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What is an Athlete's Life Worth?
A Mixed Methods Exploration of Concussion Policy and Protocol Decision-Making

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Abstract

What is an Athlete's Life Worth? A Mixed Methods Exploration of Concussion Policy and Protocol Decision-Making
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Introduction: Over 3.8 million sports concussions occur every year in the United States. Youth athletes are particularly at risk because they participate in sports at a high rate. With over 40 million youth athletes and nearly 8 million high school athletes, as many as 400,000 athletes per year report experiencing a concussion. Concussions have immediate impacts on sports performance and health; however, most concerning are the long-term mental-behavioral health consequences of repeated concussions such as depression, dementia, and suicidality. Prior sports concussion research has lacked well-designed applications of multiple-level theory and mixed and qualitative methods to understanding concussion laws, guidelines, and policies for youth athletes.

Objectives: To explore: 1) how decision-makers influence creating, adopting, and implementing sports concussion policies in Georgia high schools and youth sports; 2) how decision-makers perceive prominent sports concussion guidelines; 3) how decision-makers' perceptions of prominent sports concussion guidelines influences concussion policy adoption decisions.

Methods: The investigator applied a mixed methods design of in-depth-interviews and quantitative surveys informed by Diffusion of Innovations theory and analyzed using a grounded theory approach. Telephone and e-mail recruitment yielded thirteen interviews and seven surveys. Primary analyses involved inductive, thematic analysis and concept mapping of interviews and descriptive statistics, frequency counts, and free lists of survey data.

Results: Thirteen key themes and 58 sub-codes emerged from interviews, culminating in a concept map of 22 key themes and sub-codes. Variation in communication, resources, and knowledge regarding sports concussions was pervasive at the school and community levels, influencing sports concussion policy roles, creation, and implementation. Participants viewed prominent concussion guidelines favorably citing general use in providing concussion care but minimal influence on creating sports concussion legislation and policies in Georgia.

Conclusion: Resource variability in schools and communities influences how they create and implement sports concussion policies and thus the extent that they can adhere to Georgia's concussion law. The diffusion of this law and concussion guidelines appears incomplete, potentially leaving athletes at risk. Solutions to resource and knowledge gaps are available but require greater leadership, communication, and collaboration to address this public health issue.

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Introduction

Concussion in Sports

Over the past decade, the medical and scientific communities, along with the national media, have increasingly focused attention on sports concussions. Notable scientific and public health efforts emerged in response to the growing concussion concern. Since 2004, the Centers for Disease Control and Prevention (CDC) has developed and disseminated its *Heads Up* program to educate youth athletes, parents, and coaches about concussion awareness, safety, and protocol. Meanwhile, in 2008 Boston University established research centers to assess the long-term health impacts of sports concussions by examining the brains of deceased athletes.

Despite positive scientific and public health responses, the media and general public did not fully ascertain the severity of the concussion issue until the highly publicized head injury related deaths of several professional athletes. In Summer 2011, three National Hockey League "enforcers", players known for physical play and fighting prowess, with a history of head injuries and mental-behavioral health issues, died prematurely. Two, Rick Rypien and Wade Belak, completed suicide (Harrison, 2011; Maki, 2011). The third, Derek Boogaard, lost his life due to an accidental painkiller overdose, likely related to his confirmed diagnosis of Chronic Traumatic Encephalopathy (CTE), a neurodegenerative brain disease (Branch, 2011). The following year, hall of fame National Football League linebacker Junior Seau, renowned for his hard hits and concussion history, also completed suicide. Like Boogaard, Seau had a CTE diagnosis (Fainaru-Wada, Avila, & Fainaru, 2013). These incidents and responses, including several recent class-action lawsuits against both leagues, refocused attention on the concussion issue in the United States. Indeed, CDC estimates that as many as 3.88 million sports-related concussions occur annually in the United States (Langlois, Rutland-Brown, & Wald, 2006).

Despite increased awareness of and concerns about sports concussions, athletic participation in the US remains steady, especially in children age 18 and younger. Indeed, participation has never been higher, as over 40 million US children play organized sports each year (Kerr et al., 2014; Le Menestrel & Perkins, 2007). High school youths are particularly at risk for concussions because of their high participation rate in various sports activities that put them at risk for head injuries such as concussions (Kroshus, Kubzansky, Goldman, & Austin, 2014d). Participation in high school sports continues to increase, trending upward over the past 40 years and increasing for 26 straight-years, with over 7.8 million high school student athletes in the 2014-15 academic year (NFSHSA, 2015; Rosenthal, Foraker, Collins, & Comstock, 2014). Notably, despite increasing awareness of head injury risks, high participation rates have continued since 2007 in high concussion-risk sports such as football, ice hockey, and soccer (NFSHSA, 2015). Tackle football remains the most popular high school sport with over 1.1 million players, almost twice as many participants as the next most popular sport of track and field, despite some recent declines and yearly variations of around one-to-two percent (NFSHSA, 2015). Being a student athlete in high school appears to be the norm, as the majority of these students, 58.4%, play organized sports (CDC, 2012).

As high school sports participation has increased, so have the numbers and rates of concussions. There has been a steady increase in concussion rates in both high school and college athletes for over twenty years (Daneshvar, Nowinski, Mckee, & Cantu, 2011). Concussions are now one of the most common injuries that high school athletes experience (Marar, McIlvain, Fields, & Comstock, 2012). Indeed, the current concussion rate of 13.2% in high school athletes, with annual incidence estimates having increased from 100,000 to 400,000, suggests an increasing frequency of high school athletic-related concussions (Gessel, Fields,

Collins, Dick, & Comstock, 2007; Guerriero, Proctor, Mannix, & Meehan, 2012; Marrar et al., 2012; Yard & Comstock, 2009). Some regions in the US have reported four-fold rate increases over ten years (Lincoln et al., 2011). Although not quite as high, national data reflect this trend. A recent epidemiological study using data from "High School Reporting Information Online, a national high school sports injury surveillance system" showed the overall concussion rate more than doubled from 2005 to 2012, with rising rates in all sports studied (Rosenthal et al., 2014, p. 2). Despite advances in sports concussion awareness, knowledge, research, and prevention, the present attention to sports concussion appears to lack elements of "fundamental cultural change" with society, primarily mass media outlets, only recently recognizing the importance of this issue (Murray, Murray, & Robson, 2015; p. 77).

According to national surveillance data, concussions from organized sports led to 502,000 emergency room visits for youth, aged 8-19 years, from 2001-2005 (Bakhos, Lockhart, Myers, & Linakis, 2010). Moreover, from 1997 to 2007, concussion-related emergency room visits doubled for 8- to 13- year-old youth and increased over 200% for 14 to 19-year-old youth, who are typically high school aged (Bakhos et al., 2010). Brain injuries from sports and recreation comprise 65% of emergency room visits by youth aged 5-18 years (Baugh, Kroshus, Bourlas, & Perry, 2014; CDC 2011).

Return to Play

Beyond epidemiological concussion statistics, underreporting and undiagnosed concussions and premature return to play (RTP), i.e., resuming athletic participation before concussion symptoms have resolved and the player receives medical clearance, remain concerning issues. In some cases, this is because the concussion goes unrecognized or unreported. When accounting for unrecognized or unreported concussions in young

athletes, researchers of university football and soccer players report that the true concussion incidence rates may be six to ten times higher than most reported figures (Delaney, Lacroix, Leclerc, & Johnston, 2002; Donaldson et al., 2014). High school athletes, especially football players, tend to underreport or hide their concussions, while up to 40.5% of athletes who report a concussion still RTP prematurely, with nearly 16% of football players returning within less than one day (McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004; Register-Mihalik et al., 2013; Yard & Comstock, 2009). Further, data from national epidemiological studies suggest that premature RTP rates are not trivial. Specifically, results from the National High School Sports-Related Injury Surveillance System from 2005-2010 revealed that 15% and 8% of newly and recurrently concussed athletes, respectively, whose concussion symptoms took over one month to remediate, resumed playing three weeks or fewer post-concussion (Castile, Collins, McIlvain, & Comstock, 2012). Given high school athletes' tendency for underreporting concussions, the true prevalence for premature RTP from concussion is likely higher than the prevalence observed in surveillance system data. Nearly one third of high school aged athletes have had a prior, undiagnosed concussion, suggesting that they continued playing while symptomatic because they did not get medical clearance to return to play (Meehan, Mannix, O'Brien, & Collins, 2013).

Health Risks

Premature RTP, whether due to lack of diagnosis, misdiagnosis, or underreporting, puts athletes at risk for further injury and severe health consequences. Concussions decrease reaction times, despite an athlete's appearing symptom free, exacerbating the injury's severity and making additional concussions more likely and more severe (Harmon

et al., 2013). Suffering an additional concussion can result in internal cerebral bleeding, coma, or death (often referred to as second impact syndrome; SIS), or later cognitive impairment, as seen in conditions such as CTE or Chronic Neurocognitive Impairment (CNI; Broglio, Macciocchi, & Ferrara, 2007; Chrisman, Quitiquit, & Rivara, 2013; Guskiewicz et al., 2005; Harmon et al., 2013; Iverson, Brooks, Collins, & Lovell, 2006; Yard & Comstock, 2009). Another long-term health risk is post-concussion syndrome, wherein concussion symptoms such as dizziness, headaches, depressed mood, irritability, memory loss, or poor concentration, persist weeks, months, or years after impact (Harmon et al., 2013; Kontos, Covassin, Elbin, & Parker, 2012).

Most concerning about sports concussions are their long-term consequences for athletes' mental, behavioral, and neurological health. For athletes, repeated and increased experiences of concussions correspond to increased risk for: poorer mental health, cognitive impairment, depression, and neurodegenerative diseases such as CTE, Parkinson's, and Alzheimer's (Guskiewicz et al., 2005; Guskiewicz et al., 2007; Jordan, 2013; Montenigro et al., 2015; Stein, Alvarez, & McKee, 2014). These resulting diseases feature dementia and other cognitive and neurological problems, often presenting with such symptoms as: impaired motor skills; behavior that is aggressive, impulsive, and uninhibited; altered mood often corresponding with depression and anxiety; and cognitive issues featuring memory, thinking, and speaking difficulties (Jordan, 2013; Montenigro et al., 2014; Montenigro et al., 2015). Thus, sports concussions represent a substantial, mental-behavioral health problem because of the aforementioned resulting long-term health risks.

Whether concussion rates are increasing due to chance, changes in athletes, more

youth athletes, or improved reporting and diagnostics remains unclear (Daneshvar et al., 2011; Guerriero et al., 2012; Rosenthal et al., 2014). Such trends could relate to athletes becoming "bigger, faster, and stronger," leading to more forceful impacts and thus more concussions (Rosenthal et al., 2014, p. 10). Emergency room visits for concussions increased from 1997-2007, suggesting a potential causal role for changes in athletes; however, increased awareness of concussions or reliance on emergency rooms could also explain this finding (Bakhos et al., 2013). Still, the increasing number of concussions is concerning, and requires that all relevant personnel, such as coaches, athletic trainers (ATCs), and physicians, involved in concussion reporting, diagnosis, and treatment for high school athletes adhere to established protocols and guidelines to prevent further harm.

Current Guidelines & Laws

Fortunately, several guidelines for concussion management and RTP are available. Since 2001, concussion research and clinical experts have periodically convened at the International Symposium on Concussion in Sport (referred herein as CISG, Concussion in Sport Group) to establish consensus guidelines for the assessment, evaluation, treatment, and RTP for sports-related concussions in athletes of all ages. Depending on the location of the symposium when the guidelines were established, the literature may also refer to them as the Vienna, Prague, or Zurich guidelines.

Despite the effort to create consensus guidelines, however, concussion researchers and providers have competed over best practices for concussion management and RTP. For example, by the year 2001, more than 25 concussion grading scales were in use, each with varying guideline adherence and criteria that emphasized symptom presence and duration without incorporating clinical evidence such as neurocognitive testing (Johnston, McCrory, Mohtadi, &

Meeuwisse, 2001; Yard & Comstock, 2009). Furthermore, by the year 2009, various researchers and organizations had published some 20 different guidelines over a 20-year period (Donaldson et al., 2014; Lovell, 2009). Such proliferation is problematic because these guidelines primarily hinge on expert opinions rather than rigorous, systematic reviews of scientific or medical research and evidence (Collins, Lovell, Mckeag, 1999; Grindel, Lovell, & Collins, 2001; Lovell, 2009). Such differences in opinions seem to stem from jockeying for primacy between different providers as to their role in concussion diagnosis and management, in addition to disagreements over less significant subtleties in best practices based upon research.

Concussion researchers and providers have also inconsistently updated concussion guidelines. For instance, one of the most widely used guidelines, the American Academy of Neurology's (AAN) guidelines went unchanged for 16 years until the AAN released an updated version in 2013. Because the AAN guidelines did not change for several years, they remained more popular than the CISG guidelines that underwent more frequent revision (Notebaert & Guskiewicz, 2005; Giza et al., 2013). Thus, the CISG position statement's continual revision, in 2008 and most recently in 2012, may have further slowed their dissemination (McCrory et al., 2009, McCrory et al., 2013). Other popular guidelines are those of the American College of Sports Medicine (ACSM; Herring et al., 2011), the American Medical Society for Sports Medicine (AMSSM; Harmon et al., 2013), and the National Athletic Trainers' Association (NATA; Broglio et al., 2014), which also underwent recent updates, in 2011, 2013, and 2014, respectively. Indeed these five guidelines, CISG, AAN, AMSSM, ACSM, and NATA, appear to be the most prominent current clinical guidelines in use for sports concussion and RTP (Echemendia, Giza, & Kutcher, 2015).

Even with the growth of concussion management best practices and the resulting

availability of numerous guidelines, their diffusion and dissemination remain limited. Many ATCs do not use all recommended best practices for concussion examinations and RTP assessments (Ferrara et al., 2001; Lynall et al., 2013; Notebaert & Guskiewicz, 2005). Furthermore, researchers and providers in sports medicine and concussion management related fields seem to have differing opinions about the best methods for concussion diagnosis, management, and clearance for RTP (Lynall et al., 2013). Beyond ATCs, there is lack of research on and understanding of the diffusion of consensus statements and guidelines among physicians and other relevant stakeholders. Therefore, the extent to which the aforementioned prominent concussion RTP guidelines are in use remains unclear.

Complicating the understanding of concussion RTP guideline dissemination are the inconsistencies and lack of clarity in state laws regarding high school concussion policies. Every state has passed legislation, with subtle difference between each, often providing a bare minimum standard or little to no guidance as to implementation (Baugh et al., 2014a; Graham et al., 2014). Many of the laws, including Georgia's, do not recommend specific guidelines or standards to use, leaving policy decision makers and implementers to their own discretion (Baugh et al., 2014a; Graham et al., 2014).

In 2013, the Georgia State Legislature passed the Return to Play Act of 2013, establishing a statewide concussion policy. Specifically, starting in 2014, the law requires all schools with youth sports activities to have RTP policies with three main criteria: 1) provision of educational material to athletes' parents on concussion and head injury risk, prior to the start of every sport's season; 2) removal of athletes showing concussion symptoms from play; 3) allowing concussed athletes to RTP only after medical clearance from a physician, nurse, ATC, or physician assistant who has received concussion training (Georgia General Assembly, 2013). Moreover, under the

law, public recreation facilities that host organized youth sports (which involves fees and registration) must provide educational information sheets on concussion to parents but do not have to create a RTP policy or protocol. Finally, the law limits the liability of schools and public recreation facilities for concussions. Besides these broad criteria, the state provides no standards for the schools and facilities, and schools essentially could each develop their own policy. While standards exist, the state provides no resources or suggested concussion RTP guidelines or protocols upon which to base diagnosis and medical clearance for a concussed athlete. The law assumes coaches, trainers, school administrators, physicians, other medical personnel, and schools will follow such guidelines in adhering to the law, but there is no guarantee that this will be the case. Therefore, there may be important differences in each school's policy.

Theory Informed Approaches of Interest

Despite the involvement of a diverse array of stakeholders and the important effects of policies and environmental factors on concussion, concussion reporting and RTP research has had a narrow focus. In particular, the literature has tended to investigate athletes and coaches, interpersonal factors, and intrapersonal factors, with few studies of policy or environmental factors, combinations of these factors, or incorporation of theory (Kerr et al., 2014). Indeed, researchers and clinicians have called for more fundamental societal and cultural approaches to addressing sports concussions and raising its importance to public conscience (Murray et al., 2015). Thus, there is a need for broader and theory-informed research on concussion reporting and RTP.

Originally developed from studies of the adoption of innovative agricultural techniques, Diffusion of Innovations Theory (DOI) is also relevant to health interventions. Rogers (2002) notes the application of DOI to the adoption of health-related prevention programs in areas such

as drug addiction and abuse and HIV screening and prevention, with preventive health innovations seeking to intervene in the present to avoid future negative health outcomes (Rogers, 1995). Diffusion of preventive innovations, however, can be difficult, since their rewards seem intangible and far removed from the present, not to be seen until much later in time (Rogers, 2002).

DOI for preventive innovations seems particularly applicable to the adoption of statewide concussion legislation requiring schools to have RTP protocols and of concussion RTP guidelines for high school athletes. As described, the rewards of implementing innovative policies, protocols, and guidelines are often difficult to perceive, due to the goal of reducing future injuries by adhering to established guidelines and policies. Also, DOI recognizes the importance of social systems for adopting innovations. Thus, DOI may be applicable for innovations in concussion RTP since several social systems with an interest in concussions in high school athletes exist, such as: coaches, school administration, ATCs, physicians, parents, athletes, and policy makers. Relevant in these social systems are the communication channels, particularly the various combinations of channels between athletes, coaches, parents, ATCs, and physicians. DOI theory encapsulates the communication channels between and within social systems within the decision-making unit (DMU) construct (Rogers, 1995). The following literature review section provides further detail on the application of DOI theory to the present study.

Recognizing the dangers of underreported concussions, premature RTP after concussions, and lack of information regarding adherence to and dissemination of established RTP guidelines and the Georgia Return to Play Act of 2013, the present study will explore the following research questions:

1) How do key stakeholders influence the decision-making process for developing sports concussion RTP policies in Georgia high schools?

2) How do key stakeholders perceive consensus and official guidelines for sports concussion RTP?

3) How do key stakeholders' perceptions of these guidelines influence their decisions regarding concussion RTP and corresponding policies and protocols?

Literature Review

Concussion in Sport

A form of traumatic brain injury (TBI), concussions are complex injuries, often not easily diagnosed, with varying definitions. The concussion literature tends to use the term mild TBI and concussion interchangeably in reference to sports, as in the AAN guidelines (Giza et al., 2013). In contrast, the concussion expert panel behind the CISG guidelines, suggests that, medically, the terms refer to distinct injuries (McCrory et al., 2013). Nevertheless, at the most basic definition, concussions are TBIs caused by the "brain shaking" due to forceful contact to or near the head (McCrory et al., 2013, p. 179). The impact of the collision force leads to several complex and pathophysiological effects that may alter brain functioning, memory, orientation, and may involve loss of consciousness, future neurocognitive impairment, and physical symptoms such as headaches, nausea, fogginess, and dizziness that are not always specific, obvious, or initially present (Chrisman et al., 2013; Giza et al., 2013; McCrea et al., 2003; McCrory et al., 2013; Register-Mihalik et al., 2013). Concussions' complex nature makes them difficult to diagnose, with signs and symptoms not always presenting clearly as a concussion.

Signs and Symptoms. Fundamentally, concussions are an injury to and of the brain. However, they tend to be an invisible injury that does not present as any structural image to the

brain when using neuroimaging (Aubry et al., 2002; Jordan, 2013; McCrory et al., 2005; McCrory et al., 2009). Thus, the injury presents itself as impaired brain functioning with the most common symptoms of "headache, dizziness, and memory impairment" (Jordan, 2013, p. 222). Although symptoms sometimes appear much later after injury, onset is usually immediate with "cognitive, physical, and behavioral" presentations (Jordan, 2013, p. 222). Signs and symptoms include: 1) Cognitive: slower "information processing, disorientation, lack of awareness, confusion, amnesia, impaired memory, impaired concentration, loss of consciousness, 'feeling in a fog'"; 2) Physical "headache, dizziness, vertigo, nausea, vacant stare, impaired playing ability, loss of balance, impaired coordination, blurred vision, light sensitivity, convulsions, seizures" ; 3) Behavioral "sleep problems, irritability, emotional lability, anxiety, psychomotor retardation, apathy, fatigue, easily distracted" (Jordan, 2013, p. 224). Treatment and recovery for concussions are still not well understood but often involves rest, avoiding symptom triggers such as lights or cognitive activities, with recovery usually in a week to ten days, with youth taking longer to recover and be symptom free (Bleiberg et al., 2004; Echemendia, Putukian, Mackin, Jullian, & Shoss, 2001; Jordan, 2013; Makdissi et al., 2010; McCrea et al., 2003; McCrea, Kelly, Randolph, Cisler, & Berger, 2002; McCrory et al., 2005). However, symptoms can worsen over time, in particular with repeated exposure, and often lead to chronic symptoms and conditions.

Long-Term Health Consequences. Although most concussion related symptoms are acute and dissipate within weeks, there are several diseases associated with long-term chronic TBI and repeated concussions (Jordan, 2013). Researchers and clinicians have noted the following conditions can result from sports concussions and especially repeated concussions: CTE or Traumatic Encephalopathy Syndrome (TES), CNI, Alzheimer's (AD), Parkinson's (PD),

and Post Concussion Syndrome (PCS) (Jordan, 2013; Jordan, 2014; Montenigro et al., 2015). While each of these is a distinct disorder or condition, they all feature profound debilitation of brain functioning that impairs an individual's memory, thinking, and mood. CTE or TES has been the most notable disease with the over 157 cases diagnosed in the brains of deceased military personnel and athletes, many of them former professional players, at the Boston Brain Bank (McKee et al., 2009; McKee & Robinson, 2014; Montenigro et al., 2015). CTE appears to be a progressive disease strongly linked to repeated concussive or sub-concussive head impacts, particularly in contact sports, resulting in disabling physical, mental, and behavioral health symptoms (Dashnaw, Petraglia, & Bailes, 2012; Jordan, 2013; Montenigro et al., 2015). CTE's symptoms are severe and debilitating, with mental health symptoms often impacting mood and increasing depression, anxiety, and suicidality (Jordan, 2013). Violent and impulsive behaviors and an apparent change in the person's overall personality often overlap with the mental health symptoms and cognitive issues such as impaired memory, decision making, and attention, often culminating in dementia (Jordan, 2013; Montenigro et al., 2015; see Montenigro and colleagues (2015) for a complete list of CTE symptoms). Because of these myriad cognitive symptoms, particularly dementia, and decreases in motor skills function, CTE often appears as AD or PD, which can also result from repeated head trauma (Jordan, 2013). While CTE symptoms often manifest later, PCS is a condition wherein sports concussion symptoms fail to improve, often impairing athletes' lives with intense headaches, anxiety, depression, irritable mood, and memory issues (Jordan, 2013). Thus PCS seems to overlap with CTE but differs primarily in having a more immediate onset and being able to result form a single concussion (Jordan, 2013; McKee et al., 2013). Less clear, however, is CNI, any chronic neurological symptoms related to repeated sports concussions, which appears to be distinct from CTE but a broad, all-

encompassing condition that may appear as part of PCS (Jordan, 2014). Symptoms appear as decreased neurological and cognitive functioning such as memory, planning, information processing, and visual/spatial issues, and have been documented in athletes as young as high school aged (Jordan, 2014; Matser et al., 1998; Matser et al., 1999; Talavage et al., 2014). Because these chronic health risks of contact sports often result in severe mental, behavioral, and neurocognitive symptoms, and fundamentally alter the brain and personality of affected individuals, addressing and understanding sports concussions is a public mental health issue.

Risk Factors. Several factors are consistently related to concussion occurrence; however, the explanations sometimes belie what is actually happening. Generally, research studies find that concussions in high school athletes are more likely to occur during games than practices, in girls rather than boys, and in football as opposed to other sports (Esquivel, Haque, Keating, Marsh, & Lemos, 2013; Marar et al., 2012; Power & Barber-Foss, 1999; Yard & Comstock, 2009). Rates are also fairly high in both boys' and girls' soccer and ice hockey (Esquivel et al., 2013; Marar et al., 2012). That concussion rates are higher amidst the competition of actual games and in football, the most violent and contact-heavy sport, is not surprising. Since fewer girls play football and ice hockey, two of the more violent and contact heavy sports, the gender difference in concussion rates is initially surprising, but interpretations from national epidemiological concussion data suggest this difference may be due to tendencies to be more protective with female players and for males to RTP the same day and underreport (Yard & Comstock, 2009). Underreporting remains problematic, particularly in football, as males likely face pressure to play through injury while often citing not wanting to let their teammates or coaches down, thinking the concussion injury was not very serious, and not wanting to be taken out of the game (Chrisman et al., 2013; McCrea et al., 2004; Register-Mihalik et al., 2013; Yard

& Comstock, 2009). Overall, as previously discussed, high school athletics concussion rates are on the rise, increasing at a 16% annual rate over the course of a 10-year period (Lincoln et al., 2011).

Social-Developmental Factors. Western cultures in particular view playing team sports as a crucial part of normal social development for children with parents encouraging their kids to participate (Adams, Anderson, McCormack, 2010; Waldron & Krane, 2005). As Adams and colleagues aptly note, this belief in sports as necessary for proper social development in children and teenagers is so entrenched in the West that athletics is "intertwined with public education, and… part of the national curriculum" (Adams et al., 2010, p. 279). Once exposed to sports, youth discover new groups of friends and networks for social support and want to continue playing sports as a source for social interaction (Allender, Cowburn, & Foster, 2006). However, youth start to form identities attached to the sports culture, which often corresponds to and thus serves as a training ground for adopting stereotypical gender norms (Allender et al., 2006; Donnelly, 2000). While learning gender norms is certainly a part of social development, sports participation usually encourages strict conformity to such norms, often times extreme and paradoxical views of what it means to be masculine or feminine (Fogel, 2011; Waldron & Krane, 2005). Such norms can be so strong that athletes continue participating in sports they don't enjoy because they want to confirm identity and don't want to lose their social network (Donnelly, 2000; Waldron & Krane, 2005). Although sports values such as competition, winning, playing through injury, and doing anything it takes to win have typically been associated with the male identity, this hyper-masculinity of sports has permeated into female sports participation as well (Adams et al., 2010; Fogel 2011; Waldron & Krane, 2005).

Now, more so than ever before, the pervasive expectation, especially from parents and

coaches, is for youth athletes, both male and female, to be the best, specialize in one sport, go through intensive training and practice, and play through injuries to win and be the best in their sport (Bauman, 2005; Waldron & Krane, 2005; Wiese-Bjornstal, 2010). With such high pressures and expectations at increasingly earlier ages, athletes often endure and play through numerous injuries, over-train, and engage in risky eating habits and drug and supplement use to be the best and tough it out, as they believe this to be their identity (Fogel 2011; Waldron & Krane, 2005). Ironically, such beliefs may actually contribute to further injuries as athletes are not ready to resume playing or experience underlying chronic stress that makes them more prone to injuries in the first place (Bauman, 2005). Sports concussions are relevant to this social development youth athletes undergo as this injury becomes just another one to play through as part of the athlete identity. Indeed, recent studies of sports concussions and concussion reporting norms among high school and college athletes have demonstrated that perceived social norms of playing through and not reporting a concussion explain concussion reporting behavior (Chrisman et al., 2013; Kroshus et al., 2014d; Register-Mihalik et al., 2013). Thus, social and gender norms learned during child and adolescent development via sports reinforce hiding, underreporting, or playing through a concussion to conform to the tough, play through the pain, do whatever it takes to win or for the team expectations of sports. To offset this externality of intense over-identification with sports participation, policies and procedures that can protect athletes, especially youth athletes, are important and necessary.

Contextualizing Concussion Guidelines & Laws

Concussion protocols used in schools or by providers operate in the context of state laws and published guidelines. Therefore, understanding common and dissimilar elements of such laws and guidelines is important for understanding actual concussion care and RTP practices.

According to a recent review of historical attempts to create sports concussion guidelines, there are five prominent clinical guidelines and one review of the evidence, from the Institute of Medicine (Echemendia et al., 2015). While four of these guidelines are position statements from provider organizations (the previously mentioned AAN, ACSM, NATA, and AMSSM), only one, CISG, is a consensus statement. Even with five different clinical guidelines, they tend to agree and have few dissimilarities (Echemendia et al., 2015). Specifically, they are consistent on major aspects of approaching sports concussion care such as: using multiple tools and tests to clinically diagnose a concussion; removing athletes thought to have experienced a concussion from play; RTP for concussed athletes after medical evaluation, concussion care and clearance to RTP by a concussion-trained healthcare provider or multidisciplinary team of trained healthcare providers; individualized concussion care tailored to the specific injury and athlete (Echemendia et al., 2015). This review of sports concussion guidelines, however, provides little insight into more specific, potential differences in graduated RTP between these guidelines. Still, concussion care according to the prominent guidelines should be similar across healthcare providers trained in concussions.

As of 2014, each state in the US and Washington DC has passed legislation regarding concussions in youth sports. Reviews of these laws demonstrate that there is little variation between laws, with the vast majority applying to youth sports, middle schools, and high schools and featuring the following common major elements: no RTP within the same day, remove an athlete thought to be concussed from play, clearance to RTP by a healthcare provider, provision of concussion information to parents (Baugh et al., 2014a; Harvey, 2013). This three-pronged approach stems from the Zackery Lystedt Law, the first youth concussion law passed in the US, (Washington State) so named for the middle school football player who experienced two

concussions in one game (Harvey, 2013). While similar in applying this Lystedt Law approach, states' laws vary regarding the content of concussion information to be provided to parents, concussion education for coaches, the type of healthcare provider qualified to clear concussed athletes for play, and waivers of liability for relevant individuals and organizations such as healthcare providers, schools, and recreation facilities (Baugh et al., 2014a; Harvey 2013).

These variations may be of concern and warrant further study, but especially problematic is the lack of enforcement, monitoring, and oversight in youth sports concussions laws. Indeed, the extent of implementation of and compliance with these laws remains unknown and seems incomplete since they lack concussion reporting requirements and effective means of enforcement (Baugh et al., 2014a). Few laws provide compliance repercussions with the few that do tending to target coaches (Baugh et al., 2014a). Georgia's concussion law includes no repercussions, enforcement, or monitoring, leaving the law's implementation unclear. Also lacking in the laws, including Georgia's, are standards for use of evidence-based sports concussion guidelines and best practices. Overall, the extent that schools, teams, and youth sports leagues and facilities follow sports concussion laws and established guidelines is unknown.

Behavioral Theory and Concussion Reporting

Historically, there has been limited application of behavioral theory to sports concussion reporting and prevention, with the research tending to focus on individual-level factors and epidemiological studies. More recently, however, researchers have shifted toward incorporating theory, primarily the theory of reasoned action/ planned behavior (TRA/TPB). In one of the first a-priori applications of TRA/TPB to concussion reporting, Register-Mihalik and colleagues conducted a cross-sectional survey of 167 high school athletes (2013). The findings showed that

athletes' attitudes, subjective norms, and perceived behavioral control significantly related to concussion reporting intentions, with attitudes and social norms being the strongest predictors of intentions (Register-Mihalik et al., 2013). While increased intention to report concussions corresponded with behavioral change, meaning higher intentions predicted sitting out from athletic participation, the TRA/TPB also appeared limited. Specifically, reporting intentions did not significantly predict actual reporting of concussions. Including other relevant factors such as the coach knowledge and attitudes regarding concussion, coach approachability, access to ATCs (who primarily conduct concussion protocol), access to physician referrals, and the interaction these social systems in high school sports may improve understanding of concussion-reporting behavior (Chrisman et al., 2013; Meehan et al., 2011; Williams et al., 2012).

Over the past two years, several studies from the Harvard School of Public Health have applied TPB to concussion reporting and education. These studies tend to incorporate either norms, intentions, or a combination of these two constructs to predict concussion under-reporting behavior or to inform educational interventions aimed at decreasing concussion underreporting behavior (Baugh, Kroshus, Daneshvar, & Stern, 2014; Kroshus, Baugh, Daneshvar, & Viswanath, 2014; Kroshus, Baugh, Hawrilenko, & Daneshvar, 2014; Kroshus, Baugh, Daneshvar, Nowinski, Cantu, & 2014; Kroshus, Daneshvar, Baugh, Nowinski, & Cantu, 2013; Kroshus et al., 2014d). Two of these studies utilized prospective cohort designs to test the ability of TPB constructs, compared to concussion knowledge, to predict concussion-reporting behavior in NCAA D-I Men's Ice Hockey players. One study references a societal-value approach to social norms for its basis in theory; however, this is an extension of the perceived norms aspect of TPB (Cialdini & Trost, 1998; Fishbein & Ajzen, 1975). In both studies, perceived social norms (that other players intend to report concussion symptoms) prior to the

athletic season significantly predicted concussion reporting behavior during the season and significantly more so than did concussion knowledge (Kroshus et al., 2014a; Kroshus et al., 2014d). Moreover, concussion knowledge had no relationship to predicting concussion-reporting behavior. Concussion attitudes neither mediated nor moderated the relationship between knowledge and reporting, suggesting attitudes operated independent of knowledge.

Two more of these Harvard studies conducted cross-sectional surveys to test the fit of the TPB to concussion reporting in junior league male hockey players and the perceived social norms of concussion reporting in collegiate football players. Namely, the TPB demonstrated good fit with all constructs of attitude, self-efficacy, and subjective norms significantly predicting concussion reporting intentions, which subsequently significantly predicted concussion reporting behavior (Kroshus et al., 2014b). For football players, being an older player, e.g., senior versus freshman, related to thinking that coaches would not be supportive of players reporting concussion symptoms (Baugh et al., 2014c). Theoretically, being older, and hence around a coach and team longer, would ingrain perceived social norms more than being a newer member to the coach and team. Knowledge was not a significant predictor of outcome variables in either study.

The final two TPB-focused studies from this group evaluated the effects of educational interventions targeting concussion knowledge and reporting, also measuring TPB constructs in male ice hockey players. Results were negative for knowledge education intervention effectiveness. In particular, athletes reported stronger perceived social norms of not reporting concussions and intentions to not report concussion symptoms post-education along with no significant changes in concussion knowledge, attitudes, perceived social norms, and intention to report a concussion (Kroshus et al., 2013; Kroshus et al., 2014c). Tendencies to underreport may

have driven the results because there were high rates of underreporting and a discrepancy between individual attitudes about reporting a concussion and perceived norms of other hockey players' intent to report a concussion (Kroshus et al., 2013; Kroshus et al., 2014c). That is, athletes, in this case NCAA D-1 ice-hockey players, may seem to believe that they should report a concussion but don't perceive that other players do. Since perceived social norms were the strongest predictor of concussion reporting intentions and was also lower than individual attitudes, the results suggested that concussion under-reporting occurred and may have explained behavior because of the significant discrepancy in perceived and individual norms. (Kroshus et al., 2014c), Still, the authors note that this notion requires further, more explicit study (Kroshus et al., 2014c).

These studies are valuable in providing suggestions for alternative interventions to improve concussion reporting in athletes besides education- or knowledge-based programs. Conversely, they failed to incorporate all constructs of TPB in their design, often using one of subjective norms, intentions, attitudes, or a combination thereof. Notably absent from all of the studies was perceived behavioral control, with control beliefs represented by the proxy, self-efficacy, in only one of the studies. Moreover, these studies focused on individual, or intrapersonal, level factors, with even the social norms variables representing individual level perceptions of norms rather than an assessment of the actual social norm of the group. There are relationships within and between groups affecting concussion reporting, necessitating research that captures levels of factors beyond the individual. Indeed, research in concussion prevention suggests the need for better understanding how context, culture, and the environment affect behavior such as concussion reporting as well as dissemination of concussion RTP guidelines, resources, and policies (Donaldson et al., 2014).

In order to incorporate more contextual factors in understanding concussion reporting, five recent (published in the current year), additional studies from the Harvard group applied social-ecological informed frameworks. One study applied gender and communication frameworks to investigate the role of attitudes and beliefs about concussion reporting in coach communication about concussions with their athletes (Kroshus et al., 2015a). Another study used Bandura's social cognitive theory (SCT) to examine the reciprocal determinism of relevant variables such as: perceived social pressures to play while concussed, prior concussion history, and intentions to report experiencing a concussion (Kroshus et al., 2015b). Similarly, a third study used a cross-sectional survey to assess team ATCs' and physicians' experiences facing pressure to prematurely clear concussed athletes for play (Kroshus et al., 2015c). The fourth study incorporated aspects from bystander theory, theory of social control, and TPB to explore possible methods for promoting concussion reporting and health seeking (Kroshus, Garnett, Baugh, Calzo, 2015d). The final recent study assessed both perceived and objective social norms regarding reporting a sports concussion to determine if athletes have a discrepancy between these two norms (Kroshus, Garnett, Baugh, & Calzo, 2015e). The researchers measured relationships between concussion beliefs, perceived team norms on concussion reporting, objective concussion reporting norms, and intentions to either encourage a concussed athlete to alert a coach or medical personnel or to directly alert a coach or medical personnel.

The methodologies and findings of these studies, discussed in further detail in the following paragraphs, fill important theoretical and methodological gaps in the concussion reporting literature. Collectively, their strength is their investigation of factors affecting multiple relevant stakeholders in sports concussion reporting and RTP: coaches, athletes, ATCs, and physicians. Still these studies have limitations as quantitative studies focused on interpersonal,

social level factors in only the NCAA athletics setting without added in-depth context, necessitating further, alternative approaches in concussion reporting research.

In the first study, Kroshus and colleagues incorporated gender and communication based theories with TPB to examine the interaction of coach gender, team gender, and concussion knowledge, communication, and beliefs and attitudes (2015a). Surveys of NCAA coaches demonstrated that concussion beliefs and attitudes best predicted coach communication, with more positive concussion attitudes (believing concussions are an important issue) predicting positive communication about concussions (communicating the importance of concussions with athletes). Knowledge had little influence on communication, with most of its influence happening indirectly through attitudes and beliefs, consistent with TPB (Ajzen, Joyce, Sheikh, & Cote, 2011). Gender also modified attitudes and communication with male coaches of female teams showing the safest concussion attitudes and communication (Kroshus et al., 2015a). While the cause of the gender effects remains unclear, the study provides insight into accounting for gender in sports concussion research and education programming. Still, this study does not assess communication in context or other potential key communication channels and dynamics outside of coaches and players. There is a need to better understand communication between other relevant stakeholders in addition to coaches and players, which latter studies from the Harvard group addressed.

To better incorporate context and social factors, Kroshus and colleagues adapted the environment aspect of SCT by studying NCAA athletes' perceived pressure to play through a head injury (2015b). More specifically, they surveyed these college athletes' perceived pressure from fans, parents, coaches, and teammates to resume playing after experiencing a head impact and pressure's relationship to concussion reporting intentions (Kroshus et al., 2015b). Over 25%

of athletes reported feeling pressure to play through head injury. While only about 9% of the athletes reporting having a diagnosed concussion in the past season, nearly half of all athletes reported playing while experiencing possible concussion symptoms (Kroshus et al., 2015b). Overall, greater pressure related to lower concussion reporting intentions, except when pressured by coaches. To understand the interaction of variables, the authors constructed regression and mixture based model that revealed three different groups, stratified by their experiences of pressure to play through head injury. These groups consisted of low, team, and high pressure experiences (Kroshus et al., 2015b). The majority of athletes fit into the low pressure group with 14% in team pressure and 33% in high pressure (Kroshus et al., 2015b). Athletes in the team pressure group endorsed moderate teammate and coach pressure yet low teammate and fan pressure (Kroshus et al., 2015b). Finally, athletes in the high pressure group felt high pressure from parents, fans, coaches, and teammates, which corresponded to significantly lower concussion reporting intentions than the two other pressure groups.

Although the study addressed the context gap in sports concussion reporting, there were two key limitations. First, a key finding appeared to be that nearly half (47.56%) of athletes reported having played while experiencing concussion symptoms; however, the authors did not include this variable in the regression analyses or mixture models. Athletes' prior behavior may influence their present intentions, a point relevant to the second limitation. Also, the study appears to have an incomplete variable relationship timeline inferred by the interpretation of findings using SCT. That is, the study assessed prior experiences such as a past concussion diagnosis, playing while possibly concussed, and experiences of pressure and present intentions. While past experiences certainly are relevant for present intentions, the study does not assess the present environment and its relationship to intentions. This makes the study's explanation for

why athletes with a prior diagnosed concussion experienced more team pressure problematic. Namely, the authors suggest that SCT can explain this finding through the reciprocal determinism of the relationship between individual, behavior, and environment (Kroshus et al., 2015b). That is, concussed athletes may have interacted with teammates and coaches more in experiences related to their injury, offering more chances to experience pressure (Kroshus et al., 2015b). However, this explanation does not account for the greater pressure felt in the high pressure group and how pressure outside of the team, such as from fans and parents, led to stronger intentions to not report concussion symptoms. Furthermore, this explanation is limited by the fact that the study did not assess behavior but behavioral intentions. Moreover, the environment measured, experiencing pressure from others to play through head injury in the past season, does not represent the present environment. This past measurement of pressure makes parsing out the interaction of environment past behavior, playing through a head injury, which almost half of the athletes in the study reported doing, difficult. Future studies should continue to look at the environment's influence on sports concussion reporting and RTP, especially in context and across relevant stakeholders.

Extending the notion of pressure's effect on sports concussion RTP, Kroshus and colleagues also investigated physicians' and ATCs' experiences with pressure from others to clear concussed athletes for premature RTP (2015c). In particular, they assessed the environment as represented by the organizational structure in which NCAA ATCs and physicians work since being employed by an athletic department versus a medical department and reporting to a coach versus a physician could affect experiences of pressure (Kroshus et al., 2015c). Of note, almost two thirds of providers surveyed in the cross-sectional study reported facing pressure from athletes with over half of providers also reporting pressure from coaches (Kroshus et al., 2015c).

Other factors significantly linked to increased pressure on providers from coaches were working at a higher Division of NCAA competition (i.e. Div I or II vs. III), being a female or less experienced provider, and working in a structure that involved reporting to the athletic department. This study provides a valuable starting point for understanding the environment that key sports concussion stakeholders work in by systematically documenting sports concussion providers' experiences of pressure to prematurely clear concussed athletes. Still, the cross-sectional survey design provides no in-depth context to further describe pressure experiences. Providers were not able to describe their experiences of pressure to clear concussed athletes for play. Understanding such experiences and the communication involved could help inform sports concussion and RTP protocols, policies, and interventions. Future research investigating the dynamics of key stakeholders such as clinicians, athletes, parents, and coaches and their relationships would increase understanding of experiences such as pressure or communication.

With the final two recent studies from the Harvard group, the researchers returned to investigating athletes' concussion norms and beliefs but included additional social level factors. First, they examined the interaction of athletes' beliefs about concussions' impact on health and play, their intentions to act as a bystander to help a concussed teammate report symptoms, and their perceived team norm for reporting a concussion (Kroshus et al., 2015d). Bystander effects and theory of social control informed the use of these variables in the study. Most athletes (85%) reported they would encourage a teammate to report a concussion; however, fewer, but over half, said they would inform the coach or a team medical provider if they thought a teammate had a concussion. Results from a multivariate linear regression demonstrated several interactions among variables. Perceived norms consistently predicted intentions to encourage a teammate to seek help for a concussion and intentions to alert a coach or team clinician about a concussed

teammate (Kroshus et al., 2015d). Also, perceived norms affected the relationship between concussion beliefs and intentions to get a teammate to seek help. If athletes believed there were health consequences to playing through a concussion, their perceived team norms predicted their intentions less so than teammates who did not believe there were health consequences. This suggests that believing there are health consequences may be sufficient to explain behavior in getting teammates to seek help for a concussion but that team norms are more important when not thinking there are health consequences. Interaction results varied, however, when asking athletes about intentions to alert a coach or team health provider about a concussed teammate. In particular, for athletes who believed that playing through a concussion hurt athletic performance, perceived team norms predicted intentions less so than for athletes who did not hold these beliefs. Thus, the authors concluded that athletes' decision-making process varies based upon the intended behavior of interest, encouraging a teammate to seek help versus directly alerting a coach or team clinician (Kroshus et al., 2015d).

This study provides a foundation for improving concussion education interventions by incorporating a helping teammate bystander approach but had one key limitation regarding measurement. Specifically, the second main outcome measure, intentions to tell a coach or team clinician about a concussed teammate, assumes that communicating about a concussion to a coach is similar to communicating this to a healthcare provider. Given the pervasive pressure on team clinicians from coaches found in this group's previous study, discussed in the prior paragraph, equating clinician and coach communication in the same question seems problematic (Kroshus et al., 2015c). Parsing out different communication channels remains an important focus for future sports concussion reporting and RTP research and interventions.

The final, most recent study from the Harvard group, applied social comparison theory

by assessing both perceived and objective team norms about concussion reporting to identify potential discrepancies in these norms (Kroshus et al., 2015e). In this cross-sectional survey of college athletes, perceived team norms were the strongest predictor of intentions to report a concussion compared to objective norms. Also, the researchers found a significant difference between perceived and objective norms by averaging participants' responses by their team and comparing the average personal intention score of each team member to the average of all their team members' perceived norms scores. As predicted, the authors found that objective norms were significantly higher than perceived norms, suggesting a dissonance in concussion reporting norms such that athletes actually intend to report a concussion more than they think other athletes do (Kroshus et al., 2015e). Identifying this discrepancy in perceived versus actual norms is critical to understanding the influences of sports concussion reporting and RTP behavior. However, this cross-sectional, quantitative approach necessitates investigation of why such discrepancies occur and the influence of the broader context such as other social relationships and stakeholders in addition to athletes, culture, environment, and policy.

The quantitative, theory-driven research is valuable in identifying relevant, existing theories and factors related to sports concussion reporting in the hope of improving sports concussion education and prevention programs but has limitations. In particular, quantitative research lacks the in-depth, contextual understanding of complex topics provided by qualitative studies. A review of the literature using Google Scholar, ProQuest Dissertations & Theses, PsycInfo, and PubMed, identified just five published studies that applied qualitative research methods to understanding sports concussion guideline and policy implementation (McKenna, 2015; CDC, 2013; Chrisman, Schiff, Chung, Herring, & Rivara, 2014; Kemp, Newton, White, & Finch, 2015; Madden, 2014) The strength of the qualitative methods in these studies was mixed,

and there was further variation in the studies with only two being published articles. Of the remaining three, one was a CDC report and the other dissertations. Broadening the literature review search to include other studies of sports concussion reporting and RTP revealed eight more studies using qualitative methods, four of which were dissertations, the other four published articles (Caron, Bloom, & Bennie, 2015; Caron, Bloom, Johnston, & Sabiston, 2013; Chrisman et al., 2014; Fauré, 2006; Kasamatsu, 2014; Millette, 2005; Sarmiento, Mitchko, Klein, & Wong, 2010; Woodard Jr., 2014). The dissertations tended to study coaches and athletes, assess knowledge and attitudes related to sports concussions, and have small sample sizes that may not have achieved saturation of key themes or used only a few interviews to develop a quantitative survey (Fauré, 2006; Kasamatsu, 2014; Madden, 2014; Millette, 2005; Woodard Jr., 2014).

Thus, there is a need for qualitative approaches to understanding sports concussion reporting and prevention to elucidate the context that involves various social systems and stakeholders. The dearth of qualitative research is important to address because it prevents in-depth, contextual understanding of decision-making processes related to sports concussions, RTP, and sports concussion and RTP policies. As sports concussions continue to rise in high school athletics, it is important to understand how key stakeholders arrive upon decisions to protect athletes. The state of Georgia's approach to developing RTP policy on a school-by-school basis, similar to other states' concussion laws, offers crucial context for understanding how schools adopt or create policy. The proposed research questions not only inform on how RTP policy is developed, but who is responsible for policy direction and implementation. Qualitative research is better suited to answer these questions since it allows individuals to define themselves and their role in the creation of the policy and describe how other decision makers influence the

process. Understanding this dynamic is important for informing recommendations on how to better safeguard student athletes from head injuries that may have long lasting health implications. I will review the details of the published qualitative articles and CDC report in the following section.

Qualitative Studies of Sports Concussion Reporting & RTP

Overall, there are few published articles related to sports concussion reporting and RTP that incorporated qualitative methods. Specifically, beyond the previously mentioned published dissertations, there are six published articles and one published CDC report. For the purposes of this review, these studies fit into two main groups: 1) studies of experiences with sports concussions and reporting or identifying them (Caron et al., 2013; Caron et al., 2015; Chrisman et al., 2013; Sarmiento et al., 2010); 2) studies of implementation of sports concussion policies or guidelines (CDC, 2014; Chrisman et al., 2014; Kemp et al., 2015).

To evaluate experiences using the CDC's Heads Up concussion education toolkit in high school athletics, Sarmiento and colleagues conducted surveys and focus groups with coaches at high schools that ordered the toolkit (2010). Quantitative survey results demonstrated high use of the toolkit by coaches (90%), with most of these coaches planning to use it again in the future. Furthermore, the toolkit seemed to improve coaches' concussion knowledge, attitudes, and behavior as over a third learned something from the toolkit, half believed the toolkit made them see concussions more seriously, and over two thirds educated others about concussion management (Sarmiento et al., 2010). Focus groups helped elucidate coaches' experiences related to the toolkit and concussion identification, reporting, prevention, and management. Of note, coaches often discussed difficulties communicating with the parents of their athletes, who had less favorable attitudes and knowledge regarding concussions; however, coaches

emphasized that the toolkit facilitated communication with parents (Sarmiento et al., 2010). Furthermore, the focus groups revealed that coaches felt more informed about concussion, risks, signs, symptoms, and RTP protocol, noting that the toolkit streamlined information into a comprehensive, accessible format (Sarmiento et al., 2010).

Despite using a novel approach of mixed methods to understanding sports concussion reporting, management, and RTP, the study had key methodological flaws in sampling and qualitative analysis not addressed by the authors. Primarily, there was risk of bias because the study only included coaches from schools that had ordered and received Heads Up, suggesting that these schools were more concerned about sports concussions (Sarmiento et al., 2010). Thus, the study may not accurately represent coaches' experiences with concussion management, experiences using concussion education materials like Heads Up, and their concussion knowledge, attitudes, and practices. Next, the authors provided few details regarding qualitative analysis of focus group data. In particular, the authors did not clarify how they developed the focus group discussion guide, what immersion into audio recordings meant (e.g. were recordings transcribed or were notes and memos from focus groups primarily used?) and what common themes emerged (Sarmiento et al., 2010). Regarding themes, the authors presented focus group results according to the a-priori research questions without noting the specific themes. This is a limitation as it suggests a deductive approach that precludes observation of inductive themes that emerge from the data and a capturing of rich-detailed experiences of the participants. There may be common themes and important data not captured by the emphasis on explicit topics from the research questions. While this study allowed coaches to present their role in and experiences with sports concussion, it is important to understand the roles of other key stakeholders such as athletes, parents, or medical providers.

To address the gap in understanding athletes' lived experiences with concussions from their perspective, Caron and colleagues conducted in-depth-interviews with NHL players who retired due to concussions (2013). The researchers used an inductive approach of interpretive phenomenological analysis to highlight key themes that emerged from the five interviews. This approach explored broad research questions on how concussions affected players' health, what the dual experiences transitioning from being a professional athlete due to concussions are like, and how social relationships factored into these experiences (Caron et al., 2013). Key themes of physical and psychological symptoms related to concussions and of isolation, withdrawal, and emotional turmoil felt while recovering direct and indirect impact on retired players' health and quality of life (Caron et al., 2013). Impairments in mental health resulting from the concussion, such as experiencing depression, anxiety, and suicidal thoughts, seemed to stem from the intense, limiting physical symptoms of the injury itself, the concussion recovery process, and the difficult transition away from playing professional sports. Often isolated from their healthy teammates by coaches, players relied on their spouses for social support despite feeling withdrawn at times from their families. Players had more mixed social support experiences with coaches and healthcare providers compared to their spouses, with all players also having hidden their concussion symptoms at times from their teammates, coaches, and providers (Caron et al., 2013).

Overall, this study bolstered the sports concussion literature by using qualitative methods to understand the roles of various individuals in the concussion recovery process, though as told through just one perspective, that of athletes. The sample size of five players is small, even for qualitative research, with the authors providing no information on reaching saturation in key themes. It is possible that a larger sample size would have revealed additional themes. Also,

while the authors do not claim that results could transfer to or represent other athlete groups, non-professional athletes, especially at the high school and college levels, would likely have different experiences with sports concussions. Understanding younger, amateur athletes' concussion experiences as well as those of other stakeholders that retired athletes mentioned like coaches, medical personnel, and families remain import research gaps to address.

Accordingly, Caron and colleagues applied a similar qualitative approach to study coaches' perceived roles in dealing with concussions and athlete safety (2015). The authors conducted a case study in which they interviewed eight athletic coaches at one private high school in Canada (Caron et al., 2015). Coaches tended to learn about concussions through informal experiences of playing and coaching sports and being a parent of athletes rather than having formal training or education, despite thinking that coaches should have such training or education (Caron et al., 2015). Parents sometimes pressured coaches to play their kids before being cleared from a concussion, though not to the same extent found in other qualitative research with coaches that I previously discussed (Caron et al., 2015; Sarmiento et al., 2010). Coaches viewed themselves as key communication mediators about concussions and RTP between athletic directors, ATCs, other medical personnel, athletes, and parents of athletes but appreciated that decision-making regarding concussions was in the hands of medical personnel according to school policy (Caron et al., 2015). Regarding parents, coaches felt that despite parents' increased awareness of concussions risks, more education for parents on concussions and RTP protocols, such as the school's protocol, was necessary. Another barrier and consistent point of frustration was the hidden and unknown nature of concussions. A key manifestation of this frustration was all coaches' recalling of experiences with players who faked or hid concussion symptoms. Coaches felt their main responsibility to their athletes was minimizing

the sports' risks by teaching safe playing techniques, e.g. how to properly hit in ice hockey or tackle in football (Caron et al., 2015). Although the study employed a rigorous qualitative approach that can transfer to future studies of sports concussion roles in high schools sports, the findings appear very limited because of the case study design. One private high school may differ from other private schools and likely more so from public high schools. Additional themes and perspectives may emerge from coaches in different settings. Finally, how other individuals in the high school setting perceive their roles in managing sports concussions, RTP, and health and safety of athletes remains unclear. Coaches provided some discussion of the roles of others such as athletic trainers, but the interview guide questions did not explicitly ask about the roles of other relevant stakeholders such as athletic directors, ATCs, other healthcare providers, parents, or even athletes.

Adding to the sports concussion reporting and RTP literature, Chrisman and colleagues conducted focus groups with high school athletes to understand what influences reporting a sports concussion (2013). Although theirs was the first qualitative study of barriers to sports concussion reporting, they also applied the TPB/ Theory of Reasoned Action (TRA) retrospectively to help interpret the results. Thus they addressed the lack of qualitative research while also contributing to the, at the time, scarce application of theory in sports concussion research. Focus groups with 50 high school athletes suggested that individual-level factors such as knowledge seemed less relevant than coach approachability and communication in understanding barriers to concussion reporting (Chrisman et al., 2013). That is, although athletes displayed knowledge of concussion signs, symptoms, and risk, most still admitted they would play through injury because they believed the team and coach would want them to do so. Of note, coach approachability represented perceived approachability from the athletes' perspective,

suggesting this study focused more on individual-level factors rather than more complex social dynamics of high school athletics.

Despite addressing important research gaps, Chrisman and colleagues' (2013) focus-group study had several methodological flaws. Specifically, the authors neglected to justify or explain the development and use of key components such as the focus-group script, the coding scheme, and the TPB/TRA based analytic model. It is unclear how the authors developed the focus group script and why they chose the focus-group questions they did. Further problematic was the lack of discussion of coding scheme development for analyzing focus-group transcripts. While the authors stated the general purpose of the coding scheme as denoting factors related to reporting a sports concussion, they did not justify this deductive approach nor did they address it as a limitation (Chrisman et al., 2013). A deductive coding approach may silence inductive themes that emerge from the data by ignoring other important topics, ideas, or themes discussed by study participants. This limitation transferred into the use of a conceptual model based on TPB/TRA to analyze focus group data, which ignored a grounded theory approach based on inductive codes. Additionally, the authors chose the TPB/TRA post-hoc without justifying its relevance or addressing study findings the theory could not explain. Theory-based applications in qualitative research can be useful; however, theory's use in this study stifled the potential for richer, in-depth qualitative data. Finally, the researchers did not incorporate concussion knowledge, attitudes, and perceptions, or use of concussion protocols by other relevant stakeholders such as coaches, parents, ATCs, or other medical personnel. Thus, how other relevant factors influence sports concussion reporting remained unclear. Indeed other contexts in which high school sports teams have an ATC, team doctor, or other medical personnel may yield different results.

Overall, an increasing yet small number of studies have investigated the extent to which high schools or community sports organizations follow concussion RTP guidelines and policies and the factors influencing adherence to them (Baugh et al., 2014b; Hollis, Stevenson, McIntosh, Shores, & Finch, 2012; Yard & Comstock, 2009). Moreover, the quantitative approaches of studies of concussion RTP guideline or policy compliance have only suggested but not directly explored causes of non-compliance (Hollis et al., 2012; Yard & Comstock, 2009). Even fewer studies have done so utilizing qualitative or mixed methods approaches.

Though not a published article, the CDC produced a report on the implementation of youth sports concussion laws in Washington state and Massachusetts (2013). To understand experiences implementing the components of these laws, the study used stakeholder interviews and an environmental scan of several states' youth sports concussions legislation (CDC, 2013). The report presents lessons learned and barriers to implementation across key topics to inform future state concussion law implementation efforts. Key topic areas related to implementation included: "stakeholder roles and responsibilities; implementation requirements; knowledge and awareness; medical clearance; supporting and monitoring implementation; planning ahead to evaluate the impact of return to play" (CDC, 2013, p. 4). As noted earlier in the literature review on concussion legislation, the CDC report also found the laws in Washington and Massachusetts broad without many specific requirements for several of the key topic areas, such as: what are the roles and responsibilities of different stakeholders; who will monitor implementation and how; how will the legislation be evaluated (CDC, 2013). Thus, stakeholders must plan and convene ahead of time to come up with specific answers to such questions left unclear by the legislation (CDC, 2013). Interview participants also discussed resources needed to implement RTP with Massachusetts providing a specific RTP protocol for each school but Washington

leaving it up to individual school districts to create such protocols (CDC, 2013). Costs of proper concussion training and for implementation resources were also areas of concern. Dissemination or diffusion of the law across all stakeholder groups varied and seemed incomplete as interviewees noted that novelty and complexity stifled awareness of RTP protocols, policies, and legislation, thereby hampering implementation (CDC, 2013). Regarding monitoring, oversight, and evaluation of implementation, both laws identified responsible organizations but did not provide resources, specific mechanisms, or strategies for these efforts. Resources for such efforts as well as for implementation may hinge on their availability, which could vary between public and private schools and urban/sub-urban and rural schools (CDC, 2013). Therefore, a lack of resources or variation in resource availability could be a crucial barrier to implementation and compliance (CDC, 2013). This CDC report provides an important template for other states to reference for planning implementation of youth sports concussion laws. Still, the report did not include important stakeholder groups who may make important decisions regarding RTP from a sports concussion such as ATCs, physicians, other medical providers, and parents of athletes. Likely, the report serves the purpose of providing a broader approach as a starting point for implementation planning, but it lacks the rich detail from the interviews that could serve as concrete examples to bolster implementation or examples of how or why implementation did or do not happen.

Building off of the CDC's evaluation, Chrisman and colleagues conducted a mixed methods study exploring implementation of the concussion law in Washington State (2014). Specifically, the researchers used qualitative interviews with high school coaches and athletic directors to develop a quantitative survey to distribute to public high school coaches (Chrisman et al., 2014). Washington's concussion law requires coaches to complete annual concussion

education with around 99% of coaches reporting having done so, suggesting coaches had adequate concussion knowledge (Chrisman et al., 2014). Although coaches reported that the vast majority of athletes and parents received concussion education, this often involved just signing a required concussion form prior to each athletic season (Chrisman et al., 2014). This suggests that concussion knowledge may vary more in athletes and parents. Most coaches had ATCs for their teams, but high schools in urban areas were significantly more likely to have ATCs than rural high schools (Chrisman et al., 2014). Thus, implementation appears less complete in rural settings as coaches have reported relying on medical staff such as ATCs for making concussion-related decisions with athletes (Caron et al., 2015). While concussion knowledge is important, other recent studies suggest that other social-ecological factors such as perceived social norms have a stronger influence on concussion reporting behavior (Kerr et al., 2014; Kroshus et al., 2015d; Kroshus et al., 2015e). The finding of lower concussion education for parents and athletes is concerning, but these data came from coach reports. Also, if parents or athletes did not receive concussion education from the team or coach does not mean that they lack concussion knowledge. One key limitation of the study was the lack of detail regarding the formative qualitative interviews. How the researchers developed the interview questions or the "standardized template" used and how they analyzed interviews were unclear. Regarding analysis in particular, the authors did not explain the qualitative analysis used for the interviews. Despite the use of mixed methods, the authors relied on a quantitative survey to assess implementation. There is still a need for qualitative approaches to understanding decision-making for sports concussion policies and adherence to innovations such as concussion laws and RTP guidelines in high school and youth sports.

The final study of concussion law, policy, or guideline implementation with qualitative

methods was Kemp and colleagues' assessment of concussion RTP guideline uptake in youth football and rugby leagues in Australia (2015). Surveys of coaches and ATCs asked both quantitative and open-ended, qualitative questions about experiences implementing and attitudes toward RTP guidelines, namely the CISG consensus statement guidelines (Kemp et al., 2015; McCrory et al., 2013). Most participants, 71%, endorsed guideline use and numerous positive experiences using guidelines; however, participants reported some problems dealing with athletes, coaches, and parents who did not agree with concussion-related decisions or support the guidelines (Kemp et al., 2015). While coaches and ATCs had similar positive levels of attitudes toward the guidelines, coaches who used the guidelines had more favorable guideline attitudes at the end of the season. The opposite was true for ATCs as those who didn't use guidelines, albeit a minority, viewed them more favorably post-season. Overall, guideline use was high and attitudes were favorable in both coaches and ATCs. Still, there were some limitations with the qualitative data. First the thematic analysis of open-ended questions yielded five themes that occurred only once or twice in the data. Thus, especially given that 79 participants provided responses to the open-ended question, these may not have actually been themes since they did not represent common topics in the data. This analysis appears to be a mix of categorization, coding, and free-listing rather than thematic coding. Furthermore, there is still a need for oral qualitative data such as via interviews or focus groups that can yield more rich, in-depth descriptions of experiences in sports concussions such as use of and attitudes regarding RTP guidelines. Given the mixed strength of qualitative approaches in sports concussion research and a need for theory applications beyond intra- and interpersonal levels, well designed qualitative and mixed methods studies informed by theory remain an important gap in the literature.

DOI, Sports Concussions, & RTP

DOI Background. Linking the individual factors related to concussion reporting guidelines and protocols with the complex social system of constituents, such as athletes, coaches, providers, and parents, necessitates a multi-level approach. DOI focuses on how a new (innovative) idea such as technology, policies, or health practices and interventions gets communicated to individuals and social groups (Rogers, 2003). While the users of an innovation choose to adopt it as an individual, DOI suggests the ability to look at them as groups and organizations also (Rogers, 2003). Rogers defines the theory with four main constructs: the innovation itself, communication channels that diffuse information about the innovation, time (how long the diffusion process takes), and social systems, groups of individuals, that communicate and decide whether or not to adopt the innovation (2003). Thus, DOI theory and its emphasis on communication about innovations within and between social systems can inform the study of concussion reporting and prevention in high school athletes.

DOI Studies in Sports Concussion. Despite DOI's potential relevance, sports injury prevention has scarcely applied DOI to research and interventions, with published reviews noting just two studies to have done so, and only one specifically to concussion reporting (Finch, 2011; McGlashan & Finch, 2010). A review of Google Scholar, ProQuest Dissertations and Theses, PsycInfo, and PubMed yielded only five studies that applied DOI to study sports concussions: one published study (the same one identified in prior published reviews), two dissertations, and two master's level theses (Espinoza, 2014; McAnany, 2013; McKenna, 2015; Sawyer et al., 2010; Spradley, 2014). These studies tended to rely on quantitative methods and not focus on adherence to sports concussion guidelines and policies. Although one study, a master's level thesis, evaluated school adherence to concussion policy, data collection only included review of documents analyzed quantitatively without incorporating qualitative

approaches (McAnany, 2013). One dissertation was similar to the present proposal as it incorporated DOI and qualitative interviews to study youth sports administrators' experiences implementing concussion policy in Maryland (McKenna, 2015). Based upon the previously mentioned literature review, McKenna's study of implementing the Maryland concussion law in youth sports leagues is the only to have applied both DOI and qualitative methods to study sports concussions (2015). However, this study included only youth sports league administrators and focused on implementation of Maryland's law in one setting, youth sports.

One published study did apply DOI to sports concussions by examining the dissemination of CDC's "Heads-Up" concussion education toolkit among high school athletic coaches (Sawyer et al., 2010). Although the study revealed that most coaches and schools already had access to concussion resources and an existing concussion management and prevention plan, most coaches still found the toolkit more appealing, useful, and easier to use than other concussion resources. Perhaps the strongest finding for quick diffusion of the toolkit was that 81% of coaches at schools with pre-existing concussion management and prevention plans believed the toolkit would help to improve their current plans. While some results were encouraging, there was potential for response bias based upon the 39.3% response rate, with 190 coaches refusing to participate, and 569 coaches agreeing to a phone survey but never completing it. The authors also excluded the over 2000 unanswered survey interview calls from the response rate, suggesting a lower response rate than reported. Bias may have occurred since coaches who refused or ignored participation may have felt less concerned about concussions and proper education and protocol. Furthermore, the application of other key DOI constructs outside of time/the diffusion-innovation process and perceived characteristics of the innovation was limited. Future DOI and concussion research ought to include other key factors such as the

characteristics of the decision-making unit, social system, and the communication channels, especially since so many stakeholders are involved in high school athlete concussion reporting. Finally, whether schools use prominent concussion guidelines, such as CISG, or adhere to recent concussion laws remains unknown, making these key areas of investigation for future DOI and sports concussion research.

DOI Constructs of Interest. Recent work in Australia on concussion prevention in rugby and Australian Rules football players has recognized the need for implementation science approaches, such as DOI, to improve dissemination of sports concussion prevention, treatment, diagnostic, and RTP guidelines (Donaldson & Finch, 2013; Donaldson, Legget, & Finch, 2012; Donaldson & Poulos, 2012). Researchers note the existence of and need to incorporate multiple different stakeholders in sports concussion RTP policy decision-making and the diffusion of official concussion RTP guidelines (Baugh et al., 2014b; Donaldson & Finch, 2013; Donaldson, Legget, & Finch, 2012; Donaldson & Poulos, 2014). The prior DOI informed sports concussion studies mentioned in this review often focused on the rate of adoption or perceptions of an innovation.

Other DOI constructs of interest for diffusion of concussion RTP guidelines and policies are Knowledge and Persuasion, key steps of the innovation-decision process (Figure 1; Rogers 2003). Applying DOI theory essentially involves examining how "people talking to people spreads an innovation" (Rogers, 2002, p. 990). Understanding what affects key social systems groups' knowledge and perceptions of innovations helps contextualize diffusion. Regarding knowledge, Figure 1 breaks down the components of this construct, looking at characteristics of decision-makers that influence their awareness of an intervention. Rogers has noted that prior DOI research demonstrates higher socioeconomic status, more cosmopolitan and open

personalities, and greater access to communication channels as predictive of decision-makers having more knowledge of an innovation (2003). Beyond the individual, the socioeconomic characteristics of the schools with high school athletics programs may have a strong influence on the innovation-decision process, since proper implementation of concussion guidelines may require hiring properly trained staff, access to doctors or specialists, and purchasing of equipment for neurocognitive testing. These various factors may affect decision-making regarding the choice to adopt prominent concussion RTP guidelines (such as CISG, AAN, ACSM, AMSSM, and NATA) for developing and implementing sports concussion RTP policies and adherence to Georgia's concussion law in high schools.

Less well understood regarding DOI in general, and DOI in sports concussions, is how the decision-making unit's and communication channel's characteristics affect and interact with perceptions and adoption of innovations (Rogers, 2003). While studying perceived innovation characteristics is valuable, adding the context of communication about innovations can inform questions about who makes decisions, what decision-makers are like, and how they make decisions. With a complex topic of sports concussions that consists of many stakeholders, understanding who makes decisions to follow the innovations of sports concussion guidelines and policies and the factors influencing those decisions is important. Qualitative approaches can provide this rich, in-depth, contextual understanding, but the additional consideration of DOI can inform questions that explore decision making processes related to sports concussion RTP protocols and policies.

Based upon the critical review of the literature presented, there are several gaps to address in sports concussion research. Most notably, sports concussion reporting and RTP research has focused on individual and interpersonal level variables rather than broader societal,

environmental, and contextual factors. Additionally, there have been few sports concussion studies with well-designed qualitative or mixed methods approaches with even fewer examining broader factors and contexts like sports concussion laws, policies, and guidelines. Namely, the extent to which decision-makers adopt or follow such laws, policies, and guidelines remains unknown. This is the case especially in Georgia, which only recently began implementing sports concussion legislation. Further lacking are theory-informed qualitative and mixed methods designs, in particular applications of DOI theory to study sports concussion reporting and RTP. Therefore, there is a need for a well-designed, mixed and qualitative methods study applying DOI theory to investigate decision-making regarding the innovations of new sports concussion legislation and guidelines.

Methods

The present study was an investigation of the development of sports concussion RTP policies for Georgia high schools using mixed methods: a narrative qualitative approach of in-depth interviews (IDIs) along with quantitative surveys. More specifically, the study examined the characteristics of the decision-making unit (DMU), from DOI theory, for sports concussion RTP policies and perceptions and influence of official, consensus guidelines for sports concussion RTP (such as CISG, AAN, ACSM, AMSSM, and NATA) on the DMU.

Participants

To address the proposed questions, the primary researcher, a Rollins School Public Health MPH candidate, collaborated with the Hughston Sports Medicine Foundation, relying on purposive, snowball sampling. Based in Columbus, Georgia, the county seat of Muscogee County, the Hughston Foundation provides sports-medicine-related care and resources in its work with various schools in the Columbus metropolitan area. Using contacts from the Hughston

Foundation's school and community healthcare partnerships, the primary researcher identified school administrators, ATCs, physicians, parents, advocates, researchers, and state health department personnel as study participants for IDIs and an online survey. After each interview, the primary researcher used snowball sampling to identify additional participants by asking interview participants "Who else do you recommend I speak to about these topics." The primary researcher conducted all interviews. Thirteen in-depth interviews and seven quantitative surveys resulted from the researcher-initiated recruitment via telephone or email.

To initiate stakeholder identification and recruitment, the primary researcher obtained stakeholder contact information through collaborating with research and training personnel with the Hughston Foundation. The Foundation provided contact information for ATCs in the Foundation's ATC fellowship program, physicians and ATCs throughout the Muscogee county area, and physicians and ATCs throughout Metro Atlanta and various other areas of Georgia. The primary researcher contacted these informants via email or phone to recruit them for study participation. The Hughston Foundation also works with county-wide athletic directors, who served as a key informants for identifying school administrators, primarily athletic directors (and additional coaches and ATCs if needed) who may have been able to participate in the study.

For the online concussion RTP practices, tools, and resources survey, the researcher obtained permission to use e-mail Listservs for the Georgia Athletic Trainers Association (GATA) and The Hughston Foundation's athletic training fellows. A gatekeeper with each organization who had access to these Listservs agreed to email the web-link to the online survey to the Listserv. The primary researcher also contacted a medical society for physicians in one large metro area in Georgia as suggested by the Hughston Foundation, but that organization declined to participate in the online survey. Finally, either directly via email or via one of these

organizations, the primary researcher sent the survey electronically to 628 potential participants (though some key informants noted that not all ATCs in Georgia may be on the GATA e-mail Listserv), including interview participants who had agreed to complete the survey.

Procedures

Data collection consisted of mixed methods: qualitative IDIs and a quantitative survey in the form of an online questionnaire assessing concussion RTP practices, tools, and resources. Specifically, IDIs included potential decision makers involved in creating RTP policies and protocols in Georgia: school administrators, ATCs, physicians, parents, advocates, researchers, and state health department personnel. The primary researcher conducted the interviews, each lasting approximately one hour. Interviews took place in a private setting, such as an ATC's, administrator's, or physician's office, or in private meeting spaces at the Hughston Foundation and were audio-recorded for later transcription. To ensure confidentiality of participant interviews, the researcher de-identified transcripts, storing them electronically on a password-protected computer, and destroyed recordings after analyses. Eleven interview participants provided written informed consent while two participants interview via phone provided verbal consent. For phone interviews, the primary researcher read the informed consent form to the participants, asked them if they had any questions, and obtained their verbal consent upon completion of the consent process. To protect against missing data, the researcher created memos immediately after data collection and transcribed collected data in a timely manner, storing all data on a password-protected computer. Survey participants completed an electronic, online consent but could request additional information or verbal consent from the primary researcher. Participants responded to the survey online (made using Google Forms) via a link sent to their email address.

Topics, Constructs, & Measures

Qualitative. The student researcher developed an in-depth interview field guide (Appendix 1) for semi-structured interviews to collect data related to the characteristics of the decision-making unit from diffusion of innovations theory. Decision-making unit and communication channel constructs from the theory informed initial questions that the researcher then pilot tested with peers, reviewed and revised with input from thesis committee members, and further pilot tested with several ATCs. After pilot testing and input from peers, committee members, and ATCs, the primary researcher incorporated their feedback to clarify questions and to add additional probes. Key topics and some example questions were as follows (See Appendix 1 for complete interview guide):

Innovation Questions: Descriptions of the concussion RTP policy and/or protocol adopted by the participant and/or his or her organization, e.g., *Tell me about the return to play policy that you use? What does it require? Why was there a need for this? How did it come about?*

Decision-making Unit: The person(s) or group(s) responsible for developing and implementing the concussion RTP policy, e.g., *Can you tell me about the role you had in the RTP policy development process? Who else was involved in the process? Was there a leader?*

Communication Behavior: What stakeholders (people affected by, invested in, or who can affect an issue, program, organization, intervention, or policy [Brugha & Varvasovszky, 2000; Bryson, 2004; Koplan, Milstein, & Wetterhall, 1999; Mitchell, Agle, & Wood, 1997]) communicate with other stakeholders; the extent of the communication; the content of the

communication; the circumstances of communication. Examples include: *How much communication was/is there between the coaches, trainers, school administrators, athletic directors, physicians involved in creating and deciding on the RTP policy? Can you describe your connections to administrators, athletic directors, other coaches, athletic trainers, or physicians involved in concussion RTP policies? How was consensus made? Who ensures policies and protocols are implemented?*

Personality: Attitudes toward change, scientific research, uncertainty, control with regard to concussion RTP policies, e.g., *How much control do you feel you have over the creation and implementation of concussion policies? Can you talk about your experience learning about return to play protocols and guidelines? What are your thoughts on the scientific and medical research on concussions?*

Socioeconomic: Availability of resources in the stakeholder's external environment related to concussion RTP development and implementation, e.g., *What resources do you require to implement concussion policies like return to play? What resources do you wish were more available to develop or implement concussion RTP policies; why? What resources are actually available to help implement concussion RTP policies? How accessible are these resources?*

Quantitative. The primary researcher adapted questions from prior studies assessing concussion RTP practices to develop a self-administered quantitative survey (Appendix 3) (Ferrara, McCrea, Peterson, & Guskiewicz, 2001; Lynall, Laudner, Mihalik, Stanek, 2013; Notebaert & Guskiewicz, 2005). More specifically, the present survey integrated questions and response options from: two items from Ferrara and colleagues (2001), four items from Notebaert

and Guskiewicz (2005), and one item from Lynall and colleagues (2013). Synthesis of these prior surveys yielded a composite questionnaire on concussion-related resources such as: diagnostic tools used; RTP methods used; consensus statement and guideline familiarity and use. With the inclusion of demographic items, the final questionnaire used in the present study contained 14 items total. Of these 14 items: 5 were multiple choice questions; 1 was a ranking task, 1 was a listing task, and 7 were open-ended, free-response questions. As the study relies on DOI theory, the survey focused on the Knowledge construct of DOI, which relates to awareness of an innovation, in this case, official consensus concussion RTP guidelines. Thus, the primary researcher created additional questions, not used in the three prior surveys referenced in survey creation, that focused on perceptions and practices regarding concussion RTP guidelines. Participants responded to the survey online (made using Google Forms) via a link sent to their email address. Some sample questions were: *What methods do you usually use to make decisions about return to play after concussion; Why do you think official concussion RTP guidelines are useful or not; How might the guidelines be improved? Appendix 3 provides the full questionnaire.*

Analysis

Qualitative. Analysis involved thematic analysis with inductive codebook development via identification of key themes that emerged from IDIs. The primary researcher and two graduate research assistants (GRA) created verbatim transcripts of all thirteen interview recordings, with the primary researcher transcribing eight interviews, one GRA three interviews, and the other GRA two interviews.

To develop the codebook of key themes, the researcher collaborated with the same GRAs. These three team members read the first five transcripts to identify key themes: with the primary

researcher reading two of them, one GRA reading another two, and another GRA reading the last one and then reading one of primary researcher's transcripts. Thus, after each researcher had read two transcripts, they then discussed key themes they observed, noting common themes and related themes across the five transcripts. They discussed key themes until reaching consensus on thirteen key themes, each represented by a 1-to-3-word code. Next, the three researchers discussed sub-codes for each key theme until reaching consensus, based upon the same reading of the first five transcripts. Appendix 2 provides the final codebook used for analysis. Further interview transcription and review with project advisors led to the inclusion of six more sub-codes: Physicians (under the "Knowledge" theme); Business of Concussion (under the "Communications" theme and "Barriers" sub-code); Contesting (under the "Hierarchy" theme and "Authority" sub-code); Guidelines-Protocol, Guidelines-Influence, and Guidelines-Utility (under the "Protocol" theme). To store data and code analyses, the primary researcher used NVivo (QSR International, 2014) computer-assisted qualitative data analysis software.

Quantitative. Survey analysis consisted primarily of descriptive statistics such as frequencies, measures of central tendency, and standard deviations of seven surveys. More specifically, the researcher calculated total counts for survey questions 2-5, noting the central tendency and variance for question 6. These questions provided information on knowledge and perceptions of official, consensus RTP guidelines for concussions, one of the innovations considered for adoption by the DMU (the other being the adoption of implementing the Georgia Return to Play Act). Only participants who answered all questions were included for analyses. The online survey tool only allowed submissions once the participant had selected answers for all questions. Thus, there were no surveys with missing data.

Results

Qualitative

There were thirteen informants who participated in interviews, five female and eight male. Participants ranged in age from 23 to 62 years old with a mean age of 44.5 years. There were six categories of informants: six ATCs, three physicians, one parent advocate, one brain injury researcher, one athletic director (for a county wide school system), and one state government-public health employee. Thirteen main themes emerged from IDIs. Appendix 2 contains a list of these themes, including the 58 sub-codes used in analysis to further refine each main theme. In this section, I present additional descriptions of these thirteen main inductive themes within the context of exemplar quotes from the various stakeholders who participated in the IDIs.

Background. Participants provided an array of information on their professional and educational background as well as current educational and work responsibilities, which make up the "Background" theme. Additionally, participants explained how they became involved in their career field, current occupation, and sports concussions. Most participants expressed a passion for and history of playing sports or an interest in health and medicine as reasons for going into their chosen career. One physician, a physiatrist and rehabilitation specialist, detailed his background that led him into his career and to working with concussions:

> "I was always an athlete in high school so that was sort of my interest in sports and then had an inkling I might want to do medicine but wasn't entirely sure, started off as a mechanical engineer… but… wanted to be more involved with working with people, so medicine sort of became more interesting and thought I wanted to work in orthopedic surgery that was my initial sort of thought, I liked sports, I liked the musculoskeletal system, all the muscles were really cool, got to medical school… but I didn't like the

> operating room… but I did like working with a guy that I met in orthopedic clinic… was kind of asking me a lot of questions about function and what happens during normal daily living and how does your injury affect that … and I was like those are really interesting questions, I liked his approach and he was a rehab doc, so that was my intro to rehab medicine… During rehab residency, we do a lot of traumatic brain injuries, spinal cord injury, musculoskeletal injuries, and I really liked traumatic brain injury but I also liked musculoskeletal medicine and decided that if I had to do the bread and butter of each one of those jobs, I'd like the bread and butter of the musculoskeletal stuff better because that brought me to sports and my interest kind of stems from my prior training in traumatic brain injury so I thought that was a nice sort of almost kind of melded together really well. So. That's how I arrived doing what I'm doing."

Concussion Narrative. Experiences with concussion, whether personal or through the story of another person's experience, constituted this "Concussion Narrative" theme. Participants discussed the stories of patients with concussions or families with a concussed youth athlete and how they became familiar with concussions as a health issue. One brain injury researcher, who also had a background in concussion policy advocacy and rehabilitation therapy, recalled the story of a concussed athlete she treated:

> "One young lady… played soccer… since she was young and was a state ranked player, so she played up in middle school, she was goalie, and she had 5 or 6 concussions, and what her mother said was, she would take her to her healthcare provider, throw up, explain that she had this episode, and the provider would say, oh she has the flu! I mean that truly, this is what she told us, so that's why she had repeat concussions because nobody diagnosed it, admitted it, so she kept going back to play. Well the final one, I

> mean, she was out of school for a year… because her vision her head aches, she couldn't concentrate. She came in the first day wearing sunglasses, and I go okay so within two days they were gone, and she was admitting to us I don't wanna go back to sports, and my mother wants me to go back to sports because she played college sports, and so she said that's part of the reason why I'm hanging on to this. She told us that!"

Knowledge. Although knowledge is a component of DOI theory and informed interview questions, "Knowledge" also emerged as a key theme. In particular, discussions of knowledge focused on how stakeholders learned about concussions, RTP, and related aspects such as guidelines as policy and the perceptions of how informed various stakeholders were on concussions and RTP. Participants also offered higher-level commentary on the nature of knowledge regarding concussions. Accordingly, several sub-themes emerged within knowledge, with 9 total sub-themes and "Lack" as the most common sub-theme, instances of a stakeholder lacking knowledge on concussion and/or RTP. An orthopedic doctor in suburban metro Atlanta described his perception of improving knowledge and attitudes regarding concussion in various stakeholders:

> "Whereas, those in my generation would have been tough and just fought through a headache, and I think, so the culture of awareness and acceptance by athletic directors and coaches and understanding through education, is trickling down to the kids, and the kids are actually looking out for each other now, instead of that oh be tough fight through it, they're like hey you may have a concussion, you should go get looked at."

Conversely, there was frequent mentioning of knowledge lacking in various groups, as one public high school athletic trainer noted:

> "You know you'll get some physicians…general practitioners or pediatricians…ER

> doctors…they're not necessarily seeing concussions… General practitioners don't necessarily stay up on… orthopedic, they're not seeing that stuff all the time. That's not what they deal with all the time… They're not necessarily up to speed on current diagnoses and how to diagnose concussion and when to allow kids to return to play… I still see kids…seen…by… the pediatrician, and [pediatrician will say]… we'll hold you out for a week, and then you go back to sports. Or, I've seen some that…clearly had a concussion, went and saw their pediatrician… three days later, and didn't have a headache anymore, so the pediatrician said well you didn't have a concussion… It's sad, but we still do see that happening."

Communication. Key informants often mentioned communicating with other stakeholders about returning concussed athletes to play, to learn more about concussions and RTP, and to create concussion policy or protocols. Thus, "Communication" was another key theme; namely, it referred to instances of stakeholders speaking to one another about concussions, making decisions about or in the process of returning concussed athletes to play, or in deciding on concussion policy or school protocol. One exemplar quote came from a private high school ATC who discussed how she and many other ATCs keep up with best practices for concussion and athlete care:

> "A lot of it is just by word of mouth, communicating with your other colleagues…a lot of times at the end of the football season, I'll kinda call around and say hey how many concussions did you have? What did you guys do different this year? …I'll take that information for what it's worth, sometimes it's not worth anything, I'll say hey we're doing this, this, and this, you know that, you listen, but…at least I can say I'm trying.. this is what alot of the schools are doing, they're only hitting two days a week versus three, I

mean there's schools that four days a week! You know?"

Five sub-themes of Communication also emerged. "Barriers", instances in which there was difficulty in or obstacles to communication, was the most prevalent sub-theme.

Protocol. The "Protocol" theme included descriptions of the RTP, concussion management, or school protocols around concussions. Additionally, the theme contained 7 sub-themes, all focusing on various concussion RTP guidelines and their role and use in schools' and providers' RTP protocols. In great detail, the previously mentioned suburban metro Atlanta orthopedist explained the concussion RTP protocol he uses in his practice and with various high schools where he helped establish concussion management programs:

> "So any suspected concussion, not a diagnosed concussion, a suspected concussion doesn't go back in that same day… They have a one to two day follow-up, with my athletic trainer, depending on when it was… They'll re-evaluate them then… do some provocative measures, um that's actually a sideline evaluation, it's a vestibular ocular motor screen that's come out this year that's highly sensitive for concussion, ninety percent. So we actually use that on the sideline at game time… Then they'll re-evaluate them within twenty four to seventy two hours, and they'll administer the IMPACT test [a concussion symptom test] again, compare it to their baseline. They'll usually contact me. If I wasn't there when it happened, I'll look at their IMPACT test on my phone. I've got access to all of them remotely, and… will make some decisions. Usually they'll come in and see me and stay out of school for a day or two…Then we'll get them back into school fairly quickly because… socialization and getting them back into some sort of normal semblance of an environment's important… around their friends…but creating an environment of academic accommodation, where maybe they delay their tests for a little

> bit, reduce workloads, let ‘em take breaks. They don't go to PE. They go, you know, rest in the counselor's office or nurse's station, take a nap, they can excuse themselves from classes to avoid their symptoms from getting too bad, just to be at school a little bit…Then the first week is kind of a re-entry… approach… to school. See how they do with that. I will usually re-evaluate them in about a week, and I will repeat their IMPACT test, see how they're feeling, their symptoms are gone, their symptoms are back to normal…We start our progressive exertion program, where we'll start getting their heart rate up to certain zones and sports specific, if they're a basketball player, if they're a soccer player… into sports-specific activities over a couple of days to see if their symptoms come back. And then we usually make return to play symptoms at that, return to play decisions for contact at that point.

An exemplar quote for the sub-themes came from the previously mentioned physiatrist and rehabilitation doctor who discussed the CISG/Zurich guidelines’ utility in his concussion care and in general:

> “I think they’re excellent…are they perfect? No… nothing is perfect… you have to leave some room for interpretation because every patient is going to be different… but again I think it partially comes down to how you practice…it’s appropriate that they leave room for interpretation until there’s more evidence to definitively say one thing or another but I think it’s readily accessible, it was published in every major journal…3 different pediatrics journals 3 different sports medicine journals…now it’s open-access I mean…at least you’ve got something that your average reader can pick up and say okay I want to know more about concussion, I want to feel educated and go through biomechanics, symptoms, things to look for, red flags, generalized treatments… there’s even a section

on…future stuff so it's a good piece."

Policy-Protocol Development. While DOI theory informed interview questions about the creation of specific schools' concussion RTP protocols, participants described the process of creating statewide concussion policy, broader system concussion protocols (e.g., in a healthcare system), and specific RTP protocols within individual schools. Such descriptions constituted the "Policy-Protocol Development" key theme, which included four additional sub-themes. Reflecting on the process of creating the statewide concussion law in Georgia, an ATC in youth healthcare discussed the negotiation and political aspects of crafting the policy:

> "their lobbyists (NFL) came and spoke in Atlanta for a couple days under the NFL umbrella, and…can get in places that we couldn't so…the NFL used us and we used the NFL to get it passed is the way I look at it…well…we were told from the beginning that the law had to be budget neutral, we can't demand a school to do baseline impact testing or organizations to do baseline impact testing because there's a cost associated so the first thing we're advised…all parties involved was it had to be budget neutral so that takes a lot of bit out of a law…my thing is the GA high school association would not endorse our law in that again they wanted to stay neutral…they left it up to the individual schools and I think they should have stepped in and said something or used some of their influence to help us with that and they didn't until it was passed and then they wanted to partner or make some decisions so that really…bothers me

RTP Involvement. In discussing returning concussed athletes to play, participants mentioned their own and others' involvement in the RTP process, captured under the "RTP Involvement" theme. This theme also consisted of five sub-themes, with the two most common being "accountability", descriptions of a stakeholder's responsibility in concussion care or RTP,

and the role of parents in concussion care or RTP, the "Parents-RTP" sub-theme. The previously mentioned brain injury researcher explained the responsibilities of multiple stakeholders in concussion RTP, especially parents:

> "I think coaches are very much involved with this issue, but they don't make the final decisions for these kids, even in high school…If they're minors, it's their parents. If they're 18 and older, it's them, and they have to have benefits, so are they on their parents' healthcare?...Consumers… they have no guidance on this is good care, this isn't good care. They don't know that. They're gonna have to speak up too, and say hey, this isn't right. You know I go to clinic A and I get this treatment, but at clinic B they don't do that. You know…that's what has to happen, especially in Georgia, it's very disjointed in Georgia."

Resources. DOI theory also considers socioeconomic factors that influence perceptions and intentions to adopt innovations. The socioeconomic aspect of DOI informed some interview guide questions about the resources involved in returning concussed athletes to play, but participants mentioned resources related to sports concussion diagnosis, management, protocol, and policy. This key theme of resources also included six sub-themes, with participants tending to mention diagnostic tools, money, parents, medical providers, and time as the main resource types relevant to sports concussions. Participants also mentioned instances where there was not enough of some type of resource, coded with the sub-theme "lack." Discussing the necessary resources for implementing sports concussion RTP policy in schools, an ATC for a suburban, metro-Atlanta public school stated:

> "I think if a high school… does not have an athletic trainer… their athletic program is lacking… most medical professionals will probably agree with that…Having athletic

> trainers at the high schools is easy to do. The excuse that you will hear from the schools is they don't have funding for it… my argument to that is…well how much is an athlete's life worth. Because there are things that are gonna happen on the field that coaches may not recognize that an athletic trainer will, and an athletic trainer can save that life…An athlete in Forsyth county… had a bleed on his brain, and an athletic trainer realized there was an issue…. That athlete is alive today because of that... There's cases like that all over the places…if schools wanna make it happen, they can…The other way and to me the best way…to get athletic trainers in high schools is you hire teacher athletic trainers. Athletic trainers can teach classes. Is it ideal? Absolutely not because … it's gonna limit how much you're going…to have them there in the evening…but you now have an athletic trainer on the campus full time every day…That, is as simple as…doing with one less coach…you've got your staffing for your athletic trainer…A lot of schools now…have health occupations and sports medicine classes. Well athletic trainers can teach those classes, and we don't even have to have teachers' certificates to do that…but we can also find athletic trainers that have teaching certificates…For an athletic trainer to be teaching anatomy and biology is not a stretch…That's the stuff that we study in school all the time."

Hierarchy. The interview guide included questions designed to explore who makes decisions about sports concussions and RTP. Participants described the power dynamics in making decisions for creating and implementing sports concussion protocols and policy, often focusing on who has power and how they exert influence, constituting the "Hierarchy" theme and its most predominant sub-theme, "Authority", respectively. A county-wide athletic director in suburban west-Georgia mentioned his authority role in the hierarchy, which he used to support

the decision-making authority of medical providers:

> "I had a standard thing with my…coaches: you can never trump the trainer, we had a trainer who…trained at the (Georgia hospital) but they worked for (Georgia high school)…whatever the doctor or the trainer says, if you even question it you need to seek other employment. Whether…an ankle problem, all the way up through concussions…if the doctor says "No" and you don't like it you need to find somewhere else."

The previously quoted suburban Atlanta orthopedist and private-school ATC corroborated the athletic director, noting the combined authority roles of school administrators:

> "for it to be a successful concussion program, I need to have an administrator and an athletic director buy in, because…coaches…kick back, parents, teachers…kick back…with concussion care at my schools, we [ATCs and doctors] have a final say if a kid gets on the field or not… my athletic directors buy into that."; "if you're an athletic trainer…you gotta have your athletic director on your side…your AD has to be the one to stand beside you because we're not going to be making the best decision for that coach. We're making the best decision for that child."

Implementation. In addition to mentioning components of protocols, policy, and their creation process, participants also discussed topics related to putting sports concussion protocol and policy into practice. This "Implementation" theme included four sub-themes, with the most prevalent being "Georgia Policy," which featured statements about how the implementation of Georgia's state-wide concussion policy is going. The brain injury researcher and rehabilitation therapist previously referenced provided an exemplar quote mentioning the challenges of protocol and policy implementation, such as monitoring of the Georgia law in particular, and some personnel involved in implementation:

> "In Georgia, I have no idea…I think people are removing kids from play… but as far as making sure kids are returning symptomatic, I have no idea what's going on… I can't tell you who would for the state…There's pockets of people who…know for different schools…UGA they have contracts and do research with some high schools…Georgia State…has research studies in high school. Children's Healthcare hires or sponsors athletic trainers to be out at certain high schools …these pockets of people would know what's going on within their jurisdiction, but there's no state-wide that I'm aware of. The state… they…defer to local control, so they can't set policies really for implementation… they're happy to post materials, provide information, but they can't set policy, for local school systems....Schools aren't mandated to do healthcare, but yet they're asked to implement these laws, but…They're not required to have athletic trainers…but…the guidelines have to be implemented more at a local level…When we have research findings, that has to be translated more at a local level. Cause it's staying up in this level of researchers and somewhat…but I don't think primary care physician do because…They have so much to deal with, and maybe they haven't seen these kids [with concussions]."

Compliance. Similar to implementation is the theme of "Compliance". This theme is comprised of references to the extent to which various stakeholders adhere to sports concussion protocol or policy. While this theme had two sub-themes, the "Lacking" sub-theme was most common and mentioned more than even the overarching "Compliance" theme. Participants tended to describe compliance with protocols or policies within the context of incomplete adherence to them, in particular the Georgia concussion law. An ATC with a private sports concussion clinic, who works with multiple metro-Atlanta area schools and youth athletes,

described factors and stakeholders that can affect compliance and instances where it may be incomplete:

> "Private schools it's different. If it's a high school you're lucky if it's implemented. Or some teachers will follow and then I will get calls from different teachers that are like 'there is no way I can do this.'…We'll have those conversations that this is the different strategies you can use. And some pediatricians are not saying that they don't know anything [about sports concussions]. Three times a week, easily [the ATC encounters concussed athletes who saw pediatricians lacking sports concussion training]. And that's just what's being reported here. I'm sure it's a lot more than that…there is a couple of schools out there that say that they have had five or less concussions the whole football season… and according to all the trends…they are just not reporting, or they're not catching it, or…there is nobody there to pull the kids off….They [parents] are signing the sheet of paper, so presently, who's actually doing anything about it… there are no repercussions…We have worked with some schools outside like [a rural county in Northwest Georgia]… were (reporting)…no concussions when…other high schools they're playing the same teams are reporting and you get two.... [Schools] having too many things on their plate…I think you have to go out there and educate everybody and give them strategies that they can make it work for their particular setting."

Variability. Participants expressed that there were inherent differences in managing concussions; the injury, care, protocols, and policies could vary. This "Variability" theme encompassed six sub-themes with the two most prevalent ones being "Community" and "School". These sub-themes referred to descriptions of each community and school varying regarding sports concussion management, RTP, protocol, and policy. Reflecting on her policy

creation and advocacy role, the brain researcher and rehabilitation therapist noted several aspects of variability related to sports concussions:

> "We tried to bring in stakeholders from South Georgia, for example…[He] actually was a very big advocate about this care issue because he knew from being a state executive director what the people in the rural counties face…their hospitals are closing. They don't have doctors. So how are they gonna…keep continuing sports…And, not all schools have athletic trainers in Georgia…I think people in [South Georgia Town] don't know about that [sports concussion guidelines like CISG/Zurich] and rural communities… that is just a guideline! It's not a proven fact…that's the best available practice. I think there is a huge range of what people actually do. Depending on the athlete's age, the athlete's playing ability, and parent and team attitudes towards sport."

Several participants noted that variability did not imply negative consequences. The youth hospital ATC noted variation in implementing the Georgia concussion law across different settings:

> "I would say at the high school level…it's implemented fairly high if the school has an athletic trainer, at the youth sports levels and things like that I would say it drops down to probably 50% and then anything after that, I really don't know if it's being used or not....All organizations are [not] the same and not all schools have an AT, not all schools have somebody on the sidelines on a Friday night so we really can't force them to do much so it had to be budget neutral so that was one of the things that kind of limits the law."

He also emphasized that each concussion is different and each athlete experiences a concussion differently:

> "we know now that concussions are individual based, you can't have one scale fit everybody and all the research indicates that each athlete that sustains a concussion may recover faster or slower and you just have to accommodate that…I have stories about one concussion and I've heard and seen players have 12 and not have any mental problems at 45 or 50 so you really don't know and I think that's where research is going."

Public Health. For the final theme, participants referred to sports concussions as a broader health issue. More often than the overarching "Public Health" theme, participants compared sports concussions to other injuries ("Health Analogy subtheme) or likened the issue to a challenge in health education ("PR Communications" sub-theme.) The physiatrist/rehabilitation doctor provided an exemplar quote detailing the greater public health issue of sports concussions, noting progress as well as the ongoing need for innovative health communication:

> "[Participant's Hospital] has definitely put out messaging… public service announcements …we're encouraging people to attend webinars, we're making an effort…it only takes one parent who gets into the system and has a good experience… that parent is pretty motivated to inform their school of what care should look like no matter getting access to those people…as part of the Return to Play act they're supposed to provide learning material to coaches, students and parents prior to each season on what concussions are and how to detect it, why you need to report it, what the return to sport is going to look like generally…I think it's better, its just kind of slow and part of it is just reaching a critical mass of people that are aware it exists and people that just kind of are catching up, definitely seen that in south Atlanta, you've got a couple of big schools that kind of compete with one another in athletics and it's like oh okay well if this high school rolled out their concussion policy, we should have one too. So you just kind of have to

build awareness to a certain degree a lot of times that's your booster clubs, parents groups. You got a parent who's connected to a board or a parent who's connected to fundraising or a parent who's connected to a local political person you can kind of get the ball rolling and a lot of people are like, 'well they did it, we better do it too'."

Quantitative

A total of seven participants completed online surveys despite distribution to two separate ATC email lists (the Hughston Foundation and GATA) through members of those organizations with access to the lists. After an initial low response rate, the primary researcher contacted the same member of the GATA with access to that list to distribute the survey a second time. Interview participants also received emails with a link to the survey and a request that they pass on to other individuals, email listings, or organizations involved in sports concussion RTP. A medical society for physicians in one large metro area in Georgia initially expressed interest in the present study but subsequently declined to send the survey to its members. Even without exact numbers of individuals sent the survey, given the large membership size of the two organizations that received an email with a link to the survey, the response-rate was well below one percent. Respondents included four ATCs, two physicians, and one advocate and director for a brain injury non-profit organization. Of the ATCs, two worked in high schools, one in a hospital, and one in a sports medicine clinic. One physician worked in a sports medicine clinic and the other in an academic department.

Because of the small sample size for surveys, I will present findings from select survey items that can supplement under-addressed topics from the qualitative interviews, corroborate interview results, or differentiate from interview results. All respondents used sports concussion RTP guidelines in making RTP decisions for athletes and rated guidelines as useful. Six

participants rated the guidelines as ‘mostly’ or ‘always’ useful, and one rated them as ‘somewhat’ useful. Six respondents found the guidelines to be similar, while one indicated they can be contradictory. In addition to following RTP guidelines, respondents used eleven other methods for making decisions about clearing concussed athletes to RTP. Table 1 provides the frequencies of different methods employed for RTP decision-making, with all respondents utilizing RTP guidelines and symptom checklists and a majority clinical examinations, neuropsychological testing, and ATC recommendations.

For specific guidelines used, Table 2 provides the frequencies of various guidelines of which respondents were aware. Most respondents had heard of the CISG guidelines but mentioned nine additional guidelines. Regarding specific guidelines used, two respondents used CISG, two created their own (based upon multidisciplinary concussion provider collaboration and guidelines), one used multiple, and one used NATA. One respondent chose not to provide an answer for RTP guidelines used. Finally, respondents provided reasons why RTP guidelines were useful or not and ways to improve them. Reasons RTP guidelines are useful included: providing a consistent approach for clinicians to follow, being broad enough to cover the variation in concussions and individual athletes, and not being difficult to use. Still, respondents provided several suggestions for improving RTP guidelines such as: no one guideline is considered the best or a “gold standard”; guidelines have not been universally adopted; need to make sure guidelines are being used; including sports specific exercises for graduated RTP for the athlete in future guidelines; include more information and guidance on return to learn and having the athlete back in school, instead of just returning to playing sports; currently guidelines are resource and time intensive to implement, which could be improved; and, making guidelines or tools that are more useful for non-clinicians who may need more knowledge of or have to do

concussion management

Grounded Theory

To examine the relationships between key themes, I used the coding matrix query function in NVivo to inform the creation of a concept map. Initially including all codes and sub-codes, I then removed codes that did not appear together in the interview transcripts, which yielded a matrix of 22 codes and sub-codes. For the purposes of the concept map, displayed in Figure 2, I included relevant sub-codes of main codes even if they did not have a clear relationship with other themes in order to denote topics participants tended to talk about within the main code (these sub-codes are "business of concussion", "leader", and "diagnostic tools" and have no arrow in their relationship line in Figure 2).

"Variability" was a pervasive theme and tended to operate at the level of community or school, suggesting that each community or school was different regarding sports concussion policies and protocols for youth athletes. Variability by school and by community is a phenomenon of resource availability, as noted by its relationships with the "Resource" code, particularly its "lack" and "personnel" sub-codes. Thus, variability regarding policies and protocols for sports concussions and RTP occurs within each school and community because of access to personnel that can oversee RTP and manage sports concussions, such as ATCs and specialty healthcare providers. That is, schools with ATCs or communities with specialty physicians trained in concussion will have different approaches to youth sports concussion management than schools or communities that lack these healthcare providers. Variability also tended to appear with "Protocol", "Implementation", and its "Georgia Policy" sub-code, suggesting differences in sports concussion RTP protocols, their implementation, and the extent of implementation of Georgia's concussion law in different community or school contexts.

The two other predominant themes with numerous relationships were “Communication” and “Knowledge”, with “Variability” featuring in these themes. Communicating appeared as a tool that was crucial in many themes and processes discussed by informants. For “Communication”, stakeholders had varying levels of interaction with others, or the stakeholders involved in communication would vary. Because of varying resources like personnel, communication regarding “RTP Involvement” and “Policy-Protocol Development” would also vary. However, “Communication” linked to “RTP Involvement” and “Policy-Protocol Development” since it was a key tool used in these processes. In particular, “Communication” also appeared with “Hierarchy”, which linked to “Compliance” and ”Policy-Protocol Development”. This suggests that communicating with those involved in the power dynamics for sports concussion protocol and policy decisions was an important piece of creating buy-in for creating and complying with the protocols and policies decided on, be it at a community or school level. Regarding “Communication’s” relationship with “RTP Involvement”, it suggests that being involved in making RTP decisions for a concussed athlete involves speaking with other stakeholders to make and communicate these decisions. In particular, key informants emphasized “Accountability” in terms of their own and other stakeholders’ responsibility in the RTP process, meaning who is responsible for deciding on a policy at a school or organization and for returning a concussed athlete to play. This could include descriptions of both actual responsibility in practice and of who should be responsible for making RTP decisions. Even if who held such responsibility varied, key informants tended to mention the role of “Parents” in RTP decisions, noting that the parents control the healthcare of their children (youth athletes),or that communicating with parents was a key part of being involved in making RTP decisions. Also, there were “Barriers” to communicating, with this sub-code tending to appear with

"Communication". While informants cited a variety of barriers, one that appeared frequently, though with no relationships to other themes and sub-codes, was "Business of Concussion." Healthcare providers and organizations would not always communicate with one another or work together, instead competing for patients and money, in a more business- rather than health-based model. Finally, "Communication" tended to appear with "Knowledge", a relationship discussed in more detail in the following paragraph.

"Knowledge" was the third theme with numerous relationships, an important one being with "Communication." This relationship suggested that communicating with others was a key tool used by informants for both gaining knowledge about sports concussions and RTP and educating others to increase their knowledge on these topics. Supporting this idea is the strong relationship between "Knowledge" and its "Lack", "Parent", and "Physician" sub-codes, suggesting that informants tended to talk about inadequate concussion knowledge in parents and groups of physicians. Regarding physicians, informants usually mentioned generalist providers such as pediatricians or primary care doctors who lacked specialty training, experience, and knowledge about concussions since concussions tend to be outside of their expertise. "Lack" appeared most often with "Parent" suggesting that informants felt the knowledge gap in concussion was strongest in the parents of athletes. Moreover, "Knowledge" tended to appear with "Protocol", suggesting that increasing knowledge, especially by educating parents, was often a component of the sports concussion RTP process in the protocol. Conversely, while communicating could be a tool to increase knowledge, a lack of knowledge in parents or physicians could also impede communication as noted by the relationship that appeared between "Lack" and "Barrier", the most frequent sub-code of "Communication." Parents could get incomplete or wrong information from another provider, believe that sports concussions were not

a serious injury, or pushed their child to succeed in sports, making it difficult to communicate about RTP for their child athlete or to create buy-in to the protocol or RTP process. Finally, "Knowledge" had a relationship with "Personnel" and "Compliance", suggesting that having providers trained and informed in sports concussions was necessary for ensuring adherence to a sports concussion RTP protocol or policy.

With these numerous relationships, a grounded theory emerges whereby variation in resources and knowledge for sports concussions and RTP affects the relevant processes in conducting sports concussion RTP in youth athletes. More specifically, variable availability of the key resource of concussion trained personnel and knowledge in a school or community influences: communication (itself a key tool for knowledge and the other processes), who is involved in and responsible for RTP decisions, developing and complying with policy and protocol, and implementing policies and protocols and Georgia's concussion law. Table 3 presents a grouping of these themes into proposed categories and concepts based upon this inductive, grounded theory approach.

Discussion

Based upon a search of the literature using Google Scholar, Pro Quest Dissertations and Theses, PsycInfo, and PubMed, this is the first application of qualitative and mixed methods with DOI theory to study sports concussion policy decision-making and perceptions of sports concussion guidelines and policies for high school athletes. Given the theory-informed approach combined with mixed methods to address several research questions, I will parse out the interpretation of these numerous elements. First, I will juxtapose the grounded theory from the qualitative interviews with DOI to discuss their relationship and ability to explain the findings. Next, I will discuss how the quantitative surveys complement the qualitative interviews and

grounded theory. Finally, I will return to the research questions to interpret how both the qualitative and quantitative findings address each question.

Grounded Theory & DOI

This study extended DOI theory by using it to inform the research questions and interview guide questions of a qualitative, grounded theory approach. Moreover, this theory-informed, qualitative extension into sports concussion RTP policies and protocols for high school athletes represented a novel topic for this approach. DOI theory helped create broad questions for the overall research and the interviews to explore who makes decisions in adopting RTP guidelines in creating concussion policies that adhere to Georgia's concussion law. Moreover, while DOI focuses on adoption of an idea, practice, or object perceived to be new (Rogers, 2003), the current study shows an application for its constructs to policies and laws as well. More specifically, understanding the communication channels involved in not just creating a policy at a school, but also in carrying it out, reveals the dynamics of different individuals involved. While deciding on a concussed athlete's RTP is not an innovation decision, DOI constructs helped inform the factors that go into these decisions and that create variation in RTP practices, protocols, and policies. Many of the participants seemed to be early adopters or innovators because they had involvement with creating policy at their school or organization and the Georgia concussion law. Given this fact, DOI can explain their sports concussion knowledge and awareness of guidelines and the Georgia law. Furthermore, the socioeconomics of implementing sports concussion RTP protocols in compliance with Georgia law seem to fit with DOI theory, although socioeconomic factors in prior DOI research have focused on individual decision-makers' socioeconomic characteristics (Rogers, 2003). Because resources like personnel and diagnostic tools require money and vary in different schools and communities, DOI research

showing that higher socioeconomic status for decision-making units corresponds to earlier innovation corresponds to this finding. However, the present study extends DOI theory regarding socioeconomic factors by contextualizing the environment in which the decision-making unit operates, such as resource availability in a community. Prior research on the socioeconomic aspects of DOI focused on socioeconomic characteristics of individual decision makers and adopters and how new technologies tended to widen socioeconomic gaps (Rogers, 2003). Thus, broader, higher level environmental factors may affect the decision-making unit and process, beyond the influence of an individual's or group's socioeconomic characteristics.

There are several grounded theory findings, however, that DOI cannot explain. While DOI includes communication channels to see how innovations spread, numerous communication barriers emerged from the interviews and grounded theory. Informants cited structural barriers, like the lack of enforcement, and implementation mechanisms or groups, such as a monitoring organization, that could facilitate communication. While communication still influences adoption, DOI cannot account for the existence of barriers to communication. Another common barrier appeared as the "Business of Concussion" sub-code, which represented the phenomena of sports concussion providers, experts, and organizations not communicating or working together because of a competition for patients, money, and recognition as experts in sports concussion management. DOI includes socioeconomic characteristics as relevant to adopting an innovation, but this does not explain how a desire for resources and recognition impedes communication and diffusion. Most important regarding DOI's limitations, however, was the variable availability of resources and its effects on numerous themes in the grounded theory. In the persuasion phase of the innovation-decision process, perceived characteristics of the innovation such as relative advantage, complexity, and compatibility could fit into the structural barriers and lack of

resources found in the study (Rogers, 2003). Still, these DOI constructs focus on the innovation compared to other ideas, practices, or objects and does not explicitly address barriers and resources that exist in different settings. While the decision-making unit can be a large group such as an organization, school, state, or country, socioeconomic characteristics, of even of a group of decision-makers, differ from resources available in the greater community. For example, decision-making unit characteristics of DOI are based upon individual characteristics of early adopters that Rogers and other researchers identified in studying and applying this theory, such as being more educated or affluent (2003). That is, the environment that decision-makers are situated in may influence innovation decisions, a distinct concept from prior DOI research showing a link between higher socioeconomic status and earlier adoption (Rogers, 2003). Given the variable availability, and sometimes lack, of resources in some communities and schools, there is no "trialability" for the innovation because the option to try does not exist. Therefore, the grounded theory best explains that resource availability varying by community and school accounts for the different protocols, implementation, and communication regarding sports concussion RTP in Georgia high schools, potentially youth sports as well.

Quantitative Contributions

The quantitative survey provided additional information about perceptions of sports concussion RTP guidelines, which participants discussed less frequently in interviews. Only five key informants mentioned guidelines having an influence on the protocol and policy development process and in the actual protocol used to return concussed athletes to play. However, all survey respondents used guidelines in making RTP decisions. A higher proportion of providers such as physicians and ATCs participated in the surveys than the interviews, which could explain this discrepancy. While a majority of interview participants, nine, discussed the

usefulness of guidelines, all survey respondents reported that guidelines were useful. Of the guidelines discussed, both interviews and surveys suggested that respondents were most aware of the CISG/Zurich and NATA guidelines. Surveys suggested that many different guidelines are still in use, despite the focus on CISG and NATA in the interviews, as survey respondents mentioned nine guidelines beyond these two. Finally, surveys provided insight into ways to improve guidelines. Conversely, interviews tended to reveal information on how aware different groups were of guidelines. Thus, the surveys better helped answer why guidelines are not as well diffused or disseminated as possible.

Research Question One: *How do key stakeholders influence the decision-making process for developing sports concussion RTP policies in Georgia high schools?*

The qualitative interviews of this study best answered the first research question by revealing the roles of different stakeholders in sports concussion RTP decision-making according to the informants' emic perspective. That is, this qualitative approach allowed informants to provide their understanding of meanings and processes in context related to sports concussion, RTP, and policies for youth athletes rather than emphasizing the researcher's outsider perspective (Hennink, Hutter, & Bailey, 2011). Moreover, the study most completely answered the first research question. ATCs and some specialty physicians were key personnel for creating policies and protocols within specific schools, but according to the grounded theory that emerged, these personnel needed to secure buy-in from other stakeholders in the power structure of their setting. This often meant engaging athletic directors and coaches. Open, consistent, and frequent communication bolstered support for the ATCs and the concussion RTP process they developed. This communication was also a key tool for continued adherence to the policy or protocol, with little resistance from school personnel. There were communication issues with parents of

athletes, due to parents having inadequate knowledge about concussions according to informants. Parents had little role in developing policies at specific schools but were involved in the development of the Georgia concussion law. Beyond stakeholders themselves, however, external and environmental factors such as the availability of resources, in particular personnel such as ATCs and physicians trained in sports concussion, influenced the ability of schools and communities to develop a sports concussion RTP policy. Although the schools represented by informants in this study all had concussion protocols and policies in place for their student athletes, participants referenced many schools not having an ATC on staff or access to concussion-trained physicians in their community, suggesting potential gaps in creating policies and the effectiveness of Georgia's concussion law. Of note was the key role of the NFL in creating the Georgia concussion law and helping it pass, as mentioned by several informants. However, there were limitations in the Georgia law such as a "lack of teeth", enforcement, and oversight mechanisms, which informants involved in developing the law said was due to politics and not wanting to place a burden on communities with less capacity to implement RTP protocols and policies in their schools.

Research Question Two: *How do key stakeholders perceive consensus and official guidelines for sports concussion RTP?*

Both the qualitative interviews and quantitative survey provided insights regarding the second research question. Most interview participants were aware of guidelines but did not believe they had much role in creating their school's or organization's concussion RTP protocol or the Georgia concussion law. Still, informants found them useful as a broad approach for informing a protocol, but did not explicitly and universally incorporate them into the exact protocol used, since they could be vague and needed to be tailored to the setting. Stakeholders

seemed to find the CISG and NATA guidelines more useful than others, as they referenced awareness of them and incorporation of them into protocols more so than other guidelines. The physicians interviewed had more favorable perceptions of these guidelines, often praising the CISG/Zurich guidelines. Survey respondents also tended to use guidelines in making decisions about RTP for concussed athletes, generally finding them useful, and demonstrating the most awareness of CISG and NATA guidelines. While interviewees had few suggestions for improving guidelines, some informants mentioned making them more accessible to general audiences. Surveys provided additional suggestions for improving guidelines, such as providing more specific components, practical ways to implement them in different settings, and making them more accessible to non-research, non-academic, and non-medical personnel, which could also serve to increase their diffusion.

Research Question Three: *How do key stakeholders' perceptions of these guidelines influence their decisions regarding concussion RTP and corresponding policies and protocols?*

While the grounded theory from interviews and survey results did not directly address the third question, some interviews provided insights into guidelines' influence on policies and protocols. Physicians interviewed had favorable perceptions of concussion RTP guidelines and based much of their protocol and practice around them, while noting they were a bit vague and could not be followed step-by-step, but used as a guide to create a protocol. Various different interview respondents noted that in creating the Georgia concussion law, the changing nature of concussion knowledge, which emerged as a sub-code, prevented specific guidelines from informing the law. If concussion knowledge changes and guidelines become outdated, the law would also have to change, opening it up

for other changes with the potential to reverse progress. Furthermore, since different schools and communities have variable access to resources such as diagnostic tools, money, and especially personnel like ATCs, incorporating guideline components that are too specific related to diagnostic testing would have burdened certain areas in Georgia. Informants suggested that opposition from some stakeholders and politicians on these grounds contributed to the broader recommendations in the Georgia concussion law. One ATC mentioned adhering to NATA guidelines because this meant he would be in compliance with best practices endorsed by the organization that certifies him for his profession. With NATA guidelines being updated, the ATC noted that the updated guidelines served as a guide to revamp his school's concussion protocol. For stakeholders such as parents, the interviews indicated parents may not be as aware of guidelines, suggesting they have little influence on the decisions parents make regarding concussion RTP for their kids. More prominent in creating guidelines was communication with different medical providers and the school administration and coaching staff to gain buy-in. Guidelines may already inform the training of concussion providers, such as ATCs and specialist physicians, such that their prior training and experience are sufficient to inform protocol and policy creation, as has been suggested by prior research on providers' concussion guideline perceptions and use (Kemp et al., 2015). Overall, both interview and survey respondents had awareness of the guidelines, suggesting diffusion, but guidelines appeared to have minimal influence on developing and implementing concussion RTP protocols, policies, and legislation.

Strengths

The primary strengths of this study were its use of a systematic, theory-informed, mixed methods design. A theory-informed semi-structured approach to interviews along with survey

adaptation from prior studies provides a transferable approach by allowing others to replicate this approach in other settings. Moreover, the carefully detailed methodology enhances the ability to replicate the study. Despite the use of theory, the inductive, grounded theory for qualitative analysis provided rich, in-depth descriptions from the emic perspective of key informants. Also, the concepts that emerged from the grounded theory may apply to other settings, and at the very least, can be examined in other settings. Maxwell (2012) notes that this not only supports transferability, but also the generalizability of a qualitative approach by developing a theory that may apply in other settings. Additionally, because this grounded theory emerges from verbatim transcripts, a source of rich data, it also strengthens the validity of the findings (Maxwell, 2012). The use of DOI theory to inform questions and data collection tools also helps demonstrate negative cases that differ from the grounded theory's explanations or can be better explained by DOI. Indeed, some negative cases emerged, with two physicians noting that specialist ATCs may not be the solution to better concussion knowledge and RTP protocol implementation. They suggested training for primary care physicians or for someone affiliated with a sports team, such as an athlete leader, could improve concussion detection and diagnosis. Indeed, this is a reasonable suggestion given the limitations in resources. The majority of interviews suggested that ATCs in particular, and other concussion-trained healthcare providers, are key lynchpins for ensuring that schools have adequate concussion RTP protocols and policies. Finally, triangulation, achieved by using mixed methods and including diverse types of stakeholders, accounts for multiple perspectives, also strengthening the study's validity (Maxwell, 2012). Despite these strengths, there may be important limitations and inherent flaws in the design that reduce validity.

Limitations

The primary limitations of this study were its small survey sample size, purposive sampling strategy, and inclusion of stakeholders who seemed to be opinion leaders, change agents, and early adopters (Rogers, 2003). With seven survey respondents, this response rate of approximately one percent is too small to be representative. Also, the survey used purposive, convenience sampling rather than a random sample. The use of a gatekeeper to send the survey appeared a reasonable strategy but may have made it easier for potential participants to ignore than a more personalized approach. Indeed, interview recruitment was more successful. While the study design and concepts stemming from a grounded theory approach enhance study transferability, the setting of metropolitan areas of Georgia may be unique and not representative of other settings. However, there is value in a qualitative approach highlighting a unique setting if it can generate broader concepts or theories to apply elsewhere (Maxwell, 2012). Furthermore, it is unclear whether the study achieved saturation of key themes and the resulting concepts, given the focus on primarily expert stakeholders who were leaders or early adopters. It is possible that saturation of these experts was achieved, given that many informants kept referring the primary researcher to the same informants with whom he had already spoken. Still, the lack of stakeholders from rural, lower socioeconomic, or inner city schools, communities, and settings precluded greater saturation and understanding of experiences from those individuals' perspectives.

Finally, the study did not include athletes and coaches, partly by design because of the focus on decision-makers of concussion RTP protocol and policy. However, interviews revealed that communication with and buy-in from school coaching staff was important for putting concussion RTP into practice.

Implications

The grounded theory developed suggests variable implementation of concussion RTP policies and the Georgia concussion law. Better monitoring, oversight, and enforcement mechanisms may be necessary to strengthen the law's impact. Although not a key theme, some respondents mentioned that implementation is likely lowest in youth sports, i.e., organized sports competition outside of the middle and high school settings. More information is needed on the concussion protocols and policies of these other youth sports leagues. There is also a need to overcome the serious lack of resources, especially concussion-trained providers like ATCs. One ATC recommended that ATCs can be employed by schools as teachers and still provide part-time sports coverage. While not ideal, he stressed that this is better than nothing and overcomes some of the political will and budget issues of hiring extra staff. Other suggestions included having schools without resources identify athletics staff, parents, or athletes who can be leaders and receive basic concussion detection training. Championing telemedicine to provide such trainings or to extend training to primary care doctors or other alternative providers may also be an important option. Although not a key theme, some interview participants mentioned return to learn, i.e., returning youth athletes to school and the classroom, was often absent from school policies and the Georgia concussion law. One survey respondent also suggested that guidelines do not adequately address return to learn. Thus, greater emphasis on returning student athletes to classroom learning in addition to sports participation remains an important sports concussion policy issue.

Concerning was the competition among some providers that hampered communication and collaboration to better reach youth athletes. Although this notion requires further investigation, it is worth noting that it appeared numerous times in about half of the interviews. While participants did not mention specific individuals or groups, they cited examples of

different providers, clinics, or hospitals championing their approach to managing sports concussion for youth athletes rather than collaborating or sharing resources. Participants suggested the likely reason was competition for patients and, ultimately, money and sustained business. Four participants also commented on new diagnostic technologies that seem interesting but may offer minimal practical use or impact given the more fundamental issues of RTP implementation rather than objective concussion diagnosis. The more fundamental issue could be a lack of centralized leadership on youth sports concussions once the Georgia Return to Play Act went into effect, as suggested by three interviewees. One interview participant suggested that the lack of financial resources for such leadership and formal leadership positions might play an important role. Resources to foster collaborative leadership could be an important solution to addressing competition among sports concussion providers in Georgia.

Finally, concussion guidelines, and perhaps also concussion knowledge, do not appear to be well disseminated among parents in Georgia. Parents of youth athletes require more education related to concussions, but the guidelines and other tools may need improvements to make them diffuse more quickly or be more accessible. Still, prior research suggests that concussion knowledge is less relevant than attitudes, beliefs, and norms (Kroshus et al., 2015e); however, this research focused on athletes. The present findings suggest that parental knowledge and beliefs about concussions may influence how they pressure their kids who play sports or how they make decisions regarding concussion care for their kids. Overall, the Georgia concussion law is new, and so it may be too early to know how implementation is going, but the present findings suggest the eventual need for a systematic evaluation of the law.

Future Directions

Future studies should continue to apply mixed-methods approaches to understanding

sports concussion RTP, especially for evaluating the use of guidelines, creation of policies, and implementation and impact of youth sports concussion laws. In particular, surveys with large, representative samples, as a part of well-designed mixed-methods designs, would prove valuable. There is also a need for more studies in various settings such as: rural, lower socio-economic status, and inner cities. Including other potential decision-makers such as athletes, legislators and policymakers, and coaches, to understand their perspective on their own and others' roles in concussion RTP is another key future research area. Focus groups that include multiple stakeholders would provide insight into communication dynamics and also prove a novel approach. In Georgia especially, a systematic study of the concussion law's implementation would elucidate adherence to it and its impact.

Conclusion

Sports concussions and their prevention remain important public health priorities. The long-term damage to mental, behavioral, and physical health from head injuries, combined with increased sports participation, competitiveness, and intensity, make understanding and addressing sports concussions an urgent need. This mixed methods study informed by DOI and using grounded theory suggested that variability in the resources available in schools and communities influences their ability to and how they create and implement concussion RTP. Solutions to gaps in resources and knowledge are available but require communication and collaboration to address this great health communications challenge, as noted by several informants. Applying the overall approach of this study while addressing gaps that remain and its limitations are important directions for future sports concussion and RTP research. I leave with the words of one public high school athletic trainer who emphasized that the health, safety and lives of youth must come first in sports:

“The excuse that you will hear from the schools is they don't have funding for it… my argument to that is…well how much is an athlete's life worth. Because there are things that are gonna happen on the field that coaches may not recognize that an athletic trainer will, and an athletic trainer can save that life…An athlete in Forsyth county… had a bleed on his brain, and an athletic trainer realized there was an issue…. That athlete is alive today because of that... There's cases like that all over the places…if schools wanna make it happen, they can.”

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Appendix 1: In-depth Interview Field Guide

Introduction:
-Researcher introduces self and explains research, interview format, and how data will be used to look at themes from the interviews.

Informed Consent
-Researcher asks for: informed consent, permission to record, and if participant is ready to start. Specifically, for informed consent, researcher gives the paper informed consent form to participant, lets him or her review it, answers any questions, and has the participant complete the form to indicate willingness to participate.

-Confidentiality reminder; thank informant; researcher mentions that he will ask participant about others they may know to refer for participation; tell informant to be thinking about this.

Opening:
-Background: Hardest question of interview, how old are you? Tell me about your education. What is your current occupation or position? What is your gender? What is your race or ethnicity?

-Grand Tour Questions:
-Tell me about your career trajectory?

Probes:
-Tell me about your current position and responsibilities?
-How did you get to your current position?

-What was your first exposure to concussions?

Probes:
-What was your occupation at the time?
-Where did concussions come in at the time?
-How did you deal with them at the time?
-How do you think that first exposure or earlier experience influenced you?
-Since that first exposure, tell me about your other work and experience with concussions?

-Main research questions:
-Tell me about the return to play (RTP) policy that you use?

Probes:
-What does it require/what is the protocol?
-How was it developed?
-How did it come about?
-Why was there a need for this?
-How did your school go about developing it?
-What was being done before?
-Was there one specific, standard resource or guideline used?

-Can you tell me about the role you had in the RTP policy development process?

Probes:
-What's the role of someone in your profession in the process?
-Did your role ever change at all?

-Who else was involved in the process?

Probes:
-How did they get involved?
-Why do you think they were chosen or got involved?
-What influence did others have in developing the policy?
-Was there a leader?
-Do you think anyone else should have been involved?
-Why do you think they were not included?

Decision Making Unit Specific Questions
Communication Behavior
-How much communication was/is there between the coaches, trainers, school administrators, athletic directors, physicians involved in creating and deciding on the RTP policy?

Probes:
-What other people might be involved?
-Are there any barriers to communication about RTP policies with those involved in developing the policy?
-How could communication be improved?
-Was there agreement on what the policy would look like?
-How were differing opinions discussed? How was consensus made?
-Who has the final say or control over decision making for concussion policies at your institution?
-What do you think about people's satisfaction with the process and final policy?
-Who ensures the policies are implemented?
-How well implemented do you feel they are?

-Can you describe your connections to administrators, athletic directors, other coaches, athletic trainers, or physicians involved in concussion RTP policies?

Personality:
-How much control do you feel you have over the creation and implementation of concussion policies?

-How open are you to potential changes to the policy that you helped create?

-Can you talk about your experience learning about return to play protocols?

Probes:
- How do you learn about or research return to play protocols?
-What resources did you get for the RTP policy you were involved in?
-Where did you seek out information on concussion policies, guidelines,

treatment, and other resources?

-How do you keep track of the scientific and medical research on concussions?

-How does your school or do you decide which concussion guidelines or resources to use?

Probes:

-How have these decisions been made in the past?

-What are your thoughts on the scientific and medical research on concussions?

-Probes:

- What concussion guidelines are you aware of? How did you find out about them? Were they easily accessible?

-Did you feel like you could understand them? Could they be improved?

-What do you think about the consensus guidelines: Prague/Zurich (Annual International Convention on Concussion in Sport), American College of Sports Medicine, or American Academy of Neurology Guidelines? How useful or not are they?

-How did you and others use them?

Socioeconomic:

-What resources do you require to implement concussion policies like RTP?

Probes: Why do you require these?

-What do you wish was available?

-Why?

-What resources are actually available to help implement concussion policies?

Probes: How accessible/available are these resources? How costly?

-How does this influence your decision to incorporate them (use specific examples such as the medical guidelines, impact testing, educational materials, Guardian Caps to probe)?

-How easy or difficult is it to gain more funding or to increase your budget for concussion or sports health needs?

-How easy or difficult is it to access or receive other financial resources?

Closing

-What advice would you give to other (insert participant's profession, or other professionals) when dealing with concussions in student athletes?

-Is there anything else I should have asked you that I didn't?

-Is there anything else you would care to add?

-Researcher thanks informant for their time and asks them if they would like to refer anyone else for participation.

Appendix 2: IDI Codebook

Code	Description
Background	Informant's work and educational background and demographics -Subcodes: • **Work History**: prior careers and work • **Occupation**: job title and description • **Age** • **Education**: level of education
Knowledge	How stakeholders get information and education and extent of their information and education about sports concussions and return to play -Subcodes: • **Lack**: descriptions of information or education lacking in certain groups or settings • **Coach**: a coach's level of information and education • **Parent**: a parent's level of information and education • **Athlete**: an athlete's level of information and education • **Physicians**: a physician's level of information and education on concussion • **Sources**: where people get their information or education • **Guidelines**: extent of knowledge about official guidelines or consensus statements about sports concussions and return to play • **Concussion Unknown**: references to concussions still being not well understood • **Changing**: references to knowledge about concussions constantly and quickly changing
Resources	References to resources involved in sports concussion detection, management, policy, and protocol -Subcodes: • **Lack**: mentions of having inadequate resources • **Parents**: references to parents' role as a resource • **Personnel**: mentions of individuals or providers needed as a resource • **Time**: references to time as a resource • **Diagnostic Tools**: measures, assessment tools, and equipment used to measure concussion symptoms and diagnose concussions • **Money**: money, budgets, or finances as resources
Communication	Descriptions of communication between stakeholders involved in decisions about concussions and the act of student-athletes returning to play after concussions. -Subcodes: • **Concussion**: communication between stakeholders about

	concussion management and following return to play protocol or policy • **Barriers**: refers to any mentions of barriers to communication between stakeholders • **Business of Concussion**: descriptions of competition for patients, money, and over diagnostic tools, preventing concussion stakeholders or providers form working together • **Creation**: communication about creating concussion policies or protocols • **Lack of Referrals**: descriptions of stakeholders or providers not referring concussed athletes to proper, specialist providers
Policy/Protocol Development	Descriptions of the process of creating concussion policies or protocols -Subcodes: • **Leader**: references to who the leader of process was • **Consensus**: descriptions of how decision makers discussed differing opinions and attempted to reach agreement • **Resources**: references to information, resources, or guidelines used to inform the policy or protocol • **Guidelines-Policy**: descriptions of the role and influence of official guidelines and consensus statements as a basis for the protocol or policy
Hierarchy	Descriptions of the power dynamics involved in sports concussions, return to play, protocols, and policies -Subcodes: • **Top-Down**: references to decisions made at the top often infuse or filter down the hierarchy • **Authority**: descriptions of who has power and how they exert power and influence • **Contesting:** Instances of power/influence being contested
Variability	Variation in dealing with sports concussions, return to play, policies, and protocols. -Subcodes: • **Community**: descriptions of each community being different or unique • **School**: descriptions of each school being different • **Medical Opinion**: sports concussion and return to play management having a basis on opinion and opinions varying between providers • **Athlete**: treating each athlete differently and treating the individual athlete • **Concussion**: descriptions of each concussion being different • **Sports**: references to each sport having idiosyncrasies related to

	managing concussions
Concussion Narrative	Personal stories related to experiencing and witnessing concussions
Public Health	References to sports concussions as a public health issue -Subcodes: • **Health Analogy**: comparing concussions to other health issues • **PR Communications**: describing concussion issue as a health communications or PR challenge

Protocol	Descriptions of the steps or components of concussion management, return to play, or return to learn protocols
	-Subcodes:
	• **Guidelines-Protocol**: references to what guidelines informed protocols
	  • **Zurich/Prague/CISG**
	  • **NATA/GATA**
	  • **American College of Sports Medicine**
	  • **American Academy of Neurology**
	• **Guidelines' Influence:** descriptions of how guidelines influenced a protocol
	• **Guidelines' Utility:** descriptions of the usefulness and helpfulness of published guidelines

Compliance	References to various stakeholders' or organizations' compliance with concussion and return to play policies and protocols -Subcodes: • **Lack**: descriptions of compliance as inadequate or missing • **Language**: how vague or strict policy or protocol language is
Implementation	References to how concussion and return to play policies and protocols are put into practice/use -Subcodes: • **Personnel**: stakeholders involved in implementation • **Context**: references to how context influences implementation • **Georgia Policy**: descriptions of how well implemented the Georgia concussion law is • **Monitoring**: references to how implementation is ensured and who provides oversight
RTP Involvement	Descriptions of involvement in the sports concussion return to play process -Subcodes • **Decision-maker**: references to a stakeholder as someone who decides on the policy or protocol used • **Implementer**: references to a stakeholder as responsible for

	putting a policy or protocol in to practice • **Parents**: descriptions of parents' involvement in sports concussions and return to play • **Athletes**: descriptions of student athletes' involvement in sports concussions and return to play • **Accountability**: references to perceived responsibilities of stakeholders

Appendix 3: Concussion RTP Practices, Tools, & Resources Questionnaire

1. What is your current primary position and job title? *
(For Example: Athletic Trainer, Principal, Doctor, Coach, Athletic Director, Pediatrician)

2. What is your current primary employment/position setting? *
(Choose the answer that best describes the setting in which you primarily work; If other, please indicate)
Mark only one oval.

Sports Medicine Clinic
General Hospital Setting
High School Athletics
Academic Department
Corporate Health (e.g. doc-in-a-box)
Private Practice
Other:

3. What methods do you usually use to make decisions about return to play after concussion? * (Select All That Apply; If Other, Please Specify)
Check all that apply.

Clinical Examination
CT/MRI Scan
Physician Recommendations
Athletic Trainer Recommendations
Neuropsychological Testing
Concussion Grading Scales
Return To Play (RTP) Guidelines
Symptom Checklist
Player Self Report
Standardized Assessment of Concussion (SAC)
Other:

4. From the methods you selected above, please rank them in order of most use and least use (1 being the most used, the last number being the least used)

5. Please list the concussion return to play (RTP) guidelines you have heard of *

6. Do you use specific concussion RTP guidelines to develop concussion RTP policies or to make decisions about concussion RTP? *

Yes
No

A) If yes, what are some of the key points of the guidelines you use?

B. If yes, do you know the name or names of the guidelines you use?
(Check All that Apply)

CISG (Concussion in Sport Group; also known as Vienna, Prague, or Zurich)
American Academy of Neurology (AAN)
American College of Sports Medicine
American Medical Society for Sports Medicine
Other:

C. If Yes, how did you choose these guidelines?

7. How useful are official concussion RTP guidelines for informing your decisions about developing and/or implementing concussion RTP policies? *
(Choose One; 1 indicates the least useful, 7 the most useful)
Mark only one oval.

1. Not At All Useful
2. Mostly Not Useful
3. Somewhat Not Useful
4. Neither Useful or Not Useful
5. Somewhat Useful
6. Mostly Useful
7. Always Useful

8. Why do you think official concussion RTP guidelines are useful or not?

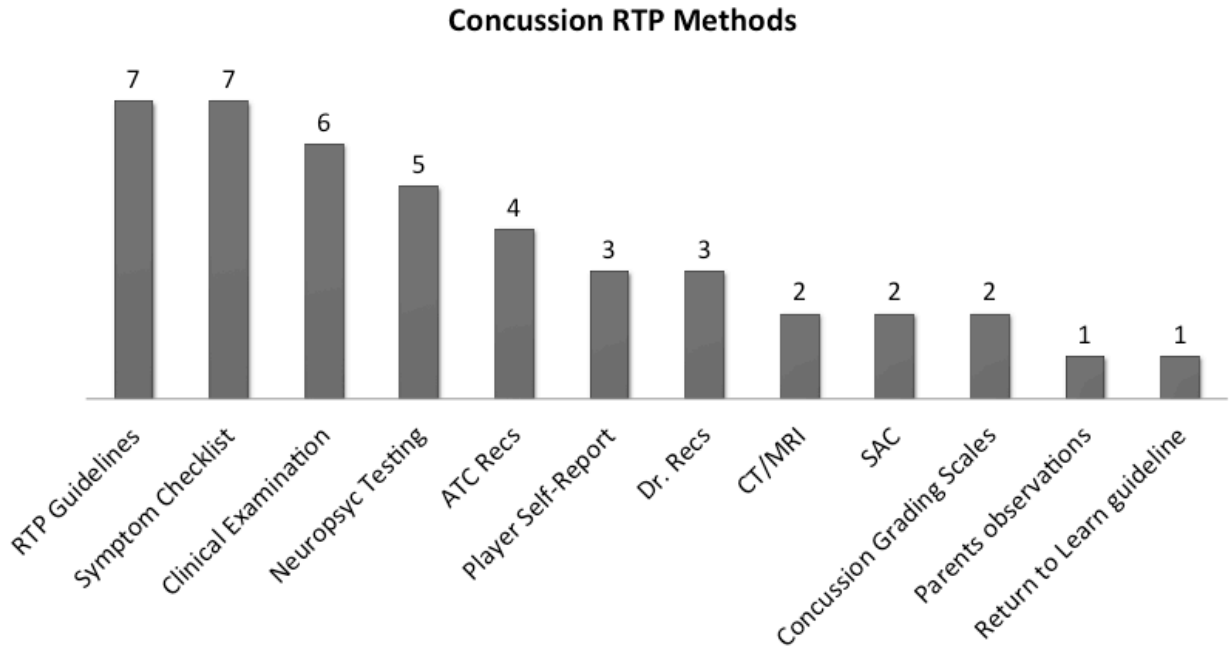
9. Do you find any of the official concussion RTP guidelines to be contradictory? *
(Please explain)

10. Is there anything about the guidelines that makes them difficult to use?
(Please explain)

11. How might such guidelines be improved?

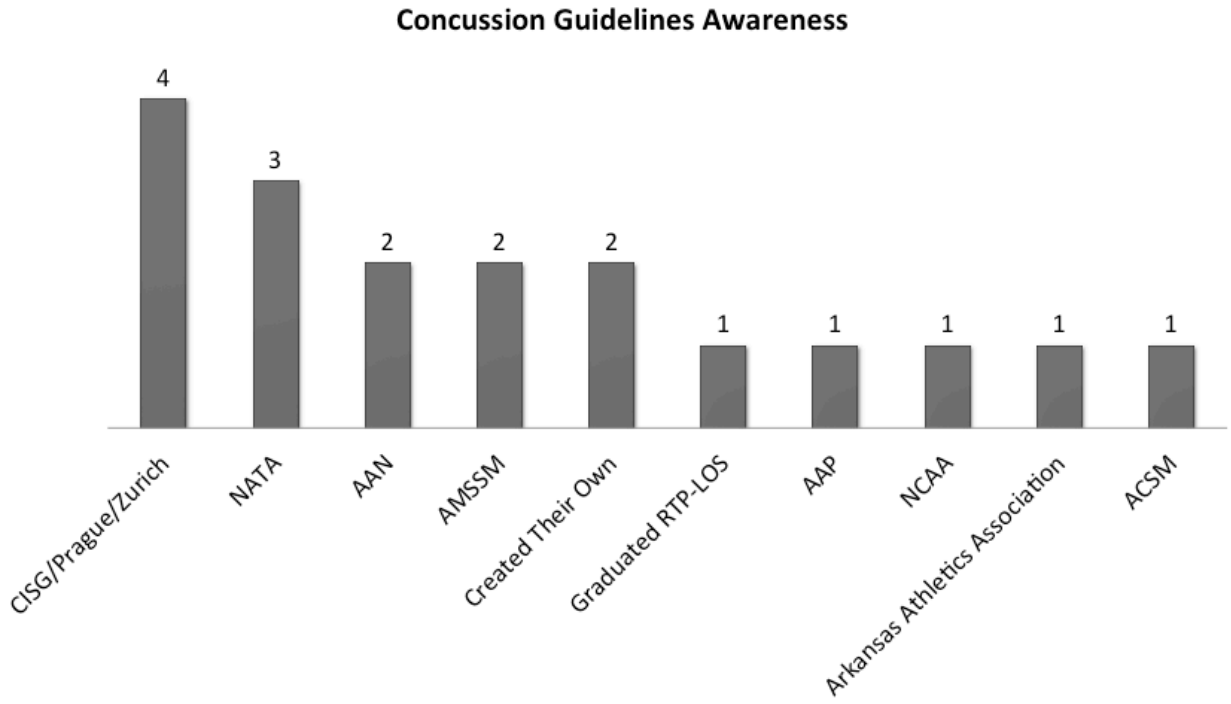
Appendix 4 Tables & Figures

Table 1



Note: Recs = Recommendations; SAC = Standardized Assessment of Concussion

Table 2

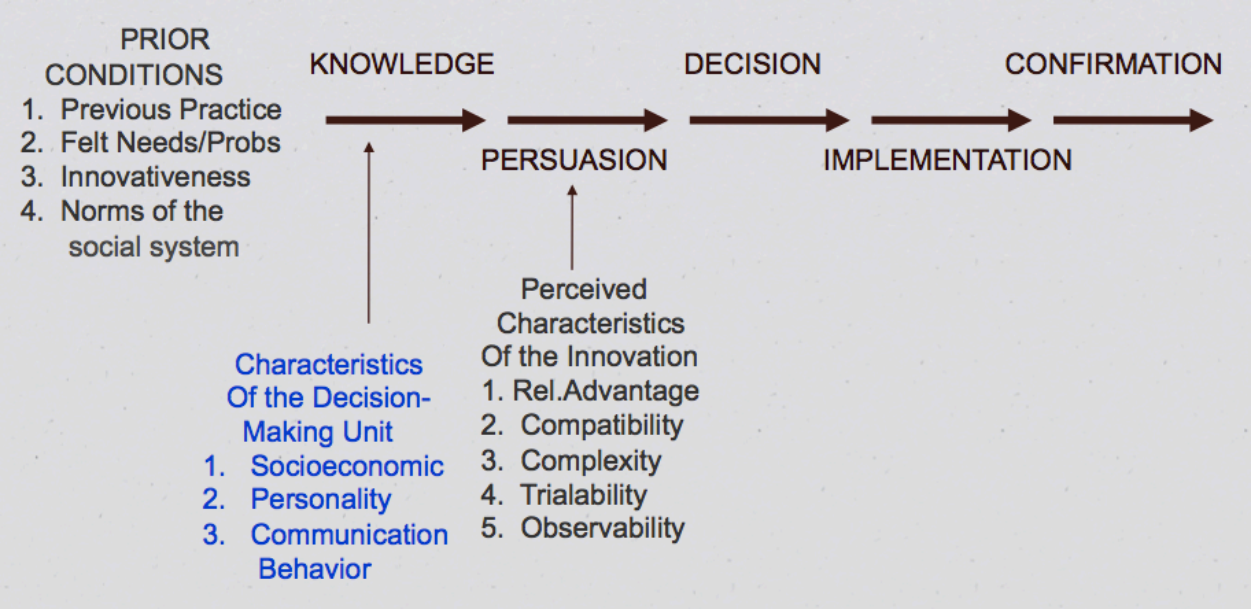


Note: AAP = American Academy of Pediatrics

Table 3 Thematic Categories and Concepts

Concept	Differing levels of resources and knowledge modify the tools, process, and components of RTP	Communicating with others and communicating to increase knowledge are used in all aspects of concussion RTP	RTP on the ground involves how protocols and policies are created, their components, how they're carried out, how carry out is ensured, and who is part of these pieces.
Category	Modifiers	Tools	RTP in Action
Common Attribute	Affect conduct of RTP processes	Used in all RTP processes	Pieces of conducting concussion RTP for youth athletes
Group of Codes	Variability School Community Resources Lack Personnel Knowledge Changing Lack Parent Physicians	Communication Barriers Knowledge	Protocol Implementation Georgia Policy RTP Involvement Accountability Parents Hierarchy Compliance Development

Figure 1 DOI: Innovation-Decision Process



Note: Adapted from Rogers (2003).

Figure 2 Concept Map