the type of sport and position you currently participate in. The information you provide will be kept private and confidential. The information will always be kept in a locked and secure location only accessible to the principle investigator (Adam McCaffrey) and Dr. Mrazik. Researchers are required to comply with the University of Alberta Standards for research participation regarding any issues of confidentiality. Your consent form will also be kept separate from any information you provide.
- The collected responses will be kept in a secure storage space for a minimum of 5 years after the study is completed. Only the principle investigator (Adam McCaffrey) and Dr. Mrazik will have access to the raw data. As such, coaches and team staff **will not** have access to the collected responses. Participant responses will be combined and analyzed and the results will be presented during the primary investigator's PhD dissertation defense. Study findings may be presented at academic or professional conferences and published in research journals.

Right and Freedom to Withdraw:

- Your participation in this study is **completely voluntary**. If you choose to participate in this study, you are free to withdraw at any time before you hand in the survey. Withdrawing your participation **will not result** in any negative consequences.

Potential Benefits and Risks:

- Your participation may reveal some insight into your own thoughts on concussions. We hope that the information we get from this study will help us better understand how to design preventative educational programming.

- There are no foreseeable risks associated with participation in the study. However, if we learn anything during the research that may affect your willingness to continue being in the study, we will tell you right away. If your participation results in unsettling feelings, thoughts, or behaviors the following campus resources are available for **University of Alberta Students: Clinical Services (780) 492-3746 or Wellness Services: (780) 492-5205. For Grant McEwen students the following resources are available: Grant McEwen Counseling Centre: (780) 497-5064.**

Contact and Further Information:

- At any point, if you have any comments, questions or concerns about this survey or your participation, you may contact the principle investigator at ajmccaff@ualberta.ca or Dr. Martin Mrazik at mrazik@ualberta.ca, (780) 492-8052.

Please keep this letter for your own information, in case you would like to contact us later.

("The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615."

Appendix B: Consent Form

Department of Educational Psychology
Faculty of Education

6-102 Education North www.uofaweb.ualberta.ca/edpsychology Tel: 780.492.5245

Consent Form

Project Title: Exploring Perceptions on Concussion Education

Principle Investigators: Adam McCaffrey, Department of Educational Psychology, University of Alberta, (ajmccaff@ualberta.ca); Dr. Martin Mrazik, Department of Educational Psychology, University of Alberta (780) 492-8052, (mrazik@ualberta.ca).

Please answer the following questions

I have received and read the copy of the informed consent?	Yes ☐
I understand that the study is voluntary?	Yes ☐
I understand that I can withdraw at any point without penalty?	Yes ☐
I understand that my responses will remain confidential?	Yes ☐

I agree to take part in this study:

Signature of Participant_____ Date_____

Printed Name of Participant _____

Appendix C: Perceptions on Concussions Questionnaire

Department of Educational Psychology
Faculty of Education

6-102 Education North www.uofaweb.ualberta.ca/edpsychology Tel: 780.492.5245

Exploring Perceptions on Concussion Education

Thank you very much for volunteering 10 minutes of your time today to complete the attached survey. Your answers to this survey are private and confidential and will not be revealed to anyone outside of the research team.

A. Demographic Information Survey

Gender _____ Age _____ Sport Played_____

Years Playing this Sport at the University/College _____

Concussion Education History

Where did you learn about what a concussion is?	**Please Circle Below**	
Media (newspapers, television)	**Yes**	**No**
Educational Workshop	**Yes**	**No**
Online Material (Informational Websites)	**Yes**	**No**
Printed Educational Material	**Yes**	**No**
Informal Discussions with athletic staff (Coaches, trainers)	**Yes**	**No**
Informal Discussions with teammates	**Yes**	**No**
Informal Discussions with parents	**Yes**	**No**
Other methods?	**Please Specify→**	

B. Please circle the number that best represents your answer to each of the following items
Directions: These questions contain statements about concussions. Please rate how strongly you agree with each statement.

	Strongly Disagree						Strongly Agree
1. People who have had a concussion are more likely to have another concussion	1	2	3	4	5	6	7
2. There is a possible risk of death if a second concussion occurs before the first one has healed	1	2	3	4	5	6	7
3. A concussion cannot cause brain damage unless	1	2	3	4	5	6	7

the person has been knocked unconscious							
4. The brain never fully heals after a concussion	1	2	3	4	5	6	7
5. It is easy to tell if a person has a concussion by the way the person looks or acts	1	2	3	4	5	6	7
6. Symptoms of a concussion can last for several weeks	1	2	3	4	5	6	7
7. Resting your brain by avoiding things such as playing video games, texting, and doing schoolwork is important for concussion recovery	1	2	3	4	5	6	7
8. After a concussion occurs, brain imaging (e.g. computer assisted tomography scan, magnetic resonance imaging, X- ray, etc.) typically shows visible physical damage to the brain (e.g., bruise, blood clot)	1	2	3	4	5	6	7
9. A concussion may cause an athlete to feel depressed or sad	1	2	3	4	5	6	7
10. Once an athlete feels "back to normal," the recovery process is complete	1	2	3	4	5	6	7
11. Even if a player is experiencing the effects of a concussion, performance will be the same as it would be had the player not experienced a concussion	1	2	3	4	5	6	7
12. Concussions pose a risk to an athlete's long-term health and well-being	1	2	3	4	5	6	7
13. A concussion can only occur if there is a direct hit to the head	1	2	3	4	5	6	7

C. Please circle the number that best represents your answer to each of the following item

"If I report what I suspect might be a concussion……."

	Strongly Disagree						Strongly Agree
1. I will hurt my team's performance	1	2	3	4	5	6	7
2. I will not be allowed to start playing or practicing when I think I'm ready	1	2	3	4	5	6	7
3. I will lose my spot in the lineup	1	2	3	4	5	6	7
4. My teammates will think less of me	1	2	3	4	5	6	7
5. I will be held out of upcoming games even if it is not a concussion	1	2	3	4	5	6	7
6. My teammates will think I made the right decision	1	2	3	4	5	6	7
7. I will be better off in the long run	1	2	3	4	5	6	7
8. The sooner I report a concussion, the sooner I'll be back at full strength	1	2	3	4	5	6	7

D. Directions: Please read each of the following scenarios and rate how strongly you agree or disagree with the statements that follow.

Scenario 1: Pat experienced a concussion during the first game of the season. Tom experienced a concussion of the same severity during a semifinal playoff game. Both players had persisting symptoms of the same duration.

	Strongly Disagree						Strongly Agree
1. My teammates would feel that Pat should have returned to play during the first game of the season	1	2	3	4	5	6	7
2. Most athletes would feel that Pat should have returned to play during the first game of the season	1	2	3	4	5	6	7
3. My teammates would feel that Tom should have returned to play during the semi-final playoff game	1	2	3	4	5	6	7
4. Most athletes would feel that Tom should have returned to play during the semi-final playoff game	1	2	3	4	5	6	7

Scenario 2: Alex experiences a concussion during a game. Alex's Coach decides to keep Alex out of the game. Alex's team loses the game.

	Strongly Disagree						Strongly Agree
1. My teammates would feel that the Coach made the right decision to keep Alex out of the game	1	2	3	4	5	6	7
2. Most athletes would feel that the Coach made the right decision to keep Alex out of the game	1	2	3	4	5	6	7

Scenario 3: Payton experiences a concussion. Payton's team has an athletic trainer on staff.

	Strongly Disagree						Strongly Agree
1. My teammates would feel that the athletic trainer, rather than Payton, should make the decision about whether Payton should return to play	1	2	3	4	5	6	7
2. Most athletes would feel that the athletic trainer, rather than Payton, should make the decision about whether Payton should return to play	1	2	3	4	5	6	7

<u>Scenario 4</u>: Morgan experienced a concussion and has a game later in the day. Morgan is still experiencing symptoms of concussion; however, Morgan knows that if he tells his Coach about the symptoms, he will keep Morgan out of the game.

	Strongly Disagree						Strongly Agree
1. My teammates would feel that Morgan should tell the coach about the symptoms	1	2	3	4	5	6	7
2. Most athletes would feel that Morgan should tell the coach about the symptoms	1	2	3	4	5	6	7
3. My teammates would continue playing while also having a headache that resulted from a minor concussion	1	2	3	4	5	6	7
4. Most athletes would continue playing while also having a headache that resulted from a minor concussion	1	2	3	4	5	6	7

E. Directions: Please rate how strongly you agree with each statement

	Strongly Disagree						Strongly Agree
1. I am confident in my ability to recognize when I have symptoms of a concussion	1	2	3	4	5	6	7
2. I am confident in my ability to report symptoms of a concussion, even when I really want to keep playing	1	2	3	4	5	6	7
3. I am confident in my ability to report symptoms of a concussion, even when I think my team-mates want me to play	1	2	3	4	5	6	7
4. I am confident in my ability to report symptoms of a concussion, even if I do not think they are all that bad	1	2	3	4	5	6	7
5. I am confident in my ability to report specific symptoms, even if I am not sure that it is actually a concussion	1	2	3	4	5	6	7

F. Directions: Please rate how strongly you agree with the statement

"In the upcoming season, I would stop playing and report my symptoms if I sustained an impact that caused me to…"

	Strongly Disagree						Strongly Agree
1. See stars	1	2	3	4	5	6	7
2. Vomit or feel nauseous	1	2	3	4	5	6	7
3. Have a hard time remembering things	1	2	3	4	5	6	7
4. Have problems concentrating on the task at hand	1	2	3	4	5	6	7
5. Feel sensitive to light or noise	1	2	3	4	5	6	7
6. Have a headache	1	2	3	4	5	6	7
7. Experience dizziness or balance problems	1	2	3	4	5	6	7
8. Feel sleepy or in a fog	1	2	3	4	5	6	7

G. **How long** after an **impact in a game** would you **wait before reporting the following persisting symptoms** to a Coach or Athletic Trainer?

Persisting Symptoms	Report Right Away						I'd Wait a Couple of Weeks Later
1. Seeing stars	1	2	3	4	5	6	7
2. Vomit or feeling nauseous	1	2	3	4	5	6	7
3. Having a hard time remembering things	1	2	3	4	5	6	7
4. Having problems concentrating	1	2	3	4	5	6	7
5. Feeling sensitive to light or noise	1	2	3	4	5	6	7
6. Having a headache	1	2	3	4	5	6	7
7. Experiencing dizziness or balance problems	1	2	3	4	5	6	7
8. Feeling sleepy or in a fog	1	2	3	4	5	6	7

H. Indicate what **<u>you have usually done</u>** when you have experienced a stressful event such as being in a **<u>high impact collision during a game</u>** that may have caused some **symptoms of a concussion**

	Strongly Disagree						Strongly Agree
1. I try to get advice from my Coach/Athletic Trainer about what to do about the symptoms	1	2	3	4	5	6	7
2. I discuss my feelings with my Coach/Athletic Trainer	1	2	3	4	5	6	7
3. I talk to my Coach/Athletic Trainer to find out more about the situation	1	2	3	4	5	6	7
4. I try to get emotional support from my Coach/Athletic Trainer about the symptoms	1	2	3	4	5	6	7
5. I talk to my Coach/Athletic Trainer about something concrete to do about the problem	1	2	3	4	5	6	7
6. I get sympathy and understanding from my Coach/Athletic Trainer	1	2	3	4	5	6	7
7. I ask my Coach/Athletic Trainer about who has dealt with similar experiences	1	2	3	4	5	6	7
8. I talk to my Coach/Athletic Trainer about how I feel about the situation	1	2	3	4	5	6	7

I. Directions: Please read the following statements. Please check Yes if the following has occurred to you and select NO if it has not occurred to you this **<u>PAST SEASON.</u>**

	No	**Yes** and **<u>Told</u>** the Coach/ Athletic Trainer	**Yes** and **<u>Did Not</u>** Tell the Coach/ Athletic Trainer
Dizziness after an impact			
Had my "bell rung"			
Saw stars after an impact			
Vomited or felt nauseous after an impact			
Forgot about what you were doing after an impact			
Had a headache during the week after an impact			
Had problems studying, concentrating or doing class work after an impact			
Felt sensitive to light and noise after an impact			
Felt sleep or in a fog after an impact			

Please provide any comments/advice on the barriers you have to recognizing and seeking help for concussions within sports that you have been in:

Thanks for being a part of the study. Your completion of the survey will potentially help us to better design educational programs for concussion management and understanding the barriers athletes face to reporting their injuries.

If you have any questions or concerns about this survey please feel free to contact the Principal Investigator of the study, Adam McCaffrey at ajmccaff@ualberta.ca,

Or the primary supervisor of this study, Dr. Martin Mrazik at mmrazik@ualberta.ca