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The Relationship Between Athletic Identity and Concussion Symptom Reporting Intention in Collegiate Athletes

Daniel Baer

THE RELATIONSHIP BETWEEN ATHLETIC IDENTITY AND CONCUSSION SYMPTOM REPORTING INTENTION IN COLLEGIATE ATHLETES

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Daniel J. Baer

Indiana University of Pennsylvania

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Indiana University of Pennsylvania
School of Graduate Studies and Research
Department of Sociology

We hereby approve the dissertation of

Daniel J. Baer

Candidate for the degree of Doctor of Philosophy

April 26, 2018 — Signature on file
John A. Anderson, Ph.D.
Professor of Sociology, Chair

April 26, 2018 — Signature on file
Christian Vaccaro, Ph.D.
Associate Professor of Sociology

April 26, 2018 — Signature on file
Neil Curtis, Ed.D.
Associate Professor of Sports Medicine
West Chester University

ACCEPTED

Signature on file
Randy L. Martin, Ph.D.
Dean
School of Graduate Studies and Research

Title: The Relationship Between Athletic Identity and Concussion Symptom Reporting Intention in Collegiate Athletes

Author: Daniel J. Baer

Dissertation Chair: Dr. John A. Anderson

Dissertation Committee Members: Dr. Christian Vaccaro
Dr. Neil Curtis

Underreporting of concussion symptoms in college athletics presents a challenge for sports medicine clinicians in evaluating and diagnosing such injuries. Some athletes do not report concussion symptoms because they do not recognize that they have a brain injury, however many athletes intentionally withhold symptoms to avoid removal from sport participation. The purpose of this cross-sectional survey study was to examine individual factors that influence college athletes' intentions to report concussion symptoms. The study examines concussion symptom reporting intention in NCAA student-athletes in Pennsylvania, using the reasoned action approach and identity theory as theoretical frameworks.

An anonymous survey about athletic identity, attitudes, social pressure, and perceived control provided insight to the determinants of concussion underreporting. In total, 2,649 U.S. born student-athletes from 23 sports, across 22 colleges/universities completed the survey. Factor analysis revealed that intention to report concussion symptoms, the primary dependent variable, was unidimensional. Independent variables, attitude towards symptom reporting and athletic identity, were also unidimensional, while perceived social pressure (injunctive and descriptive norms) and perceived behavioral control (capacity and autonomy) were each two-dimensional.

Hierarchical regression analysis revealed positive effects of attitude, descriptive norms, injunctive norms, and capacity on intention to report concussion symptoms. Athletic identity had a small negative effect on intention when operating through the reasoned action variables. Additionally, participation in collision sports had a small negative effect on intention, while perceived knowledge of concussion symptoms had a small positive effect, both operating through the reasoned action variables. The full regression model explained 14.24% of the variance in concussion reporting intention.

These findings may help clinicians develop more focused interventions that address key social and individual determinants of underreporting, including attitude, perceived injunctive and descriptive norms, and capacity to report. Athletic identity, sport type, and perceived understanding of concussion symptoms also influence reporting intention to a lesser extent.

Previous research in this area has failed to address a diverse population of athletes from different sports, and relatively few studies have specifically targeted a college-age population. This study adds to the literature by combining the reasoned action approach with identity theory to investigate concussion underreporting across various college sports.

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CHAPTER 1

INTRODUCTION

The emergence of sport-related concussion as a public health concern over the past two decades has increased awareness and understanding of the potential dangers of traumatic brain injuries (TBI) in sports (Bramley, Patrick, Lehman, & Silvis, 2012; Kerr et al., 2014; Kroshus, Daneshvar, Baugh, Nowinski, & Cantu, 2014; Wiebe, Comstock, & Nance, 2011). As researchers, healthcare providers, athletes, and the general public continue to learn more about sport-related concussion, they begin to understand the potentially devastating short-term and long-term effects of sport-related TBI (i.e. concussion). The likelihood of negative outcomes following such injuries increases when the injuries go undiagnosed and/or unmanaged. Many researchers and clinicians recommend a comprehensive multidimensional concussion assessment battery (Broglio et al., 2014; Register-Mihalik, Guskiewicz, Mihalik, et al., 2013; Van Kampen, Lovell, Pardini, Collins, & Fu, 2006); however, despite efforts in the medical community to make concussion assessment as objective as possible, healthcare providers continue to have difficulty identifying mild TBI, and accurate evaluation often relies heavily on subjective information reported by patients.

Ample evidence exists to demonstrate the unwillingness of patients participating in organized sports to disclose concussion symptoms or seek medical care for a variety of interpersonal, intrapersonal, cultural, and policy-related reasons (Kerr et al., 2014; Kroshus, Kubzansky, Goldman, & Austin, 2015; McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004; Register-Mihalik, Linnan, et al., 2013). While many policies promote safe recovery timelines and prevent same day return to sport for concussed patients, Kerr

et al. (2014) suggested that such policies may actually inadvertently promote nondisclosure of concussion symptoms because athletes know that if they report symptoms they will be withheld from participation.

Identifying individual and social factors that influence patients' motivation to report concussion symptoms to a healthcare provider, coach, parent, or teammate assists in the development of targeted interventions that aim to reduce the number of undiagnosed concussions in athletes. When athletes with undiagnosed concussions continue exercising or participating in sport without ample recovery time, they may experience prolonged symptoms or increase their risk for catastrophic injury with a subsequent concussive impact. Understanding reasons for nondisclosure may aid in the development of prevention and management strategies that address the multifaceted nature of symptom reporting, and thereby encourage safer athlete behaviors (Kerr et al., 2014).

Many interventions designed to reduce concussion underreporting focus on educating athletes about recognizing concussion symptoms and warning them about the potential negative outcomes associated with sport-related TBI. A growing body of evidence, however, questions the assertion of concussion knowledge as the most important factor in predicting symptom-reporting behavior, noting a lack of significant association between concussion knowledge and underreporting (Chrisman, Quitiquit, & Rivara, 2013; Kerr, Register-Mihalik, Kroshus, Baugh, & Marshall, 2015; Kroshus, Baugh, Daneshvar, Nowinski, & Cantu, 2015; Kroshus, Baugh, Daneshvar, & Viswanath, 2014; Kroshus, Kubzansky, et al., 2015; Mrazik et al., 2015). Previous research on nondisclosure of concussion symptoms highlights the role of social norms in influencing

behavior, but few studies have examined the role of athletic identity in influencing athletes' motivation to report concussion symptoms (Kroshus, Kubzansky, et al., 2015). Kroshus, Kubzansky, et al. (2015) classified athletic identity as a moderating variable that interacts with perceived concussion reporting norms to increase the odds of non-reporting behavior. To expand upon these initial findings, I conducted a quantitative, cross-sectional survey study using the reasoned action approach and identity theory, to examine the role of athletic identity as it contributes to the problem of underreporting of sport-related concussions.

Statement of the Problem

Wiebe et al. (2011), Bramley et al. (2012), Kroshus, Baugh, et al. (2015), and Kroshus, Daneshvar, et al. (2014) have all identified sport-related concussion as a public health concern in the United States. As I outline in this section, the public health threat associated with such injuries stems from the high incidence of concussion in sport, the high incidence of concussion underreporting, and the potential dangers associated with underreporting.

Despite the difficulty in estimating the actual number of undiagnosed concussions, Langlois, Rutland-Brown, and Wald (2006) used data from the Centers for Disease Control and Prevention (CDC) to estimate the incidence of both diagnosed and undiagnosed sport-related TBI as 1.6 to 3.8 million per year. The CDC has not published a revised annual incidence estimate since 2006; however, Rosenthal, Foraker, Collins, and Comstock (2014) published results of a national epidemiological study of concussions in high school athletes from 2005 to 2012, which showed an increase in concussions from 0.23 per 1,000 injury exposures in 2005-2006, to 0.51 per 1,000 injury

exposures in 2011-2012, indicating that diagnosed sport-related TBIs are on the rise in that population. More recent high school epidemiology data from 2011-2012 through 2013-2014 shows an overall incidence of 0.39 sport-related concussions per 1,000 exposures (O'Connor et al., 2017). Wasserman, Kerr, Zuckerman, and Covassin (2016) similarly conducted a 2009 to 2014 epidemiological study of concussions in National Collegiate Athletic Association (NCAA) athletes, which revealed an overall rate of 0.45 concussions per 1,000 exposures across 25 different collegiate sports. The rate was much higher in games than in practices, with 1.5 concussions per 1,000 game exposures, and only 0.26 concussions per 1,000 practice exposures (Wasserman et al., 2016).

Sport-related concussions can occur in any sport, but based on high school and college epidemiology studies, they occur most frequently in men's football, men's ice hockey, men's lacrosse, and women's soccer (O'Connor et al., 2017; Powell & Barber-Foss, 1999; Rosenthal et al., 2014; Wasserman et al., 2016). The large percentage of undiagnosed injuries makes the actual incidence of sport-related concussion difficult to identify (Kerr et al., 2014; Kroshus, Baugh, et al., 2014; Kroshus, Garnett, Hawrilenko, & Baugh, 2015; Langlois et al., 2006; McCrea et al., 2004; Meehan, d'Hemecourt, Collins, & Comstock, 2011; Register-Mihalik, Guskiewicz, McLeod, et al., 2013). However, existing evidence suggests that 30% to 62% of sport-related concussions go undiagnosed (Broglio et al., 2010; Fraas, Coughlan, Hart, & McCarthy, 2014; Kaut, 2003; Kerr et al., 2015; Kroshus, Garnett, Hawrilenko, et al., 2015; Llewellyn, Burdette, Joyner, & Buckley, 2014; McCrea et al., 2004; Wallace, Covassin, Nogle, Gould, & Kovan, 2017). Wallace et al. (2017) suggested that this rate may even be much higher, noting that when counting both confirmed concussions and "bell-ringers" (i.e. potential concussions),

78.6% of high school athletes in their study did not report symptoms. Similarly, among professional football players in the Canadian Football League, Delaney, Caron, Correa, and Bloom (2018) reported that 82.1% of respondents failed to report at least one potential concussion during the course of a season.

Defining Concussion

Many definitions of concussion exist in the literature, however for this study I used the definition recommended from the fourth International Conference on Concussion in Sport (McCrory et al., 2013). This definition represents the most comprehensive and frequently cited definition of concussion available at the time of this study. McCrory et al. (2013) defined concussion as a brain injury characterized by a "complex pathophysiological process affecting the brain, induced by biomechanical forces" (p. 250). A direct or indirect blow to the head causes a concussion, which typically results in transient neurological impairment, indicating a "functional" disturbance of the brain without structural injury (McCrory et al., 2013). Due to the subjective nature of concussion assessment, patient honesty in reporting somatic, cognitive, and/or emotional symptoms remains essential for accurate diagnosis and proper management.

Concussion Underreporting

Based on existing prospective research (Kroshus, Baugh, et al., 2015; Meier et al., 2015), retrospective research (Davies & Bird, 2015; Delaney, Lamfookon, Bloom, Al-Kashmiri, & Correa, 2015; Fraas et al., 2014; Kaut, 2003; Kroshus, Garnett, Hawrilenko, et al., 2015; Llewellyn et al., 2014; McCrea et al., 2004; Torres et al., 2013; Williamson & Goodman, 2006), cross-sectional studies (Bramley et al., 2012; Kerr et al., 2015;

Meehan, Mannix, O'Brien, & Collins, 2013; Register-Mihalik, Guskiewicz, McLeod, et al., 2013; Sye, Sullivan, & McCrory, 2006; Wallace et al., 2017), and qualitative investigations (Chrisman et al., 2013), a clear discrepancy exists between the number of reported concussions and the actual number of concussions occurring in sports. This triangulation across various research methodologies provides strong evidence that many athletes continue to participate in their sport without reporting concussion symptoms to a coach or healthcare provider.

As mentioned above, common barriers to concussion symptom reporting include intrapersonal, interpersonal, cultural, and policy-related factors. Previous research indicates that intrapersonal barriers relate to knowledge (not knowing the injury is serious enough to report, or not knowing that they have a concussion) and internal motivation to continue sport participation (not wanting to leave a game or practice, or not wanting to miss future games or practices) (Broglio et al., 2010; Davies & Bird, 2015; Kerr et al., 2014; Kroshus, Daneshvar, et al., 2014; Llewellyn et al., 2014; McCrea et al., 2004; Register-Mihalik, Guskiewicz, McLeod, et al., 2013). Interpersonal barriers relate to perceived expectations (not wanting to let teammates or coaches down) (Broglio et al., 2010; Davies & Bird, 2015; Kerr et al., 2014; Kroshus, Daneshvar, et al., 2014; Llewellyn et al., 2014; McCrea et al., 2004; Register-Mihalik, Guskiewicz, McLeod, et al., 2013) and perceived external pressure (pressure from coaches, teammates, parents, etc.) (Kroshus, Garnett, Hawrilenko, et al., 2015). More globally, cultural factors include sport culture and sport norms associated with physical toughness and the acceptance of pain and risk (Coakley, 2015; Nixon II, 1993). Lastly, policy-level factors that influence

concussion symptom reporting include mandatory concussion education and concussion-related legislation, which each of the 50 states and Washington DC have now passed.

In college athletes, Llewellyn et al. (2014) found that 49.7% of male and female athletes did not report symptoms. Kroshus, Garnett, Hawrilenko, et al. (2015) found that 47.6% of male and female college athletes continued to participate in their sports while having concussion symptoms. On the lower end, Kaut (2003) noted that 30.4% of concussed college athletes continued to play while experiencing headaches. Of the athletes surveyed in this study, football players were most likely to continue playing with a headache, with 61.2% reporting this behavior (Kaut, 2003). In high school football players, McCrea et al. (2004) found that 52.7% of players with potential concussion symptoms did not report those symptoms to a coach or athletic trainer when they were injured. Similarly, Wallace et al. (2017) reported that about 55% of high school athletes did not report concussions; however, when they included "bell-ringers" or potential concussive events, 78.6% failed to report symptoms.

The trend of concussion underreporting among athletes extends beyond the United States as well. Alarmingly, among professional football players in the Canadian Football League, Delaney et al. (2018) found that 82.1% of participants failed to report concussion symptoms one or more times during the 2015 season. Fraas et al. (2014) found that 46.6% of professional Irish rugby players did not report concussion symptoms to anyone. In Italian club soccer, Broglio et al. (2010) reported that 62.1% of concussed athletes did not report symptoms to anyone.

Dangers Associated With Concussion Underreporting

Underreporting of concussion symptoms creates a health concern because of the potentially catastrophic outcomes associated with underdiagnosis, delayed care, and mismanagement of sport-related brain injuries. Possible negative outcomes associated with concussion, repeated concussion, and cumulative subconcussive impacts include second impact syndrome, chronic traumatic encephalopathy (CTE), post-concussion syndrome, and mental health issues (Boden, Tacchetti, Cantu, Knowles, & Mueller, 2007; Kroshus, Baugh, et al., 2015; Povlishock, 2013; Prins, Alexander, Giza, & Hovda, 2013). In this section, I address each of these injury categories in greater detail to contextualize the dangers associated with not seeking care for a sport-related brain injury.

Second impact syndrome. Second impact syndrome presents acute danger when a second concussive event occurs before a patient has recovered from an initial brain injury (Byard & Vink, 2009). This "second impact" may result in cerebral swelling, rapid and pronounced neurological deterioration, and possibly death (Byard & Vink, 2009). While not specifically labeling cases as second impact syndrome, Boden et al. (2007) reported that 39% of high school and college football players who suffered catastrophic brain injuries between 1989 and 2002, sustained their injuries while still symptomatic from a previous concussion.

Chronic traumatic encephalopathy. Initially described in the 1920s by Martland (1928) as "punch drunk," healthcare providers now recognize CTE as a chronic degenerative condition associated with repeated blows to the head over the course of an athletic career (McKee et al., 2009). Concerns over CTE arose following the publication of a high-profile brain autopsy case by Omalu et al. (2005). CTE may present as a

protracted onset of progressive cognitive degeneration and dementia, and it has anecdotally been associated with depression and suicide (McKee et al., 2009). Unfortunately, current diagnostic criteria only allow for post-mortem identification of CTE. Nonetheless, the fundamental cause of CTE is known and preventable.

Post-concussion syndrome. Post-concussion syndrome, which researchers and healthcare providers associate with multiple concussions (Leddy, Sandhu, Sodhi, Baker, & Willer, 2012), involves prolonged recovery and chronic concussion symptoms beyond the typical 7-10 day recovery period. Ahman, Saveman, Styrke, Björnstig, and Stålnacke (2013) reported that symptoms of mild TBI can last as long as 11 years. Even in patients whose symptoms resolve within a few weeks of the initial injury, Kroshus, Garnett, Hawrilenko, et al. (2015) noted that the breadth of possible symptoms can significantly limit an athlete's activities of daily living.

Mental health issues. In a long-term study of TBI in Sweden, Fazel, Wolf, Pillas, Lichtenstein, and Långström (2014) reported an association between TBI and higher rates of premature mortality and suicide, especially in cases involving depression, substance abuse, and/or other types of psychiatric comorbidities. Somatic, cognitive, and emotional symptoms associated with concussion can also interfere with activities of daily living, create a health burden, and affect overall quality of life for concussion patients (Kontos, Covassin, Elbin, & Parker, 2012; Kroshus, Garnett, Hawrilenko, et al., 2015; Prichep, McCrea, Barr, Powell, & Chabot, 2013).

Brewer (1993) suggested a greater risk of depression following any injury, in athletes who identify strongly with their social role as an athlete. Although concussion can impact quality of life in any patient regardless of athletic participation, athletes who

identify strongly with their athlete role may be at greater risk for depressive symptoms following concussion because they might interpret the injury as more of a major life event that separates them from their central source of self-worth (Brewer, 1993). Events that "disrupt the pursuit of self-defining activities" can elicit depression symptoms (Brewer, 1993, p. 360; Oatley & Bolton, 1985).

To summarize, despite increasing rates of diagnosed sport-related concussions, underdiagnosis of concussions in athletes remains problematic because of the reliance on subjective information provided by the patient in order to make an accurate diagnosis. Athletes historically do not seek care for all concussions, and often avoid reporting symptoms to a coach or healthcare provider for a variety of intrapersonal, interpersonal, cultural, and policy-related reasons. This unwillingness to disclose symptoms adds to the public health concern surrounding sport-related concussion because of the potentially devastating effects of undiagnosed and unmanaged brain injuries. To find ways to address these problems, researchers and healthcare providers continue to explore the causes of concussion symptom underreporting.

Researcher Positionality Statement

I am a licensed athletic trainer with 11 years of experience providing healthcare services to college student-athletes. I initially became interested in athletic training after suffering sport-related injuries in high school, and subsequently working with different healthcare providers during my recovery. The care that I received inspired me to pursue a career in sports medicine so that I could deliver the same level of care to other injured athletes.

During my high school ice hockey career, I suffered two concussions, which resulted in temporary physical, cognitive, and emotional symptoms, and temporarily prevented me from participating in physical activity. In both of these instances, I knew that I had an injury, so I told my coach and I removed myself from participation. In my experience as an athletic trainer, however, I have worked with patients who have put themselves at an unnecessary increased risk for severe brain injury by lying about concussion symptoms and participating in contact or collision sports, either immediately following a concussive impact or before they have fully recovered from a previous concussion. My concern for my patients' overall health and wellbeing, and my curiosity about why someone would make such a seemingly irrational choice have piqued my interest in this topic.

Purpose of the Study

The purpose of this study was to identify and quantify factors that determine college athletes' intentions to report concussion symptoms to a coach or athletic trainer. Integrating both the reasoned action approach (Fishbein & Ajzen, 2010) and identity theory as the foundational underpinnings for this study, I administered a cross-sectional survey to NCAA collegiate athletes in Pennsylvania across all sports, to examine the role of attitude, perceived social pressure, perceived behavioral control, and athletic identity on athletes' intention to report concussion symptoms.

With the widespread problem of concussion underreporting in sports, I hoped to determine characteristics of athletes that point to those with a higher or lower risk of not reporting. The results of this study increase the research knowledge base in the area of concussion underreporting, but also provide insight to athletic trainers, coaches, and

athletic administrators, to help develop proactive and supportive programming that encourages athletes to seek appropriate care for sport-related brain injuries. This research expands upon the existing application of reasoned action theory in the concussion reporting literature and improves measurement of the factors that contribute to concussion underreporting, especially in a collegiate population.

Research Questions

The cross-sectional survey administered in this study provided data specifically addressing the following research questions:

1. Do the individual characteristics of an athlete influence concussion reporting intention?
2. Does athletic identity directly affect concussion reporting intention?
3. Does an athlete's concussion reporting attitude, perceived social pressure, and perceived behavioral control directly affect concussion reporting intention?
4. Do concussion reporting attitude, perceived social pressure, and perceived behavioral control mediate the effect of athletic identity on reporting intention?

To answer these research questions, I administered a survey using items that measure the constructs of the reasoned action approach for predicting behavioral intention (Fishbein & Ajzen, 2010; Kroshus, Baugh, et al., 2014; Register-Mihalik, Linnan, et al., 2013), and I also used items from the Athletic Identity Measurement Scale (AIMS; Brewer & Cornelius, 2001).

Significance of the Study

Despite the potential long-term and short-term dangers and sequelae associated with both concussive and subconcussive impacts, sport culture and commitment to the

athlete role contribute to high rates of concussion nondisclosure. By investigating the role of attitudes, norms, perceived control, and athletic identity on concussion reporting intention, this study has implications for expanding existing theory, research, and practice in the area of concussion underreporting.

This study adds to the existing body of research on concussion symptom underreporting by merging two theories: the reasoned action approach and identity theory. Although several research studies and meta-analyses have combined these theoretical frameworks (Paquin & Keating, 2016; Rise, Sheeran, & Hukkelberg, 2010), very few studies have employed this approach to investigate concussion symptom reporting (Kroshus, Kubzansky, et al., 2015).

Hagger, Anderson, Kyriakaki, and Darkings (2007) studied the effect of identity on intentional health-related behaviors, and found that social identity positively affected attitudes, perceived social pressure (subjective norms), and perceived behavioral control in a risky health behavior (binge drinking). Hagger et al. (2007) suggested that future research should replicate their model "in other behavioral contexts to arrive at converging evidence for the effects of identity considerations on intentional behavior" (p. 365). Presently, Kroshus, Kubzansky, et al. (2015) have put forth one of the few studies that directly measured athletic identity relative to concussion symptom reporting, however this study did not implement the full reasoned action approach. In a meta-analysis of studies incorporating identity to supplement the reasoned action model, Rise et al. (2010) found that the addition of identity significantly increased the amount of variance explained by the model. Combining these two approaches to investigate the problem of concussion underreporting contributes to the literature in this area.

This investigation also contributes to the research literature by studying symptom reporting predictors in various collegiate sports. Previous research on concussion reporting intention has mostly focused on high school athletes (Bramley et al., 2012; Chrisman et al., 2013; Kurowski, Pomerantz, Schaiper, & Gittelman, 2014; Register-Mihalik, Guskiewicz, McLeod, et al., 2013; Register-Mihalik, Linnan, et al., 2013; Register-Mihalik, Valovich McLeod, Linnan, Guskiewicz, & Marshall, 2016). Those studies that have measured concussion reporting intention in college athletes have mostly focused on a very specific population of male NCAA Division I ice hockey players (Kroshus, Baugh, et al., 2015; Kroshus, Daneshvar, et al., 2014). Kroshus, Garnett, Hawrilenko, et al. (2015) did measure concussion reporting intention across collegiate athletes from seven different sports, but this study did not measure all components of the reasoned action approach. In addition to studying concussion reporting intention in a broader athlete population, this study validates a survey instrument for future use by practitioners and researchers.

The practical significance of this research includes the continued development of intervention strategies that may help reduce the problem of concussion underreporting. Because of the potential dangers associated with sport-related TBI, accurate diagnosis is critical in preventing complications and improving patient outcomes. Identifying characteristics that predict nondisclosure of symptoms, and understanding reasons for underreporting, may assist in the development of more focused intervention strategies to increase symptom reporting, leading to more accurate assessment and better recognition of brain injuries. Improved recognition may contribute to improved injury management,

decreased risk of recurrent and catastrophic injury, and improved long-term and short-term patient outcomes.

The addition of athletic identity as a possible predictor of concussion reporting intention also has practical significance. As described by Malcolm (2011), sports medicine practitioners must treat athlete-patients holistically, and manage injuries as part biological and part social. Clinicians must remember to treat the *patient*, not just the injury, because each athlete-patient experiences injury from a unique frame of reference. For clinicians, understanding the behavioral implications of a patient's self-concept as an athlete may allow for a greater understanding of the patient's individual needs, while also creating a safe, trusting environment in which the patient may be more willing to disclose concussion symptoms.

Concussion underreporting is a multifaceted problem that requires a multifaceted approach to inquiry. Ultimately, athletic identity needs to change in a way that makes safety, symptom-reporting, and care-seeking part of that identity, with a greater emphasis on longevity of a career and the importance of life beyond athletics. Understanding and quantifying reasons for underreporting concussion symptoms may lead to better assessment accuracy and fewer undiagnosed brain injuries, which contributes to improved patient outcomes. Continued research of the sociology behind sport-related concussion may produce new knowledge to improve diagnosis, patient care, and quality of life, while reducing morbidity and mortality associated with sport-related TBI.

Definitions of Terms

Table 1 provides a glossary of conceptual definitions for key terms used throughout this study. Operational definitions for all variables are included in Chapter 3.

Table 1

Glossary of Terms

Term	Definition
Athletic Identity	"The degree to which an individual identifies with the athlete role" (Brewer, Van Raalte, & Linder, 1993, p. 237)
Attitude	A person's evaluation of a behavior as being favorable or unfavorable (Fishbein & Ajzen, 2010)
• Instrumental Attitude	Anticipated positive or negative consequences of a behavior (e.g. beneficial vs. harmful; Fishbein & Ajzen, 2010)
• Experiential Attitude	Perceived positive or negative experiences associated with a behavior (e.g. pleasant vs. unpleasant; Fishbein & Ajzen, 2010)
Concussion	A brain injury caused by a direct or indirect blow to the head, characterized by transient neurological impairment, without structural injury to the brain (McCrory et al., 2013)
Intention	"The subjective probability of performing a behavior" (Fishbein & Ajzen, 2010, p. 40)
Perceived Behavioral Control	The extent to which people believe they are capable and/or have control over performing a behavior (Fishbein & Ajzen, 2010)
• Capacity	Ability to perform a behavior (Fishbein & Ajzen, 2010)
• Autonomy	Degree of control over performing a behavior (Fishbein & Ajzen, 2010)
Perceived Social Pressure	Overall normative pressure to perform or not perform a behavior based on what a person believes he or she ought to do (injunctive norm) and what he or she believes others would do (descriptive norm) (Fishbein & Ajzen, 2010). Sometimes referred to as "subjective norm" in reasoned action research.
• Injunctive Norm	An individual's perception of what others think he or she should do (Fishbein & Ajzen, 2010)
• Descriptive Norm	An individual's perception of what others would do (Fishbein & Ajzen, 2010)
Social Referents	Individuals who exert influence over a person's behavior through direct or indirect social pressure, which may or may not be intentional

Limitations and Delimitations

The cross-sectional design of this study represents a limitation because data collected at a discrete point in time precludes the establishment of temporal order, which is a necessary criterion for making causal inferences. However, because I measured future behavioral intention as the outcome of interest, and because I did not administer any intervention, the use of a pretest-posttest survey seems unwarranted. Additionally, I provide support for the proposed causal relationships through a mediation model hypothesized in Chapter 2.

This study design also presents delimitations regarding time, geographic region, and level of sport participation. Again, because of the cross-sectional design, I only collected data during one academic semester, which may limit the generalizability of the results across time; however, because I had different cohorts based on year in school, I observed differences among freshmen, sophomore, junior, and senior athletes to understand the potential changes that occur over the duration of a college athletic career. Geographically, I recruited all participants from universities in Pennsylvania, affecting the generalizability across states or countries.

Chapter Summary

In this chapter, I have summarized the problem of concussion underreporting in sport, including an overview of current estimates of nondisclosure of concussion symptoms, common barriers to symptom reporting, and the dangers associated with repeated concussions, especially those that are undiagnosed or mismanaged. I also explained my position and why I have chosen to investigate the problem of concussion symptom underreporting in athletes. Next, I introduced the purpose of the study and

outlined the overall research questions that informed this investigation. I then provided an overview of the significance of this study, defined key terms, and acknowledged important limitations and delimitations of the study.

In Chapter 2, in my review of the literature, I provide historical context for the problem of concussion underreporting in athletes and summarize important research in this area. I also provide an overview of the theoretical framework for this study, including the reasoned action approach, identity theory, how these two theories inform one another, and how they inform my research. Lastly, I lay out the conceptual framework for this study.

In Chapter 3, I explain the methodology of this study in detail, including the overall research design, variables and hypothesized relationships among variables, sampling strategy, data collection methods, and data analysis methods. I also note the limitations and ethical considerations associated with this research. Chapters 4 and 5 include a detailed report of the results and discussion, respectively.

CHAPTER 2

LITERATURE REVIEW

The first section of this chapter provides an overview of the existing literature on concussion underreporting in athletes. The historical background of the problem and a subsequent summary of the theories applied in previous research establish a theoretical context that I further develop in the second section of the chapter by outlining how the reasoned action approach and identity theory inform my understanding of concussion underreporting. The final sections of this chapter synthesize key concepts and theories to lay out a conceptual framework with specific research questions that guided the investigation and informed the hypotheses outlined in Chapter 3.

Historical Background

A seminal study by McCrea et al. (2004) identified the following four primary reasons for athletes not reporting concussion symptoms: (a) did not think it was serious enough, (b) did not know it was a concussion, (c) did not want to leave the game or practice, and (d) did not want to let teammates down. The first two reasons directly relate to education and knowledge about concussions, while the last two reasons are more psychosocial in nature. Evidence regarding the importance of knowledge and education about the dangers of concussion in influencing symptom reporting is mixed and inconclusive (Ahmed, Sullivan, Schneiders, & McCrory, 2012; Bramley et al., 2012; Chrisman et al., 2013; Esquivel, Haque, Keating, Marsh, & Lemos, 2013; Kroshus, Daneshvar, et al., 2014; Manasse-Cohick & Shapley, 2014; Register-Mihalik, Guskiewicz, McLeod, et al., 2013; Sye et al., 2006); however, the social context surrounding sport injury provides useful information that helps clarify the reasons for not

reporting concussion symptoms. In this section, I summarize existing research on predictors of concussion underreporting, which suggests that social factors influence reporting behavior more than concussion education and knowledge do.

Many concussion researchers, including Register-Mihalik, Guskiewicz, McLeod, et al. (2013) and Esquivel et al. (2013), call for increased educational efforts in an attempt to arm athletes with the information they need to make an informed decision about reporting concussion symptoms to a trained healthcare professional. While a general knowledge and understanding of concussion symptoms among athletes is necessary in order for them to know when they should seek medical care, the assumption that increasing athletes' knowledge about concussions increases concussion reporting currently lacks empirical support.

McCrea et al. (2004) noted that lack of knowledge regarding the potential consequences of undiagnosed and mismanaged concussion contributes to the likelihood that athletes will not recognize or report concussions. However, the authors of this study only surveyed male high school football players, not accounting for other factors that may be associated with varying value sets and motivations based on sport, age, sex, and level of play (Register-Mihalik, Guskiewicz, McLeod, et al., 2013). Although McCrea et al. (2004) attributed athletes' underreporting to a lack of knowledge, their findings suggest that there are also personal (not wanting to leave the game) and social (not wanting to disappoint teammates) factors that affect attitudes towards concussion and contribute to the culture of risk and resistance in sports.

Register-Mihalik, Guskiewicz, McLeod, et al. (2013) also reported an association between knowledge and concussion reporting in high school athletes; however, Kroshus,

Daneshvar, et al. (2014) and Chrisman et al. (2013) found that athletes participating in their studies expressed willingness to play while concussed, despite relatively high degrees of concussion knowledge. In two cross-sectional studies of high school athletes, Kurowski et al. (2014), and more recently Wallace et al. (2017), reported no relationship between concussion knowledge and reporting behavior. Even more concerning, Kroshus, Baugh, et al. (2014) actually found that greater knowledge scores were significantly associated with *decreased* intention to report concussion symptoms.

Interventions aimed at improving concussion knowledge may successfully achieve the goal of improving knowledge; however, they do not necessarily increase the likelihood that athletes will report concussion symptoms (Chrisman et al., 2013). In a pretest-posttest study measuring concussion knowledge and attitudes before and after an education intervention, Manasse-Cohick and Shapley (2014) found a significant increase in concussion knowledge, but no significant change in attitude towards concussion. In a similar prospective study, Kurowski, Pomerantz, Schaiper, Ho, and Gittelman (2015) found that high school athletes participating in a preseason concussion education program displayed improved concussion knowledge and attitudes immediately following the intervention, but by the end of the season the effects diminished substantially. Of the participants in the education group who sustained a potential concussion during the season (n = 43), 72% continued to play despite symptoms, suggesting that the education intervention had little influence on symptom reporting behavior (Kurowski et al., 2015). Torres et al. (2013) corroborated this trend in collegiate athletes, noting that despite formal concussion education, 43% of previously concussed athletes had consciously

hidden symptoms, and 22% of athletes indicated that they would be unlikely or very unlikely to report future concussions.

While some level of knowledge regarding concussion symptoms is a necessary precursor to symptom-reporting behavior, Mrazik et al. (2015) suggested that educating athletes about recognizing concussion symptoms may simultaneously provide them with the knowledge that they need to avoid detection of their injuries. Several researchers (Chrisman et al., 2013; Kroshus, Baugh, et al., 2014; Register-Mihalik, Linnan, et al., 2013) have examined interpersonal and intrapersonal factors affecting concussion reporting by applying the reasoned action approach, which emphasizes the importance of attitudes, social norms, and perceived control in predicting behavioral intention. Congruent with this theory, knowledge and empirical evidence may not translate to improved symptom reporting behavior if the presentation of this information does not address the underlying behavioral beliefs, normative beliefs, and control beliefs that ultimately influence an athlete's intention to report symptoms. Ajzen, Joyce, Sheikh, and Cote (2011) found low correlations between knowledge and behavior across multiple health-related behaviors, including low correlation between AIDS knowledge and intended condom use (Sheeran & Taylor, 1999); colorectal cancer knowledge and screening behavior (Guerra, Dominguez, & Shea, 2005); breast cancer knowledge and self-examination behavior (Schlueter, 1982); diabetes knowledge and control behaviors (Spirito et al., 1993); osteoporosis knowledge and prevention behaviors (Ievers-Landis et al., 2003); and alcohol knowledge and drinking behaviors (Ajzen et al., 2011). Across four separate studies of behavior, Ajzen et al. (2011) found that "the accuracy of factual information… was largely irrelevant" in predicting intentions and behavior (p. 106). In

these studies, behavior-specific knowledge consistently contributed very little to the explained variance in both intention and behavior (Ajzen et al., 2011).

Athletes who identify strongly with their role as an athlete behave in a way that upholds the perceived expectations of that role (Grossbard et al., 2009; Podlog et al., 2013). Within this context, it seems reasonable to postulate that in spite of known symptoms and known risks, an athlete may perceive the benefits of "toughing it out" as being greater than the risks of acknowledging a concussion. In support of this supposition, Malcolm (2011) noted that an athlete's desire to participate in a game or competitive event that aligns with his or her identity can produce a "diminution of interest in the physiological repair of the body and/or longer term health, and thus a rejection of scientific knowledge" (p. 293).

Ultimately, behavior stems from rational choices that align with an individual's attitudes towards the behavior, perceived normative pressure, perceived control over the behavior, and perceived confluence with a particular identity role. In the following sections, I elaborate on these key tenets from the conceptual perspective of the reasoned action approach and identity theory. I then explore how these tenets influence behavioral intention.

Theoretical Framework

Kerr et al. (2014) and Register-Mihalik et al. (2013) have advocated for the importance of using theory to investigate concussion underreporting, arguing that the multifactorial nature of the problem must be matched by equally complex theory to guide the development of effective multipronged intervention strategies. To address the complexity of the problem of concussion underreporting at a micro-level of analysis, the

reasoned action approach combined with identity theory – specifically athletic identity – serve as the primary theoretical frameworks for this study. Below I provide an overview for each of these theoretical approaches, highlighting key constructs, previous applications in research, and limitations of each. I also provide a rationale, supported by empirical evidence, to support my decision to combine these two theories to investigate concussion symptom reporting in athletes.

The Reasoned Action Approach

As a theoretical model for predicting and explaining human social behavior, the reasoned action approach dictates that attitudes, subjective norms, and perceived control predict behavior by influencing intention to perform a given behavior (Ajzen, 2012; Fishbein & Ajzen, 2010). This theoretical approach initially developed out of Fishbein's (1963) expectancy-value model, in which beliefs about outcome expectancies were presumed to predict behavior (Ajzen, 2012; Fishbein & Ajzen, 2010). With the addition of a normative belief construct, the expectancy-value model evolved into the theory of reasoned action (TRA; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 2010). Later, after the addition of a perceived behavioral control construct, the theory took on a new title as the theory of planned behavior (TPB; Ajzen, 1991; Fishbein & Ajzen, 2010). The constructs that encompass all iterations of the development of this theory now have earned the moniker, "the reasoned action approach" (Fishbein & Ajzen, 2010). The reasoned action approach serves as the primary theoretical framework for this study. Many authors refer to either the TRA or TPB when describing this theory; however, to maintain consistency with the most current verbiage, I refer to both of these theories as the reasoned action approach.

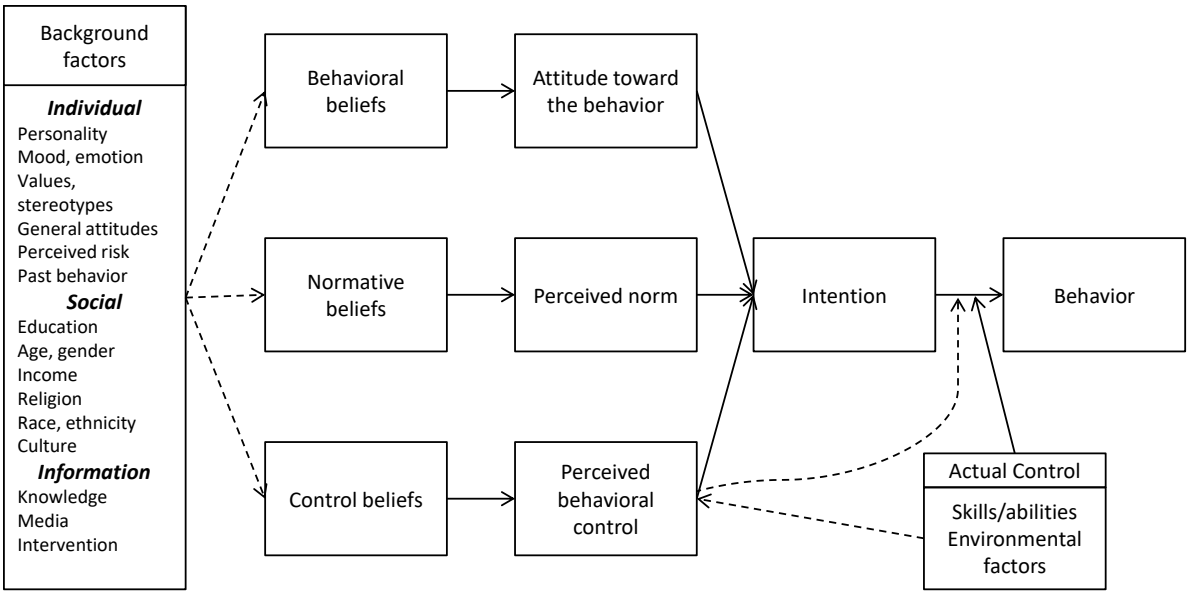

Figure 1. Schematic of the reasoned action approach. From *Predicting and Changing Behavior: The Reasoned Action Approach* (p.22), by M. Fishbein and I. Ajzen, 2010, New York, NY: Psychology Press. Copyright 2010 by Taylor & Francis Group. Reprinted with permission.

According to the reasoned action approach, as outlined in Figure 1, intention precedes behavior. Attitude towards the behavior, perceived social pressure to perform (or not perform) the behavior, and perceived behavioral control all precede behavioral intention. Sets of formative beliefs underlie each of these three key constructs. Behavioral beliefs precede attitudes, normative beliefs precede perceived social pressure, and control beliefs precede perceived behavioral control. Many published studies do not account for underlying beliefs, and focus instead on the constructs that directly affect intention (Armitage & Conner, 2001; McEachan, Conner, Taylor, & Lawton, 2011; McEachan et al., 2016). Recent applications of the reasoned action approach include two subcomponents for each of the three determinants of behavioral intention (McEachan et al., 2016). The subcomponents of each reasoned action construct appear in Figure 2.

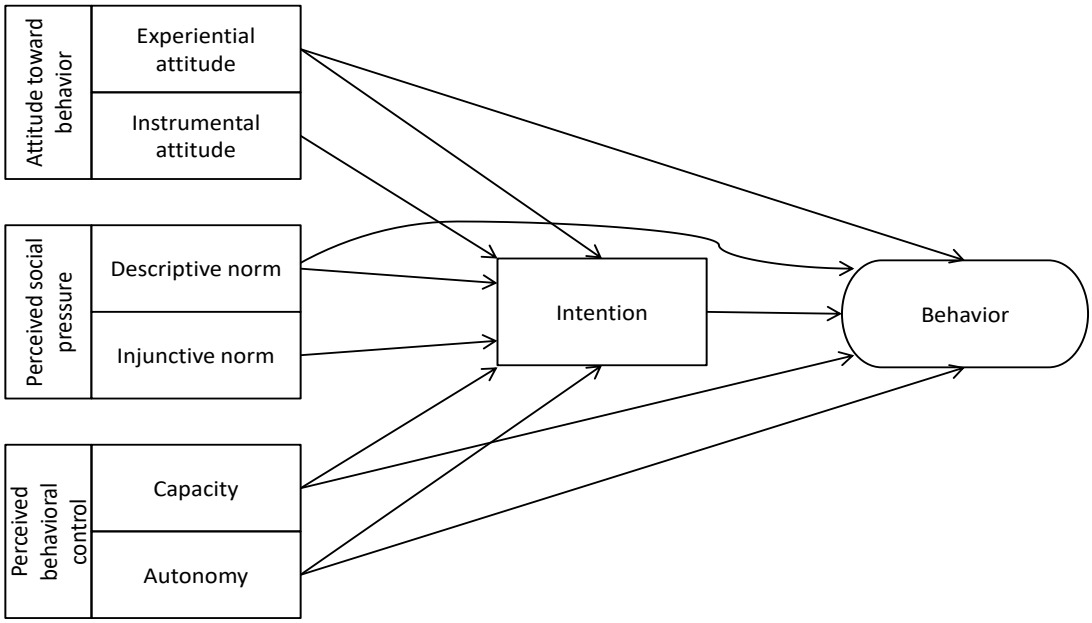

Figure 2. Subcomponents of the reasoned action approach. Adapted from "Meta-Analysis of the Reasoned Action Approach (RAA) to Understanding Health Behaviors" by R. McEachan et al., 2016, *Annals of Behavioral Medicine, 50*, p. 593. Copyright 2016 by Springer. Adapted with permission.

Intention. According to the reasoned action approach, if attitude, perceived social pressure, and perceived behavioral control all lead to intention, then the desired behavior (i.e. honest reporting of concussion symptoms) becomes more likely. Fishbein and Ajzen (2010) defined behavioral intention as "the subjective probability of performing a behavior" (p. 40). Although intention may not predict behavior in all contexts, meta-analyses of the reasoned action approach indicate average intention-behavior correlations between 0.43 and 0.62 (Armitage & Conner, 2001; Fishbein & Ajzen, 2010; McEachan et al., 2011; McEachan et al., 2016). In a summary of health-related behaviors, however, Ajzen and Albarracin (2007) reported a range of significant correlations between health-related intentions and behaviors from 0.75 to 0.96.

In a meta-analysis of studies applying the reasoned action approach to various health behaviors, McEachan et al. (2016) reported that five of the six reasoned action approach subcomponents (autonomy was not significant) explained 58.7% of the variance in intention, and that intention independently explained 30.4% of the variance in behavior. Armitage and Conner (2001) found that the reasoned action approach explained more variance in intention with the use of multi-dimensional measures of intention.

Specific to concussion symptom reporting, Kroshus, Baugh, et al. (2015) prospectively identified a link between intention and behavior, noting that athletes who intended to report symptoms were 1.63 times more likely to do so compared to athletes who did not intent to report. Despite achieving statistical significance ($p \leq 0.001$), intention actually explained very little variance in reporting behavior ($R^2 = 0.06$) (Kroshus, Baugh, et al., 2015). This finding indicates a need for future research that adequately controls for additional variables relevant to the reasoned action approach, as well as patient demographics.

Attitude. Attitude towards behavior refers to "a person's disposition to respond favorably or unfavorably with respect to a psychological object" (Fishbein & Ajzen, 2010, p. 77). Behavioral beliefs, the antecedents to attitude, represent a subjective probability that a behavior will have positive or negative outcomes (expectancy-value model). Belief strength (expectation that the outcome will occur) and attitude evaluation (positive or negative value) comprise the two key elements of behavioral beliefs. Regarding concussion reporting, Kroshus, Baugh, et al. (2014) and Register-Mihalik,

Linnan, et al. (2013) identified attitude as a critical determinant of both intention and behavior.

Subcomponents of attitude include experiential attitude and instrumental attitude (Fishbein & Ajzen, 2010; McEachan et al., 2016). Instrumental attitude represents cognitive processes regarding the utility of a behavior (e.g. useful vs. useless), whereas experiential attitude represents more affective process, categorizing a behavior as either pleasant or unpleasant (Fishbein & Ajzen, 2010). McEachan et al. (2016) found that instrumental and experiential attitudes produced direct effects on intention independent of one another. Additionally, both attitudes had an indirect effect on behavior by modifying intention; however, experiential attitude also had a direct effect on behavior, separate from intention.

Perceived social pressure. Perceived social pressure (sometimes referred to as "subjective norm" or "normative pressure") consists of two different types of norms: injunctive norms and descriptive norms (Fishbein & Ajzen, 2010). Injunctive norms emerge from perceptions about what important others think one should do, while descriptive norms concern the potential actor with what he or she thinks important others would do. Both types of norms arise from underlying normative beliefs, in addition to an individual's motivation to comply with those beliefs.

In a global sense, perceived behavioral norms based on sport culture, as well as various sub-cultures (e.g. football norms versus soccer norms), influence concussion reporting intention and behavior. According to Blumer (1969), culture and social systems "set conditions" for action, even if they do not fully determine action (p. 72). In a more specific context, important social referents likely to influence an athlete's decision

to disclose concussion symptoms include coaches, teammates, family members, and athletic trainers (Kroshus, Garnett, Hawrilenko, et al., 2015; Register-Mihalik, Guskiewicz, McLeod, et al., 2013; Register-Mihalik, Linnan, et al., 2013).

Injunctive norms and the motivation to comply with them garner more influence when an athlete – either subconsciously or consciously – considers the anticipated rewards or sanctions arising from relationships with important social referents (Kroshus, Garnett, Hawrilenko, et al., 2015; Register-Mihalik, Guskiewicz, McLeod, et al., 2013; Register-Mihalik, Linnan, et al., 2013). The perceived views of these social referents can positively or negatively influence intention to seek care (Register-Mihalik, Linnan, et al., 2013). Complying with the sport ideology of "playing hurt" and "toughing it out," an athlete may hesitate to report concussion symptoms for fear of violating cultural sport norms and being judged or considered "weak" by teammates, coaches, or friends (Malcom, 2006). Additionally, Kroshus, Garnett, Hawrilenko, et al. (2015) acknowledged that parents and coaches possess the ability to exert pressure on student-athletes because they control valuable commodities, including playing time, scholarships, tuition money, and affection. Because of the rewards associated with physical and mental toughness and fearlessness in sport, and the sanctions associated with violating the norms and values of sport culture, many athletes may feel that hiding symptoms and continuing to play through injuries serves as the appropriate rational choice. Conversely, if an athlete sees teammates seeking medical care for concussion and has a supportive coach, this may positively influence the intent to report symptoms. A qualitative study of barriers to concussion symptom reporting in high school athletes (Chrisman et al., 2013) revealed that coaches play a crucial role in influencing athletes' willingness to disclose

concussion symptoms, depending on whether they provided positive or negative feedback regarding care of concussions and other injuries.

Chrisman et al. (2013) also demonstrated the importance of peers and teammates in influencing symptom reporting behavior, as several subjects indicated that they did not want to "let the team down" by being injured and missing time. In this study, norms had a greater influence on behavior than attitudes and perceived behavioral control (Chrisman et al., 2013). Register-Mihalik, Guskiewicz, McLeod, et al. (2013) also advocated for a "safe reporting environment" (p. 652) to encourage athletes to speak with a qualified healthcare provider about a suspected TBI.

Descriptive norms relate to perceived hypothetical behavior of important others, or previously modeled behavior of important others. Some athletes may model behavior after peers or other athletes whom they believe possess a level of expertise, or whom they wish to emulate. In a meta-analysis of the theory of planned behavior, Manning (2009) found that injunctive norms correlated strongly with intention, while descriptive norms correlated strongly with behavior, implying that both sets of norms add value to the reasoned action model (McEachan et al., 2016).

Armitage and Conner (2001) and McEachan et al. (2016) both identified perceived social pressure (subjective norms) as a weak indicator of behavioral intention in previous research because of errors in the measurement of this construct. Armitage and Conner (2001) noted that many studies in their meta-analysis used single-item measures, which proved inadequate for capturing the nuances of social pressure. When controlling for type of measure, Armitage and Conner (2001) identified a significantly stronger correlation between norms and intention in studies that implemented multi-item

measures of this construct. McEachan et al. (2016) also criticized previous reasoned action research for only including injunctive norms to operationally define social pressure and norms.

Perceived behavioral control. Similar to Bandura's (1977) concept of self-efficacy, Fishbein and Ajzen (2010) defined perceived behavioral control as "the extent to which people believe that they are capable of performing a given behavior" (p. 154). Control beliefs that precede perceived control emphasize belief strength and the power of the control factor to facilitate or impede the behavior.

The subcomponents contained within the construct of perceived behavioral control include capacity and autonomy (Fishbein & Ajzen, 2010; McEachan et al., 2016). Capacity relates to an individual's perceived ability to perform a behavior, while autonomy captures the perceived level of control over performing the behavior (Fishbein & Ajzen, 2010). McEachan et al. (2016) found that capacity and autonomy each correlated strongly with health-related intentions and behaviors; however, they observed in multiple regression analysis that only capacity showed statistical significance in predicting intention and behavior when controlling for other variables.

Previous applications of the reasoned action approach. In a meta-analysis of studies applying the reasoned action approach to various health behaviors, the reasoned action model explained 58.7% of the variance in behavioral intention, and 32.3% of the variance in actual behavior (McEachan et al., 2016). Previous applications of the reasoned action approach in health behaviors involved investigations into safe sex practices (Sheeran & Taylor, 1999), healthy eating (Armitage & Conner, 1999a; Hagger et al., 2007; Karpinski & Milliner, 2016), exercise and physical activity (de Bruijn,

Verkooijen, de Vries, & van den Putte, 2012; Hagger et al., 2007), health screenings (Guerra et al., 2005; Schlueter, 1982), drug use (Armitage, Conner, Loach, & Willetts, 1999; Conner & McMillan, 1999), alcohol use and abuse (Ajzen et al., 2011; Hagger et al., 2007; Johnston & White), and smoking (Yzer & van den Putte, 2014). Using the reasoned action framework to investigate concussion symptom reporting in male ice hockey players, Kroshus, Baugh, et al. (2014) found that attitudes, subjective norms (perceived pressure), and reporting self-efficacy (perceived behavioral control), were all significantly associated with behavioral intention. Similarly, Register-Mihalik, Linnan, et al. (2013) found that a multivariate reasoned action model explained 58% of the variance in concussion reporting intention among high school athletes.

Limitations to the reasoned action approach. Several authors have suggested that the perceived social pressure component of the reasoned action approach should be modified or extended to account for the complexity of normative behavior and the influence of self-identity as informed by role theory and variations of identity theory (Armitage & Conner, 1999b; Fishbein & Ajzen, 2010; Sparks & Shepherd, 1992; Terry & Hogg, 1996). Armitage, Norman, and Conner (2002) found that the reasoned action approach accounted for significant variance in health-related intentions and behavior; however, they acknowledged that the theory failed to mediate the effects of demographic variables, and they recommended further investigation of the influence of role identities and self-schemas on health behaviors. The addition of identity to the reasoned action model in previous research has shown improved explanatory ability of the overall model by explaining more of the variance in behavioral intention than the reasoned action model

alone (Armitage & Conner, 1999b; Conner & McMillan, 1999; Fishbein & Ajzen, 2010; Rise et al., 2010; Sparks & Shepherd, 1992).

Kroshus, Garnett, Hawrilenko, et al. (2015) claimed that the reasoned action approach alone does not adequately explain concussion symptom reporting intention and behavior because it does not sufficiently address environmental context. While it is true that the reasoned action approach alone cannot fully predict intention and behavior, I argue that the theory does account for contextual elements of the social environment (perceived norms) and physical environment (perceived and actual behavioral control). The implementation of a simplified reasoned action model by some researchers prevents full exploration of some contextual elements of the model. Kroshus, Garnett, Hawrilenko, et al. (2015) suggested that social cognitive theory (SCT; Bandura, 1986), in conjunction with the reasoned action approach, provides for a more comprehensive understanding of the contextual influences for concussion symptom reporting by tying together psychological determinants, environment, and behavior. However, since environment and behavior are already included in the reasoned action approach, social cognitive theory really only adds the dimension of psychological determinants to the model. A more appropriate conceptualization of individual-level psychological influences on behavior can be achieved through the application of identity theory (Stryker & Burke, 2000), which includes elements of role identity, identity salience, and commitment (Hogg, Terry, & White, 1995).

Identity Theory

Identity theory falls under the umbrella of "structural symbolic interactionism" (Stryker, 1980), which emphasizes the relationship between the individual and society

(Burke & Stets, 2009). The meanings associated with multiple social roles form the multifaceted and organized construct of self, which reflects society through adherence to role-related behavioral tendencies (Hogg et al., 1995; Stryker & Burke, 2000). Identity theory allows for various representations of self, based on the roles that individuals play. Each distinct role has a distinct identity with a different meaning for self. As different identity roles emerge, they garner meaning and become reified through social interaction.

Hogg et al. (1995) labeled identity as "the pivotal concept linking social structure with individual action" (p. 257), with mutual influence exerted by both the self on society, and by society on the self. Similar to Giddens' (1984) structuration theory, in which human agency creates social structure, and social structure shapes human behavior (Miles, 2012), the self creates behavior, and behavior shapes the self within the context of defined roles (Hogg et al., 1995). For athletes, and for anyone fulfilling a particular role, meeting the preconceived assumptions and expectations associated with their role enhances self-esteem, while failing to meet those norms or standards decreases self-esteem and increases psychological distress (Hogg et al., 1995).

Individuals learn social roles through group commitment and through positive views of others who embody the same role. A team environment can strengthen commitment to a role. Identifying strongly with a particular group may moderate the relationship between the subjective norms and intention constructs of the reasoned action approach, by influencing the perceived importance of compliance with group norms (Fishbein & Ajzen, 2010). Fishbein and Ajzen (2010) and Sparks and Shepherd (1992) suggested that identity also directly influences behavioral intentions, in conjunction with the key constructs of the reasoned action approach. The perceived norms associated with

the role of the athlete, and the perceived views of others within the sport social network, or "sportsnet" (Nixon II, 1992), may influence athletes' intention to report concussion symptoms (Register-Mihalik, Linnan, et al., 2013). From an identity theory perspective, an athlete who identifies strongly with the athlete role may value competition more than his or her own health and wellbeing, despite evidence of the possible risks (Malcolm, 2011).

Identity salience. Hogg et al. (1995) defined identity salience as the "likelihood that the identity will be invoked in diverse situations" (p. 257). Individuals have many role identities, but depending on different contexts and situations, different role identities emerge as more prominent or salient (Burke & Stets, 2009). Identity salience influences behavior through the mimicry of others who are viewed positively in the same or similar role (Hogg et al., 1995). Additionally, the more social relationships one has, and the more importance ascribed to those relationships within a particular role identity, the greater the salience of that identity. In this way, role commitment determines identity salience (Hogg et al., 1995); however identity salience conforms to a "salience hierarchy" (McCall & Simmons, 1966) influenced by role prominence, support in that role, intrinsic and extrinsic rewards, and perceived opportunity (Burke & Stets, 2009). For example, the importance of a playoff or a championship game may distort an athlete's perception and place athletic identity as the more salient role, ahead of the role of student, son/daughter, brother/sister, boyfriend/girlfriend, patient, etc.

Limitations to identity theory. Fishbein and Ajzen (2010) highlighted a methodological flaw in existing applications of identity theory to the reasoned action approach, noting that previous studies have not shown evidence of construct validity for

measuring self-identity. As I explain in subsequent pages, a previously validated measure of identity, the Athletic Identity Measurement Scale (AIMS), mitigates this concern.

Additionally, Fishbein and Ajzen (2010) criticized the use of importance scale items to measure identity as being too similar to measurements of attitude toward a behavior. Paquin and Keating (2016) made a comparable argument about studies whose identity measures are too similar to intended behavior measures, noting that behavior-specific identity items on a survey may actually measure the same construct as intent items. For example, if someone identifies as a smoker, then he or she is more likely to intend to smoke. In the current study, similarity between athletic identity and concussion symptom reporting attitudes and intention is not a limitation because these are clearly distinct constructs, and the identity role of interest is not specific to the behavior of interest.

Athletic Identity

Brewer et al. (1993) identified three dimensions of athletic identity measured by the AIMS: social identity, exclusivity, and negative affectivity (Brewer & Cornelius, 2001; Martin, Mushett, & Eklund, 1994). Social identity is a measure of athletic identity commitment, and exclusivity is a measure of athletic identity salience. The concept of negative affectivity indicates that there is a negative emotional response from athletes when they are unable to participate in their sport (Martin et al., 1994). Based on the likelihood of higher level athletes having higher levels of athletic identity commitment and salience, athletes may assign socially constructed value to behaviors that they believe are normative to their team or sport. Consistent with typical team dynamics, Kroshus,

Kubzansky, et al. (2015) noted that high group cohesion and frequent opportunities for interaction and communication help to predict strong group norms among collegiate sports teams. This also reflects the observations of Hogg et al. (1995) that role commitment is high when individuals perceive that "many of their important social relationships are predicated on occupancy of that role" (p. 258).

Commitment to the athlete role often involves the acceptance of risk and pain as a normative aspect of sport culture (Curry, 1993; Malcom, 2006; Nixon II, 1992, 1993). The norms associated with "sport ethic" dictate that athletes with a strong athletic identity accept risk, make sacrifices for the game, and do not show pain or weakness (Malcom, 2006). Nixon (1993) noted that individuals who associate their "livelihood" with a sport or team more often acknowledged pain and injury as "worth the risk" of participating in sports (p. 187). Specific to concussion, if an athlete perceives that reporting symptoms detracts from the athletic role, he or she will be less likely to report a concussion after a suspected injury (Kroshus, Kubzansky, et al., 2015). Controlling for perceived reporting norms, Kroshus, Kubzansky, et al. (2015) found that higher athletic identity correlated with greater likelihood of underreporting, and that perceived team concussion reporting norms were significantly associated with non-reporting of concussion symptoms. These findings lack generalizability beyond an NCAA Division I ice hockey population, and further investigation is needed to determine the relationship between athletic identity and concussion symptom reporting across different sports, ages, sexes, races, and ethnicities.

Previous use of athletic identity in predicting behaviors. Sport psychology and sociology research on athletic identity has often focused on identity's influence on psychological and emotional responses to injury (Brewer, 1993; Green & Weinberg,

2001; Wiechman & Williams, 1997). However, researchers have also demonstrated correlation of athletic identity with risk-related behaviors, including alcohol use (Grossbard et al., 2009), rehabilitation overadherence, and premature return to sport following injury (Podlog et al., 2013). Grossbard et al. (2009) noted that athletes who identify more strongly with members of their sport network demonstrate a greater likelihood of adhering to perceived norms of that network, regardless of risk. The authors found that in college athletes with a higher AIMS score of athletic identity, descriptive norms positively correlated with drinking behavior, while in individuals with low AIMS scores descriptive norms negatively correlated with drinking (Grossbard et al., 2009).

Also related to risky health behaviors, Podlog et al. (2013) identified athletic identity as a positive predictor of ignoring the recommendations of healthcare providers, and of prematurely returning to sport before fully recovering from an injury. Similarly, Weinberg, Vernau, and Horn (2013) concluded that higher athletic identity correlated with greater willingness to play through pain and injury in a sample of recreational basketball players. Regarding concussion reporting behavior, preliminary evidence suggests an interaction effect between athletic identity and perceived norms in the prediction of symptom reporting (Kroshus, Kubzansky, et al., 2015). The current paucity of research in this area warrants further investigation to establish the relationship between athletic identity and risk-related health behaviors.

Competing Theories

In addition to the reasoned action approach, research on health behaviors has included several other theoretical approaches, including the health belief model (HBM)

and the transtheoretical model (TTM). In this section, I acknowledge and provide an overview of these theories, and explain why the reasoned action approach emerges as a more appropriate model for exploring the problem of concussion underreporting.

One of the most widely used health behavior theoretical approaches in the literature, the HBM (Rosenstock, 1990) considers a patient's perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy related to a given health behavior. As previously discussed in the historical background section of this chapter, existing research on concussion underreporting has shown that knowledge and understanding of *susceptibility* and *severity* have less influence on reporting behavior than other social and psychological factors do. The *benefits* of reporting injury and seeking care for concussion represent an expectancy-value assessment similar to the behavioral beliefs that underlie the attitude construct of the reasoned action approach. Similarly, perceived *barriers* relate directly to the control beliefs underlying the perceived behavioral control construct of the reasoned action approach. The model also includes a measure of *self-efficacy*, which is conceptually very similar to perceived behavioral control (Fishbein & Ajzen, 2010). The HBM does not include a measure of behavioral intention. In summary, the HBM provides little additional explanatory value for concussion reporting beyond the reasoned action approach, and several constructs display redundancy between the two models.

The TTM (Prochaska & DiClemente, 2005), sometimes called the stages of change model (Kearney & O'Sullivan, 2003), attempts to predict health-related behavioral change by examining the stages of precontemplation, contemplation, preparation, action, and maintenance. This approach implies that behavioral change

starts with a subconscious (*precontemplative*) acknowledgement of the existence of unhealthy behavior (Prochaska & DiClemente, 2005). Next, the conscious process of *contemplation* produces a willingness or intention to change the unhealthy behavior. In the *preparation* stage, an individual begins making concrete plans and commits to the behavioral change, before moving to the *action* stage, in which the behavioral change actually occurs. Lastly, in the *maintenance* stage, the individual must sustain the health behavior and avoid relapsing back into the unhealthy behavior (Prochaska & DiClemente, 2005). The TTM represents an integrative, multidimensional behavioral model intended to address ongoing habitual health-related behaviors, such as smoking. Although the TTM does incorporate the concept of behavioral intention, its focus on sustainable long-term behavioral change makes it inappropriate for examining the single-event problem of concussion nondisclosure. While concussion underreporting can become a recurring problem, it is less associated with habitual behavioral patterns, and more a problem of healthcare avoidance.

Although the HBM and TTM are applicable in other areas of health behavior research, the reasoned action approach allows for a more thorough analysis of the antecedents of concussion reporting intention and behavior. The HBM includes some measures that are similar to attitudes and perceived control, however the model does not include a measure of behavioral intention, and places less emphasis on normative social pressure as compared to the reasoned action model. The TTM is broad in scope, addressing biological, psychological, and social factors related to heath behaviors; however, this model is less applicable for evaluating a singular action, such as not reporting a concussive event to a coach or healthcare provider. The reasoned action

approach, supplemented by identity theory, provides a more comprehensive approach to understanding the intrapersonal, interpersonal, and cultural factors that influence concussion underreporting.

Conceptual Framework

Identity theory provides an explanation of the meanings that individuals attach to the various social roles that they inhabit, and how these roles relate to one another. Identity theory also seeks to explain how identities influence cognitive, emotional, and behavioral processes (Burke & Stets, 2009), and guide identity-relevant behaviors (Rise et al., 2010). For example, individuals who identify strongly with a particular role or social category are more likely to behave in a manner that conforms to the social expectations and norms associated with that particular role. Because of the reasoned action approach's similar focus on predicting behavior, social psychologists have often attempted to merge identity theory with the reasoned action approach to improve prediction of behavioral intention, as evidenced by several studies and meta-analyses that address this combined approach (Conner & Armitage, 1998; Paquin & Keating, 2016; Rise et al., 2010). In this section, I explain why adding identity theory to the reasoned action approach provides an appropriate framework for understanding why athletes choose not to disclose concussion symptoms. I then build upon existing models for merging these two theories to create a concept map specific to my research on athletic identity and concussion symptom underreporting.

Fishbein and Ajzen (2010) maintained an assumption of sufficiency of the reasoned action framework, arguing that additional variables are unlikely to improve the prediction of behavioral intention. However, they did acknowledge that strong group

identification can influence the relationship between perceived social pressure and intention, and that identity may even directly influence intention (Fishbein & Ajzen, 2010). That is, the greater the commitment to a particular identity role within a group, the more likely a person is to conform to the perceived normative social pressure associated with that role. Therefore, in individuals with stronger group identities, perceived social pressure becomes increasingly important in predicting intention. Specific to athletic identity, Kroshus, Garnett, Hawrilenko, et al. (2015) also suggested that an individual's level of identification with the referent group can modify the extent to which that person is motivated to conform to perceived norms. Furthermore, both Grossbard et al. (2009) and Wiechman and Williams (1997) found that stronger athletic identity was associated with greater adherence to team norms (Kroshus, Kubzansky, et al., 2015). This fits the notion that individuals perform "identity-congruent behaviors" (Paquin & Keating, 2016, p. 2) to confirm their sense of self and their occupancy of a particular social role.

Some researchers insist that the inclusion of an identity variable in the reasoned action framework, like the other constructs of the model, must conform to the principle of compatibility (Fishbein & Ajzen, 2010; Paquin & Keating, 2016). Fishbein and Ajzen (2010) described the principle of compatibility as a requirement that survey items contain the same target, action, context, and time elements of the behavior of interest. That is, all contextual elements surrounding the survey design must be compatible with the behavior. Others argue that the addition of an identity variable measured in this way merely reflects past performance of the behavior of interest (Rise et al., 2010). I maintain this latter view

regarding the redundancy of identity measures that approximate behavioral measures too closely.

Although Fishbein and Ajzen (2010) noted that the addition of any variables to the reasoned action approach should adhere to the principle of compatibility, they also proposed that additional variables should be "conceptually independent" (p. 282), applicable to a broad range of behaviors, and should consistently improve prediction of behavioral intention. This assumption calls into question the validity of some measures of identity used in previous research. Measuring identity in a way that is compatible with the dependent variable (behavior or behavioral intention) fails to add any unique explanation of variance because it is not conceptually different from the dependent variable. Rather, items used to measure identity must demonstrate discriminant validity in reference to items used to measure behavioral intention to ensure the measurement of two distinct constructs.

In a meta-analysis of identity in the reasoned action framework, Paquin and Keating (2016) reported a stronger correlation between identity and behavioral intention in studies that used behavior-specific measures of identity. However, when the behavior of interest is concussion symptom reporting, a behavior-specific identity is inappropriate, and would be more likely to reflect current or previous behavior than it would identity. The construct of *athletic identity* represents a conceptually different measure that is not synonymous with the behavior of interest. Athletic identity, in fact, applies to a large scope of behaviors in the athletic realm, and is not specifically associated with concussion at all, or with injury for that matter. Nevertheless, athletic identity as a modifier for concussion symptom reporting intention and behavior makes intuitive sense

because athletes with stronger athletic identities often normalize pain and injury (Nixon II, 1993; Podlog et al., 2013), and may participate in their sport "to the extent that their physical health is jeopardized" (Brewer et al., 1993, p. 241).

Paquin and Keating (2016) used structural equation modeling to identify two models of identity and reasoned action that fit their data well. They referred to the better fit of the two models as the unconstrained "manifest-intention" model (Figure 3). In this model, identity and intent are measures of a single latent variable labeled "intention." Therefore, in studies that aligned with this model, items used to measure identity and intent showed great similarity. Not surprisingly, Paquin and Keating (2016) found that the manifest-intention model only fit the data well for studies that used behavior-specific identity measures, indicating a lack of discriminant validity between identity and intention in those studies.

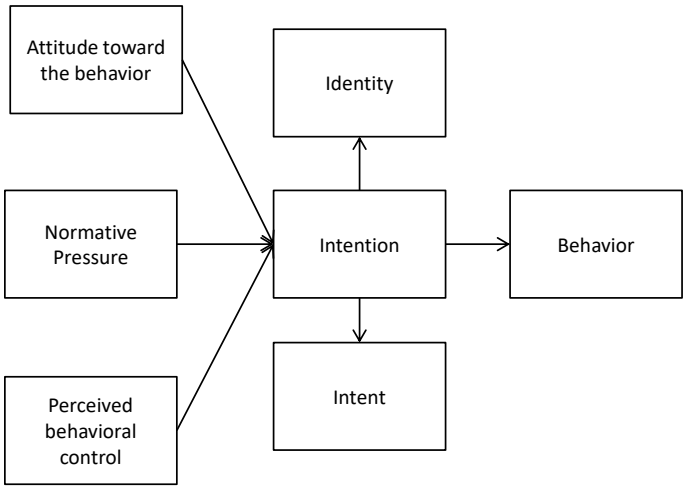

Figure 3. Paquin and Keating's manifest-intention model incorporating identity in the reasoned action framework. From "Fitting Identity in the Reasoned Action Framework: A Meta-Analysis and Model Comparison" by R. S. Paquin and D. M. Keating, 2016, *Journal of Social Psychology*, p. 4. Copyright 2016 by Taylor & Francis Group. Reprinted with permission.

Conversely, the second best fitting model, the unconstrained "augmented model" (Figure 4), in which identity has both an indirect and direct effect on intention, fit the data well for studies utilizing identity measures that were *not* behavior-specific. As previously discussed, athletic identity is not behavior-specific, and is conceptually different from concussion symptom reporting intention. For this reason, the augmented model shows greater utility than the manifest-intention model in explaining the role of athletic identity in influencing behavioral intention to report concussion symptoms. Paquin and Keating's (2016) augmented model serves as the foundation of my conceptual framework.

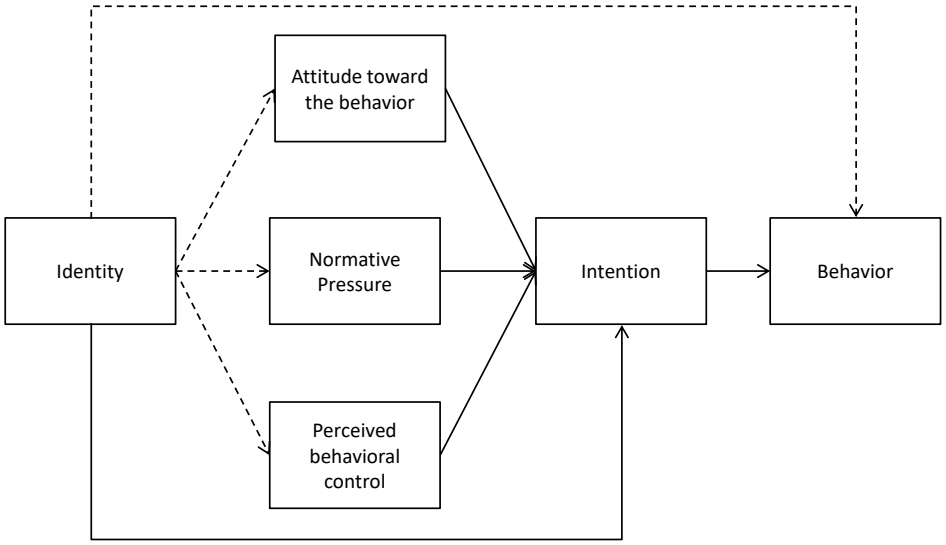

Figure 4. Paquin and Keating's augmented model incorporating identity in the reasoned action framework. From "Fitting Identity in the Reasoned Action Framework: A Meta-Analysis and Model Comparison" by R. S. Paquin and D. M. Keating, 2016, *Journal of Social Psychology*, p. 4. Copyright 2016 by Taylor & Francis Group. Reprinted with permission

Overall, Paquin and Keating (2016) did not recommend the addition of an identity variable into the reasoned action approach. However, this interpretation is inconsistent

with the findings from another meta-analysis by Rise et al. (2010), who used different inclusion and exclusion criteria and different analytical methods in their study. Rise et al. (2010) reported appropriate discriminant validity of identity in comparison to all of the primary reasoned actioned constructs, with the highest correlation occuring between identity and attitude (r = .37). Using a two-step hierarchical regression analysis, Rise et al. (2010) found that the inclusion of identity into the reasoned action approach significantly improved the prediction of intention, with the new model explaining 41% of the variance in intention, as opposed to the 35% of variance that was explained before the addition of identity. Overall, identity accounted for 6% additional explained variance in intention after controlling for the primary reasoned action constructs, and it accounted for an additional 9% when also controlling for past behavior (Rise et al., 2010).

Drawing from Paquin and Keating's (2016) augmented model, Figure 5 shows the proposed relationships among all variables in this study. The primary constructs of the reasoned action approach mediate the relationship between athletic identity and concussion reporting intention. I measured intention as opposed to actual concussion symptom reporting behavior, because directly measuring behavior would require participants to suffer a concussion at some point in the duration of the study.

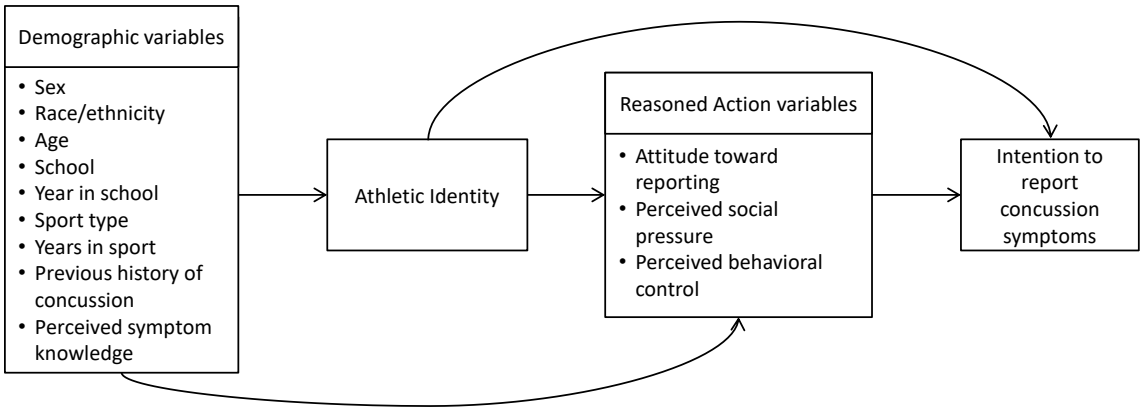

Figure 5. Concept map incorporating athletic identity into the reasoned action approach.

I have adapted the demographic and control variables from Fishbein and Ajzen's (2010) original conceptualization of these variables to make them more relevant to the context of athletic participation. Regarding age and year in school/years in sport, Miller and Kerr (2003) found that a singular focus on the athlete role was strongest early in college student-athletes' careers, with a shifting focus towards role diversification and adoption of additional role identities (academic and social) towards the end of college. In alignment with these findings, I predicted that athletes earlier in their college careers would identify more strongly with the athlete role compared to those who are closer to graduating.

Regarding sex, Weinberg et al. (2013) reported that men and women are both socialized into sport in similar ways, and are equally likely to play sports despite pain and injuries; however, evidence suggests that men typically have a stronger athletic identity than women (Brewer et al., 1993; Wiechman & Williams, 1997). Additionally, Torres et al. (2013) found that men were less likely to report concussion symptoms to a coach or athletic trainer. In this study, I predicted that men would have lower intention to report concussion symptoms compared to women. Regarding race, Harrison, Sailes, Rotich, and Bimper (2011) identified stronger athletic identities in African-American athletes when compared to Caucasian athletes. Regarding sport, Hadiyan and Sheikh (2015) indicated that different sports have different levels of athletic identity. Because race and sport may produce differences in athletic identity and in attitudes and normative pressure, I controlled for these variables. Lastly, previous research shows that athletes with a history of concussions are sometimes less likely to report subsequent concussions to coaches or athletic trainers (Torres et al., 2013). Because previous concussion history

may influence attitudes, perceived norms, and perceived control, I also included concussion history as a control variable.

I hypothesized that attitude towards symptom reporting, perceived social pressure, and perceived behavioral control would directly influence symptom reporting intention, while also mediating the relationship between athletic identity and reporting intention. This conceptual framework provides clear parameters for my research, synthesizing identity theory and the reasoned action approach to investigate the relationship between athletic identity and concussion symptom nondisclosure. I have provided an overview of the two major theories, as well as a visual concept map, which merges athletic identity with the reasoned action framework (Figure 5).

Research Questions

Based on the conceptual framework described above, the research questions guiding this investigation include the following:

1. Do the individual characteristics of an athlete influence concussion reporting intention?
2. Does athletic identity directly affect concussion reporting intention?
3. Does an athlete's concussion reporting attitude, perceived social pressure, and perceived behavioral control directly affect concussion reporting intention?
4. Do concussion reporting attitude, perceived social pressure, and perceived behavioral control mediate the effect of athletic identity on reporting intention?

Chapter Summary

In this chapter, I provided a historical overview of the problem of concussion underreporting in athletics. While many researchers attribute symptom underreporting to

an overall lack of concussion knowledge, a growing body of evidence suggests that athletes generally have a strong understanding of the symptoms and potential risks of sport-related concussion. Additionally, research suggests that social factors, such as pressure from coaches, peers, and parents, influence concussion reporting behaviors more than knowledge does.

Next, I explained the theoretical foundations for my research, which included a detailed examination of the reasoned action approach and a discussion of identity theory; including the specific role of athletic identity as it relates to behavioral motivation of athletes. Predicated on the assumption that behavioral intention predicts actual behavior, the three primary antecedents to intention in the reasoned action approach include attitude towards the behavior (experiential and instrumental attitudes), perceived social pressure (descriptive and injunctive norms), and perceived behavioral control (capacity and autonomy). Identity theory supplements reasoned action with its focus on social roles and the rational adherence to the norms and values associated with particularly salient roles. In high level athletes, athletic identity becomes a very prominent role, which influences how athletes respond to injuries within the context of competitive sports.

Lastly, I synthesized the two primary theoretical frameworks for this research to create a more comprehensive conceptual framework and visual concept map. Based on existing research combining the reasoned action approach with identity theory, I have proposed a model whereby the key constructs of the reasoned action approach mediate the relationship between athletic identity and symptom reporting. This conceptual framework and concept map guided my research methods, which I discuss in detail in the next chapter.

CHAPTER 3

METHODS

In the previous chapter, I summarized the existing literature on concussion underreporting and outlined the theoretical and conceptual frameworks for this study. In this chapter, I provide an overview of the study, explain the variables and hypotheses guiding the research, and discuss the sampling strategy, data collection methods, data analysis, and study limitations. The study overview section includes the purpose of the study, research questions, and an overview of the research design. In the variables and hypotheses section, I identify all independent and dependent variables used in the study and hypothesize the relationships between variables. In the sampling strategy section, I identify the inclusion and exclusion criteria for the study and explain the sampling and recruitment procedures that I used. I operationally define all variables in the section on data collection procedures and outline the survey instrument that I used. In the data analysis section, I include the statistical procedures that I used to test my hypotheses regarding the relationships among variables. Lastly, I discuss study limitations and ethical considerations, and provide a chapter summary.

Study Overview

Purpose and Research Questions

The purpose of this study is to quantify the interplay between the constructs of the reasoned action approach and athletic identity in determining college athletes' intentions to report concussion symptoms to a coach or athletic trainer. Understanding the role of athletic identity, and identifying objective, quantifiable measures to determine the influence of attitudes, perceived social pressure, and perceived behavioral control on an

athlete's intent to report concussion symptoms may help healthcare providers identify athletes who are less likely to disclose their injuries. As discussed in chapter 2, the research questions guiding this study include the following:

1. Do the individual characteristics of an athlete influence concussion reporting intention?
2. Does athletic identity directly affect concussion reporting intention?
3. Does an athlete's concussion reporting attitude, perceived social pressure, and perceived behavioral control directly affect concussion reporting intention?
4. Do concussion reporting attitude, perceived social pressure, and perceived behavioral control mediate the effect of athletic identity on concussion reporting intention?

Research Design

Operating under the post-positivist paradigm, and using the reasoned action approach and identity theory to frame my research, I conducted a cross-sectional survey to investigate the factors that influence concussion symptom reporting among college athletes. With the unit of analysis at the individual level, I recruited male and female NCAA student-athletes from 22 colleges and universities, and from a variety of sports, to complete an online survey via Qualtrics survey software. I constructed the survey to investigate the effects of the reasoned action model and athletic identity on athletes' intentions to report concussion symptoms.

I chose to focus on *intention* to report symptoms rather than *actual* symptom reporting behavior because measuring behavior requires participants to actually suffer a concussion during the study. Also, self-reporting plays a key role in identifying

concussions, which offers a further rationale for this measure. Measuring behavior not only lacks feasibility, but would also substantially reduce the final sample size. Meta-analyses of the reasoned action approach offer some validity of this measure with results indicating moderate correlation between intention and behavior (Armitage & Conner, 2001; Fishbein & Ajzen, 2010; McEachan et al., 2011; McEachan et al., 2016); therefore, I used behavioral intention as the primary dependent variable.

To measure the reasoned action constructs and their subcomponents, I used survey items from Register-Mihalik (2010) and Kroshus, Baugh, et al. (2014), as well as several novel items to measure intention, descriptive norms, and autonomy. Because Register-Mihalik's measures of intention are vague, I constructed a new measure of intention that includes situational variability, such as symptom severity, symptom duration, and type of athletic event (e.g. practice vs. game). In this study I used factor analytic methods to assure that single internally consistent dimension of situational variability exists.

To quantify athletic identity, I used the 7-item Athletic Identity Measurement Scale or AIMS (Brewer & Cornelius, 2001). I also collected background information, including race, sex, years in sport, category of sport (collision, contact, or limited/non-contact), previous history of concussion, and previous symptom reporting behavior. I conducted factor analyses and established internal consistency of each construct. I excluded items from the analysis that failed to load on a particular factor, indicated high uniqueness, had low item-test values, had low item-rest values, or decreased the internal consistency of a construct. Through the process of eliminating unnecessary items, I

created a shorter form of the survey that provides a valid and reliable measurement instrument for use in future research.

Administering an online survey for data collection proved inexpensive, allowed for a robust and diverse sample of athletes over a broad geographic range, and allowed for rapid data collection and analysis (Monette, Sullivan, & DeJong, 2008). To ensure reasonable response rates, I sent a pre-survey notice to inform participants about the survey, and I requested that someone familiar to the athletes (coaches, athletic trainers, athletic administrators, etc.) distribute the actual survey via email and encourage survey completion. I also sent two follow-up emails to remind student-athletes to complete the survey. All survey participants remained anonymous and I report all results in aggregate.

Variables and Hypotheses

In this section, I describe the independent and control variables in the study, and provide a list of hypothesized relationships to the primary dependent variable (concussion reporting intention). The three categories of independent variables include (a) demographic variables, (b) reasoned action variables, and (c) athletic identity. In addition to investigating the direct effects of each independent variable category on symptom reporting intention, I also investigated the mediating effect of athletic identity on the relationship between reasoned action variables and concussion reporting intention.

Fishbein and Ajzen (2010) identified age, sex, education, and race/ethnicity as social background factors in the reasoned action model. I included all of these variables as control variables, as well as years in primary sport, sport type, and previous concussion history because of their relevance to the population of college student-athletes. In addition to the variables mentioned above, Fishbein and Ajzen (2010) also

included income, religion, and culture as social background factors. Fishbein and Ajzen (2010) did not operationally define culture; however I used sport type (limited/non-contact sports, contact sports, and collision sports) as a measure of culture, which I predicted would relate to attitudes, norms, and perceived control to influence concussion reporting intention. Because self-reported income may not accurately measure socioeconomic status in college students (Smith & McCann, 1998), I chose to exclude income as a demographic variable. I also eliminated religion as a demographic variable because college athletes do not commonly view religion as a strong identity role (Hoover, 2012).

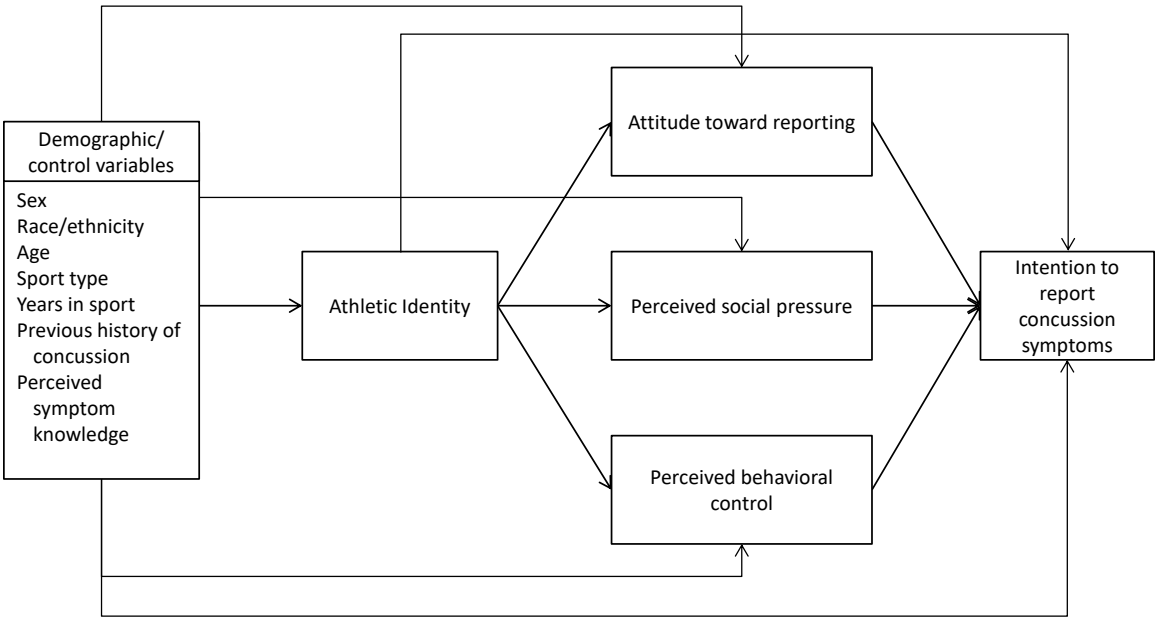

Figure 6. Causal model summarizing the proposed relationships among variables.

The independent variables in this study included athletic identity and the three primary constructs of the reasoned action approach: attitude towards concussion reporting, perceived social pressure, and perceived behavioral control. As discussed in the literature review chapter and depicted in Figure 6, each reasoned action variable served as a mediating variable between athletic identity and concussion reporting

intention. I predicted that athletic identity would have a direct negative effect on concussion reporting intention.

Hypotheses

The research questions and the causal model above (Figure 6) provided the basis for the following hypotheses.

Hypothesis 1: All things being equal, men will have lower intentions to report concussion symptoms than women do.

Hypothesis 2: Respondents who participate in limited or non-contact sports will demonstrate a stronger intention to report concussion symptoms than those who participate in contact or collision sports.

Hypothesis 3: Athletes with greater athletic identity will have lower intentions to report concussion symptoms than athletes with lesser athletic identity do.

Hypothesis 4: Athletes with safer attitudes towards concussion reporting will have a greater intention to report concussion symptoms than athletes with less safe attitudes do.

Hypothesis 5: Athletes who perceive less pressure from important social referents regarding concussion reporting will have a greater intention to report concussion symptoms than athletes who perceive greater social pressure.

Hypothesis 6: Athletes who perceive greater control over concussion reporting behavior will have a greater intention to report concussion symptoms than athletes who perceive less control.

Hypothesis 7: Attitudes, perceived social pressure, and perceived behavioral control will mediate the relationship between athletic identity and concussion symptom reporting intention.

Sampling Strategy

I recruited a sample of athletes from a variety of NCAA varsity sports at 17 universities within the Pennsylvania State Athletic Conference (PSAC), as well as five other colleges and universities in the Greater Philadelphia area. Men's sports included baseball, basketball, cross country, diving, football, golf, ice hockey, lacrosse, rowing, soccer, swimming, tennis, track & field, water polo, and wrestling. Women's sports included acrobatics & tumbling, basketball, cheerleading, cross country, diving, field hockey, golf, ice hockey, lacrosse, rowing, rugby, soccer, softball, swimming, tennis, track & field, volleyball, and water polo. I distributed the final survey to approximately 8,769 student-athletes. A summary of the number of athletes at each participating institution is included in Table 2.

Table 2

Number of NCAA Student-Athletes at Each Institution

College/University	Athletes
Institution A	418
Institution B	131
Institution C	275
Institution D	291
Institution E	347
Institution F	494
Institution G	357
Institution H	539
Institution I	249
Institution J	403
Institution K	447
Institution L	419
Institution M	205
Institution N	587
Institution O	400
Institution P	248
Institution Q	465
Institution R	445
Institution S	480
Institution T	537
Institution U	566
Institution V	466
Total	8,769
Mean	399

Sampling and Recruitment Procedures

To establish the most effective recruitment method, I developed a convenience sample by contacting athletic trainers at 24 NCAA institutions in Pennsylvania, to ask if they were willing to assist in distributing the survey to their student-athletes, and if they have access to student-athlete email addresses. If the athletic trainers were not interested in participating, or if they did not have access to student-athlete email addresses, then I asked them who is the best person at their institution to contact as a liaison for distributing the survey. Based on the assumption that online surveys distributed via email

generally produce a lower response rate than those administered in person (Nulty, 2008), I individualized the recruitment strategy for each institution to achieve the highest possible response rate from each institution. Athletic administrators at two institutions declined participation. Figure 7 shows a flow chart indicating the liaison at each institution who distributed the online Qualtrics survey via email.

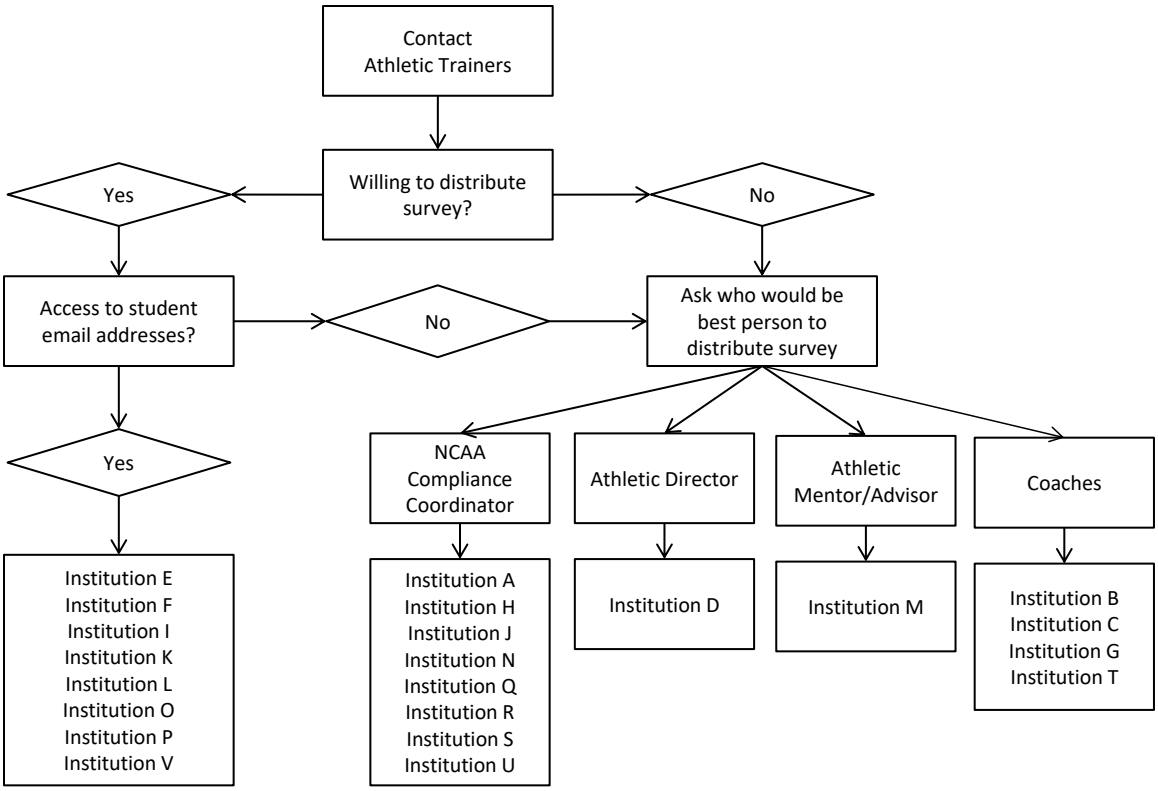

Figure 7. Flow chart for recruitment of university personnel who distributed surveys.

Prior to collecting any data, I obtained approval from Indiana University of Pennsylvania's Institutional Review Board (Appendix A and B). I also obtained letters of approval from representatives at each participating institution, acknowledging that data collection would take place with their student-athletes.

To improve response rate, I offered three different types of incentives. First, to ensure that potential participants received the pertinent survey information, I provided

$50 in Amazon.com gift cards to the individuals at each institution who agreed to forward the survey emails for me. Second, I offered a group incentive to the institutions by providing $300, $200, and $100, respectively, to the Student-Athlete Advisory Committees at the top three institutions with the highest participation. This created a competition among the institutions, and potential participants were able to see real time total of the number of participants from each school. Lastly, I offered an individual incentive by offering $100 to five randomly selected participants. To maintain anonymity of the participants, I created a second Qualtrics survey link that student-athletes could access to provide their name and contact information upon survey completion to enter the drawing for $100. In a study of online survey response rates, Sauermann and Roach (2013) found that larger prizes with lower odds of winning produced the highest response rate. That is, offering $100 to five participants generates more responses than offering $5 to 100 participants. In the same study, Sauermann and Roach (2013) also found that providing financial incentives led to fewer missing items.

Data Collection Methods

I entered all survey items (Appendix F) into the Qualtrics survey software program, in preparation for distributing the survey. Concurrently, I identified individuals at each participating university to help to distribute the survey (Figure 7). Survey invitations from an authority figure who is familiar to the participants demonstrates legitimacy of the request, and thus influences the decision to participate (Petrovčič, Petrič, & Lozar Manfreda, 2016). I asked the liaison at each institution to forward a series of emails to student-athletes to request their participation in the survey. Multiple

survey requests produce a greater response rate (Nulty, 2008; Sanchez-Fernandez, Munoz-Leiva, & Montoro-Rios, 2012; Sauermann & Roach, 2013).

A pre-notification email alerted student-athletes that they would be receiving a link to participate in a survey in the near future. The survey email and two subsequent follow-up emails provided the Qualtrics survey link for student-athletes to access the survey. I modified the wording of each email message to show potential participants that the request was genuine and that a real person is investing time and effort into the research (Sauermann & Roach, 2013). Sauermann and Roach (2013) found that changing the wording of each contact attempt improved the odds of response by 36%. Additionally, I asked student-athletes in each email to "please consider participating" and thanked them for their time and participation. In a study of varying email survey invitation components, Petrovčič et al. (2016) found that a combination of authority and a plea for help produced the greatest response rate.

Instrumentation

Below, I outline the measurement strategies for the reasoned action model concussion reporting survey (RAM-CR). I am borrowing or modifying some of the items developed by Register-Mihalik (2010), who established content validity of her reasoned action concussion reporting survey through review by three content experts. Register-Mihalik (2010) also reported test-retest reliability of the survey, and internal consistency as determined by a Cronbach's alpha greater than 0.7 (Tavakol & Dennick, 2011). Additionally, I used survey items from the AIMS (Brewer & Cornelius, 2001) to measure athletic identity, and from Kroshus, Baugh, et al. (2014) to measure capacity in the

reasoned action model. Table 3 contains a summary of all of the variables and the proposed relationships among them.

Table 3

Summary of All Variables, Measurements, and Proposed Relationships

Variable	Measurement	Level of measurement	Proposed relationships
Intention	Mean of all intention items (likelihood scale)	Continuous	Primary DV
Attitude	Mean of all attitude items (semantic differential scale)	Continuous	IV for intention; Mediator for AI on intention
Descriptive normative pressure	Mean of PSP items 1-4	Continuous	IV for intention; Mediator for AI on intention
Injunctive normative pressure	Mean of PSP interaction terms (norm strength x motivation to comply)	Continuous	IV for intention; Mediator for AI on intention
Capacity	Mean of PBC items 2-5	Continuous	IV for intention; Mediator for AI on intention
Autonomy	Mean of PBC items 6-7	Continuous	IV for intention; Mediator for AI on intention
Athletic identity	Mean score of all AIMS items	Continuous	IV for intention; Mediated by reasoned action variables

After administering the survey, I performed an exploratory factor analysis on the measures of the reasoned action approach. I eliminated items from the final analysis that did not load highly and that had large uniqueness values on determined factors. I then calculated Cronbach's alpha for each factor (i.e. construct), and eliminated items that did

not display high item-test or item-rest correlations or substantially reduce the alpha coefficient.

Demographic & control variables. I controlled for age, race/ethnicity, sex, sport type, number of years participating in sport, number of previous concussions, and perceived concussion symptom knowledge. To determine age, I asked participants to report their current age at the time of the survey. I measured race/ethnicity by asking participants whether they classify themselves as a racial or ethnic minority student. Participants identified sport played using the list of sports provided above and in Appendix F. Some student-athletes play more than one varsity sport, so participants were able to choose more than one item; however, participants only identified sports that they participate in at the NCAA varsity level, not sports that they play recreationally.

Sport type. Rice (2008) classified sports as contact, limited contact, and non-contact sports. He further subdivided contact sports into categories of collision sports and contact sports, defining collision sports as those in which "athletes purposely hit or collide with each other or with inanimate objects (including the ground) with great force" (p. 841). In contact sports, athletes "routinely make contact with each other or with inanimate objects" (p. 841), however it is with less force and less risk for injury compared to collision sports. In limited contact sports, incidental contact occurs infrequently, and in non-contact sports contact is "rare and unexpected" (Rice, 2008, p. 841). Based on these classifications, I divided sports into three categories: collision, contact, and limited/non-contact.

Collision sports included football, ice hockey, men's lacrosse, rugby, and wrestling. Contact sports included acrobatics & tumbling, basketball, cheerleading,

diving, field hockey, gymnastics, women's lacrosse, soccer, and water polo. Limited/Non-contact sports included baseball, cross country, golf, rowing, softball, swimming, tennis, track & field, and volleyball. The survey asked participants to select their primary sport from a drop-down list. I then re-coded responses to identify sport type.

Reasoned action variables. In the following pages, I provide an overview of the measures I used for each component and subcomponent of the reasoned action approach.

Intention. Register-Mihalik (2010) measured symptom reporting intention using three similar items: "I intend to report," "I plan to report," and "I will make an effort to report," each measured on a 7-point Likert scale. Register-Mihalik (2010) reported a high Cronbach's alpha ($\alpha = 0.94$) for these items. However, because symptom reporting varies under different conditions (e.g. practice vs. game) these items fail to acknowledge situational factors. Kroshus, Baugh, et al. (2014) have previously assessed intention to report concussion symptoms using a list of eight concussion symptoms, and a 7-point scale to indicate whether they intended to immediately report the presence of each symptom if it occurred after an impact. This approach provides more context for symptom reporting, but is still incomplete. To account for situational variability in reporting intention, I constructed seven items that address symptom severity, relative importance of sport participation (practice vs. regular competition vs. championship), and duration of symptoms (Appendix F).

Attitude. Fishbein and Ajzen (2010) defined attitude as the evaluation of an object, concept, or behavior as being favorable or unfavorable. As the developers of the reasoned action approach, they recommended the semantic differential as an effective

method of measuring attitude towards a behavior. I measured attitude towards concussion symptom reporting using six of the seven semantic differential word pairs developed by Register-Mihalik (2010). Register-Mihalik (2010) reported a very good Cronbach's alpha of 0.83 for these seven items (DeVellis, 2003). I eliminated one item used by Register-Mihalik (scoring symptom reporting as extremely difficult versus extremely easy) because it measures perceived capacity or control, not attitude towards the behavior.

Perceived social pressure. Perceived social pressure consists of injunctive norms (what others think I should do) and descriptive norms (what others would do). Register-Mihalik's operationalization of this construct only addressed injunctive norms and their underlying injunctive normative beliefs, so I have constructed four items that measure descriptive norms (Appendix F). To measure injunctive norms, I am adapting several normative belief items created by Register-Mihalik (2010), because these items capture not just the overall assessment of a behavior as "normal," but also allow for the positive or negative evaluation that an individual ascribes to these norms. That is, these measures assess beliefs about what important social referents would want the participant to do, as well as how motivated the participant is to comply with what the various social referents want.

For each specific social referent individual or group, the product of normative belief strength and motivation to comply creates a composite score for injunctive normative beliefs. Fishbein and Ajzen (2010) proposed that the product of injunctive norm belief strength and motivation to comply is proportional to the injunctive norm itself. To maintain consistency with the recommendations from Fishbein and Ajzen

(2010) for measuring injunctive normative beliefs, I modified the wording of these items slightly. By multiplying norm belief strength and motivation to comply for each of the four social referents (coaches, teammates, parents, and athletic trainer), I condensed eight items into four scores measuring injunctive norms.

Perceived behavioral control. Much like her measure of intention, Register-Mihalik (2010) measured perceived behavioral control using three similar items (Cronbach's $\alpha = 0.71$). To provide more context for different reporting conditions, I instead used five items from Kroshus, Baugh, et al. (2014) that address perceived control (self-efficacy) in different situations (Cronbach's $\alpha = 0.91$). These items all address capacity to perform the behavior, so I constructed two items to address autonomy, which is the other subcomponent of perceived control.

Athletic identity. I measured athletic identity using the 7-item AIMS survey, with all items rated on a 7-point Likert scale (Brewer & Cornelius, 2001; Brewer et al., 1993). Brewer et al. (1993) initially developed the AIMS as a 10-item unidimensional measure of athletic identity designed to capture social, cognitive, and affective aspects of identity (Brewer & Cornelius, 2001). Brewer et al. (1993) established internal consistency of the AIMS across three separate studies, with Cronbach's alpha values ranging from 0.81 to 0.93. In the same three studies, Brewer et al. (1993) established construct validity of the AIMS. The authors demonstrated convergent validity with the Perceived Importance Profile (PIP) sport competence construct ($r = 0.42$ to 0.83) (Fox, 1987), the Self-Role Scale ($r = 0.61$) (Curry & Weiss, 1989), and the Sport Orientation Questionnaire subscales for competitiveness ($r = 0.53$), goal orientation ($r = 0.26$), and win orientation ($r = 0.34$) (Gill & Deeter, 1988). They also found that AIMS scores

correlated with level of athletic involvement. Brewer et al. (1993) established discriminant validity with the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960); the Self-Esteem Scale (r = -0.01) (Rosenberg, 1965); the PIP constructs of perceived importance of fitness (r = 0.06), body attractiveness (r = 0.22), and strength (r = 0.15); the Physical Self-Perception Profile (Fox & Corbin, 1989) measure of physical self-esteem (r = 0.11); and athlete skill level as rated by coaches (r = -0.08).

Subsequent factor analyses of the AIMS have suggested that it is a multidimensional construct with three to four separate factors (Hale, James, & Stambulova, 1999; Martin et al., 1994). The most current version of the AIMS uses a 7-item, 3-factor scale, which includes social identity, exclusivity, and negative affectivity, in addition to a more global composite measure of a higher order athletic identity construct (Brewer & Cornelius, 2001; Proios, 2012; Weinberg et al., 2013). Several researchers have established the reliability and validity of the 7-item AIMS (Brewer & Cornelius, 2001; Visek, Hurst, Maxwell, & Watson, 2008). Weinberg et al. (2013) found a Cronbach's alpha of 0.90 for the higher order AIMS construct. For analysis of this construct in the current study, I used the mean AIMS score as a measure of the latent variable, athletic identity.

Data Analysis

Testing Research Hypotheses

I analyzed all data using the Stata 13 statistical software package. I conducted factor analyses for each construct of the reasoned action model, including intention, attitudes, perceived social pressure, and perceived behavioral control. I excluded items from the final data analysis if they did not load onto any particular factor, had high

uniqueness values, low item-test values, low item-rest values, or if they limited the Cronbach's alpha calculation to ≤ 0.70 (Tavakol & Dennick, 2011). I also conducted a factor analysis of the AIMS.

After identifying latent variables through factor analysis, I used hierarchical regression to first examine the effects of each of the following on concussion reporting intention: (a) demographic variables, (b) athletic identity, and (c) reasoned action variables. The proposed hierarchical regression appears in Table 4. In each step of the regression analysis, I determined how much variance the independent variables explain in the dependent variable. I also compared how much additional variance occurs with each subsequent step. As I performed the regression analysis, I critiqued each model to determine how well it fits the underlying assumptions.

Table 4

Hierarchical Regression Steps with Symptom Reporting Intention as the Dependent Variable

Block		Variables added
1	Demographic variables	Sex Age Race/ethnicity Sport type Years in primary sport Previous concussion history Perceived symptom knowledge
2	Athletic identity	AIMS
3	Reasoned action variables	Attitude towards reporting Perceived social pressure Perceived behavioral control

Limitations

A cross-sectional survey design creates a barrier to making causal assertions because it lacks time ordering, which is essential for establishing causation. However, in a recent meta-analysis of studies incorporating identity into the reasoned action framework, Paquin and Keating (2016) found that, specific to studies that examined identities not directly associated with the behavior of interest, the most appropriate model indicated that identity precedes attitudes, perceived norms, and perceived behavioral control. This notion aligns with identity theory, in which roles have expectations that guide attitudes and behaviors (Burke & Stets, 2009). Additionally, because I am asking participants about their intentions regarding *future* behaviors, I can potentially infer ordered relationships. Ultimately, correlation does not explicitly imply causation. In terms of a causal construct, this study provides descriptive data exploring the relationship between these determined measures, yet it explores relationships via the assertion of a theoretically and research-based causal path.

Ethical Considerations

Prior to conducting this study, I acquired approval from Indiana University of Pennsylvania's IRB to ensure the integrity of the research and the protection of participants by minimizing risk (Appendix A and B). Participants in this study provided informed consent via the Qualtrics survey software, and were able withdraw from the study at any time without any penalty. I conducted all research in accordance with the National Athletic Trainers' Association code of ethics (National Athletic Trainers' Association, 2016). In chapter 4, I report all findings as they pertain to my research questions, and I do not withhold any important results.

Chapter Summary

In this chapter, I have provided an overview of the research design and methods that I used to quantify the effects of individual characteristics, athletic identity, and the reasoned action constructs on concussion symptom reporting intention. I have also described how I identified mediating effects of each of the reasoned action constructs on the relationship between athletic identity and concussion reporting intention. I listed my hypotheses, explained my sampling strategy, operationally defined all variables, and described the survey instrument that I used. Lastly, I summarized the process of data analysis, and I acknowledged the research limitations and ethical considerations pertinent to this study. In the following chapter, I present the findings of this study. I then discuss these findings in greater depth in the last chapter.

CHAPTER 4

DATA AND ANALYSIS

This chapter provides the results of the data analysis methods presented in the previous chapter. I will first describe respondent demographics and response rate, followed by a detailed summary of the variables included in the final analysis. For both the dependent variable – intention to report concussion symptoms – and the independent variables, I used factor analysis and calculated Cronbach's alpha to develop multi-item scales. After presenting an interpretation of the factor analysis and Cronbach's alpha results, I elaborate on the multiple regression model proposed in the previous chapter to explore the following research questions:

- Do the individual characteristics of an athlete influence concussion reporting intention?
- Does athletic identity directly affect concussion reporting intention?
- Does an athlete's concussion reporting attitude, perceived social pressure, and perceived behavioral control directly affect concussion reporting intention?
- Do concussion reporting attitude, perceived social pressure, and perceived behavioral control mediate the effect of athletic identity on reporting intention?

Participants

Response Rate

As described in Chapter 3, I recruited 2,965 NCAA student-athletes from various sports and institutions throughout Pennsylvania to complete an online survey. Of the 24 institutions that I contacted, 22 schools (91.67%) participated in the study. The liaisons at each institution distributed the survey to approximately 8,769 student-athletes. 3,513

(40.06%) students accessed the Qualtrics survey; however, 198 of them only clicked on the link and provided no responses. Additionally, 224 students completed the demographic questions only and provided no other responses. One hundred six students only completed page one of the survey, which included items on symptom reporting intention, athletic identity, and attitudes, but not perceived social pressure, perceived behavioral control, or previous history of concussion. One respondent completed most of the survey, but did not answer any questions about perceived behavioral control. Similarly, four respondents who completed most of the survey did not answer any of the attitude questions, and six respondents omitted a majority of the questions on perceived social pressure. I did not include any of these partial survey responses in the demographic summaries or final data analysis. I also deleted cases in which the sport and sex did not align with any of the teams surveyed (e.g. "football" and "female"). After deleting these cases from the data set, 2,965 respondents completed the survey, for a completion rate of 33.81%.

Survey completion rates varied by institution (Table 5). The highest completion rate was at Institution Q, where 75.05% of student-athletes completed the survey. The lowest response was at Institution T, where only 9.87% of student-athletes completed the survey. One potential explanation for the large variability in responses may stem from the varying survey distribution methods employed. For example, at Seton Hill, the NCAA compliance coordinator distributed the survey to all student-athletes. However, at schools like Institution T, Institution G, and Institution C, which had some of the lowest completion rates, the coaches were responsible for distributing the survey to their respective teams. This added another step in the survey distribution process because

athletic trainers forwarded emails to the coaches, and the coaches were then supposed to forward those emails to their teams. I was only able to confirm that the athletic trainers forwarded the emails to the coaches, but I could not verify what the coaches did after that, so it is unclear how many student-athletes actually received the survey emails from coaches. Even those who did receive emails from coaches may not have received all four separate emails (pre-survey notification, survey email, and two follow-up reminders).

Table 5

Survey Completion Rates by Institution

College/University	Athletes	Respondents	Completion Rate
Institution A	418	153	0.3660
Institution B	131	47	0.3588
Institution C	275	65	0.2364
Institution D	291	55	0.1890
Institution E	347	153	0.4409
Institution F	494	213	0.4312
Institution G	357	55	0.1541
Institution H	539	151	0.2801
Institution I	249	111	0.4458
Institution J	403	105	0.2605
Institution K	447	143	0.3199
Institution L	419	152	0.3628
Institution M	205	52	0.2537
Institution N	587	203	0.3458
Institution O	400	128	0.3200
Institution P	248	55	0.2218
Institution Q	465	349	0.7505
Institution R	445	159	0.3573
Institution S	480	132	0.2750
Institution T	537	53	0.0987
Institution U	566	271	0.4788
Institution V	466	144	0.3090
School not indicated	n/a	16	n/a
Total	8,769	2,965	0.3381
Mean	399	135	n/a

Demographic Information

Of the 2,965 respondents who completed the survey, 2,649 (89.34%) identified the United States as their country of origin. By comparison, 156 (5.26%) respondents indicated non-U.S. countries of origin, and 160 (5.40%) did not indicate a country of origin. Because of the potential influence of cultural differences on survey responses, and because of the small portion of respondents from non-U.S. backgrounds, I decided to exclude non-U.S. born respondents in the final analysis. Tables 6, 7, and 8 provide an overview of the demographics for the 2,649 U.S. born respondents. Although 55% of the student-athlete population contacted were males and 45% were females, 65% of the sample of respondents were female, while only 35% of the respondents were male.

Table 6

Respondent Characteristics by Sport Type

Sport type	Sports	Males	Females	Total
Limited/non-contact	Baseball, Cross Country, Golf, Rowing, Softball, Swimming, Tennis, Track & Field, Volleyball	373	830	1,203 (46.3%)
Contact	Acrobatics & Tumbling, Basketball, Cheerleading, Diving, Field Hockey, Gymnastics, Women's Lacrosse, Soccer, Water Polo	138	830	968 (37.2%)
Collision	Football, Ice Hockey, Men's Lacrosse, Rugby, Wrestling	406	22	428 (16.5%)
Total		917	1,682	2,599

Table 7

Continuous Demographic Variables

Demographic Variable	Mean	Standard Deviation	Range
Age	20.02	1.36	18-25
Years in sport	7.74	1.99	1-11

Table 8

Categorical Demographic Variables

Demographic Variable	Frequency (n)	Percentage
Sex		
Male	927	34.99%
Female	1,712	64.63%
Missing	10	0.38%
Race/Ethnicity		
Minority	333	12.57%
Non-minority	2,293	86.56%
Missing	23	0.87%
Sport type		
Limited/non-contact	1,207	45.56%
Contact	972	36.69%
Collision	428	16.16%
Missing	42	1.59%
Year in school		
Freshman	739	27.90%
Sophomore	642	24.24%
Junior	638	24.08%
Senior	538	20.31%
5^{th} year	52	1.96%
Graduate student	25	0.94%
Missing	15	0.57%
History of concussion		
Yes	1,274	48.09%
No	1,366	51.57%
Missing	9	0.34%
NCAA Division		
Divison I	36	1.36%
Division II	2,220	83.81%
Division III	393	14.84%

Variables

Dependent Variable

For the dependent variable, intention to report concussion symptoms, I conducted an exploratory factor analysis of the seven items used to measure this construct (Appendix F, Items 9-15). The results indicated that these seven items constituted one

factor for the latent variable, intention (Table 9; Eigenvalue: 4.73), with a very good Cronbach's alpha of 0.93 (DeVellis, 2003). The one-factor model explained 91.81% of the variance across these seven items, and each item demonstrated reasonably high item-test and item-rest correlations (Table 10). I assessed whether dropping any of these items would increase the alpha value, but they did not increase, therefore I retained all seven items.

Based on the factor analysis results and the high internal consistency of the items measuring intention, I created a multi-item scale by calculating the mean of the seven items for each respondent. A total of 34 cases had missing intention scale values; however, 32 cases were missing only one value, while two cases were missing two values. Given the high Cronbach's alpha of 0.93, I created a mean scale score for each case, irrespective of the missing values. Univariate analysis of the intention mean score revealed an approximately normal distribution (Table 11; Figure 8).

Table 9

Factor Analysis of Intention

Factor	Eigenvalue	Difference	Proportion of Variance	Cumulative Variance
Factor1	**4.69345**	**4.09483**	**0.9181**	**0.9181**
Factor2	0.59862	0.50965	0.1171	1.0352
Factor3	0.08897	0.11311	0.0174	1.0526
Factor4	-0.02414	0.01135	-0.0047	1.0479
Factor5	-0.03549	0.05289	-0.0069	1.0409
Factor6	-0.08838	0.03255	-0.0173	1.0237
Factor7	-0.12093	.	-0.0237	1.0000

Table 10

Cronbach's alpha for Intention

Item	N	Sign	Item-Test Correlation	Item-Rest Correlation	Average Interitem Covariance	Alpha if item deleted
Practice symptoms	2649	+	0.8952	0.8529	2.535931	0.9105
Game symptoms	2647	+	0.9019	0.8619	2.524745	0.9096
Playoff symptoms	2643	+	0.8168	0.7446	2.627906	0.9209
Symptoms < 24hrs	2644	+	0.7458	0.6551	2.759686	0.9290
Symptoms > 1wk	2643	+	0.8659	0.8092	2.532296	0.9144
Mild symptoms	2636	+	0.8376	0.7775	2.645904	0.9177
Severe symptoms	2645	+	0.8023	0.7208	2.617946	0.9235
Test scale					2.60636	0.9290

Table 11

Univariate Analysis of Intention

Mean	Median	Std. Deviation	Pseudo Std. Dev.	n
4.205	4.286	1.674	1.588	2649

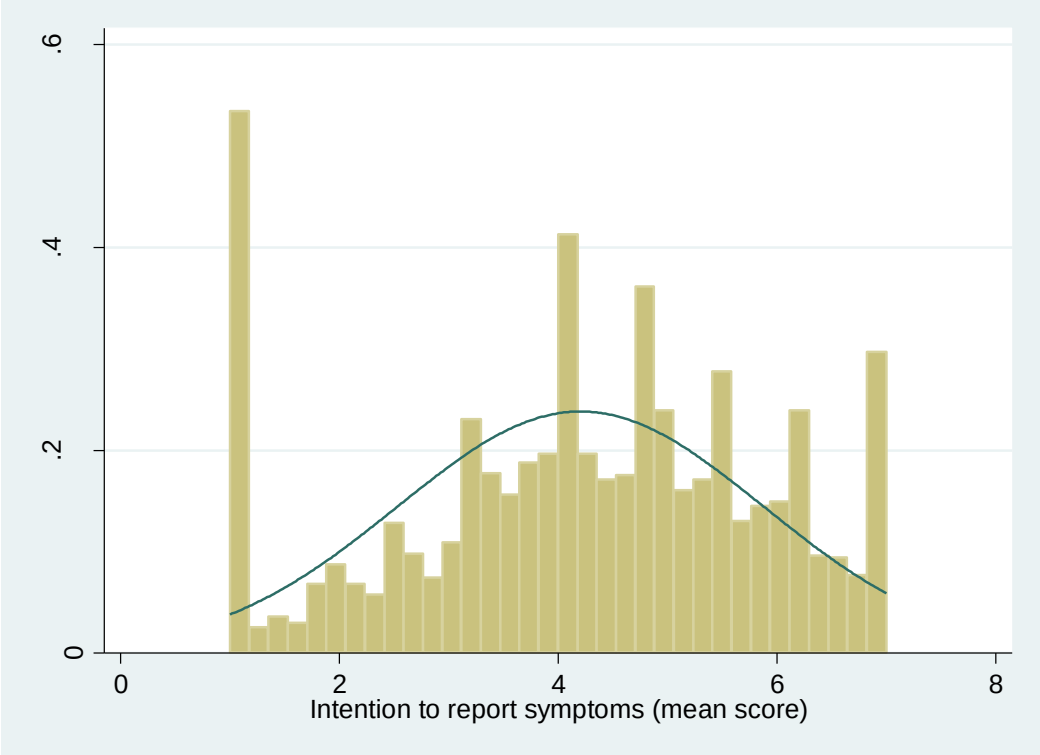

Figure 8. Histogram of intention mean composite scores.

Independent Variables

To confirm the dimensionality of the reasoned action variables, I conducted factor analyses of the attitude items, perceived social pressure items, and perceived behavioral control items. Factor analysis of the reasoned action variables revealed five dimensions. Attitude proved to be unidimensional, while the other two reasoned action items demonstrated two dimensions each. The factor analysis indicated that descriptive normative pressure and injunctive normative pressure existed as dimensions of perceived social pressure, and capacity and autonomy existed as dimensions of perceived behavioral control. To validate the uniqueness of the five latent variables associated with reasoned action items, I also ran a factor analysis of all 19 items using orthogonal rotation. As expected, the results of this larger factor analysis were identical to the results of the individual factor analyses, further validating the theoretical foundations and dimensionality of these measures. Detailed results of the factor analyses and subsequent univariate analyses are included below.

Attitude. I initially used six survey items (Appendix F, Items 24-29) on a semantic differential scale to measure attitude towards concussion symptom reporting (Register-Mihalik, 2010). Register-Mihalik (2010) reported a very good Cronbach's alpha of 0.83 for the seven items that she included in her measure of attitude (DeVellis, 2003). I included only six of the items developed by Register-Mihalik (20101) in the survey, and eliminated the item quantifying concussion reporting on a scale from extremely difficult to extremely easy because this is a measure of control, not a measure of attitude. I also reverse coded two of the items (Item 25: pleasant/embarrassing; and

Item 27: good/bad) so that all low scores on these six items indicated negative symptom reporting attitudes, and all high scores indicated positive symptom reporting attitudes.

Exploratory factor analysis supported the use of a one-factor model for attitude (Table 12; Eigenvalue: 3.23). I also computed Cronbach's alpha to assess the internal consistency of this measure (Table 13). After conducting these analyses, I removed the semantic differential item qualifying concussion reporting as pleasant versus embarrassing. All other semantic differentials in this portion of the survey were clear opposites; however, embarrassing is not the opposite of pleasant, making the choice somewhat ambiguous. Statistically, this item failed to load on the "attitude" factor with the remaining items in this category. The pleasant/embarrassing also had a high uniqueness value (0.92) in the one-factor model and resulted in a lower Cronbach's alpha (0.82). After eliminating this item, Cronbach's alpha improved to 0.90. Dropping this item in favor of a five-item attitude scale makes the scale more theoretically and statistically sound.

Forty-two cases had missing values for attitude items (15 cases had one missing value, 1 case had two missing values, 7 cases had three missing values, and 19 cases had four missing values). In creating a composite score of attitude, I used a conservative approach of imputing the median for missing values (Acuna & Rodriquez, 2004). I chose to use the median versus the mean because the distribution for each attitude item had had a negative skew. After imputing missing values, I generated a mean score to create a multi-item scale for all five attitude items (Table 14; Figure 9).

Table 12

Factor Analysis of Attitude

Factor	Eigenvalue	Difference	Proportion of Variance	Cumulative Variance
Factor1	**3.23047**	**3.19567**	**1.0711**	**1.0711**
Factor2	0.03480	0.08188	0.0115	1.0826
Factor3	-0.04708	0.05057	-0.0156	1.0670
Factor4	-0.09764	0.00686	-0.0324	1.0346
Factor5	-0.10450	.	-0.0346	1.0000

Table 13

Cronbach's alpha for Attitude

Item	N	Sign	Item-Test Correlation	Item-Rest Correlation	Average Interitem Covariance	Alpha if item deleted
Cowardly/Brave	2649	+	0.8017	0.6922	1.898537	0.8959
Harmful/Beneficial	2649	+	0.8783	0.8004	1.715707	0.8730
Bad/Good	2649	+	0.7797	0.6645	1.955304	0.9013
Unimportant/Important	2649	+	0.8717	0.7888	1.719462	0.8756
Worthless/Valuable	2649	+	0.9100	0.8495	1.643809	0.8618
Test scale					1.786564	0.9035

Table 14

Univariate Analysis of Attitude

Mean	Median	Std. Deviation	Pseudo Std. Dev.	n
5.312	5.6	1.406	1.334	2649

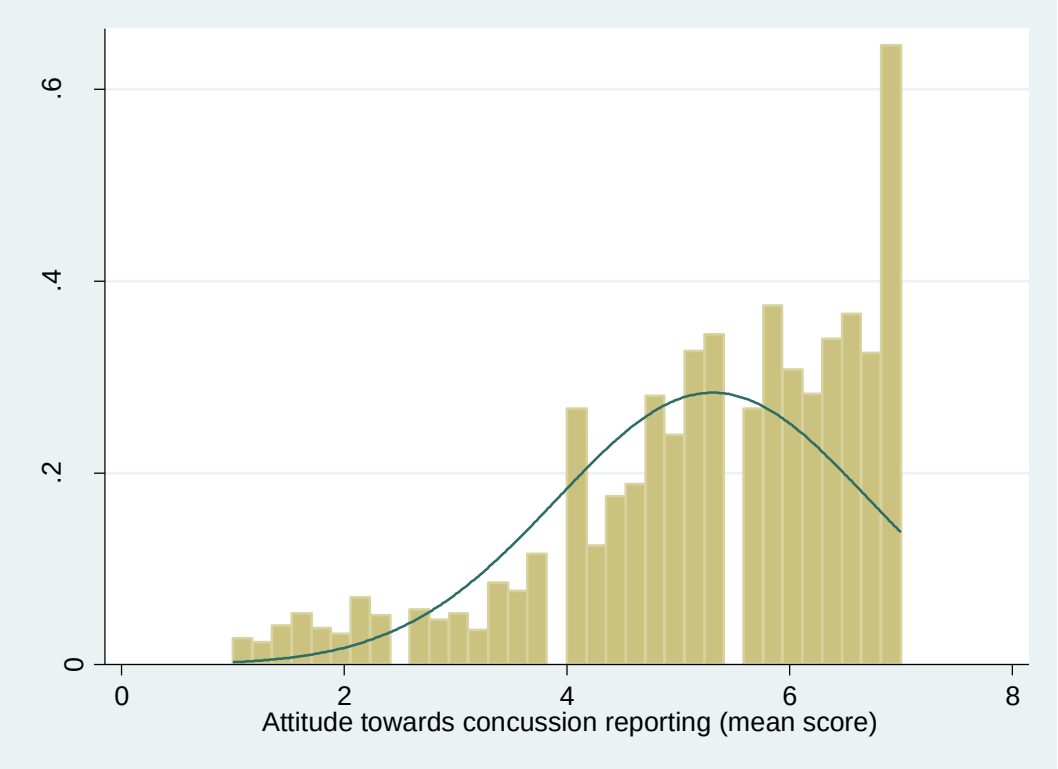

Figure 9. Histogram of attitude mean composite scores.

Perceived social pressure. I measured perceived social pressure using 12 items (Appendix F, Items 30-41). I adapted eight items from measures used by Register-Mihalik (2010) for injunctive norms (Items 34-41), and created four novel items to measure descriptive norms (Items 30-33). The eight items measuring injunctive norms consist of pairs of items that represent four different social referent groups (coaches, teammates, parents, and athletic trainers). Each pair consists of a normative belief strength and motivation to comply. I measured belief strength on a scale from -3 ("I should not report") to +3 ("I should report"), and I measured motivation to comply on a scale from 1 ("I do not want to do what others want me to do") to 7 ("I do want to do what others want me to do"). By multiplying these two items for each social referent, I generated four "injunctive norm" terms, as proposed by Fishbein and Ajzen (2010, p.

136). This multi-item scale ranged from -21 to +21, where positive scores indicate normative pressure to report symptoms and negative scores indicate normative pressure to not report symptoms.

Factor analysis supported a two-factor model of perceived social pressure (Table 15). A scree plot (Figure 10) provided further evidence to support a two-factor model. Orthogonal rotation provided more clearly identifiable factor loadings for descriptive and injunctive norms (Table 16). The four-item descriptive norm multi-item scale has a very good Cronbach's alpha of 0.83 (Table 17), and the four-item injunctive norm multi-item scale has a respectable Cronbach's alpha of 0.79 (Table 19). Seventeen respondents had missing values for descriptive norm items, with only three of those cases having missing values for more than one item. Forty-eight respondents had missing values for injunctive norm interaction terms, with only two respondents missing values for more than one item. As with the attitude measures, I replaced missing values by imputing the median value of each item (Acuna & Rodriquez, 2004). I then generated mean scores for descriptive norms (Table 18; Figure 11) and injunctive norms (Table 20; Figure 12).

Table 15

Factor Analysis of Perceived Social Pressure

Factor	Eigenvalue	Difference	Proportion of Variance	Cumulative Variance
Factor1	**3.02562**	**1.84868**	**0.8332**	**0.8332**
Factor2	**1.17694**	**1.17076**	**0.3241**	**1.1573**
Factor3	0.00618	0.01924	0.0017	1.1590
Factor4	-0.01306	0.07949	-0.0036	1.1554
Factor5	-0.09255	0.02698	-0.0255	1.1299
Factor6	-0.11953	0.03297	-0.0329	1.0970
Factor7	-0.15250	0.04714	-0.0420	1.0550
Factor8	-0.19963	.	-0.0550	1.0000

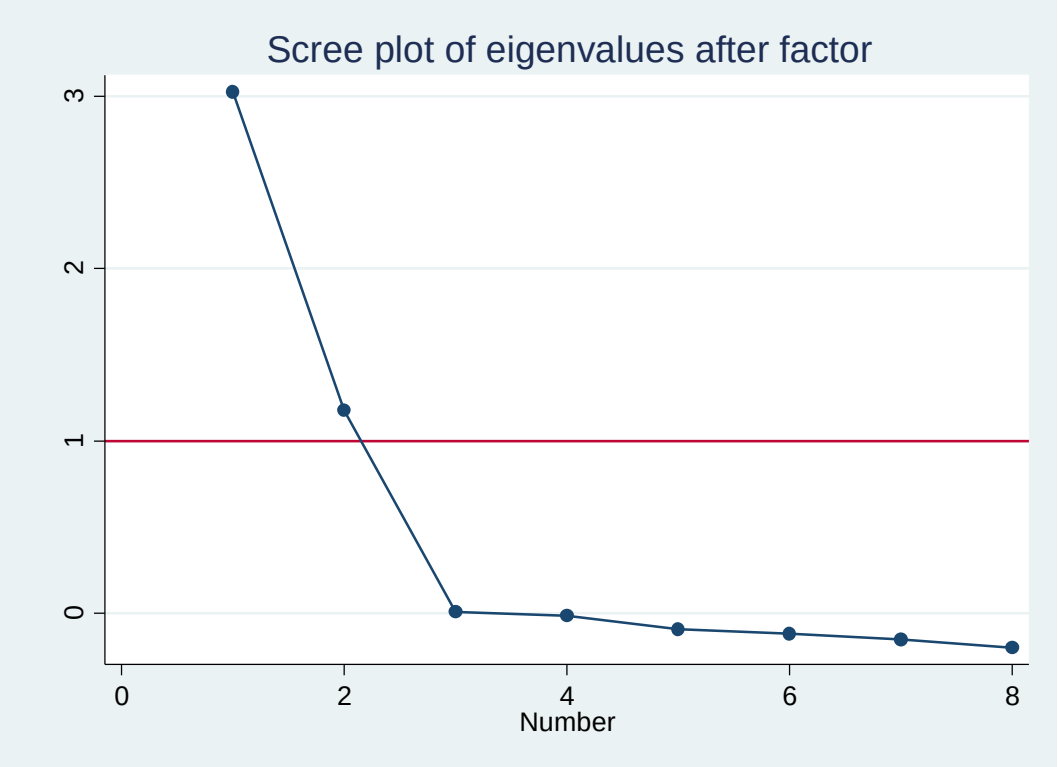

Figure 10. Scree plot of perceived social pressure following factor analysis.

Table 16

Factor Loadings for Perceived Social Pressure With Orthogonal Rotation

Variable	Descriptive Norms	Injunctive Norms	Uniqueness
People like me	**0.5919**	0.2323	0.5952
People in my sport	**0.8000**	0.0917	0.3508
My teammates	**0.7833**	0.1880	0.3506
College athletes	**0.6947**	0.0866	0.5097
Coach pressure	0.1850	**0.6635**	0.5250
Teammate pressure	0.3946	**0.5633**	0.5250
Parent pressure	0.1247	**0.7107**	0.4786
Athletic trainer pressure	0.0703	**0.7333**	0.4565

Table 17

Cronbach's alpha for Descriptive Normative Pressure

Item	N	Sign	Item-Test Correlation	Item-Rest Correlation	Average Interitem Covariance	Alpha if item deleted
People like me	2649	+	0.7499	0.5658	1.307642	0.8297
People in my sport	2649	+	0.8614	0.7329	1.031227	0.7559
My teammates	2649	+	0.8631	0.7208	.9911383	0.7623
College athletes	2649	+	0.7891	0.6430	1.258657	0.7993
Test scale					1.147166	0.8330

Table 18

Univariate Analysis of Descriptive Normative Pressure

Mean	Median	Std. Deviation	Pseudo Std. Dev.	n
4.291	4.250	1.174	1.112	2649

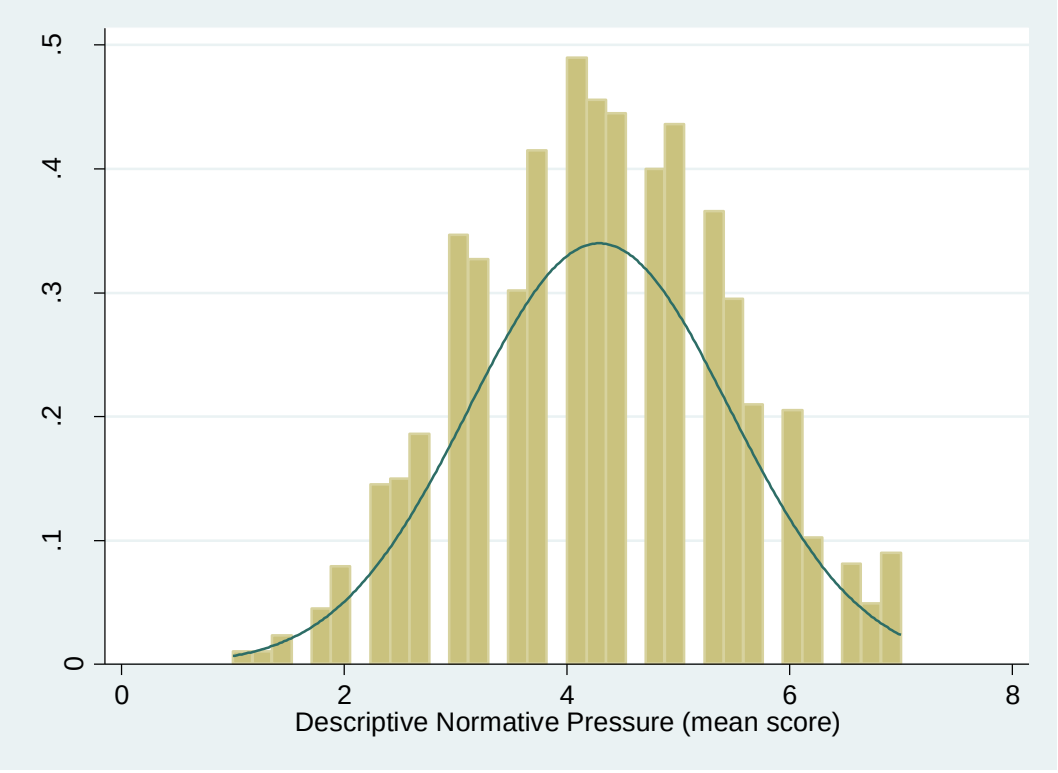

Figure 11. Histogram of descriptive normative pressure mean composite score.

Table 19

Cronbach's alpha for Injunctive Normative Pressure

Item	N	Sign	Item-Test Correlation	Item-Rest Correlation	Average Interitem Covariance	Alpha if item deleted
Coach pressure	2649	+	0.8143	0.6236	22.57081	0.7296
Teammate pressure	2649	+	0.7784	0.5589	24.63946	0.7664
Parent pressure	2649	+	0.7911	0.6238	25.05087	0.7291
Athletic trainer pressure	2649	+	0.7747	0.6348	27.62582	0.7353
Test scale					24.97174	0.7913

Table 20

Univariate Analysis of Injunctive Normative Pressure

Mean	Median	Std. Deviation	Pseudo Std. Dev.	n
13.180	14.000	5.618	5.560	2649

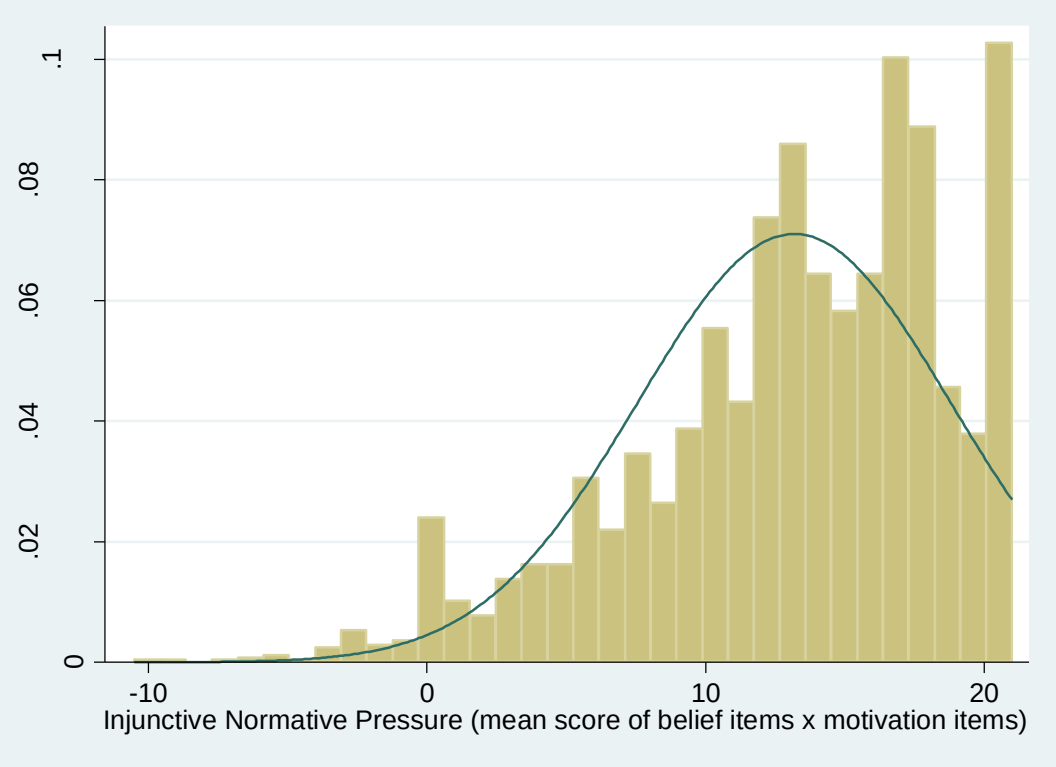

Figure 12. Histogram of injunctive normative pressure mean composite scores.

Perceived behavioral control. I initially included seven Likert scale items in the survey to measure perceived behavioral control (Appendix F, Items 42-48); however, the item 42 ("I am confident in my ability to recognize the symptoms of a concussion"), is a conceptually different type of question compared to the other perceived behavioral control items, which more specifically address capacity and autonomy related to symptom reporting. Theoretically, item 42 seems to measure perceived knowledge of symptoms as opposed to behavioral control. Statistically, this variable also did not clearly load onto either of the perceived behavioral control dimensions in the factor analysis, and it demonstrated low item-rest correlation and high uniqueness. Perceived symptom knowledge may still have utility in predicting concussion symptom reporting; however, it is not a measure of perceived control. Therefore, I included perceived concussion symptom knowledge as a background/control variable, instead of as a measure of perceived behavioral control.

After dropping item 42 from the scale, factor analysis of the remaining six items provided evidence of a two-factor model for perceived behavioral control. Despite an Eigenvalue less than one for factor 2 (Table 21), the scree plot (Figure 13) provided evidence of a two-factor model for perceived behavioral control. Orthogonal rotation made the factor loadings more clear for the two perceived behavioral control subscales: capacity and autonomy (Table 22). The four capacity items demonstrated a very good Cronbach's alpha of 0.94 (Table 23), while the two autonomy items also had a very respectable Cronbach's alpha of 0.80 (DeVellis, 2003).

Table 21

Factor Analysis of Perceived Behavioral Control

Factor	Eigenvalue	Difference	Proportion of Variance	Cumulative Variance
Factor1	**3.37510**	**2.47516**	**0.8434**	**0.8434**
Factor2	**0.89995**	**0.79243**	**0.2249**	**1.0683**
Factor3	0.10752	0.18531	0.0269	1.0952
Factor4	-0.07779	0.01254	-0.0194	1.0757
Factor5	-0.09033	0.12245	-0.0226	1.0532
Factor6	-0.21278	.	-0.0532	1.0000

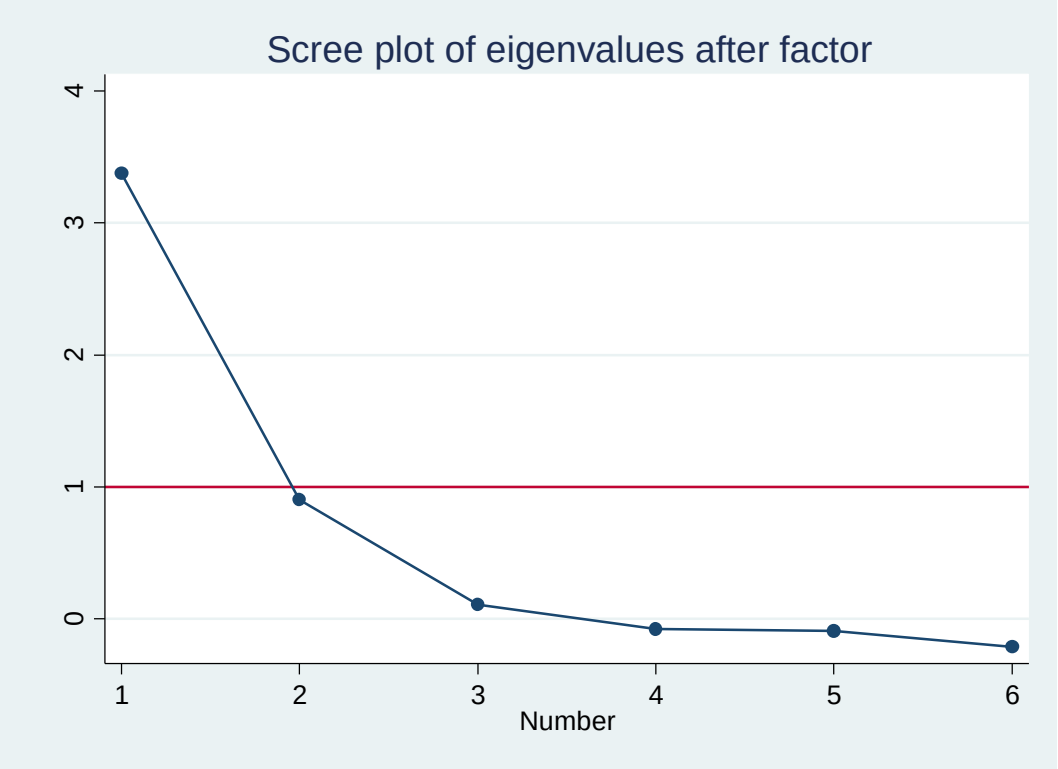

Figure 13. Scree plot of perceived behavioral control following factor analysis.

Table 22

Factor Loadings for Perceived Behavioral Control With Orthogonal Rotation

Variable	Capacity	Autonomy	Uniqueness
Report when I want to play	**0.8866**	0.1406	0.1682
Report when team wants me to play	**0.8911**	0.1505	0.1583
Report even if symptoms are not bad	**0.9020**	0.1112	0.1559
Report if I am unsure it is a concussion	**0.8270**	0.1596	0.2522
Reporting is up to me	0.1638	**0.7299**	0.4404
I have complete control	0.1705	**0.7270**	0.4424

Table 23

Cronbach's alpha for Capacity

Item	N	Sign	Item-Test Correlation	Item-Rest Correlation	Average Interitem Covariance	Alpha if item deleted
Report when I want to play	2647	+	0.9169	0.8571	2.192912	0.9168
Report when team wants me to play	2646	+	0.9212	0.8626	2.155853	0.9146
Report even if symptoms are not bad	2645	+	0.9390	0.8838	1.960002	0.9072
Report if I am unsure it is a concussion	2645	+	0.8983	0.8104	2.092594	0.9320
Test scale					2.100325	0.9370

Table 24

Univariate Analysis of Capacity

Mean	Median	Std. Deviation	Pseudo Std. Dev.	n
5.010	5.250	1.497	1.483	2649

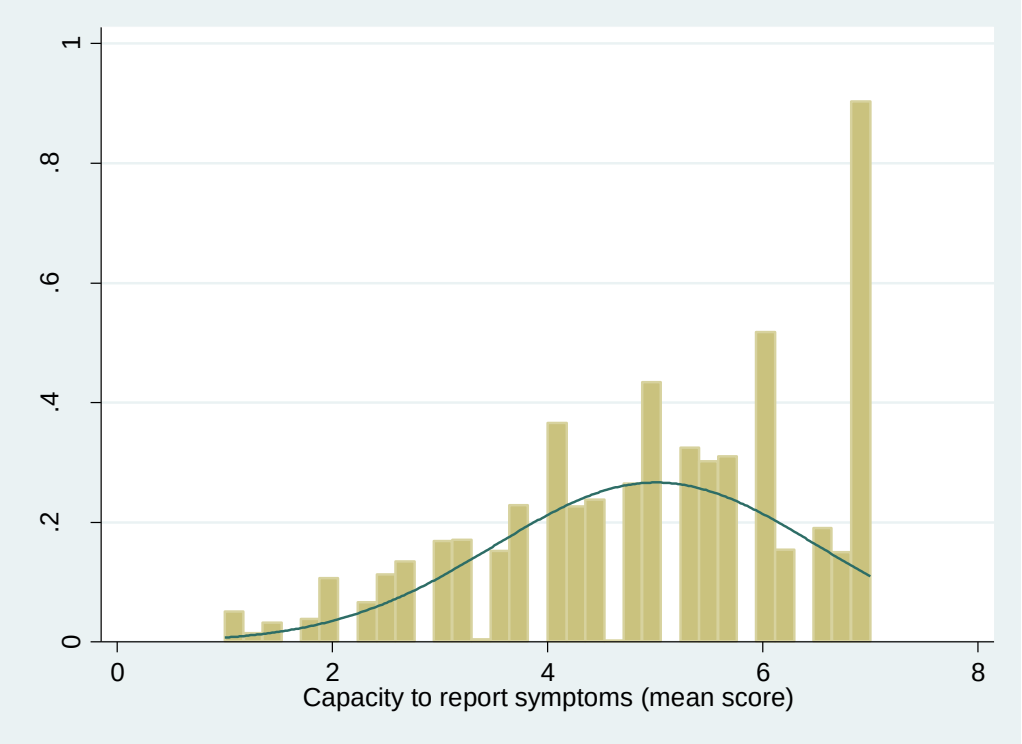

Figure 14. Histogram of capacity mean composite score.

For capacity, 13 cases existed with missing values. Each of these had only one missing value. Based on the low number of missing values and the very high Cronbach's alpha of 0.94, I generated a mean multi-item scale for capacity irrespective of missing values (Table 24; Figure 14). For autonomy, only 11 cases had missing values. Because autonomy is only a 2-item scale, and because of the negative skew and slightly lower Cronbach's alpha of 0.80, I used the more conservative approach and imputed the median for these missing values (Acuna & Rodriquez, 2004) before creating a mean multi-item scale (Table 25; Figure 15).

Table 25

Univariate Analysis of Autonomy

Mean	Median	Std. Deviation	Pseudo Std. Dev.	n
5.664	6.000	1.312	1.483	2649

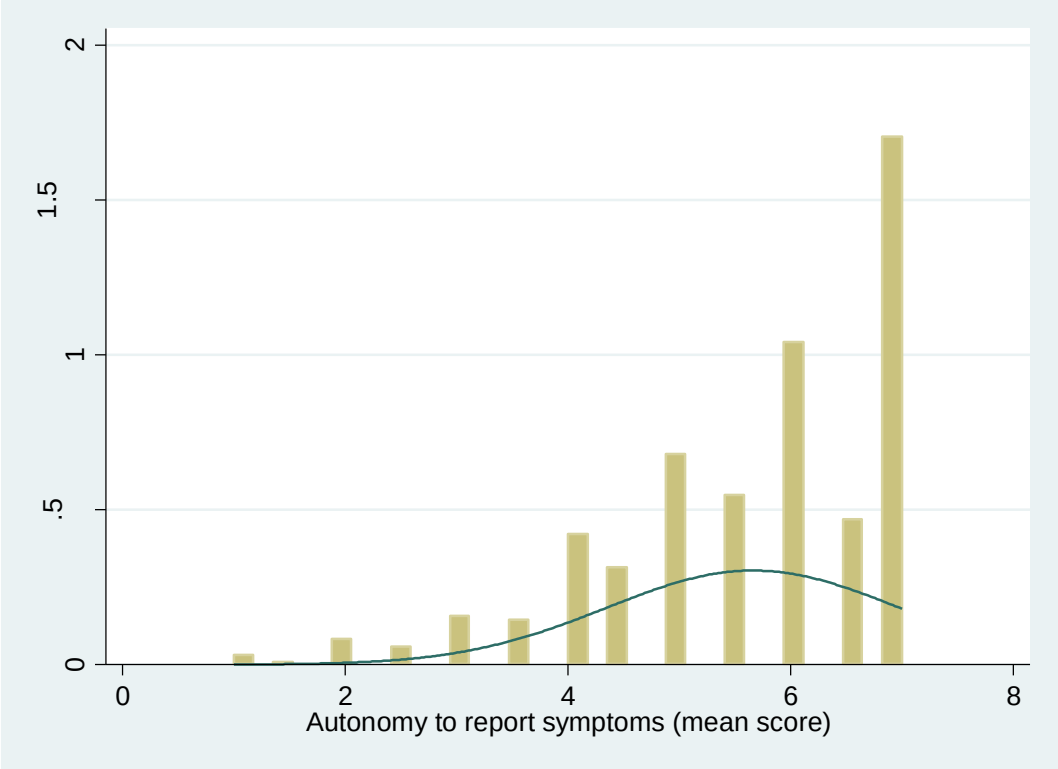

Figure 15. Histogram of autonomy mean composite score.

Athletic identity. Through exploratory factor analysis, I determined that the 7-item AIMS measured only one factor (Table 26; Eigenvalue: 2.49). The one-factor model explained 85.50% of the variance across the AIMS items.

To assess the reliability/internal consistency of this measure in the current study, I found a Cronbach's alpha of 0.77 (Table 27). DeVellis (2003) proposed that alpha levels between 0.70 and 0.80 are respectable, while alpha levels between 0.80 and 0.90 are very good. Based on these criteria, I am confident in the internal consistency of the AIMS in this study. Despite slightly lower item-test and item-rest correlations for the "Self-identity" item (item 17: "I consider myself an athlete"), this item is fundamental to measuring one's identity as an athlete, and elimination of this item failed to improve

Cronbach's alpha. Therefore, I decided to retain item 17 in the calculation for the mean AIMS score.

I identified one missing value in 23 cases, and I identified two missing values in only one case. I accounted for missing values by calculating a mean value across all seven AIMS items (Table 28; Figure 16). Table 29 provides a summary of all variables.

Table 26

Factor Analysis of Athletic Identity

Factor	Eigenvalue	Difference	Proportion of Variance	Cumulative Variance
Factor1	**2.49343**	**1.73961**	**0.8550**	**0.8550**
Factor2	0.75382	0.44391	0.2585	1.1135
Factor3	0.30991	0.37905	0.1063	1.2198
Factor4	-0.06913	0.07972	-0.0237	1.1961
Factor5	-0.14885	0.05015	-0.0510	1.1450
Factor6	-0.19901	0.02487	-0.0682	1.0768
Factor7	-0.22388	.	-0.0768	1.0000

Table 27

Cronbach's alpha for Athletic Identity

Item	N	Sign	Item-Test Correlation	Item-Rest Correlation	Average Interitem Covariance	Alpha if item deleted
Self-identity	2649	+	0.4560	0.3581	.7491129	0.7727
Sport goals	2646	+	0.6027	0.4876	.6702302	0.7518
Athlete friends	2644	+	0.5827	0.4316	.6562693	0.7576
Part of life	2638	+	0.7758	0.6336	.5064687	0.7137
Spend time	2648	+	0.7737	0.6284	.5056575	0.7148
Self esteem	2647	+	0.6480	0.4713	.5976292	0.7515
Injury response	2646	+	0.6951	0.5162	.5583787	0.7431
Test scale					.6062332	0.7738

Table 28

Univariate Analysis of Athletic Identity

Mean	Median	Std. Deviation	Pseudo Std. Dev.	n
5.601	5.714	0.885	0.847	2649

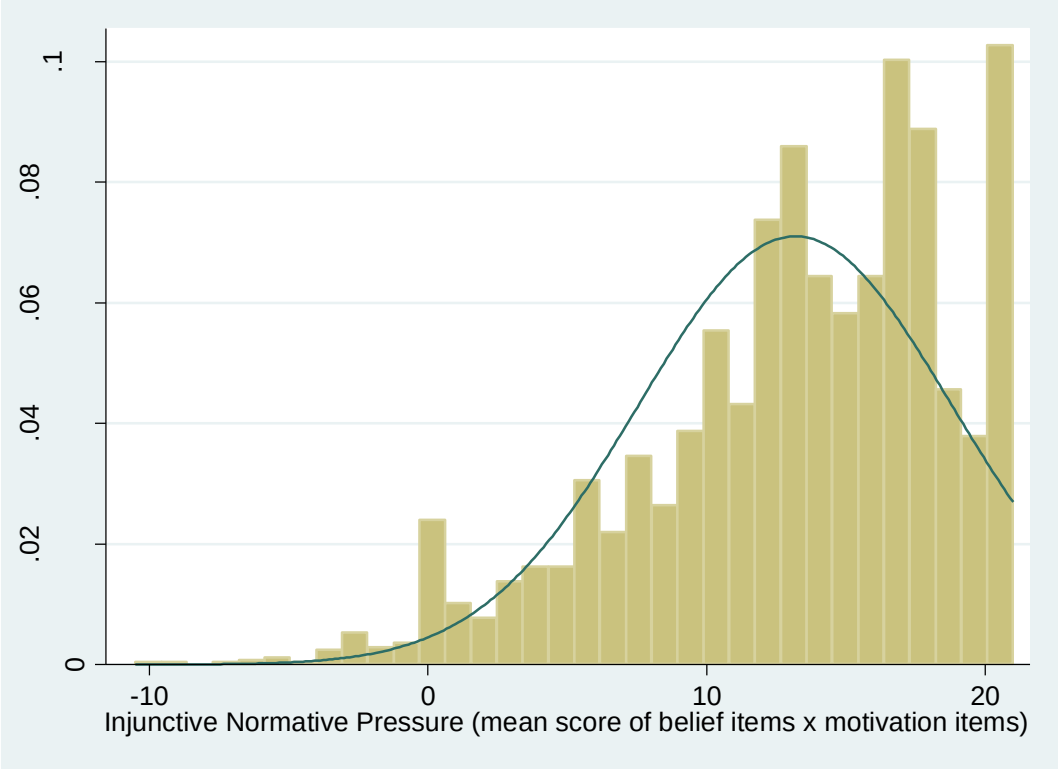

Figure 16. Histogram of AIMS mean composite score.

Table 29

Summary of Variables

Variable	Variable Type	Source	Description
Intention	Dependent variable (endogenous outcome)	Mean multi-item scale of items 9-15	Probability that respondent will report concussion symptoms
Attitude	Independent variable (endogenous mediator)	Mean multi-item scale of items 24, 26-29	Evaluation of concussion reporting as favorable or unfavorable
Descriptive norms	Independent variable (endogenous mediator)	Mean multi-item scale of items 30-33	Perception of how others would behave (dimension of PSP)
Injunctive norms	Independent variable (endogenous mediator)	Mean multi-item scale of interactions between belief strength (34-37) and motivation to comply (38-41)	Perception of what others think the respondent should do if experiencing concussion symptoms (dimension of PSP)
Capacity	Independent variable (endogenous mediator)	Mean multi-item scale of items 43-46	Ability to report concussion symptoms (dimension of PBC)
Autonomy	Independent variable (endogenous mediator)	Mean multi-item scale of items 47-48	Degree of control over reporting concussion symptoms (dimension of PBC)
Athletic identity	Independent variable (endogenous mediator)	Mean multi-item scale of items 17-23	Degree to which respondent identifies with the athlete role
Sex	Control variable	Survey item 1	Male or female
Minority status	Control variable	Survey item 3	Minority or non-minority student
Age	Control variable	Survey item 2	Age at time of survey
Sport type	Control variable	Survey item 6	Limited/non-contact, contact, or collision sport
Years in sport	Control variable	Survey item 7	Number of years participating in primary sport since age 12
Concussion history	Control variable	Survey items 50	Number of previous concussions
Perceived knowledge	Control variable	Survey item 42	Perceived ability to recognize concussion symptoms

Model Building

In this section, I describe the application of ordinary least squares (OLS) regression to analyze the statistical relationships among the variables discussed above. The causal model described in chapter 3 provides a framework for examining the combined effects of the independent variables on influencing concussion reporting intention (Table 29). I used hierarchical (nested) regression to examine the additional variance explained by each step of the causal model. The final hierarchical regression model (Figure 17) includes seven control variables (sex, minority status, age, sport type, years in sport, concussion history, and perceived knowledge) and six endogenous mediating variables (athletic identity, attitude, descriptive normative pressure, injunctive normative pressure, capacity, and autonomy).

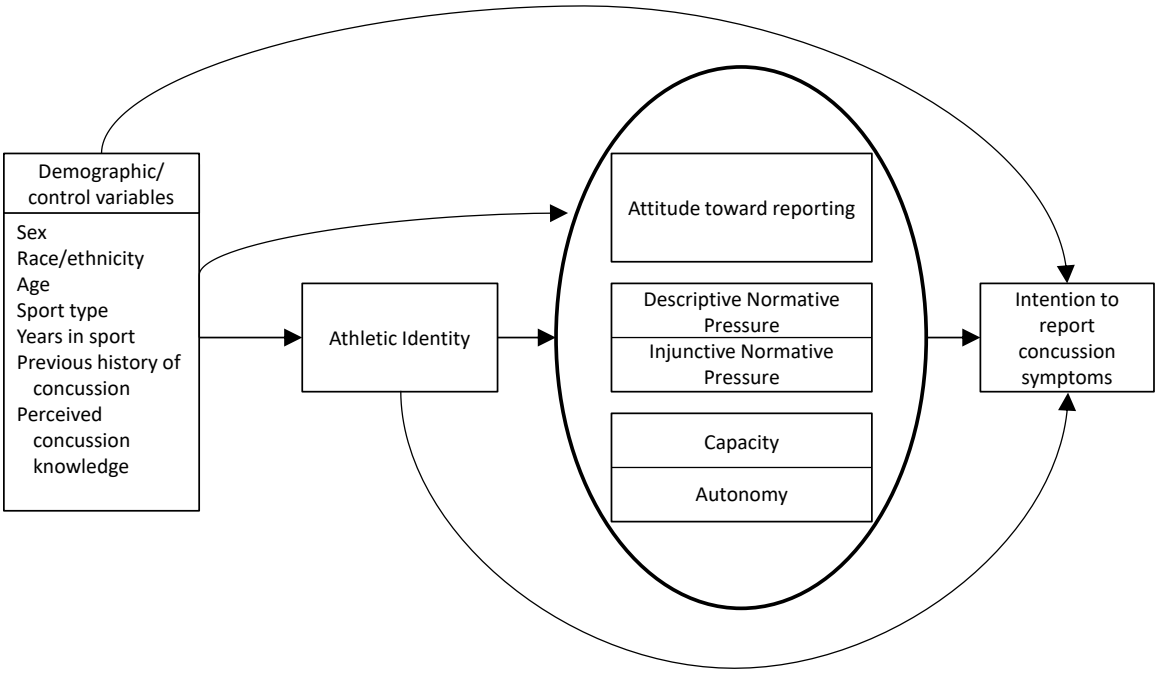

Figure 17. Revised causal model summarizing the relationships among variables.

Table 30 below displays the full output from the regression of intention on all other independent variables ($R^2 = 0.1424$). Using this full regression model, the variables that demonstrate a significant direct effect ($p \leq .05$) on intention include attitude towards reporting, descriptive normative pressure, injunctive normative pressure, and capacity to report. Consistent with the causal model above, I conducted hierarchical regression to identify changes in the coefficient of determination (R^2) with the addition of each group of variables.

Table 30

Regression of Intention on All Independent Variables

Independent variables	Coefficient	Standard Error	p-value	b^*[a]
Sex	.0825076	.0868889	0.342	.0232663
Age	.0490914	.0283808	0.084	.0397750
Minority status	-.1887101	.1108088	0.089	-.0371885
Contact sport	.0945409	.0719563	0.189	.0271457
Collision sport	-.0676805	.1114164	0.544	-.0142716
Years in sport	-.0069507	.0198403	0.726	-.0082663
Concussion history	.0389209	.0281625	0.167	.0255038
Perceived knowledge	-.0340946	.0294057	0.246	-.0250791
Athletic identity	-.06942	.0395112	0.079	-.0364472
Attitude	.0759311	.0267732	***0.005**	.0628123
Descriptive norms	.1885445	.0353751	***0.000**	.1305990
Injunctive norms	.0324122	.006982	***0.000**	.1070158
Capacity	.2223027	.0265386	***0.000**	.1958342
Autonomy	.0321659	.026905	0.232	.0251861
_cons	.8568929	.6154051	0.164	.

Note. R^2 value = 0.1424. Adjusted R^2 value = 0.1373
n = 2,366
[a]b^* = standardized regression coefficient

Model Critique

Following the OLS regression, the variance inflation factors (VIF) in table 31 provide evidence that the model does not have a problem with multicollinearity. The residuals versus fitted values (RVF) plot revealed slight heteroscedasticity, requiring the

use of robust standard errors (Figure 18). A leverage versus squared residuals (LVR2) plot failed to identify any severe outliers or influential cases (Figure 19), suggesting that OLS regression with robust standard errors was a more appropriate model than robust regression (Hamilton, 1992).

Table 31

Test for Multicollinearity

Variable	VIF	1/VIF
Capacity	1.87	0.535302
Perceived knowledge	1.62	0.617633
Collision sport	1.53	0.655104
Sex	1.47	0.678021
Injunctive norms	1.44	0.693762
Age	1.44	0.696787
Years in sport	1.41	0.708570
Descriptive norms	1.41	0.710321
Autonomy	1.21	0.827212
Contact sport	1.20	0.832211
Attitude	1.18	0.850908
Concussion history	1.13	0.885332
Athletic identity	1.06	0.941639
Minority status	1.06	0.945705
Mean VIF	1.36	

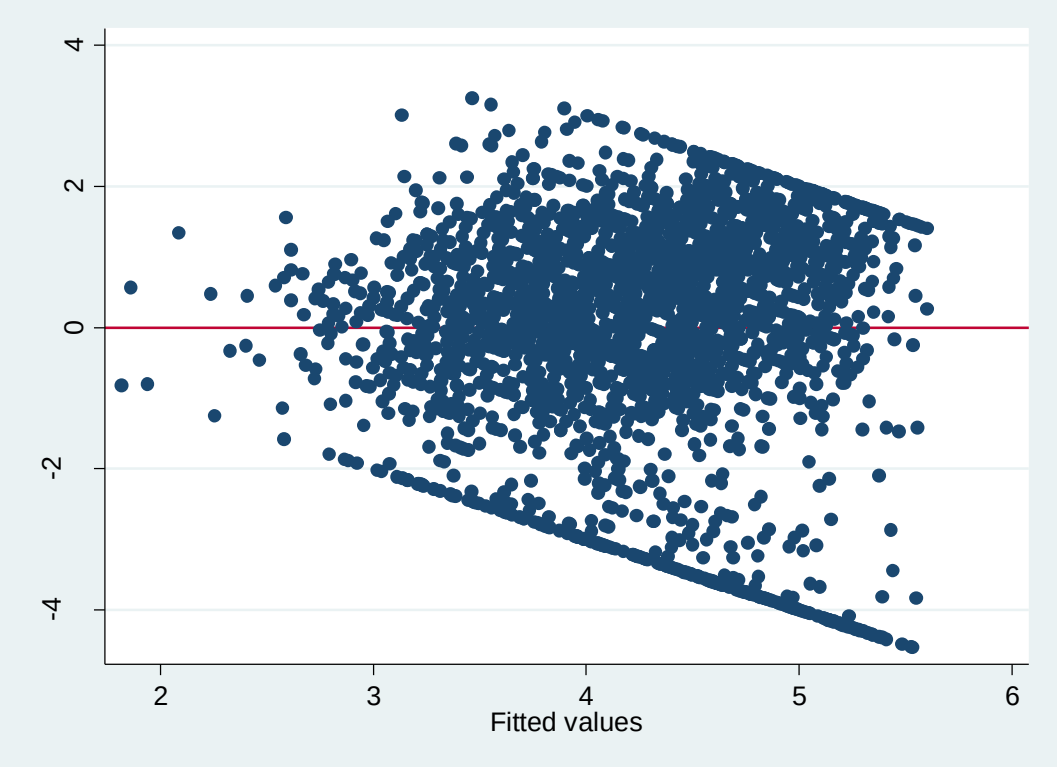

Figure 18. Residuals versus fitted squares plot for the full OLS model.

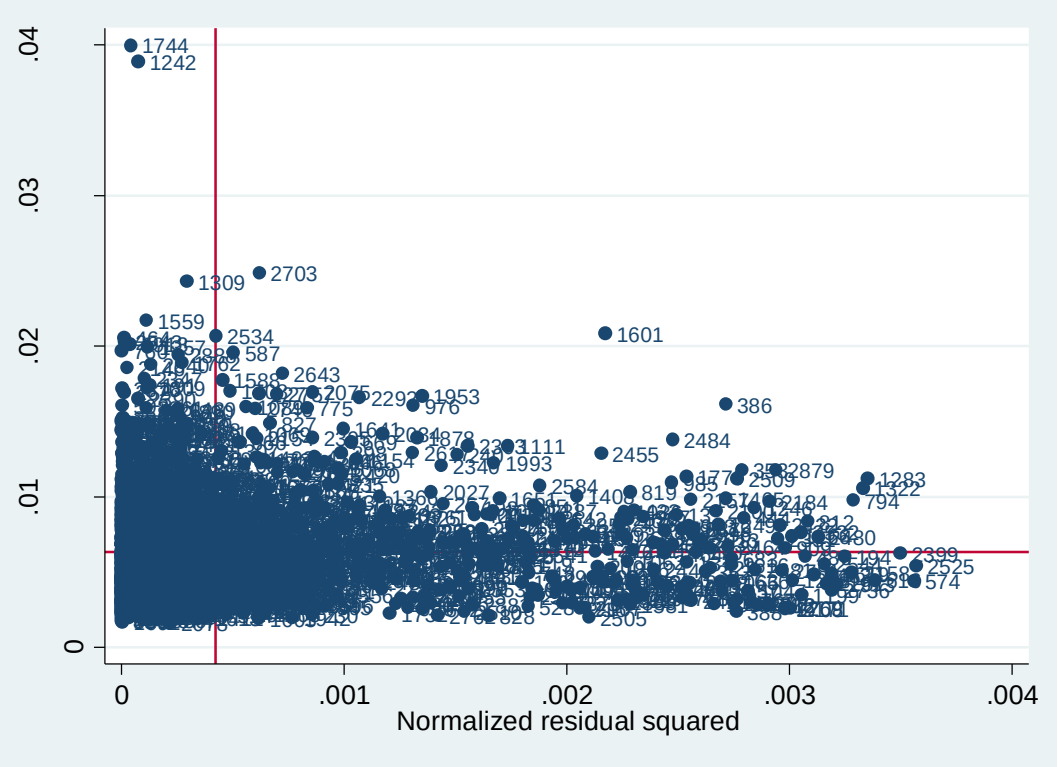

Figure 19. Leverage versus squared residuals plot for the full OLS model.

OLS regression using robust standard errors provided the most appropriate model for interpreting these data. Using the Huber-White sandwich estimator of variance to calculate robust standard errors in the OLS model corrected for the slight heteroscedasticity present in each model (Hamilton, 2013). Without the Huber-White sandwich estimator of variance, the full regression model produced an R^2 value of 0.1424 and an adjusted R^2 value of 0.1373. This minimal difference (0.0051) between the R^2 and the adjusted R^2 provides evidence of a relatively parsimonious model.

Post-priori, I investigated interactions between several independent variables. As expected, I did not identify any meaningful interaction effects between variables, therefore I have not included interaction terms in this report (Mehmetoglu & Jakobsen, 2017).

Hierarchical Regression

Aligning with the proposed causal model for this study, I used hierarchical OLS regression to regress concussion symptom reporting intention on (a) demographic variables; (b) athletic identity and demographic variables; and (c) reasoned action variables, athletic identity, and demographic variables. Statistically significant findings ($p < .05$) from each step of the hierarchical regression are presented in Table 32.

Table 32

Hierarchical Regression of Symptom Reporting Intention on All Independent Variables

Predictor	*t*-statistic	*p*-value	b^{*a}	R^2	ΔR^2
Step 1				0.0392	
Sex	1.46	0.146	.0375974		
Age	1.36	0.174	.0331846		
Minority status	-1.77	0.077	-.0386079		
Contact sport	-0.51	0.609	-.0111270		
Collision sport	-2.35	**0.019***	**-.0592292**		
Years in sport	-1.26	0.208	-.0311855		
Concussion history	-1.88	0.060	-.0382559		
Perceived knowledge	8.62	**0.000***	**.1711461**		
Step 2				0.0416	0.0024 (p = .026*)
Sex	1.36	0.175	.0351706		
Age	1.15	0.252	.0281177		
Minority status	-1.59	0.112	-.0350323		
Contact sport	-0.39	0.698	-.0084419		
Collision sport	-2.32	**0.021***	**-.0584645**		
Years in sport	-1.05	0.292	-.0261492		
Concussion history	-1.83	0.068	-.0368679		
Perceived knowledge	8.81	**0.000***	**.1758517**		
Athletic identity	-2.22	**0.026***	**-.0495633**		
Step 3				0.1424	0.1008 (p < .001*)
Sex	0.95	0.342	.0232663		
Age	1.73	0.084	.0397750		
Minority status	-1.70	0.089	-.0371885		
Contact sport	1.31	0.189	.0271457		
Collision sport	-0.61	0.544	-.0142716		
Years in sport	-0.35	0.726	-.0082663		
Concussion history	1.38	0.167	.0255038		
Perceived knowledge	-1.16	0.246	-.0250791		
Athletic identity	-1.76	0.079	-.0364472		
Attitude	2.84	**0.005***	**.0628123**		
Descriptive norms	5.33	**0.000***	**.1305990**		
Injunctive norms	4.64	**0.000***	**.1070158**		
Capacity	8.38	**0.000***	**.1958342**		
Autonomy	1.20	0.232	.0251861		

n = 2,366

*p < .05

[a]b^* = standardized regression coefficient

Block one of the hierarchical regression (intention on demographic variables) revealed an R^2 value of 0.0392, with collision sport participation and perceived knowledge showing statistical significance. The addition of athletic identity in Block 2 produced an R^2 value of 0.0416 – an increase of only 0.0024 – with collision sport participation, perceived knowledge, and athletic identity demonstrating statistical significance. Adding the reasoned action variables in Block 3 increased the R^2 value to 0.1424, an increase of 0.1008. According to Mehmetoglu and Jakobsen (2017), an R^2 value between 0.1 and 0.3 indicates a moderate effect in social science research. The only reasoned action variable that did not significantly predict intention was autonomy. Figure 20 shows the partial regression leverage plots for all independent variables that directly affect concussion symptom reporting intention. These plots depict the effect of each variable on intention, while controlling for all other variables (Hamilton, 2013).

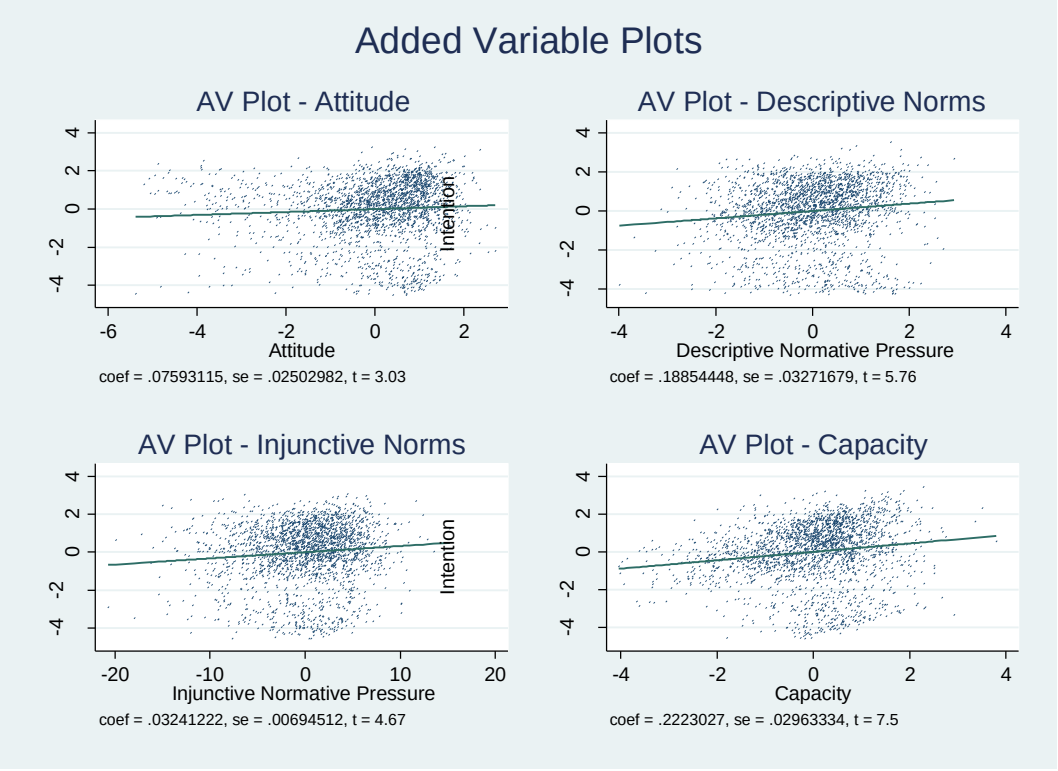

Figure 20. Partial regression leverage plots

Mediation

Considering the full OLS model, no demographic variables had a direct effect on intention while controlling for other variables. In Blocks 1 and 2 of the hierarchical regression, collision sport participation and perceived knowledge had an effect on intention. By adding athletic identity to the model in Block 2, athletic identity demonstrated a significant effect on intention, and the addition resulted in a miniscule change in the standardized coefficients for collision sport participation and perceived knowledge. However, when accounting for the reasoned action approach, all three of these variables fail to produce a significant effect on intention. Therefore, the reasoned action variables – attitude, descriptive norms, injunctive norms, and capacity – fully mediate the effect of collision sport participation, perceived knowledge, and athletic identity on concussion reporting intention.

Hypothesis Testing

I used hierarchical OLS multiple regression to test the hypothesized relationships among variables in this study (Table 33). The data did not support hypothesis 1, that sex would be a significant predictor of concussion symptom reporting intention. Irrespective of other variables, sex did not demonstrate statistical significance in any step of the hierarchical regression (Table 32).

The data partially supported hypothesis 2, which suggested that sport type would predict concussion symptom reporting intention. I hypothesized that limited/non-contact sports would demonstrate greater intention to report than both contact and collision sports. Collision sports showed statistical significance in blocks 1 and 2 of the nested regression, but the effect on intention was minimal. The addition of the reasoned action

variables in block 3 completely dissipated the small effect of collision sports, suggesting that the small negative effect of this variable was mediated by the reasoned action variables – specifically attitude, descriptive norms, injunctive norms, and capacity. Limited/non-contact sports and contact sports were not statistically different from one another in the prediction of concussion symptom reporting intention, and neither of these variables demonstrated an effect on intention at any level of the nested regression.

Hypothesis 3, that higher athletic identity would be associated with lower concussion symptom reporting intention, was also only partially supported by the data. Similar to collision sport participation, athletic identity had a negative effect on intention; however, when controlling for all variables, it became evident that this effect was fully mediated by the reasoned action variables.

Hypotheses 4 and 5 were fully supported by the data. Irrespective of the other variables, attitude towards concussion symptom reporting was positively associated with symptom reporting intention. Similarly, perceived social pressure, which I identified as having two factors (descriptive normative pressure and injunctive normative pressure) showed a positive association with symptom reporting intention in both factors.

Perceived behavioral control was also identified as two separate factors (capacity and autonomy), however, all things being equal, only capacity showed a positive association with symptom reporting intention. Although autonomy did not have a significant effect on intention in this study, hypothesis 6 was still supported in that capacity did demonstrate a significant positive direct effect on intention.

Table 33

Hypothesis Test Results Summary

Number	Hypothesis	Conclusion
1	All things being equal, men will have lower intentions to report concussion symptoms than women do.	Not supported
2	Respondents who participate in limited or non-contact sports will demonstrate a stronger intention to report concussion symptoms than those who participate in contact or collision sports.	Partially supported (collision sports had no direct effect[a])
3	Athletes with greater athletic identity will have lower intentions to report concussion symptoms than athletes with lesser athletic identity do.	Partially supported (no direct effect[a])
4	Athletes with safer attitudes towards concussion reporting will have a greater intention to report concussion symptoms than athletes with less safe attitudes do.	Supported (direct effect)
5	Athletes who perceive less pressure from important social referents regarding concussion reporting will have a greater intention to report concussion symptoms than athletes who perceive greater social pressure.	Supported (direct effect)
6	Athletes who perceive greater control over concussion reporting behavior will have a greater intention to report concussion symptoms than athletes who perceive less control.	Supported (capacity had direct effect; autonomy had no effect)
7	Attitudes, perceived social pressure, and perceived behavioral control will mediate the relationship between athletic identity and concussion symptom reporting intention.	Supported

[a]Effects were suppressed by the addition of reasoned action variables.

Lastly, hypothesis 7 indicated that the effect of athletic identity on concussion symptom reporting would be mediated through the reasoned action variables. This hypothesis was supported, as the effect of athletic identity on concussion reporting intention was fully mediated through the reasoned action variables. The significant effect

of athletic identity in block 2 of the nested regression (b^* = -0.0496) became insignificant with the addition of the variables in block 3 (b^* = -0.0364). The results indicate that the positive effects of the reasoned action variables suppressed the negative effect of athletic identity on reporting intention (MacKinnon, Krull, & Lockwood, 2000).

Chapter Summary

In this chapter, I provided a detailed explanation of the data analysis and results for this study. I first discussed the sample characteristics and response rate, and explained my criteria for keeping or eliminating cases from the final data analysis. I also provided a summary of respondent demographics.

Next, I discussed the dependent and independent variables used in this investigation. This section included the results of univariate analysis for each variable, as well as an explanation of the scale development for the dependent and independent variables. I conducted factor analyses and calculated Cronbach's alpha to create mean multi-item scales for concussion symptom reporting intention, attitudes towards symptom reporting, descriptive normative pressure to report symptoms, injunctive normative pressure to report symptoms, capacity to report symptoms, autonomy to report symptoms, and athletic identity.

After developing internally consistent scales for these variables, I used OLS regression strategies to test my proposed causal model and the hypothesized relationships among variables. A critique of the overall regression model revealed patterns of heteroscedasticity; however, I accounted for heteroscedasticity by using robust standard errors. Analysis of outliers revealed no cases that exerted influence on the overall model.

Based on this critique, I am confident that OLS regression is the most appropriate model for the data collected.

Because I proposed that athletic identity would act as a mediating variable between demographics and the reasoned action variables, I used hierarchical (i.e., nested) regression to determine how much each set of variables (demographic variables, athletic identity, and reasoned action variables) influenced concussion symptom reporting intention and noted the changes in significance, standardized coefficients, and R^2 values at each step.

In the next chapter, I will present the implications of this research and discuss recommendations for behavioral interventions relative to my findings, as well as recommendations for future research. I will also review the limitations and delimitations of this study.

CHAPTER 5

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

In this chapter, I review and summarize the key findings of the research. Based on these findings, and building upon existing literature, I provide recommendations for potential interventions to positively influence concussion symptom reporting behavior. I also discuss the limitations and delimitations of this investigation, and provide recommendations for future research.

As discussed in chapter one, concussion symptoms often go undetected or unreported in athletes across various sports and competition levels, sometimes with devastating consequences. Based on the prevalence of concussion underreporting in a wide variety of athletes, the purpose of this study was to identify individual characteristics that influence college athletes' intentions to report concussion symptoms to a coach or athletic trainer. A theoretical framework known as the reasoned action approach (Fishbein & Ajzen, 2010) suggests that intention determines behavior, and that attitudes, perceived norms, and perceived behavioral control collectively determine intention. Various individual, social, and environmental background factors influence the behavioral, normative, and control-based beliefs that determine attitudes, perceived norms, and perceived control (Fishbein & Ajzen, 2010). The reasoned action approach formed one of the underpinnings of the conceptual framework used in this investigation to study concussion symptom reporting intention.

Identity theory (Stryker, 1980) also provides a means of understanding individual motivations to comply with behavioral norms. Because of this, identity theory, and more specifically athletic identity, formed an additional element of the conceptual framework.

Athletic identity describes an athlete's commitment to the social norms and expectations associated with the internalized role identity of "athlete" (Brewer, 1993). Through socialization into the athlete role, individuals apply meaning and value to the role, and to the normative behaviors associated with it (Burke & Stets, 2009). Because athletes with a strong and salient athletic identity may value the role of athlete more than other identities and roles that they inhabit (Brewer & Cornelius, 2001; Brewer et al., 1993; Miller & Kerr, 2003; Stephan & Brewer, 2007; Wiechman & Williams, 1997; Yukhymenko-Lescroart, 2014), I predicted an inverse relationship between athletic identity and concussion symptom reporting intention.

To test the proposed relationships embedded in these theories, I conducted a hierarchical OLS regression to quantify the influence of demographic variables, athletic identity, attitude, perceived social pressure (descriptive norms and injunctive norms), and perceived behavioral control (capacity and autonomy) on concussion symptom reporting intention.

Summary of Key Findings

Factor Analysis Results

The RAM-CR survey instrument utilized in this study consisted of 51 items. For the dependent variable, the novel seven-item scale measuring concussion symptom reporting intention (M = 4.21; SD = 1.67) consisted of one factor and produced a Cronbach's alpha of 0.93. This internally consistent scale may have utility in future research on concussion reporting intention because it captures the variation of intention under different reporting conditions. Armitage and Conner (2001) have suggested that multi-dimensional measures of intention explain more variance in intention.

For the independent variables, one of the three primary reasoned action variables (attitude) contained only one factor, while the other two primary reasoned action variables (perceived social pressure and perceived behavioral control) each contained two factors. To measure attitude, I initially included six items from Register-Mihalik (2010), but dropped one item from the final scale following factor analysis. The five-item, one-factor attitude scale generated a very good Cronbach's alpha of 0.90 (DeVellis, 2003).

Consistent with the subcomponents suggested by McEachan et al. (2016), perceived social pressure contained two distinct factors: descriptive norms and injunctive norms. The four-item descriptive norm scale had a strong Cronbach's alpha of 0.83 (DeVellis, 2003), while the four-item injunctive norm scale also had a respectable Cronbach's alpha of 0.79 (DeVellis, 2003).

Also consistent with McEachan et al. (2016), perceived behavioral control contained two factors: capacity and autonomy. One item asking about the ability to recognize symptoms did not load on either of these factors; therefore I included this item as a background/control variable (perceived concussion knowledge), not as a perceived behavioral control item. After making this change, the four-item capacity scale demonstrated a very high Cronbach's alpha of 0.94, which is consistent with the findings of Kroshus, Baugh, et al. (2014), who reported a Cronbach's alpha of 0.91 using the 5-item scale. The novel two-item autonomy scale demonstrated a highly respectable Cronbach's alpha of 0.80 (DeVellis, 2003).

For athletic identity, the seven-item AIMS (Brewer & Cornelius, 2001) had a respectable Cronbach's alpha of 0.77 (DeVellis, 2003), with factor analysis supporting a one-factor AIMS in this study. This finding is similar to that of Brewer and Cornelius

(2001), who reported a Cronbach's alpha of 0.81 for the seven-item AIMS. Some studies have supported a three-factor (Hale et al., 1999; Proios, 2012; Weinberg et al., 2013), or even a four-factor (Martin et al., 1994) measure using the AIMS. Studies by Hale et al. (1999) and Proios (2012) are difficult to compare, because the authors did not report Cronbach's alpha values. Weinberg et al. (2013) reported a high Cronbach's alpha of 0.90 for the full AIMS with alphas of 0.87, 0.89, and 0.76 for the social identity, exclusivity, and negative affectivity subscales, respectively. However, this study included a relatively homogeneous sample of 130 intramural basketball players, which is very different from the current study's sample of 2,649 varsity college athletes from 23 different sports. Using a nine-item version of the AIMS, Martin et al. (1994) found a Cronbach's alpha of 0.79 using the full scale, with lower alpha values for each of four subscales (exclusivity: 0.72, self-identity: 0.72, social identity: 0.65, negative affectivity: 0.64).

Hypothesis Testing Results

As discussed in chapter 4, I tested all research hypotheses using OLS multiple regression. Hierarchical regression illustrated the change in the coefficient of determination with the addition of each group of variables and provided insights into mediation effects. The overall OLS regression model explained 14.24% of the variance in concussion symptom reporting intention, which Acock (2012) describes as a moderate R^2 value. Changes in statistical significance and the standardized regression coefficients at each step of the hierarchical regression revealed evidence of mediation. Below I present the results in relation to the hypotheses investigated in this study and discuss

them in terms of the literature and the theoretical and conceptual foundations presented above.

Hypothesis 1: Symptom reporting intention by sex. All things being equal, I hypothesized that men would have lower intentions to report concussions than women. Contrary to the findings of Torres et al. (2013), who found that men were less likely to report concussion symptoms than women, sex did not play a role in determining concussion symptom reporting intention in any step of the hierarchical regression model. Although men (M = 4.04; SD = 1.72) expressed slightly lower intention to report concussion symptoms than women (M = 4.29; SD = 1.64), this difference was statistically insignificant, and controlling for additional variables in the full regression model negated any differences in reporting intention by sex.

Many previous studies on concussion underreporting have failed to control for sex differences in their research. Several researchers have only investigated underreporting in male athletes (Fraas et al., 2014; Kroshus, Baugh, et al., 2015; Kroshus, Baugh, et al., 2014; Kroshus, Daneshvar, et al., 2014; Kroshus, Kubzansky, et al., 2015; McCrea et al., 2004; Sye et al., 2006). Other investigators have included both male and female athletes in their studies, but either did not analyze or did not report on sex differences (Bramley et al., 2012; Davies & Bird, 2015; Delaney et al., 2015; Llewellyn et al., 2014; Register-Mihalik, Guskiewicz, McLeod, et al., 2013; Register-Mihalik et al., 2016).

In one of the few studies that identified a significantly lower likelihood of reporting among males, Torres et al. (2013) studied a small sample of 262 athletes from the same university. The cause of the sex difference in this study is unclear, however, because the researchers did not control for sport or for other potentially influential

variables in their analysis. Kurowski et al. (2014) found a difference in self-reported behavior between male and female high school athletes, although only 112 females participated in this study and sport comparison was limited because the authors coded sport as a dichotomous variable (soccer versus other). This means that in Kurowski's analysis, football (male), wrestling (male), and basketball (male and female) formed one sport category, which may have affected the influence of sport and sex on behavior.

Consistent with the findings of this study, Meehan et al. (2013) discovered no difference between males and females in previous reporting behaviors among patients visiting concussion clinics. Register-Mihalik, Linnan, et al. (2013) also failed to identify significant differences by sex in a sample of 167 high school athletes, although the authors acknowledged that the sample size was not robust enough to draw conclusions about the role of sex. In a retrospective study of former collegiate athletes, Kerr et al. (2015) identified safer symptom reporting behaviors among female athletes overall, but when controlling for sport, men and women demonstrated similar reporting behaviors.

Two separate studies by Kroshus and colleagues identified greater reporting intention among females, but the authors attributed this difference to perceived team norms and social pressure, independent of sex (Kroshus, Garnett, Hawrilenko, et al., 2015; Kroshus, Garnett, Baugh, & Calzo, 2015). This finding is consistent with the current study, given that attitudes, norms, and perceived control mediated any apparent differences in reporting intention by sex. Overall, the current study supports the existing literature that male and female athletes demonstrate similar concussion reporting behaviors, particularly when statistically controlling for other variables, such as sport and normative pressure.

Hypothesis 2: Symptom reporting intention by sport type. I hypothesized that athletes participating in limited or non-contact sports would demonstrate stronger intention to report concussion symptoms than those participating in contact or collision sports. The data partially supported this hypothesis. Collision sport participation had a weak negative effect on concussion reporting intention in the first two steps of the hierarchical regression; however, this effect appeared fully mediated through the reasoned action variables since the effect became insignificant after adding reasoned action variables to the model. Limited/non-contact and contact sports did not demonstrate any statistical differences in predicting intention. Nonetheless, sport type may play a small role in influencing behavioral intention as a background factor acting through attitude, norms, and perceived control.

Previous research has produced mixed results regarding the role of sport or sport type in influencing concussion symptom reporting. Many studies have focused on athletes from only one sport, such as football (Delaney et al., 2018; Lininger, Wayment, Hergatt Hufman, Craig, & Irving, 2017; McCrea et al., 2004), ice hockey (Kroshus, Baugh, et al., 2015; Kroshus, Baugh, et al., 2014; Kroshus, Daneshvar, et al., 2014; Kroshus, Kubzansky, et al., 2015), rugby (Fraas et al., 2014; Sye et al., 2006), and soccer (Bramley et al., 2012). Kroshus, Garnett, Hawrilenko, et al. (2015) studied underreporting in a variety of college contact and collision sports, but did not report intention by sport. Few studies to date have examined concussion reporting intention by sport category (contact, collision, and limited/non-contact).

Llewellyn et al. (2014) examined concussion underreporting across a variety of college sports. Although the authors did not group sports by category, further

interpretation of Llewellyn et al.'s results shows that the highest rates of underreporting occurred in contact and collision sports, including soccer (contact), football (collision), field hockey (contact), and cheerleading (contact). This is somewhat contrary to my finding that only collision sport participation influenced reporting intention. However Llewellyn et al.'s results should be interpreted with caution, because they only reported descriptive statistics (i.e. reporting rates) from a small sample of 161 former athletes. They did not control for other potential influences on symptom reporting.

Register-Mihalik, Guskiewicz, McLeod, et al. (2013) examined several different high school sports, but also did not group sports by category. Again, further interpretation shows that the authors identified the highest rates of underreporting in collision and contact sports, including football (collision), cheerleading (contact), and soccer (contact). Although Register-Mihalik et al. accounted for some additional variables, such as knowledge and attitudes, this study was also limited by a small sample size of 167. The authors also failed to control for norms and perceived behavioral control. Additionally, Register-Mihalik et al. used a retrospective design with previous behavior as the dependent variable, whereas I used a cross-sectional design with behavioral intention as the dependent variable, making comparison difficult between the two studies.

The results of the current investigation suggest that participants in collision sports may have a lower intention to report concussion symptoms compared to participants in contact and limited/non-contact sports because the specific sport environment influences attitudes, norms, and control. Based on these findings, further research is warranted to investigate the role of sport type in concussion reporting. Qualitative research among

athletes from a variety of sports may guide future researchers in identifying additional characteristics that influence concussion reporting intention.

Hypothesis 3: Symptom reporting intention by athletic identity. I hypothesized that athletes with a stronger athletic identity would have lower intentions to report concussion symptoms than those with weaker athletic identity. The results partially support this hypothesis, demonstrating a weak negative effect of athletic identity on reporting intention, which was completely mediated by the reasoned action variables.

Athletic identity was measured on a multi-item scale ranging from one to seven, with higher scores indicating stronger athletic identity. This variable demonstrated a negative skew within the sample of collegiate athletes, indicating a stronger overall tendency towards higher athletic identities among respondents.

The participants in this study all came from a background of varsity collegiate athletics, with an average of 7.74 years of experience in their current sport. At this level of competition and experience, it is not surprising that participants tended to exhibit high scores for athletic identity. The lack of adequate variability in athletic identity may explain the small effect of this variable in the second block of the regression, which was suppressed in the full regression model.

Very few studies to date have investigated the relationship between concussion athletic identity and concussion reporting intention. In a qualitative study on reasons for underreporting concussions, Lininger et al. (2017) conducted focus groups with 11 collegiate football players and identified athletic identity as one of the major themes associated with nondisclosure of symptoms. In a quantitative study investigating underreporting in male college ice hockey players, Kroshus, Kubzansky, et al. (2015)

found that athletic identity weakly moderated the association between symptom reporting norms and behavior, but they did not specifically measure behavioral intention.

Although athletic identity did not have a significant direct effect on intention at the 0.05 alpha level ($p = 0.079$) in this study, I identified a weak negative effect of athletic identity on symptom reporting intention in the second block of the hierarchical regression. Future research in populations with a greater degree of variability in athletic identity may produce clearer evidence regarding the role of athletic identity on concussion reporting intention. For example, athletic identity may prove more influential at high school, youth, or club levels of sport participation, where the level of competitiveness appears relatively lower or while identity roles are still developing.

Hypothesis 4: Symptom reporting intention by attitude. I hypothesized that athletes with safer concussion reporting attitudes would have greater intention to report symptoms than those with less safe attitudes. The data supported this hypothesis, with attitude demonstrating a weak positive effect on intention to report ($b^* = .063$; $p = .005$). Attitude towards concussion reporting was measured on a multi-item scale ranging from one to seven, with higher scores indicating safer reporting attitudes. Univariate analysis revealed a negative skew, demonstrating that respondents overall tended to have more positive attitudes towards reporting.

The five-item semantic differential attitude scale used in this study originated from Register-Mihalik, Linnan, et al. (2013), who created the original seven-item semantic differential scale. Register-Mihalik et al. reported a Cronbach's alpha of 0.83; however, reducing the scale to five items in the current study produced an improved Cronbach's alpha of 0.90. Kroshus, Baugh, et al. (2014) measured attitudes differently

using eight Likert scale items assessing the perceived consequences of concussion symptom disclosure, reporting an "undesirable" Cronbach's alpha of 0.62 (DeVellis, 2003). In a different study, Kroshus, Kubzansky, et al. (2015) measured attitude by asking respondents to rate how they would feel about decisions made by coaches or other athletes. This assessment of the "correctness" of another person's response to a hypothetical scenario does not reflect the Fishbein and Ajzen (2010) definition of attitude as the allocation of value to a behavior, rating the behavior as favorable or unfavorable. In contrast to some of the other attitude measures previously identified in the literature, the attitude scale created by Register-Mihalik and adapted for the current study provides a theoretically and statistically sound measure of attitude consistent with the recommendations of Fishbein and Ajzen (2010).

Despite some differences in measurement, the current findings regarding the role of attitude in predicting concussion reporting intention are consistent with previous research. Register-Mihalik, Linnan, et al. (2013) found that attitude had the greatest effect on intention to report concussion compared to all other reasoned action variables. Kroshus, Baugh, et al. (2014) also reported that attitude significantly predicted intention to report, despite the poor internal consistency of their attitude measure. In contrast, Kroshus, Kubzansky, et al. (2015) found no significant effect of attitude on concussion reporting behavior; however, this study did not incorporate the full reasoned action framework, and the authors operationalized attitude differently, as discussed above, which may explain why the findings did not align. The current findings that attitude has a weak positive effect on intention is consistent with other studies with similar methods. Future studies of concussion reporting intention should include a measure of attitude.

Hypothesis 5: Symptom reporting intention by perceived social pressure.

Previous research examining the effect of social norms on concussion reporting intention (Kroshus, Baugh, et al., 2014; Kroshus, Daneshvar, et al., 2014; Kroshus, Garnett, Baugh, et al., 2015; Kroshus, Kubzansky, et al., 2015; Register-Mihalik, Linnan, et al., 2013) suggests that norms play a significant role in determining intention to report. Based on the key social referents identified by Register-Mihalik (2010) within an athlete's network (coaches, teammates, parents, and athletic trainers), I hypothesized that athletes perceiving less negative social pressure from important social referents would have a greater intention to report concussion symptoms than athletes who perceived greater negative pressure from these referents. Negative social pressure indicates perceived norms that encourage nondisclosure of concussion symptoms. Conversely, positive social pressure in this context indicates perceived norms that encourage symptom reporting.

Previous studies have measured subjective norms as a unidimensional construct; however, I identified two distinct dimensions of perceived norms. This distinction may explain why I found weak individual effects of descriptive and injunctive norms. One of the criticisms of previous reasoned action research involves the inclusion of items that only measure injunctive norms, and do not account for descriptive norms (McEachan et al., 2016). For example, Register-Mihalik, Linnan, et al. (2013) included a variety of items addressing subjective norms, but these items only measured injunctive norms, or perceptions of how one "ought to" behave. Kroshus applied items from Rosenbaum and Arnett's (2010) Concussion Attitude Index in several studies (Kroshus, Baugh, et al., 2014; Kroshus, Daneshvar, et al., 2014; Kroshus, Garnett, Baugh, et al., 2015; Kroshus,

Kubzansky, et al., 2015), which also reflect perceptions about what others think (injunctive), and not about what others would do (descriptive). The current study is one of the few investigations of concussion underreporting that accounts for this problem by differentiating different types of normative pressure. This more detailed and nuanced measure of perceived normative pressure more accurately captures the elements of perceived norms proposed by Fishbein and Ajzen (2010).

Descriptive norms, which represent perceptions regarding the behavior of others, were measured using a multi-item scale ranging from one to seven, with lower scores indicating negatively perceived norms and higher scores indicating more positively perceived norms. Injunctive norms, which represent an individual's perceptions of how others think he or she *should* behave, ranged from -10.5 to 21, with lower scores indicating negatively perceived norms and higher scores indicating more positively perceived norms. Most of the respondents in this sample scored relatively high on the injunctive norm scale, indicating that this population tended to have a more positive perception regarding the expectations of important social referents.

The current findings support previous research findings that normative pressure from coaches, teammates, parents, and athletic trainers influences athletes' intention to report concussion symptoms. Irrespective of other variables, descriptive norms ($b^* = .131$; $p < .001$) and injunctive norms ($b^* = .107$; $p < .001$) each demonstrated a weak positive effect on concussion reporting intention. Consistent with the meta-analysis by McEachan et al. (2016) on the reasoned action approach and health behaviors, both injunctive and descriptive norms were significant predictors of intention in this study.

Future research on concussion underreporting should measure both injunctive and descriptive norms. Importantly, evidence-based interventions aimed at reducing concussion non-disclosure should address societal and sport-based norms associated with reporting, and attempt to correct athletes' misperceptions of group norms (Kroshus, Garnett, Baugh, et al., 2015).

Hypothesis 6: Symptom reporting intention by perceived behavioral control. I hypothesized that athletes who perceived greater control over their own concussion reporting behavior would have a greater intention to report symptoms than those who perceived less control. Very few studies of concussion underreporting among athletes have accounted for perceived behavioral control (Kroshus, Baugh, et al., 2014; Register-Mihalik, Linnan, et al., 2013). Several studies have used a partial reasoned action approach to investigate this problem, but only measured attitudes and perceived social pressure, not perceived behavioral control (Kroshus, Daneshvar, et al., 2014; Kroshus, Garnett, Baugh, et al., 2015; Kroshus, Kubzansky, et al., 2015).

Kroshus, Baugh, et al. (2014) incorporated the full reasoned action approach, replacing perceived behavioral control with self-efficacy. According to Fishbein and Ajzen (2010) and McEachan et al. (2016), self-efficacy is interchangeable with capacity, which is the perceived ability (e.g. ease versus difficulty) to perform a behavior. However, while Kroshus, Baugh, et al. (2014) did measure capacity, they did not include a measure of autonomy, which is the amount of control one has over performing a behavior (Fishbein & Ajzen, 2010). Register-Mihalik, Linnan, et al. (2013) also used the full reasoned action approach; however, they only included three direct measures of perceived behavioral control, and did not identify capacity and autonomy as two separate

constructs. The current study is one of the few investigations of concussion underreporting that has included perceived behavioral control, and is the only study to date to include measures for both capacity and autonomy.

In the studies that did measure some aspect of perceived behavioral control, Kroshus, Baugh, et al. (2014) and Register-Mihalik, Linnan, et al. (2013) both reported that perceived control significantly predicted concussion reporting intention. The current findings support these previous studies. Capacity had the greatest total effect on intention ($b^* = .196$; $p < .001$) compared to all other variables assessed in this study. However, according to Acock (2012), a standardized regression coefficient less than 0.20 represents a weak effect.

Autonomy, conversely, did not show a statistically significant effect on concussion reporting intention. This scale contained only 2 items, making it a less robust measure. Additionally, in univariate analysis, autonomy demonstrated a negative skew, indicating a high degree of perceived volitional control. Yzer (2007) suggests that the reasoned action approach only accounts for behaviors that are not under complete volitional control. The mean autonomy score was particularly high in this study, and only 8.57% of participants responded negatively (disagree or strongly disagree) to questions about the degree of control they have in reporting concussion symptoms. Because autonomy varied very little at the univariate level, it did not significantly influence concussion reporting intention. Interestingly, this finding is consistent with the results of a meta-analysis by McEachan et al. (2016), who found that autonomy was the only reasoned action variable that demonstrated no statistical significance relative to health-related intentions and behaviors.

Future research should measure both capacity and autonomy as elements of perceived behavioral control. Investigators may benefit, however, from additional items to create a valid measure of autonomy, because the two-item measure in this study did not produce a significant effect on intention. Capacity had the largest direct effect on intention, however perceived behavioral control in general has been understudied in concussion reporting research. Additional research is warranted to explore the reasons that capacity had the greatest effect on reporting intention among college athletes in this study.

Hypothesis 7: Mediation of athletic identity through reasoned action variables. I hypothesized that attitudes, perceived social pressure, and perceived behavioral control would mediate the relationship between athletic identity and concussion symptom reporting intention. Athletic identity demonstrated statistical significance when first added to the hierarchical regression; however, its effect was suppressed when the reasoned action items were added to the regression model (MacKinnon et al., 2000). In addition to athletic identity, collision sport participation and perceived concussion knowledge were also fully mediated through the reasoned action variables, although the overall effect of all three of these variables on intention was minimal.

Previous research on the influence of athletic identity on concussion reporting is limited. Kroshus, Kubzansky, et al. (2015) investigated athletic identity, reporting attitudes, and reporting norms in relation to reporting intention, however they did not assess for a mediating effect. In a meta-analysis of studies adding identity into the reasoned action approach, Paquin and Keating (2016) provided evidence that certain

types of identities (i.e. those that do not directly correspond to the behavior of interest) are mediated by attitude, normative pressure perceived control (Figure 4). Athletic identity is an example of an identity that fits this mediation model, because it is not equivalent to concussion reporting behavior. One example in the literature that resembles the mediation effect found in the current study is the association between identity and binge drinking investigated by Hagger et al. (2007). The authors found that personal identity and social identity both significantly predicted attitude, norms, and perceived control, and that attitudes, norms, and perceived control all significantly predicted intention to engage in binge drinking (Hagger et al., 2007). The indirect effect of personal and social identity, however, was completely mediated through the reasoned action variables, with no significant direct effect on intention.

The current findings suggest that athletic identity may be an important background factor that can negatively influence concussion reporting intention. Future research to quantify specific indirect and direct effects among these variables will contribute to understanding the true role that athletic identity plays in this context. Again, because athletic identity did not vary substantially within this sample, research in other populations of athletes may further clarify the influence of athletic identity operating through the reasoned action framework. In addition to identity, other personal factors that may be considered in future research on concussion reporting intention include team loyalty, risk-taking behavior, and previous concussion reporting behavior. These characteristics may also be mediated by the reasoned action variables.

Limitations and Delimitations

One of the methodological limitations to this study was the varying recruitment strategized employed at each institution. I individualized recruitment to achieve the highest possible response rate, but this strategy was not fully implemented at each of the 22 institutions. At most institutions, I sent recruitment emails to a liaison at the school, who then forwarded the messages to the student athletes and verified that all emails were sent to all student-athletes. At some institutions, however, the liaison at the school forwarded recruitment emails to the coaches, and then the coaches became responsible for forwarding to the student-athletes. When this happened, I was not able to verify that all emails were forwarded to all teams because emails were sent individually to teams, rather than to all student-athletes at the institution. Coaches from some teams may not have sent any at all, or some may have only sent one or two emails, rather than four separate emails as designed. Although the individualized recruitment strategy effectively controlled for the organizational structure within each athletic department and produced a large response rate overall, the four schools that relied on coaches produced lower response rates.

Another difference from team to team is that some sports were in-season at the time of the survey, and some sports were not. This could have affected the way that athletes interpreted survey items. For example, senior students who graduated in the fall or completed their final competitive season in the fall would not be able to answer questions about future reporting intention if their collegiate athletic career had ended.

To maintain a reasonable survey length, and based on the lack of evidence discussed in chapter 2 that concussion education influences reporting behavior, I chose

not to directly measure concussion knowledge. The addition of a knowledge measure regarding the recognition of symptoms and risk associated with playing while concussed could have potentially explained additional variance in intention. However, I measured subjective perceptions of concussion symptom knowledge, which had a slight effect on reporting intention when operating through the reasoned action variables. Although this measure was subjective and did not account for actual concussion knowledge, it does offer a measure of self-report knowledge. The minimal effect associated with this variable supports the findings in the literature, which conclude that concussion knowledge does not directly affect reporting behavior.

Lastly, I measured intention to report concussion symptoms, not actual behavior. Although directly measuring behavior was not possible in this study, Ajzen and Albarracin (2007) reported a range of significant correlations between health-related intentions and behaviors from 0.75 to 0.96, suggesting that intention may be an appropriate proxy for health-related behaviors when the behavior cannot be directly measured. As was the case in this study – in both capacity and autonomy – with a high degree of perceived behavioral control, intention becomes a greater predictor of behavior (Fishbein & Ajzen, 2010).

As a delimitation, the sample of respondents included only U.S.-born NCAA varsity student-athletes in Pennsylvania. This represents a diverse sample of sports from different NCAA levels (i.e. divisions); however, results may not be generalizable to club sports, non-college athletes, or to other geographic regions. Nonetheless, the sample size of 2,649 student-athletes from 23 different sports across 22 institutions represents the largest and one of the most comprehensive studies of concussion underreporting to date.

Recommendations

Theory and Conceptual Framework

The findings of this study build upon previous research and support the use of the reasoned action approach in analyzing the problem of concussion underreporting in college athletes. Although research on the antecedents to behavior in other contexts has included subcomponents of attitude, perceived social pressure, and perceived behavioral control (Fishbein & Ajzen, 2010; McEachan et al., 2016), this is one of the first studies to include subcomponents of perceived social pressure and perceived behavioral control in the context of concussion reporting intention.

Fishbein and Ajzen (2010) recommended evaluating sets of survey items for internal consistency, ensuring discriminant validity, and conducting factor analysis of all scales (p. 452). In this study, factor analysis and assessment of internal consistency provided evidence for a unidimensional measure of attitude, however, regarding perceived social pressure and perceived behavioral control, these analyses supported a two-factor approach. Attitudes may include both cognitive and affective components, perceived pressure can include both the expected desires and the expected behaviors of social referents, and perceived control may involve efficacy as well as autonomy. When formulating questionnaires, future researchers should design items that capture the reasoned action subcomponents. Researchers should also confirm the consistency, validity, and factor structure of their designed measures before conducting further data analysis.

This study provides limited evidence for the addition of an athletic identity measure into the reasoned action approach. For predicting different behaviors outside of

concussion reporting, researchers should identify whether the inclusion of an identity measure is theoretically sound based on the behavior being measured and the population of interest. Identity theory dictates that individuals who become socialized into a particular role, and internalize the perceived values associated with that role, are more likely to behave in a manner congruent with their perceived role expectations (Burke & Stets, 2009). For populations and behaviors associated with specific role identities, the addition of an identity measure may explain additional variance in intention and/or behavior, especially when operating through mediating variables such as attitude, social pressure, and perceived control. Regarding concussion underreporting, additional research is required to further investigate the role of athletic identity in non-collegiate athlete populations.

The results of this study provide evidence that athletic identity influences concussion reporting intention in college athletes when operating through the reasoned action variables. Beyond concussion underreporting, the study also provides an appropriate theoretical perspective for investigating the broader problem of overall injury underreporting among athletes. The confluence of the reasoned action approach and identity theory is a useful framework for future investigations.

Clinical Application

In applying the reasoned action approach to behavioral interventions, McEachan et al. (2016) warned against the application of a "one size fits all" intervention. Rather, they suggested that interventions should target key predictors of intention relative to the behavior of interest. In this study, capacity ($b^* = .196$), descriptive norms ($b^* = .131$), injunctive norms ($b^* = .107$), and reporting attitudes ($b^* = .063$) had positive direct

effects on concussion reporting intention. Prior to adding the reasoned action variables into the hierarchical regression, perceived concussion symptom knowledge had a weak positive effect on intention, while athletic identity and participation in collision sports both had weak negative effects on intention. However, these variables failed to demonstrate significant direct effects on intention in the full regression model. Collectively, these research findings may guide the design of interventions aimed at improving concussion reporting behaviors. In this section, I present recommendations for designing intervention strategies to improve concussion symptom reporting.

Influencing perceived behavioral control. Ajzen and Albarracin (2007) recommended utilizing different intervention strategies to account for each component of the reasoned action approach. In this study, capacity demonstrated the greatest direct effect on reporting intention; therefore, changing a athlete's capacity to report concussion symptoms may increase symptom disclosure. To improve perceived behavioral control (i.e. capacity), Ajzen and Albarracin (2007) recommended behavioral skills arguments and training, such as providing strategies to accomplish the behavior. Ajzen and Albarracin (2007) also reported that active interventions involving behavioral skills training or counseling were more effective in changing behavior than passive interventions that relied exclusively on presentations without activities. An active intervention designed to engage participants and improve capacity may be the use of role-playing activities and/or scenario-based training to allow athletes to practice how they would communicate with a coach or healthcare provider to report concussion symptoms.

Influencing perceived social pressure. In the current study, both injunctive and descriptive norms demonstrated significant direct effects on concussion reporting

intention. To address both of these elements of perceived social pressure, Ajzen and Albarracin (2007) recommended normative arguments to increase favorable norms relative to the behavior. For example, demonstrating that an individual's social network actually supports the behavior may accomplish this objective. Similarly, Kroshus, Kubzansky, et al. (2015) suggested that athletes may often misperceive concussion reporting norms and assume that most other athletes have less safe beliefs and attitudes about reporting. To address the discrepancy between actual and perceived norms, they recommended presenting information to correct these misperceptions.

In a meta-analysis of health intervention strategies, Durantini, Albarracin, Mitchell, Earl, and Gilette (2006) found that expert presenters were more effective than laypersons in changing behavior. However, when accounting for norms, information presented by laypersons who were similar to the audience members produced greater behavioral changes than information from dissimilar presenters. To educate athletes on how similar others view concussion symptom reporting (descriptive norms), interventions should include discussions or presentations from other current athletes or recent graduates who can share their views and/or experiences with either reporting or not reporting concussion symptoms. This strategy may reduce the misperceptions about concussion reporting norms and provide athletes with a more accurate representation of how other similar athletes perceive concussions. In addition to peers, content experts should also be part of any intervention program; however, the role of the content expert is to influence the behavioral beliefs and outcome evaluations that inform an athlete's attitudes, not to change descriptive normative beliefs.

To influence injunctive norms, interventions should also target important social referents, including teammates, coaches, parents, and athletic trainers. In the current study, respondents generally had a strong tendency towards complying with what they thought their teammates, coaches, parents, and athletic trainers wanted them to do. If these social referents clearly articulate their expectations regarding concussion reporting to athletes, it can affect their perceptions about the behavior and influence their intentions. An open dialogue with clear communication regarding the symptom reporting expectations of each social referent category may help to clarify misperceived injunctive norms. The proposed intervention strategy above, of teammates or other athletes presenting information or leading discussions, can provide clarity to athletes in the audience or discussion group regarding actual peer reporting norms. Regarding the coaches' role in influencing concussion reporting, Baugh, Kroshus, Daneshvar, and Stern (2014) identified low perceived coach support as a significant predictor of athletes' nondisclosure of concussion symptoms. Coaches play an important role in shaping the culture and norms of a team environment. Kroshus, Kubzansky, et al. (2015) suggested that coaches' silence on the issue of concussion reporting may be perceived by athletes as an "implicit endorsement" (p. 101) of nondisclosure of symptoms. Therefore, coaches should communicate openly with their teams about their views and expectations in order to create a safe reporting environment. Coach support and approachability is especially important in settings where an athletic trainer is not available or not on site, because the coach becomes the central support person for athletes to report injuries.

Influencing attitudes. In addition to influencing norms and capacity, behavioral interventions should also contain attitudinal argument to appeals to an individual's beliefs

about the utility and consequences of the symptom reporting behavior. Although it had a small total effect on intention, attitude was a statistically significant predictor of reporting intention in this study. The intervention strategies described above from both experts and from other social referents, provide an attitudinal argument by demonstrating the physical and psychological health benefits of choosing to report concussion symptoms immediately (Ajzen & Albarracin, 2007). Fishbein and Ajzen (2010) argued that the behavioral beliefs that determine attitudes can be altered by either changing the strength of a belief, or by changing a person's beliefs about the outcome of a behavior. In the latter approach, providing athletes with information about the outcome of reporting their concussion symptoms may improve their attitudes toward the behavior.

Although didactic educational interventions about concussions have been largely ineffective in altering attitudes or symptom reporting behavior, knowledge is certainly a prerequisite for reporting. Therefore, some level of education is required as part of a concussion intervention. Specifically, interventions addressing behavioral outcomes may have a greater effect on reporting attitudes than interventions that simply describe the signs and symptoms of a concussion. For example, athletes' outcome evaluations and attitudes towards reporting may become more positive if they are informed that delayed concussion reporting is associated with prolonged recovery, decreased memory, decreased processing speed and reaction time, and more severe symptoms (Asken et al., 2018; Elbin et al., 2016; Taubman, Rosen, McHugh, Grady, & Elci, 2016).

The role of the athletic trainer. Compared the other social referents included in this study, athletic trainers had the highest mean injunctive norm influence, suggesting that the athletic trainer plays an important role in establishing a culture of safety within

athletic environments. As an experienced healthcare provider proficient in the diagnosis and management of concussion, and as a person who is familiar to the athlete, the athletic trainer is also critical to the behavioral intervention aimed at improving concussion reporting intention. The athletic trainer can provide expert opinion about the positive health benefits of concussion symptom reporting to influence behavioral beliefs, outcome evaluations, and attitudes toward reporting. Additionally, as someone within the athlete's social network, athletic trainers influence team norms and play a part in developing a culture of safety and overall wellness. Lastly, athletic trainers, simply by their presence, increase behavioral control and capacity by being available to intervene or talk with an athlete following an injury.

Recommendations for Future Research

The unidimensional seven-item intention scale developed for this study (Cronbach's alpha = 0.93) provides an internally consistent measure of symptom reporting intention that may demonstrate utility in future research on reporting intention. Specifically, the scale includes items that capture the situational variations that occur in the symptom reporting environment within an athletic context. Some previous studies (Kroshus, Baugh, et al., 2015; Kroshus, Garnett, Hawrilenko, et al., 2015) have used only one item to measure concussion reporting intention. Register-Mihalik, Linnan, et al. (2013) used three items to measure reporting intention; however, these items did not account for situational variability or severity of symptoms. Emily Kroshus has accounted for varying types of symptoms in several studies (Kroshus, Baugh, et al., 2014; Kroshus, Garnett, Baugh, et al., 2015), by providing a list of symptoms and asking respondents to identify how much they intend to report each symptom. This captures some of the

nuance in reporting intention, but still does not address severity or situational context. The novel reporting intention scale developed for this study provides additional perspective surrounding an athlete's intent to report symptoms under various conditions.

Methodologically, the inclusion of control variables and a measure of athletic identity explained additional variance in concussion reporting intention and allowed for statistical control of these variables. Additionally, based on factor analyses and Cronbach's alpha calculations, the use of multi-item scales provided valid and internally consistent measures of various elements of the reasoned action approach. Control variables and valid multi-item scales should be included in future research.

Another strength of this study is the large sample size (n = 2,649), representing an estimated survey completion rate of 32.87%. Individualized survey distribution methods based on the institution proved more effective at some schools than at others. Completion rates by institution ranged from 9.31% (Institution T) to 75.05% (Institution Q). Schools where the institution's NCAA compliance officer distributed survey emails demonstrated the highest total completion rate at 37.71%. Surveys distributed by athletic trainers produced a comparable completion rate of 36.37%. Surveys distributed by the athletic director or by an advisor resulted in completion rates of 25.37% and 17.23%, respectively. Schools in which coaches were responsible for distributing survey emails generated the lowest total completion rate, with only 15.81% of athletes completing surveys at these schools. For this last category, I was unable to verify whether the individual coaches for each team across four institutions all sent the pre-survey notification email, survey email, and reminder emails. Therefore, some athletes at these schools may not have received all of the emails, and conceivably, some may not have

received any emails. Based on the current findings, researchers should consider distributing future surveys via NCAA compliance officers and athletic trainers to achieve the highest survey completion rates. Multiple monetary incentives (both individual and institution-based) and multiple email requests also may have increased athletes' willingness to complete the survey used in this study.

Because the sample for this study consisted of only U.S.-born collegiate athletes, future studies should compare these findings to non-U.S. populations and high school athletes. Studying the antecedents to concussion reporting in a younger population and developing evidence-based interventions at an earlier age may establish safer reporting behaviors that could translate to safer reporting behaviors in college over time. Additionally, although previous concussion history was not a significant predictor of intention in this study, accounting for the role of previous concussion reporting behavior may explain additional variance in symptom reporting intention in future studies. Several variables approached statistical significance in the final regression model, however they were not statistically significant at the 0.05 level and their total effect on intention was negligible. These variables include age ($p = 0.084$), minority status ($p = 0.089$), and athletic identity ($p = 0.079$). Based on the seriousness of sport-related brain injuries, the potential effect of these variables on concussion reporting intention should not be overlooked, and may point to potential future research. Additional qualitative research will also improve understanding of the individual characteristics associated with concussion underreporting.

In this study, all of the NCAA athletes who participated had access to an athletic trainer in some capacity; however, I did not inquire about direct onsite availability of an

athletic trainer during all practices and competitions. As such, the perceived availability of an athletic trainer and the comfort with seeking care from the athletic trainer may vary by sport and by institution. In their study of concussion reporting behaviors in high school athletes, Wallace et al. (2017) found that athletes at schools without an athletic trainer had significantly lower concussion knowledge and reported fewer concussions, especially during games. Further research is warranted to determine whether access or perceived access to an athletic trainer influences symptom reporting capacity.

Long-term studies that measure behavior, as well as intention, in various populations may also prove valuable in this area of research. Kroshus, Kubzansky, et al. (2015) suggested that future research include a measure of social desirability in conjunction with measuring reporting norms. Another area for future social norms research involves examining the misperceptions of concussion reporting norms (Kroshus, Garnett, Baugh, et al., 2015). Additional variables that I did not measure in this study that may expand future research in this area include socioeconomic status, team loyalty, tendency towards risk-taking behaviors, and previous reporting behavior. Future qualitative research will also help to identify important variables and inform survey design for additional quantitative studies.

Most importantly, future research on the effectiveness of evidence-based behavioral interventions will help healthcare providers and athletic administrators develop better strategies to improve the attitudes and norms around concussion reporting. Interventions intended to improve the culture of safety in sports and encourage athletes to seek help for a concussion require careful planning and evaluation.

In summary, the theoretical framework, the novel measure of concussion reporting intention, and the support for using multi-item scales may aid researchers in future investigations. To achieve the highest possible response rate, emails sent from the institution's NCAA compliance officer or an athletic trainer seem to produce greater survey completion rates. Future research should include non-U.S. born participants, more diverse athlete populations, and athletes with and without access to an athletic trainer. Qualitative studies, as well as longitudinal studies of actual behavior (as opposed to intention to perform a behavior), will also add to the literature in this area. Lastly, it is imperative that the best available research evidence guides the development and implementation of intervention strategies to improve concussion reporting behavior.

Conclusions

The purpose of this study was to critically examine the role of attitudes, norms, perceived control, and athletic identity in predicting college athletes' intentions to report concussion symptoms to a coach or athletic trainer. The reasoned action approach and identity theory provide an appropriate framework for interpreting the relationships among these variables. Other researchers have attempted to quantify the rate of concussion underreporting, or to identify reasons for nondisclosure of concussions; however, many previous studies are limited by small sample sizes or lack of variety in participants. Based on my review of the literature, this is the largest study of concussion reporting intention to-date.

This study builds upon previous research on the causes of concussion underreporting and expands upon existing survey methods. Register-Mihalik (2010) developed and validated a very thorough survey instrument to examine the role of the

reasoned action approach (Theory of Planned Behavior) in predicting concussion reporting intentions and behaviors. The RAM-CR survey instrument used in this study contains many items from Register-Mihalik's original instrument; but it also includes a perceived control/self-efficacy measure from Kroshus, Baugh, et al. (2014), the AIMS (Brewer, 1993), a measure of autonomy, and a more nuanced measure of behavioral intention to report concussion symptoms. The RAM-CR may be a useful instrument for future research and should be validated in non-collegiate athlete populations for future use.

Finally, based on the findings of this study, future intervention programs aimed at improving concussion symptom reporting in collegiate athletes should use a multipronged approach to modifying behavior. This includes addressing student-athletes' capacity for reporting symptoms by incorporating role playing or situation-based interventions.

To address descriptive norms, intervention programs should include peer presentations or discussions in an attempt to modify the misperceived normative beliefs that "most athletes" would not report. To improve injunctive norms, interventions should promote communication and open dialogue with teammates, coaches, parents, and athletic trainers; and encourage coaches to explicitly state their expectations about reporting concussion symptoms. Lastly, future intervention programs should improve attitudes towards reporting by educating athletes, not just about identifying symptoms, but about the negative outcomes associated with non-reporting.

References

Acock, A. C. (2012). *A gentle introduction to Stata* (Revised 3rd ed.). College Station, TX: Stata Press.

Acuna, E., & Rodriquez, C. (2004). The treatment of missing values and its effect in the classifier accuracy. In D. Banks, F. R. McMorris, P. Arabie & W. Gaul (Eds.), *Classification, clustering, and data mining applications: Studies in classification, data analysis, knowledge organization*. Berlin, Germany: Springer.

Ahman, S., Saveman, B. I., Styrke, J., Björnstig, U., & Stålnacke, B.-M. (2013). Long-term follow-up of patients with mild traumatic brain injury: A mixed-methods study. *Journal of Rehabilitation Medicine, 45*(8), 758-764. doi: 10.2340/16501977-1182

Ahmed, O. H., Sullivan, S. J., Schneiders, A. G., & McCrory, P. R. (2012). Concussion information online: Evaluation of information quality, content and readability of concussion-related websites. *British Journal of Sports Medicine, 46*(9), 675-683. doi: 10.1136/bjsm.2010.081620

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2012). Martin Fishbein's legacy: The reasoned action approach. *The Annals of the American Academy of Political and Social Science, 640*, 11-27.

Ajzen, I., & Albarracin, D. (2007). Predicting and changing behavior: A reasoned action approach. In I. Ajzen, D. Albarracin & R. Hornik (Eds.), *Prediction and change of health behavior: Applying the reasoned action approach*. Mahwah, NJ: Lawrence Erlbaum Associates.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I., Joyce, N., Sheikh, S., & Cote, N. G. (2011). Knowledge and the prediction of behavior: The role of information accuracy in the Theory of Planned Behavior. *Basic & Applied Social Psychology, 33*(2), 101-117. doi: 10.1080/01973533.2011.568834

Armitage, C. J., & Conner, M. (1999a). Distinguishing perceptions of control from self-efficacy: Predicting consumption of a low-fat diet using the theory of planned behavior. *Journal of Applied Social Psychology, 29*(1), 72-90. doi: 10.1111/j.1559-1816.1999.tb01375.x

Armitage, C. J., & Conner, M. (1999b). Predictive validity of the theory of planned behaviour: the role of questionnaire format and social desirability. *Journal of Community & Applied Social Psychology, 9*(4), 261-272.

Armitage, C. J., & Conner, M. (2001). Efficacy of the Theory of Planned Behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471.

Armitage, C. J., Conner, M., Loach, J., & Willetts, D. (1999). Different perceptions of control: Applying an extended Theory of Planned Behavior to legal and illegal drug use. *Basic & Applied Social Psychology, 21*(4), 301-316.

Armitage, C. J., Norman, P., & Conner, M. (2002). Can the Theory of Planned Behaviour mediate the effects of age, gender and multidimensional health locus of control? *British Journal of Health Psychology, 7*(3), 299.

Asken, B. M., Bauer, R. M., Guskiewicz, K. M., McCrea, M. A., Schmidt, J. D., Giza, C. C., . . . Clugston, J. R. (2018). Immediate removal from activity after sport-related concussion is associated with shorter clinical recovery and less severe symptoms in collegiate student athletes. *American Journal of Sports Medicine*, 1-10. doi: 10.1177/0363546518717984

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1986). *Social foundations of thought and action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Baugh, C. M., Kroshus, E., Daneshvar, D. H., & Stern, R. A. (2014). Perceived coach support and concussion symptom-reporting: Differences between freshmen and non-freshmen college football players. *Journal of Law, Medicine & Ethics, 42*(3), 314-322. doi: 10.1111/jlme.12148

Blumer, H. (1969). Symbolic interactionism. In C. Calhoun, J. Gerteis, J. Moody, S. Pfaff & I. Virk (Eds.), *Contemporary sociological theory* (3rd ed.). West Sussex, UK: Wiley-Blackwell.

Boden, B. P., Tacchetti, R. L., Cantu, R. C., Knowles, S. B., & Mueller, F. O. (2007). Catastrophic head injuries in high school and college football players. *American Journal of Sports Medicine, 35*(7), 1075-1081.

Bramley, H., Patrick, K., Lehman, E., & Silvis, M. (2012). High school soccer players with concussion education are more likely to notify their coach of a suspected concussion. *Clinical Pediatrics, 51*(4), 332-336. doi: 10.1177/0009922811425233

Brewer, B. W. (1993). Self-identity and specific vulnerability to depressed mood. *Journal of Personality, 61*(3), 343-364.

Brewer, B. W., & Cornelius, A. E. (2001). Norms and factorial invariance of the Athletic Identity Measurement Scale. *The Academic Athletic Journal, 15*, 103-113.

Brewer, B. W., Van Raalte, J. L., & Linder, D. E. (1993). Athletic identity: Hercules' muscles or Achilles heel? *International Journal of Sport Psychology, 24*(2), 237-254.

Broglio, S. P., Cantu, R. C., Gioia, G. A., Guskiewicz, K. M., Kutcher, J., Palm, M., & Valovich McLeod, T. C. (2014). National Athletic Trainers' Association position statement: Management of sport concussion. *Journal of Athletic Training, 49*(2), 245-265. doi: 10.4085/1062-6050-49.1.07

Broglio, S. P., Vagnozzi, R., Sabin, M., Signoretti, S., Tavazzi, B., & Lazzarino, G. (2010). Concussion occurrence and knowledge in italian football (soccer). *Journal of Sports Science & Medicine, 9*(3), 418-430.

Burke, P. J., & Stets, J. E. (2009). *Identity Theory*. New York, NY: Oxford University Press.

Byard, R. W., & Vink, R. (2009). The second impact syndrome. *Forensic Science, Medicine, and Pathology, 5*(1), 36-38. doi: 10.1007/s12024-008-9063-7

Chrisman, S. P., Quitiquit, C., & Rivara, F. P. (2013). Qualitative study of barriers to concussive symptom reporting in high school athletics. *Journal of Adolescent Health, 52*, 330-335. doi: 10.1016/j.adohealth.2012.10.271

Coakley, J. (2015). *Sports in society: Issues and controversies* (11th ed.). New York, NY: McGraw-Hill.

Conner, M., & Armitage, C. J. (1998). Extending the Theory of Planned Behavior: A review and avenues for further research. *Journal of Applied Social Psychology, 28*(15), 1429-1464.

Conner, M., & McMillan, B. (1999). Interaction effects in the Theory of Planned Behaviour: Studying cannabis use. *British Journal of Social Psychology, 38*(2), 195-222 128p. doi: 10.1348/014466699164121

Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology, 24*(4), 349-354. doi: 10.1037/h0047358

Curry, T. J. (1993). A little pain never hurt anyone: Athletic career socialization and the normalization of sports injury. *Symbolic Interaction, 16*(3), 273-290.

Curry, T. J., & Weiss, O. (1989). Sport identity and motivation for sport participation: A comparison between American college athletes and Austrian student sport club members. *Sociology of Sport Journal, 6*(3), 257-268.

Davies, S. C., & Bird, B. M. (2015). Motivations for underreporting suspected concussion in college athletics. *Journal of Clinical Sport Psychology, 9*(2), 101-115.

de Bruijn, G.-J., Verkooijen, K., de Vries, N. K., & van den Putte, B. (2012). Antecedents of self identity and consequences for action control: An application of the Theory of Planned Behaviour in the exercise domain. *Psychology of Sport and Exercise, 13*(6), 771-778. doi: 10.1016/j.psychsport.2012.05.008

Delaney, J. S., Caron, J. G., Correa, J. A., & Bloom, G. A. (2018). Why professional football players chose not to reveal their concussion symptoms during a practice or game. *Clinical Journal of Sport Medicine, 28*(1), 1-12. doi: 10.1097/JSM.0000000000000495

Delaney, J. S., Lamfookon, C., Bloom, G. A., Al-Kashmiri, A., & Correa, J. A. (2015). Why university athletes choose not to reveal their concussion symptoms during a practice or game. *Clinical Journal of Sport Medicine, 25*(2), 113-125.

DeVellis, R. F. (2003). *Scale development: Theory and applications* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Durantini, M. R., Albarracin, D., Mitchell, A. L., Earl, A. N., & Gilette, J. C. (2006). Conceptualizing the influence of social agents of behavior change: A meta-analysis of the effectiveness of HIV-prevention interventionists for different groups. *Psychological Bulletin, 132*(2), 212-248. doi: 10.1037/0033-2909.132.2.212

Elbin, R. J., Sufrinko, A., Schatz, P., French, J., Henry, L., Burkhart, S., . . . Kontos, A. P. (2016). Removal from play after concussion and recovery time. *Pediatrics, 138*(3), 1-10. doi: 10.1542/peds.2016-0910

Esquivel, A., Haque, S., Keating, P., Marsh, S., & Lemos, S. (2013). Concussion management, education, and return-to-play policies in high schools: A survey of athletic directors, athletic trainers, and coaches. *Sports Health, 5*(3), 258-262. doi: 10.1177/1941738113476850

Fazel, S., Wolf, A., Pillas, D., Lichtenstein, P., & Långström, N. (2014). Suicide, fatal injuries, and other causes of premature mortality in patients with traumatic brain injury: A 41-year Swedish population study. *JAMA Psychiatry, 71*(3), 326-333. doi: 10.1001/jamapsychiatry.2013.3935

Fishbein, M. (1963). An investigation of the relationships between beliefs about an object and the attitude toward that object. *Human Relations, 16*(3), 233-239.

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press.

Fox, K. R. (1987). *Physical self-perceptions and exercise involvement.* (Unpublished doctoral dissertation). Arizona State University, Tempe, AZ.

Fox, K. R., & Corbin, C. B. (1989). The physical self-perception profile: Development and preliminary validation. *Journal of Sport & Exercise Psychology, 11*(4), 408-430.

Fraas, M. R., Coughlan, G. F., Hart, E. C., & McCarthy, C. (2014). Concussion history and reporting rates in elite Irish rugby union players. *Physical Therapy in Sport, 15*(3), 136-142. doi: 10.1016/j.ptsp.2013.08.002

Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. Berkeley, CA: University of California Press.

Gill, D. L., & Deeter, T. E. (1988). Development of the Sport Orientation Questionnaire. *Research Quarterly for Exercise & Sport, 59*(3), 191-202.

Green, S. L., & Weinberg, R. S. (2001). Relationships among athletic identity, coping skills, social support, and the psychological impact of injury in recreational participants. *Journal of Applied Sport Psychology, 13*(1), 40-59.

Grossbard, J. R., Geisner, I. M., Mastroleo, N. R., Kilmer, J. R., Turrisi, R., & Larimer, M. E. (2009). Athletic identity, descriptive norms, and drinking among athletes transitioning to college. *Addictive Behaviors, 34*(4), 352-359. doi: 10.1016/j.addbeh.2008.11.011

Guerra, C. E., Dominguez, F., & Shea, J. A. (2005). Literacy and knowledge, attitudes, and behavior about colorectal cancer screening. *Journal of Health Communication, 10*(7), 651-663. doi: 10.1080/10810730500267720

Hadiyan, H., & Sheikh, M. (2015). How different sports establish different athletic identity levels. *International Journal of Kinesiology & Sports Science, 3*(3), 28-32. doi: 10.7575/aiac.ijkss.v.3n.3p.28

Hagger, M. S., Anderson, M., Kyriakaki, M., & Darkings, S. (2007). Aspects of identity and their influence on intentional behavior: Comparing effects for three health behaviors. *Personality and Individual Differences, 42*(2), 355-367.

Hale, B. D., James, B., & Stambulova, N. (1999). Determining the dimensionality of athletic identity: A "Herculean" cross-cultural undertaking. *International Journal of Sport Psychology, 30*(1), 83-100.

Hamilton, L. C. (1992). *Regression with graphics: A second course in applied statistics*. Belmont, CA: Duxbury Press.

Hamilton, L. C. (2013). *Statistics with Stata: Updated for version 12*. Boston, MA: Brooks/Cole.

Harrison, L., Sailes, G., Rotich, W. K., & Bimper, A. Y. (2011). Living the dream or awakening from the nightmare: Race and athletic identity. *Race Ethnicity and Education, 14*(1), 91-103. doi: 10.1080/13613324.2011.531982

Hogg, M. A., Terry, D. J., & White, K. M. (1995). A tale of two theories: A critical comparison of identity theory with social identity theory. *Social Psychology Quarterly, 58*(4), 255-269.

Hoover, D. R., Jr. (2012). *A balancing act: Division III student-athletes time demands and life roles.* (Doctoral dissertation). Retrieved from ProQuest. (ERIC No. ED549212)

Ievers-Landis, C. E., Burant, C., Drotar, D., Morgan, L., Trapl, E. S., & Kwoh, C. K. (2003). Social support, knowledge, and self-efficacy as correlates of osteoporosis preventive behaviors among preadolescent females. *Jounal of Pediatric Psychology, 28*(5), 335-345.

Johnston, K. L., & White, K. M. Binge-drinking: A test of the role of group norms in the Theory of Planned Behaviour. *Psychology & Health, 18*(1), 63-77.

Karpinski, C. A., & Milliner, K. (2016). Assessing intentions to eat a healthful diet among National Collegiate Athletic Association Division II collegiate athletes. *Journal of Athletic Training, 51*(1), 89-96. doi: 10.4085/1062-6050-51.2.06

Kaut, K. P. (2003). Reports of head injury and symptom knowledge among college athletes: Implications for assessment and educational intervention. *Clinical Journal of Sport Medicine, 13*(4), 213.

Kearney, M. H., & O'Sullivan, J. (2003). Identity shifts as turning points in health behavior change. *Western Journal of Nursing Research, 25*(2), 134-152 119p.

Kerr, Z. Y., Register-Mihalik, J. K., Kroshus, E., Baugh, C. M., & Marshall, S. W. (2015). Motivations associated with nondisclosure of self-reported concussions in former collegiate athletes. *American Journal of Sports Medicine.* doi: 10.1177/0363546515612082

Kerr, Z. Y., Register-Mihalik, J. K., Marshall, S. W., Evenson, K. R., Mihalik, J. P., & Guskiewicz, K. M. (2014). Disclosure and non-disclosure of concussion and concussion symptoms in athletes: Review and application of the socio-ecological framework. *Brain Injury, 28*(8), 1009-1021. doi: 10.3109/02699052.2014.904049

Kontos, A. P., Covassin, T., Elbin, R. J., & Parker, T. (2012). Depression and neurocognitive performance after concussion among male and female high school and collegiate athletes. *Archives of Physical Medicine & Rehabilitation, 93*(10), 1751-1756.

Kroshus, E., Baugh, C. M., Daneshvar, D. H., Nowinski, C. J., & Cantu, R. C. (2015). Concussion reporting intention: A valuable metric for predicting reporting behavior and evaluating concussion education. *Clinical Journal of Sport Medicine, 25*(3), 243-247.

Kroshus, E., Baugh, C. M., Daneshvar, D. H., & Viswanath, K. (2014). Understanding concussion reporting using a model based on the Theory of Planned Behavior. *Journal of Adolescent Health, 54*(3), 269-274. doi: 10.1016/j.jadohealth.2013.11.011

Kroshus, E., Daneshvar, D. H., Baugh, C. M., Nowinski, C. J., & Cantu, R. C. (2014). NCAA concussion education in ice hockey: An ineffective mandate. *British Journal of Sports Medicine, 48*(2), 135-140. doi: 10.1136/bjsports-2013-092498

Kroshus, E., Garnett, B., Hawrilenko, M., & Baugh, C. M. (2015). Concussion under-reporting and pressure from coaches, teammates, fans, and parents. *Social Science & Medicine, 134*, 66-75. doi: 10.1016/j.socscimed.2015.04.011

Kroshus, E., Garnett, B. R., Baugh, C. M., & Calzo, J. P. (2015). Social norms theory and concussion education. *Health Education Research, 30*(6), 1004-1013. doi: 10.1093/her/cyv047

Kroshus, E., Kubzansky, L. D., Goldman, R. E., & Austin, S. B. (2015). Norms, athletic identity, and concussion symptom under-reporting among male collegiate ice hockey players: A prospective cohort study. *Annals of Behavioral Medicine, 49*(1), 95-103. doi: 10.1007/s12160-014-9636-5

Kurowski, B., Pomerantz, W. J., Schaiper, C., & Gittelman, M. A. (2014). Factors that influence concussion knowledge and self-reported attitudes in high school athletes. *Journal of Trauma and Acute Care Surgery, 77*(3 Suppl 1), S12-S17. doi: 10.1097/TA.0000000000000316

Kurowski, B., Pomerantz, W. J., Schaiper, C., Ho, M., & Gittelman, M. A. (2015). Impact of preseason concussion education on knowledge, attitudes, and behaviors of high school athletes. *Journal of Trauma and Acute Care Surgery, 79*(3 Suppl 1), S21-S28. doi: 10.1097/TA.0000000000000675

Langlois, J. A., Rutland-Brown, W., & Wald, M. M. (2006). The epidemiology and impact of traumatic brain injury: A brief overview. *Journl of Head Trauma Rehabilitation, 21*(5), 375-378.

Leddy, J. J., Sandhu, H., Sodhi, V., Baker, J. G., & Willer, B. (2012). Rehabilitation of concussion and post-concussion syndrome. *Sports Health, 4*(2), 147-154. doi: 10.1177/1941738111433673

Lininger, M. R., Wayment, H. A., Hergatt Hufman, A., Craig, D. I., & Irving, L. H. (2017). An exploratory study on concussion-reporting behaviors from collegiate student athletes' perspectives. *Athletic Training & Sports Health Care, 9*(2), 71-80. doi: 10.3928/19425864-20161116-01

Llewellyn, T., Burdette, G. T., Joyner, A. B., & Buckley, T. A. (2014). Concussion reporting rates at the conclusion of an intercollegiate athletic career. *Clinical Journal of Sports Medicine, 24*(1), 76-79. doi: 10.1097/01.jsm.0000432853.77520.3d

MacKinnon, D. P., Krull, J. L., & Lockwood, C. M. (2000). Equivalence of the mediation, confounding and suppression effect. *Prevention Science, 1*(4), 173.

Malcolm, D. (2011). Sport medicine, injured athletes and Norbert Elias's sociology of knowledge. *Sociology of Sport Journal, 28*(3), 284-302.

Malcom, N. L. (2006). "Shaking it off" and "toughing it out": Socialization to pain and injury in girls' softball. *Journal of Contemporary Ethnography, 35*(5), 495-525.

Manasse-Cohick, N. J., & Shapley, K. L. (2014). Concussion education for high school football players: A pilot study. *Communication Disorders Quarterly, 35*(3), 182-185. doi: 10.1177/1525740113506605

Manning, M. (2009). The effects of subjective norms on behaviour in the Theory of Planned Behaviour: A meta-analysis. *British Journal of Social Psychology, 48*(Pt 4), 649-705. doi: 10.1348/014466608X393136

Martin, J. J., Mushett, C. A., & Eklund, R. (1994). Factor structure of the athletic identity measurement scale with adolescent swimmers with disabilities. / A estrutura do agrupamento de uma escala de medidas da identidade atletica de nadadores adolescentes com deficiencias. *Brazilian International Journal of Adapted Physical Education Research, 1*(1), 87-99.

Martland, H. S. (1928). Punch drunk. *Journal of the American Medical Association, 91*(15), 1103-1107. doi: 10.1001/jama.1928.02700150029009

McCall, G. J., & Simmons, J. L. (1966). *Identities and interactions*. New York, NY: Free Press.

McCrea, M., Hammeke, T., Olsen, G., Leo, P., & Guskiewicz, K. (2004). Unreported concussion in high school football players: Implications for prevention. *Clinical Journal of Sports Medicine, 14*(1), 13-17.

McCrory, P., Meeuwisse, W. H., Aubry, M., Cantu, B., Dvorak, J., Echemendia, R. J., . . . Turner, M. (2013). Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012. *British Journal of Sports Medicine, 47*(5), 250-258. doi: 10.1136/bjsports-2013-092313

McEachan, R., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. *Health Psychology Review, 5*(2), 97-144.

McEachan, R., Taylor, N., Harrison, R., Lawton, R., Gardner, P., & Conner, M. (2016). Meta-analysis of the Reasoned Action Approach (RAA) to understanding health behaviors. *Annals of Behavioral Medicine, 50*(4), 592-612. doi: 10.1007/s12160-016-9798-4

McKee, A. C., Cantu, R. C., Nowinski, C. J., Hedley-Whyte, E. T., Gavett, B. E., Budson, A. E., . . . Stern, R. A. (2009). Chronic traumatic encephalopathy in athletes: progressive tauopathy after repetitive head injury. *Journal of Neuropathology and Experimental Neurology, 68*(7), 709-735. doi: 10.1097/NEN.0b013e3181a9d503

Meehan, W. P., d'Hemecourt, P., Collins, C. L., & Comstock, R. D. (2011). Assessment and management of sport-related concussions in United States high schools. *American Journal of Sports Medicine, 39*(11), 2304-2310. doi: 10.1177/0363546511423503

Meehan, W. P., Mannix, R. C., O'Brien, M. J., & Collins, M. W. (2013). The Prevalence of undiagnosed concussions in athletes [Abstract]. *Clinical Journal of Sports Medicine*. doi: 10.1097/JSM.0b013e318291d3b3

Mehmetoglu, M., & Jakobsen, T. G. (2017). *Applied statistics using Stata: A guide for the social sciences*. Thousand Oaks, CA: SAGE Publications.

Meier, T. B., Brummel, B. J., Singh, R., Nerio, C. J., Polanski, D. W., & Bellgowan, P. S. (2015). The underreporting of self-reported symptoms following sports-related concussion. *Journal of Science and Medicine in Sport, 18*(5), 507-511. doi: 10.1016/j.jsams.2014.07.008

Miles, J. A. (2012). *Management and organization theory*. San Francisco, CA: Jossey-Bass.

Miller, P. S., & Kerr, G. A. (2003). The role experimentation of intercollegiate student athletes. *Sport Psychologist, 17*(2), 196.

Monette, D. R., Sullivan, T. J., & DeJong, C. R. (2008). *Applied social research: A tool for the human services* (8th ed.). Belmont, CA: Cengage Learning.

Mrazik, M., Dennison, C. R., Brooks, B. L., Yeates, K. O., Babul, S., & Naidu, D. (2015). A qualitative review of sports concussion education: Prime time for evidence-based knowledge translation. *British Journal of Sports Medicine, 49*(24), 1548-1553. doi: 10.1136/bjsports-2015-094848

National Athletic Trainers' Association. (2016). Code of Ethics. from http://www.nata.org/membership/about-membership/member-resources/code-of-ethics

Nixon II, H. L. (1992). A social network analysis of influences on athletes to play with pain and injuries. *Journal of Sport & Social Issues, 16*(2), 127-135.

Nixon II, H. L. (1993). Accepting the risks of pain and injury in sport: Mediated cultural influences on playing hurt. *Sociology of Sport Journal, 10*(2), 183-196.

Nulty, D. D. (2008). The adequacy of response rates to online and paper surveys: What can be done? *Assessment & Evaluation in Higher Education, 33*(3), 301-314.

O'Connor, K. L., Baker, M. M., Dalton, S. L., Dompier, T. P., Broglio, S. P., & Kerr, Z. Y. (2017). Epidemiology of sport-related concussions in high school athletes: National Athletic Treatment, Injury and Outcomes Network (NATION), 2011-2012 through 2013-2014. *Journal of Athletic Training, 52*(3), 175-185. doi: 10.4085/1062-6050-52.1.15

Oatley, K., & Bolton, W. (1985). A social-cognitive theory of depression in reaction to life events. *Psychological Review, 92*, 372-388. doi: 10.1037/0033-295X.92.3.372

Omalu, B. I., DeKosky, S. T., Minster, R. L., Kamboh, M. I., Hamilton, R. L., & Wecht, C. H. (2005). Chronic traumatic encephalopathy in a National Football League player. *Neurosurgery, 57*(1), 128-134. doi: 10.1227/01.NEU.0000163407.92769.ED

Paquin, R. S., & Keating, D. M. (2016). Fitting identity in the reasoned action framework: A meta-analysis and model comparison. *The Journal of Social Psychology*, 1-17. doi: 10.1080/00224545.2016.1152217

Petrovčič, A., Petrič, G., & Lozar Manfreda, K. (2016). The effect of email invitation elements on response rate in a web survey within an online community. *Computers in Human Behavior, 56*, 320-329. doi: 10.1016/j.chb.2015.11.025

Podlog, L., Gao, Z., Kenow, L., Kleinert, J., Granquist, M., Newton, M., & Hannon, J. (2013). Injury rehabilitation overadherence: Preliminary scale validation and relationships with athletic identity and self-presentation concerns. *Journal of Athletic Training, 48*(3), 372-381.

Povlishock, J. T. (2013). The window of risk in repeated head injury. *Journal of Neurotrauma, 30*(1), 1-1. doi: 10.1089/neu.2013.9942

Powell, J. W., & Barber-Foss, K. D. (1999). Traumatic brain injury in high school athletes. *Journal of the American Medical Association, 282*(10), 958-963.

Prichep, L. S., McCrea, M., Barr, W., Powell, M., & Chabot, R. J. (2013). Time course of clinical and electrophysiological recovery after sport-related concussion. *Journal of Head Trauma Rehabilitation, 28*(4), 266-273.

Prins, M. L., Alexander, D., Giza, C. C., & Hovda, D. A. (2013). Repeated mild traumatic brain injury: mechanisms of cerebral vulnerability. *Journal of Neurotrauma, 30*(1), 30-38.

Prochaska, J. O., & DiClemente, C. C. (2005). The Transtheoretical Approach. In J. C. Norcross & M. R. Goldfried (Eds.), *Handbook of Psychotherapy Integration* (2nd ed., pp. 147-171). New York, NY: Oxford University Press.

Proios, M. (2012). Factor validity of the Athletic Identity Measurement Scale in a Greek sample. *International Journal of Sport & Exercise Psychology, 10*(4), 305-313.

Register-Mihalik, J. K. (2010). *An assessment of high school athletes' and coaches' knowledge, attitudes, and behaviors concerning sport-related concussion* (Doctoral dissertation, University of North Carolina at Chapel Hill). Retrieved from https://cdr.lib.unc.edu/record/uuid:f434cecc-dd64-4942-b3e2-d741b8323a71

Register-Mihalik, J. K., Guskiewicz, K. M., McLeod, T. C. V., Linnan, L. A., Mueller, F. O., & Marshall, S. W. (2013). Knowledge, attitude, and concussion-reporting behaviors among high school athletes: A preliminary study. *Journal of Athletic Training, 48*(5), 645-653. doi: 10.4085/1062-6050-48.3.20

Register-Mihalik, J. K., Guskiewicz, K. M., Mihalik, J. P., Schmidt, J. D., Kerr, Z. Y., & McCrea, M. A. (2013). Reliable change, sensitivity, and specificity of a multidimensional concussion assessment battery: Implications for caution in clinical practice. *Journal of Head Trauma Rehabilitation, 28*(4), 274-283. doi: 10.1097/HTR.0b013e3182585d37

Register-Mihalik, J. K., Linnan, L. A., Marshall, S. W., McLeod, T. C. V., Mueller, F. O., & Guskiewicz, K. M. (2013). Using theory to understand high school aged athletes' intentions to report sport-related concussion: Implications for concussion education initiatives. *Brain Injury, 27*(7/8), 878-886. doi: 10.3109/02699052.2013.775508

Register-Mihalik, J. K., Valovich McLeod, T. C., Linnan, L. A., Guskiewicz, K. M., & Marshall, S. W. (2016). Relationship between concussion history and concussion knowledge, attitudes, and disclosure behavior in high school athletes. *Clinical Journal of Sport Medicine*.

Rice, S. G. (2008). Medical conditions affecting sports participation. *Pediatrics, 121*(4), 841-848. doi: 10.1542/peds.2008-0080

Rise, J., Sheeran, P., & Hukkelberg, S. (2010). The role of self-identity in the theory of planned behavior: A meta-analysis. *Journal of Applied Social Psychology, 40*(5), 1085-1105. doi: 10.1111/j.1559-1816.2010.00611.x

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Rosenstock, I. M. (1990). The health belief model: Explaining health behavior through expectancies. In K. Glanz, F. M. Lewis & B. K. Rimer (Eds.), *Health behavior and health education: Theory, research, and practice.* (pp. 39-62). San Francisco, CA, US: Jossey-Bass.

Rosenthal, J. A., Foraker, R. E., Collins, C. L., & Comstock, R. D. (2014). National high school athlete concussion rates from 2005-2006 to 2011-2012. *American Journal of Sports Medicine, 42*(7), 1710-1715. doi: 10.1177/0363546514530091

Sanchez-Fernandez, J., Munoz-Leiva, F., & Montoro-Rios, F. J. (2012). Improving retention rate and response quality in web-based surveys. *Computers in Human Behavior, 28,* 507-514. doi: 10.1016/j.chb.2011.10.023

Sauermann, H., & Roach, M. (2013). Increasing web survey response rates in innovation research: An experimental study of static and dynamic contact design features. *Research Policy, 42*, 273-286. doi: 10.1016/j.respol.2012.05.003

Schlueter, L. A. (1982). Knowledge and beliefs about breast cancer and breast self-examination among athletic and nonathletic women. *Nursing Research, 31*(6), 348-353.

Sheeran, P., & Taylor, S. (1999). Predicting intentions to use condoms: A meta-analysis and comparison of the Theories of Reasoned Action and Planned Behavior. *Journal of Applied Social Psychology, 29*(8), 1624-1675. doi: 10.1111/j.1559-1816.1999.tb02045.x

Smith, K. M., & McCann, C. W. (1998). *The validity of students' self-reported family incomes*. Paper presented at the Association for Institutional Research, Minneapolis, MN.

Sparks, P., & Shepherd, R. (1992). Self-identity and the Theory of Planned Behavior: Assessing the role of identification with 'green consumerism'. *Social Psychology Quarterly, 55*(4), 388-399.

Spirito, A., Ruggiero, L., Duckworth, M., Low, K. G., Coustan, D. R., McGarvey, S. T., & Khoury, M. R. (1993). The relationship of diabetes knowledge to regimen compliance and metabolic control during pregnancy. *Psychology & Health, 8*(5), 345-353. doi: 10.1080/08870449308401927

Stephan, Y., & Brewer, B. W. (2007). Perceived determinants of identification with the athlete role among elite competitors. *Journal of Applied Sport Psychology, 19*(1), 67-79.

Stryker, S. (1980). *Symbolic interactionism: A social structural version*. Menlo Park, CA: Benjamin Cummings.

Stryker, S., & Burke, P. J. (2000). The past, present, and future of an identity theory. *Social Psychology Quarterly, 63*(4), 284-297.

Sye, G., Sullivan, S. J., & McCrory, P. (2006). High school rugby players' understanding of concussion and return to play guidelines. *British Journal of Sports Medicine, 40*(12), 1003-1005. doi: 10.1136/bjsm.2005.020511

Taubman, B., Rosen, F., McHugh, J., Grady, M. F., & Elci, O. U. (2016). The timing of cognitive and physical rest and recovery in concussion. *Journal of Child Neurology, 31*(14), 1555-1560. doi: 10.1177/0883073816664835

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*, 53-55. doi: 10.5116/ijme.4dfb.8dfd

Terry, D. J., & Hogg, M. A. (1996). Group norms and the attitude-behavior relationship: a role for group identification. *Personality & Social Psychology Bulletin, 22*, 776-793. doi: 10.1177/0146167296228002

Torres, D. M., Galetta, K. M., Phillips, H. W., Dziemianowicz, E. M. S., Wilson, J. A., Dorman, E. S., . . . Balcer, L. J. (2013). Sports-related concussion: Anonymous survey of a collegiate cohort. *Neurology: Clinical Practice, 3*(4), 279-287.

Van Kampen, D. A., Lovell, M. R., Pardini, J. E., Collins, M. W., & Fu, F. H. (2006). The "value added" of neurocognitive testing after sports-related concussion. *American Journal of Sports Medicine, 34*(10), 1630-1635. doi: 10.1177/0363546506288677

Visek, A. J., Hurst, J. R., Maxwell, J. P., & Watson, J. C. (2008). A cross-cultural psychometric evaluation of the Athletic Identity Measurement Scale. *Journal of Applied Sport Psychology, 20*(4), 473-480.

Wallace, J., Covassin, T., Nogle, S., Gould, D., & Kovan, K. (2017). Knowledge of concussion and reporting behaviors in high school athletes with and without access to an athletic trainer. *Journal of Athletic Training, 52*(3), 228-235. doi: 10.4085/1062-6050-52.1.07

Wasserman, E. B., Kerr, Z. Y., Zuckerman, S. L., & Covassin, T. (2016). Epidemiology of sports-related concussions in National Collegiate Athletic Association athletes from 2009-2010 to 2013-2014: symptom prevalence, symptom resolution time, and return-to-play time. *American Journal of Sports Medicine, 44*(1), 226-233.

Weinberg, R., Vernau, D., & Horn, T. (2013). Playing through pain and injury: Psychosocial considerations. *Journal of Clinical Sport Psychology, 7*(1), 41-59.

Wiebe, D. J., Comstock, R. D., & Nance, M. L. (2011). Concussion research: A public health priority. *Injury Prevention, 17*(1), 69-70. doi: 10.1136/ip.2010.031211

Wiechman, S. A., & Williams, J. (1997). Relation of athletic identity to injury and mood disturbance. *Journal of Sport Behavior, 20*(2), 199.

Williamson, I. J. S., & Goodman, D. (2006). Converging evidence for the under-reporting of concussions in youth ice hockey. *British Journal of Sports Medicine, 40*(2), 128-132.

Yukhymenko-Lescroart, M. A. (2014). Students and athletes? Development of the Academic and Athletic Identity Scale (AAIS). *Sport, Exercise, and Performance Psychology, 3*(2), 89-101.

Yzer, M. (2007). Does perceived control moderate attitudinal and normative effects on intention? A review of conceptual and methodological issues. In I. Ajzen, D. Albarracin & R. Hornik (Eds.), *Prediction and change of health behavior: Applying the reasoned action approach*. Mahwah, NJ: Lawrence Erlbaum Associates.

Yzer, M., & van den Putte, B. (2014). Control perceptions moderate attitudinal and normative effects on intention to quit smoking. *Psychology of Addictive Behaviors, 28*(4), 1153-1161. doi: 10.1037/a0037924

Appendix A

IRB Approval 2/6/2017

Indiana University of Pennsylvania
www.iup.edu

Institutional Review Board for the
Protection of Human Subjects
School of Graduate Studies and Research
Stright Hall, Room 113
210 South Tenth Street
Indiana, Pennsylvania 15705-1048

P 724-357-7730
F 724-357-2715
irb-research@iup.edu
www.iup.edu/irb

February 6, 2017

Daniel Baer
402 Wynne Avenue
Havertown, PA 19083

Dear Mr. Baer:

Your proposed research project, "The relationship between athletic identity and concussion symptom reporting intention in collegiate athletes," (Log No. 17-016) has been reviewed by the IRB and is approved for the following sites: IUP, Bloomsburg University, Bryn Athyn College, Cabrini College, California University of Pennsylvania, East Stroudsburg University, Immaculata University, Kutztown University, Lock Haven University, Mansfield University, Mercyhurst University, Millersville University, University of Pittsburgh at Johnstown, Shippensburg University, Slippery Rock University, Swathmore College, Ursinus College, West Chester University, Widener University, and Gannon University. In accordance with 45CFR46.101 and IUP Policy, your project is exempt from continuing review. This approval does not supersede or obviate compliance with any other University requirements, including, but not limited to, enrollment, degree completion deadlines, topic approval, and conduct of university-affiliated activities.

You should read all of this letter, as it contains important information about conducting your study.

Now that your project has been approved by the IRB, there are elements of the Federal Regulations to which you must attend. IUP adheres to these regulations strictly:

1. You must conduct your study exactly as it was approved by the IRB.
2. Any additions or changes in procedures must be approved by the IRB before they are implemented.
3. You must notify the IRB promptly of any events that affect the safety or well-being of subjects.
4. You must notify the IRB promptly of any modifications of your study or other responses that are necessitated by any events reported in items 2 or 3.

The IRB may review or audit your project at random *or* for cause. In accordance with IUP Policy and Federal Regulation (45CFR46.113), the Board may suspend

or terminate your project if your project has not been conducted as approved or if other difficulties are detected

Although your human subjects review process is complete, the School of Graduate Studies and Research requires submission and approval of a Research Topic Approval Form (RTAF) before you can begin your research. If you have not yet submitted your RTAF, the form can be found at http://www.iup.edu/page.aspx?id=91683 .

While not under the purview of the IRB, researchers are responsible for adhering to US copyright law when using existing scales, survey items, or other works in the conduct of research. Information regarding copyright law and compliance at IUP, including links to sample permission request letters, can be found at http://www.iup.edu/page.aspx?id=165526.

I wish you success as you pursue this important endeavor.

Sincerely,

Jennifer Roberts, Ph.D.
Chairperson, Institutional Review Board for the Protection of Human Subjects
Professor of Criminology

JLR:jeb

Cc: Dr. John Anderson, Dissertation Advisor
Ms. Brenda Boal, Secretary

Appendix B

IRB Revision 2/24/2017

Indiana University of Pennsylvania
www.iup.edu

Institutional Review Board for the
Protection of Human Subjects
School of Graduate Studies and Research
Stright Hall, Room 113
210 South Tenth Street
Indiana, Pennsylvania 15705-1048

P 724-357-7730
F 724-357-2715
irb-research@iup.edu
www.iup.edu/irb

February 24, 2017

Mr. Daniel Baer
402 Wynne Avenue
Havertown, PA 19083

Dear Mr. Baer:

The IRB office received research site approval from Seton Hill University and Edinboro University for your proposed research project, "The relationship between athletic identity and concussion symptom reporting intention in collegiate athletics," (Log No. 17-016). On behalf of the IRB, I have approved the research site. Please forward additional letters of research site approval as you receive them so they can be added to your IRB file. As you know, data can only be collected and analyzed from sites with official research site approval on file. You must send the approvals to the IRB office and receive a formal letter of IRB approval for each site before you initiate data collection.

I wish you success as you pursue this important endeavor.

Sincerely,

Jennifer Roberts, Ph.D.
Chairperson, Institutional Review Board for the Protection of Human Subjects
Professor of Criminology

JLR:jeb

Cc: Dr. John Anderson, Dissertation Advisor

Appendix C

Research Topic Approval Form

Indiana University of Pennsylvania
www.iup.edu

Office of Assistant Dean for Research
School of Graduate Studies and Research
Stright Hall, Room 113
210 South Tenth Street
Indiana, Pennsylvania 15705-1048

P 724-357-7730
F 724-357-2715
www.iup.edu/research

February 13, 2017

Daniel Baer
402 Wynne Avenue
Havertown, PA 19083

Dear Mr. Baer:

Now that your research project has been approved by the Institutional Review Board for the Protection of Human Subjects, I have reviewed and approved your Research Topic Approval Form.

The Thesis/Dissertation Manual, additional resources, and information to help you start writing can be found at http://www.iup.edu/graduatestudies/thesis/default.aspx.

Based on the information you have provided on your RTAF, your anticipated graduation date is the earlier of August 2017 or your time-to-degree deadline. This means that you must defend by **no later than July 1, 2017** and all necessary documents are due by this date. A description of the required documents can be accessed at http://www.iup.edu/page.aspx?id=116439. Your dissertation must be submitted to the School of Graduate Studies & Research by July 15, 2017 if you desire to graduate by your anticipated date. You must apply for graduation by August 1, 2017. For deadlines for subsequent graduation dates, please access http://www.iup.edu/page.aspx?id=16683.

Finally, if you change your topic, the scope or methodology of your project, or your committee, a new Research Topic Approval Form must be completed.

I wish you well and hope you find this experience to be rewarding.

Sincerely,

Hillian E. Creely, J.D., Ph.D.
Assistant Dean for Research

HEC/bb

xc: Dr. Yaw Asamoah, Dean
Dr. John Anderson, Graduate Coordinator and Dissertation Committee Chairperson
Ms. Julie Bassaro, Secretary

Appendix D

Recruitment Emails

PRE-NOTIFICATION EMAIL

Hi [NAME],
Thank you again for your assistance in distributing the survey for my research. Please forward this information to the student-athletes at your institution at your earliest convenience to let them know that they will be receiving a link to complete a survey next week. Please copy me on your email. I will send you the survey link on Sunday night to go out on Monday. Thanks!

Hello student-athletes,
I am a doctoral student at Indiana University of PA and a faculty member/athletic trainer at West Chester University. In a few days, you will receive a link to participate in a survey. This is part of a research study that I am conducting to evaluate the relationship between athletic identity and concussion symptom reporting intention in collegiate athletes. Student-athletes at several colleges/universities across Pennsylvania will participate in this anonymous survey. To thank you for participating, I am offering the following incentives:

- **Five student-athletes who complete the survey will be randomly selected to receive $100 each.**

- **The Student-Athlete Advisory Committees at the top three schools with the highest numbers of survey responses will receive $300, $200, and $100, respectively. The SAACs can use those funds however they see fit.**

Please consider participating in this survey. I really appreciate your time. If you have any questions, please contact me at d.j.baer@iup.edu.

Thanks again!

Dan

Dan Baer
Ph.D. student, Indiana University of PA
Instructor/Athletic Trainer, West Chester University of PA

SURVEY EMAIL

Hello again,

Please forward the link below to the student-athletes at your institution. Thank you again for your assistance.

Student-athletes, please consider taking 10 minutes to complete this survey. Your responses are completely anonymous.
Survey Link: https://iup.co1.qualtrics.com/SE/?SID=SV_3w0gq4xuAUv3P3D

Five student-athletes who complete the survey will be randomly selected to receive $100 each to thank them for participating.

The Student-Athlete Advisory Committees at the top three schools with the highest numbers of survey responses will receive $300, $200, and $100, respectively. The SAACs can use those funds however they see fit.

More information about your participation is provided when you click on the link. Please do not hesitate to contact me at d.j.baer@iup.edu with any questions. Thank you!

Dan

Dan Baer
Ph.D. student, Indiana University of PA
Instructor/Athletic Trainer, West Chester University of PA

FOLLOW UP 1

Hi [NAME],
Please re-send the link below to the student-athletes at your institution to remind them that the survey is still available for those who would like to participate. Thank you again!

Survey link: https://iup.co1.qualtrics.com/SE/?SID=SV_3w0gq4xuAUv3P3D

Student-athletes, if you have not yet done so, please consider taking 10 minutes to complete this survey. Check the link below to see which schools are in the lead to win money!
Leaderboard:
https://iup.co1.qualtrics.com/results/public/aXVwLVVSXzZtcHNaUDAzdE4wQm9JNS01ODVlMTY0MzdkYzBiZDE0MDAyZTBlNDY=#/pages/Page_4b3f86f7-5e5d-4882-bec1-981cbf4165d6

Five student-athletes who complete the survey will be randomly selected to receive $100 each to thank them for participating.

The Student-Athlete Advisory Committees at the top three schools with the highest numbers of survey responses will receive $300, $200, and $100, respectively. The SAACs can use those funds however they see fit.

More information about your participation is provided when you click on the link. Please do not hesitate to contact me at d.j.baer@iup.edu with any questions. Thank you.

If you have already completed the survey, I apologize for the repeat email. Because your responses are anonymous, you cannot be identified, so I have no way of removing you from an email list. Please encourage your teammates to also complete the survey. Thank you for your time and participation.

Dan

Dan Baer
Ph.D. student, Indiana University of PA
Instructor/Athletic Trainer, West Chester University of PA

FOLLOW UP 2

Hi [NAME],
Please send the link again to the student-athletes at your institution to remind them that the survey is still available for anyone who wants to participate. Thanks again!

Survey link: https://iup.co1.qualtrics.com/SE/?SID=SV_3w0gq4xuAUv3P3D

Student-athletes – thank you to those of you who have already completed the survey. Your time and participation are greatly appreciated! If you have not had the chance yet, please consider taking 10 minutes to complete the survey. There is still time to enter the drawing to win $100!

Check the link below to see which schools are in the lead to win money for their SAAC.
Leaderboard:
https://iup.co1.qualtrics.com/results/public/aXVwLVVSXzZtcHNaUDAzdE4wQm9JNS01ODVlMTY0MzdkYzBiZDE0MDAyZTBlNDY=#/pages/Page_4b3f86f7-5e5d-4882-bec1-981cbf4165d6

Five student-athletes who complete the survey will be randomly selected to receive $100 each to thank them for participating.

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More information about your participation is provided when you click on the survey link. Please do not hesitate to contact me at d.j.baer@iup.edu with any questions. Thank you.

If you have already completed the survey, I apologize for the repeat email. Because your responses are anonymous, you cannot be identified, so I have no way of removing you from an email list. Thank you for your time and participation. Please encourage your teammates to also complete the survey.

Dan

Dan Baer
Ph.D. student, Indiana University of PA
Instructor/Athletic Trainer, West Chester University of PA

Appendix E

Informed Consent Statement

You are invited to participate in this research study through Indiana University of PA. The following information is provided to help you to make an informed decision whether or not to participate. If you have any questions please do not hesitate to ask. You are eligible to participate because you are an NCAA student-athlete.

The purpose of this study is to determine how athletic identity, attitudes, social pressure, and perceived control influence intention to report concussion symptoms among college athletes. The information gained from this study may improve understanding of the problem of concussion underreporting. Participation in this study will require approximately 10 minutes of your time. There are no anticipated risks associated with participating in this study.

Your participation in this study is voluntary. You are free to decide not to participate in this study or to discontinue the survey at any time by exiting your web browser. This will not adversely affect your relationship with the investigator or IUP. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you choose to participate, your responses will be completely anonymous; all information will be held in strict confidence and will have no bearing on services you receive from the University. The information obtained in the study may be published in scientific journals or presented at scientific meetings but your identity will be completely anonymous. Once you submit your survey, it cannot be withdrawn because the data you provide cannot be traced to you.

Your participation in this study implies that you are providing consent. Please contact the project coordinator or the faculty sponsor if you have any questions.

Daniel Baer, MS, LAT, ATC **Ph.D. Student/Project Coordinator** **Administration & Leadership Studies** **Indiana University of Pennsylvania** **Phone: 610-436-2139** **d.j.baer@iup.edu**	**John Anderson, Ph.D.** **Faculty Sponsor** **Administration & Leadership Studies** **Indiana University of Pennsylvania** **Phone: 717-720-4064** **jaa@iup.edu**

This project has been approved by the Indiana University of Pennsylvania Institutional Review Board for the Protection of Human Subjects (Phone: 724-357-7730).

VOLUNTARY CONSENT:

By completing this survey, I acknowledge that I have read and understand the information on this page and I consent to volunteer to be a subject in this study. I understand that my responses are completely anonymous and that I have the right to discontinue participation at any time.

Survey Powered By Qualtrics

Appendix F

Survey Instrument

DEMOGRAPHICS/BACKGROUND INFORMATION

Please select the appropriate response from the dropdown list for each question in this section.

1. Sex: Male Female
2. Age (in years): 18, 19, 20, 21, 22, 23, 24, 25 or older
3. Do you classify yourself as a racial or ethnic minority student? Yes, No
4. School: Bloomsburg, Bryn Athyn, Cabrini, California, Cheyney, Clarion, East Stroudsburg, Edinboro, Gannon, Immaculata, IUP, Kutztown, Lock Haven, Mansfield, Mercyhurst, Millersville, Pitt-Johnstown, Seton Hill, Shippensburg, Slippery Rock, Swarthmore, Ursinus, West Chester, Widener
5. Year in School (academic): Freshman, Sophomore, Junior, Senior, 5th year, Grad student
6. Primary Sport: Acrobatics & Tumbling, Badminton, Baseball, Basketball, Cheerleading, Cross Country, Diving, Field Hockey, Football, Golf, Gymnastics, Ice Hockey, Lacrosse, Rowing, Rugby, Soccer, Softball, Swimming, Tennis, Track & Field, Volleyball, Wrestling, Water Polo
7. Since you were 12 years old, how many years have you participated in your primary sport (include organized sport only)? 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or more
8. Are you an international athlete? Yes, No

Please answer the questions below based on the following definition of concussion.

A concussion is a traumatic brain injury that can be caused by a blow to the head, face, neck, or elsewhere on the body, with an impulsive force transmitted to the head. Concussion typically results in rapid onset of short-lived symptoms; however symptoms sometimes develop minutes or hours later. Concussion may or may not involve loss of consciousness. (McCrory et al., 2013)

Each concussion is different, but some of the common symptoms of concussion are headache, dizziness, sensitivity to light or sound, fatigue, drowsiness, confusion, difficulty concentrating, difficulty remembering, feeling more emotional or irritable, and difficulty sleeping.

Now that you know what the symptoms of a concussion are, please indicate below how likely you are to report concussion symptoms to a coach or athletic trainer under the following circumstances:

9. Symptoms that occur during practice
   Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
   1 2 3 4 5 6 7
10. Symptoms that occur during a regular season competition
   Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
   1 2 3 4 5 6 7
11. Symptoms that occur during a playoff or championship competition
   Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
   1 2 3 4 5 6 7
12. Symptoms that last for 24 hours or less
   Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
   1 2 3 4 5 6 7

13. Symptoms that last for more than 1 week

Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
1 2 3 4 5 6 7

14. Mild concussion symptoms

Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
1 2 3 4 5 6 7

15. Severe concussion symptoms

Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
1 2 3 4 5 6 7

16. In general, if one of your teammates experiences concussion symptoms following a blow to the head, how likely are you to tell a coach or athletic trainer?

Extremely unlikely ___ ___ ___ ___ ___ ___ ___ Extremely likely
1 2 3 4 5 6 7

Please indicate how much you agree or disagree with the following statements.

17. I consider myself an athlete.

Strongly disagree ___ ___ ___ ___ ___ ___ ___ Strongly agree
1 2 3 4 5 6 7

18. I have many goals related to sport.

Strongly disagree ___ ___ ___ ___ ___ ___ ___ Strongly agree
1 2 3 4 5 6 7

19. Most of my friends are athletes.

Strongly disagree ___ ___ ___ ___ ___ ___ ___ Strongly agree
1 2 3 4 5 6 7

20. Sport is the most important part of my life.

Strongly disagree ___ ___ ___ ___ ___ ___ ___ Strongly agree
1 2 3 4 5 6 7

21. I spend more time thinking about sport than anything else.

Strongly disagree ___ ___ ___ ___ ___ ___ ___ Strongly agree
1 2 3 4 5 6 7

22. I feel bad about myself when I do poorly in sport.

Strongly disagree ___ ___ ___ ___ ___ ___ ___ Strongly agree
1 2 3 4 5 6 7

23. I would be very depressed if I were injured and could not compete in sport.

Strongly disagree ___ ___ ___ ___ ___ ___ ___ Strongly agree
1 2 3 4 5 6 7

Please indicate how you feel about the following statement for each word pair listed below.
For me to report possible concussive symptoms to a coach or medical professional when I experience them is:

24. Cowardly ___ ___ ___ ___ ___ ___ ___ Brave
1 2 3 4 5 6 7

25. Pleasant ___ ___ ___ ___ ___ ___ ___ Embarrassing
1 2 3 4 5 6 7

26. Harmful ___ ___ ___ ___ ___ ___ ___ Beneficial
1 2 3 4 5 6 7

27. Good ___ ___ ___ ___ ___ ___ ___ Bad
1 2 3 4 5 6 7

28. Unimportant ___ ___ ___ ___ ___ ___ ___ Important
1 2 3 4 5 6 7

29. Worthless __ __ __ __ __ __ __ Valuable
    1 2 3 4 5 6 7

Please answer the following questions based on your perceptions of concussion symptom reporting.

30. Most people like me report possible concussion symptoms to a coach or a medical professional, when they experience them.

    Never __ __ __ __ __ __ __ Always
    1 2 3 4 5 6 7

31. How many people in your sport do you think report possible concussion symptoms to a coach or a medical professional, when they experience them?

    Virtually none __ __ __ __ __ __ __ Almost All
    1 2 3 4 5 6 7

32. How many of your teammates report possible concussion symptoms to a coach or a medical professional, when they experience them?

    Virtually none __ __ __ __ __ __ __ Almost All
    1 2 3 4 5 6 7

33. How many college athletes report possible concussion symptoms to a coach or a medical professional, when they experience them?

    Virtually none __ __ __ __ __ __ __ Almost All
    1 2 3 4 5 6 7

34. When it comes to reporting possible concussion symptoms to a coach or medical professional, my coaches think that:

    I should not __ __ __ __ __ __ __ I should
    1 2 3 4 5 6 7

35. When it comes to reporting possible concussion symptoms to a coach or medical professional, my teammates think that:

    I should not __ __ __ __ __ __ __ I should
    1 2 3 4 5 6 7

36. When it comes to reporting possible concussion symptoms to a coach or medical professional, my parents think that:

    I should not __ __ __ __ __ __ __ I should
    1 2 3 4 5 6 7

37. When it comes to reporting possible concussion symptoms to a coach or medical professional, my athletic trainer thinks that:

    I should not __ __ __ __ __ __ __ I should
    1 2 3 4 5 6 7

Please indicate how much you agree or disagree with the following statements.

38. In general, I want to do what my coaches think I should do.

    Strongly disagree __ __ __ __ __ __ __ Strongly agree
    1 2 3 4 5 6 7

39. In general, I want to do what my teammates think I should do.

    Strongly disagree __ __ __ __ __ __ __ Strongly agree
    1 2 3 4 5 6 7

40. In general, I want to do what my parents think I should do.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

41. In general, I want to do what my athletic trainer thinks I should do.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

42. I am confident in my ability to recognize the symptoms of a concussion.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

43. I am confident in my ability to report symptoms of a concussion, even when I really want to keep playing.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

44. I am confident in my ability to report symptoms of a concussion, even when I think my teammates want me to play.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

45. I am confident in my ability to report symptoms of a concussion, even if I do not think they are all that bad.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

46. I am confident in my ability to report specific symptoms, even if I am unsure that it is actually a concussion.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

47. It is mostly up to me whether or not I report symptoms of a concussion.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

48. I have complete control over whether or not I report symptoms of a concussion.

Strongly disagree __ __ __ __ __ __ __ Strongly agree
1 2 3 4 5 6 7

49. Have you ever had a concussion or experienced concussion symptoms?

Yes, No

If answered "yes" to number 43, move on to number 44 and 45. If answered "no" to number 43, survey is complete.

50. How many *diagnosed* concussions have you previously had?

1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or more

51. When you have experienced possible concussion symptoms, how often have you reported them to someone (e.g. coach, athletic trainer, etc.)?

Never __ __ __ __ __ __ __ Always
1 2 3 4 5 6 7

Appendix G

Survey Incentive

Thank you for completing this survey! Your participation is greatly appreciated.

If you would like to provide your email address to be entered in a random drawing to receive $100 for your participation in this survey, please open the link below. Five participants will be randomly selected to receive $100 each.

ENTER DRAWING

To view the survey LEADERBOARD, click on the link below. The school with the highest number of survey responses will receive $300 towards their Student-Athlete Advisory Committee (SAAC). The second highest will receive $200 towards their SAAC, and the third highest will receive $100 to their SAAC. If you do not wish to see the leaderboard, you may now close this page.

Survey response leaderboard by school

Survey Powered By Qualtrics

Participants who chose to provide contact information to enter in a random drawing to receive $100, were redirected to the following Qualtrics survey.

Please provide your contact information below to be entered in a random drawing to receive $100 for your participation in the survey you have just completed. Five students who have completed the survey will be randomly chosen to receive $100 each.

Name	
School	
email address	

Survey Powered By Qualtrics