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The Role of Athletic Scholarship on Suboptimal Performance in Baseline Concussion Testing

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We the undersigned committee, having examined the submitted doctoral research project, “The Role of Athletic Scholarship on Suboptimal Performance in Baseline Concussion Testing” by Lauren E. Goworowski, M.S. hereby indicate its unanimous approval.

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Abstract

Title: The Role of Athletic Scholarship on Suboptimal Performance in Baseline Concussion Testing

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Objective: To date, there is a very limited amount of research regarding the topic of sandbagging (*i.e.,* intentional poor performance) during concussion baseline testing in a collegiate athlete population. It is known that student-athletes may underreport their concussive symptoms so they can return to play more quickly, and may purposefully lower their baseline results to appear less impaired following a head injury so as to avoid exclusion from play (Echemendia & Cantu, 2003; Reilly 2011). At this point in time, it is difficult to make statements regarding sandbagging because the incidence of this behavior is unknown. Accordingly, this study had a two-fold purpose; (a) to describe the incidence of self-reported sandbagging behaviors on baseline neurocognitive testing at this institution and (b) to identify factors predicting suboptimal effort on baseline neurocognitive assessments. Furthermore, scholarship status in relation to effort given on baseline testing was explored, representing a novel finding.

Method: Seventy-four graduated student-athletes from the Florida Institute of Technology (FIT) completed an online survey that asked them to look back on their baseline testing attitude and performance during their time at FIT. Participants answered demographic questions, reported their athletic scholarship aid status during their years at FIT, and rated the level of effort they gave at baseline testing. In addition, participants were asked to report if they sandbagged at baseline testing. If they admitted to sandbagging, they were asked what their reasons were for committing this behavior via provided answer choices or a text entry box. Lastly, participants reported if they ever heard a teammate say he or she sandbagged. The current study allowed for the identification of athletes who admitted to performing with less than maximal effort at baseline testing, including those who intentionally wanted a low score. This study could then determine how poor effort, and sandbagging appeared across several measures, correcting for a major limitation of previous research. Both performance-based measures (Sport Concussion Assessment Tool, 2nd, 3rd, 5th Edition (SCAT-2, SCAT-3, SCAT-5); Immediate Post Concussion Assessment Tool (ImPACT); Patient Health Questionnaire, 9 item (PHQ-9)) and effort-based measures (Rey Word Recognition Test (WRT); Rey Dot Counting Test (DCT); ImPACT Invalidity Index) were included. Qualitative observation was utilized rather than a statistical comparison with a significant outcome due to a small number of sandbaggers in the sample.

Results: 20% of this sample admitted via self-report to not giving their best effort at baseline testing, and reasons for committing this behavior varied. Seven percent of the sample admitted to sandbagging, with the most frequent reason being fear of losing playing time. Additionally, 31% of the sample admitted that they heard a teammate say that he or she sandbagged at baseline testing. The most common reasons participants heard their teammates give for sandbagging were fear of losing playing time, followed by fear of someone taking his or her position and fear of losing athletics scholarship aid. Supporting the importance of such financial assistance, 70% of the sample reported they could not have attended FIT without their athletics scholarship aid.

Conclusions: This survey allowed the FIT Concussion Management Program (CMP) to learn more information about their athletes and check in on how seriously athletes viewed concussion testing. A very small number of athletes admitted to sandbagging behavior, and even then, they did not engage in this behavior during every year of participation, which is welcome news for the CMP. This study posed questions, and collected information that is not well known or discussed, and therefore significantly added to the incomplete literature that currently exists on sandbagging, how it might be measured most accurately, and the conditions that motivate participants to the behavior. The primary limitation was the small number of participants who admitted to giving sub-optimal effort on their baseline tests. Future research using this methodology should grow the sample size until a sufficient number of sandbaggers have identified themselves to allow inferential statistical comparisons. Additionally, the existent record keeping of contact information was not optimal, and in future studies that attempt to solicit responses

from former athletes, it will be necessary to take extraordinary measures to find up-to-date contact information.

Keywords: Concussion, Effort, Motivation, Scholarship

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The Role of Athletic Scholarship on Suboptimal Performance in Baseline Concussion Testing

Introduction

All Florida Tech student-athletes are required to participate in a Concussion Management Program (CMP) as part of the overall medical assurance that they are fit and safe to participate in intercollegiate athletics. It is imperative to obtain valid test scores that are representative of the athletes' true cognitive abilities during the preseason (baseline testing), because these scores are then compared to post-trauma test results to determine if a concussion diagnosis is warranted. Since the management of sport concussions and return-to-play following concussion is guided empirically by ongoing research, it is to the benefit of student-athletes that research is conducted to identify potential motivating factors determining why athletes might perform poorly on baseline testing. If athletes do not provide adequate effort during the pre-injury baseline testing, their obtained scores may be much lower than what would be considered normal for them. In such a scenario, even though post-trauma performance might be much lower than true ability, they might not be much different than the invalid baseline. Thus, clinicians would make diagnostic errors, under-diagnosing concussions. Such a misdiagnosis could have serious health consequences.

This study allowed for a better understanding of how many athletes performed with suspect effort, and also identified athletes who intentionally performed poorly. The act of intentionally performing poorly at baseline is referred to as "sandbagging," and the literature currently lacks identified motivating factors that contribute to an athlete's poor performance. Furthermore, only one study wherein athletes self-reported sandbagging was identified in the literature (Schatz, Elbin, Anderson, Savage & Covassin, 2017). Moreover, this study had several limitations: e.g. exclusion of football players, inability to match up survey responses with assessment results. The current study is novel in that it incorporates athletics scholarship aid, and aims to determine if scholarship might serve as a motivating factor for poor baseline performance. It would be reasonable to surmise that players with "more to lose" might have more of an inclination to sandbag. Student-athletes who are heavily reliant on their athletics scholarship aid money to finance their college education might be more likely to sandbag. Moreover, students who need athletics scholarship aid to maintain enrollment at the university may fear that their education could be in jeopardy if they miss playing time.

The Florida Tech CMP begins in the preseason when all student-athletes undergo testing to determine their normal (baseline) performance on tests of simple and complex reaction time, speed of mental processing, attention and concentration, learning and memory, coordination, and balance. A survey was distributed as a self-report measure to determine how well athletes perceived their performance on baseline testing, and also identify athletes who intentionally performed poorly. Scholarship status was reported by the athlete in the survey. This study only included athletes who had graduated and who no longer report to the athletics department.

Participants' scores on measures included in the CMP battery were obtained and analyzed. The effort-based measures in this study included the Rey Word Recognition Test (WRT) and Rey Dot Counting Test (DCT), and the Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) invalidity index. Additionally, the researchers looked at other neurocognitive measures administered during baseline concussion testing (*i.e.,* Sport Concussion Assessment Tool, 2nd Edition, 3rd Edition, 5th Edition (SCAT2, SCAT3, SCAT5); Patient Health Questionnaire, 9-item (PHQ-9)).

In summary, accurate diagnosis of a concussion, and correct determination that a student has recovered sufficiently to return to normal team activities following a concussion are critical for preserving the health and safety of student-athletes. Any empirical advances in diagnosis and return-to-play considerations that can be offered to student-athletes contribute greatly to their current and long-term health. The current literature lacks identification of motivating factors to perform poorly on baseline, as well as self-reported indication that sandbagging behavior exists. Financial scholarship as a motivating factor for sandbagging has never been reported.

Review of Literature

Sport-Related Concussion; what is it?

America currently faces an epidemic of sport-related concussions (SRC) that likely affects between 1.6 to 3.8 million athletes each year (Langlois, Rutland-Brown, & Wald, 2006). Most recently, SRC has been defined as "a traumatic brain injury induced by biomechanical forces"(McCrory et al., 2017; pg. 2). Concussions can be caused by a bump, blow or jolt to the head, but can also result from a fall that causes the brain to move back and forth within the skull; hence, there is an acceleration and deceleration of brain tissues of different densities. Historically, SRC has been considered a metabolic injury, rather than causing major structural damage, as the functional disturbance cannot be seen using standard neuroimaging (Henry et al., 2011). Individuals who experience SRC exhibit a range of clinical signs and symptoms, which may or may not involve loss of consciousness (LOC). The hallmarks of concussion are confusion and amnesia, with headache being the most commonly reported symptom (Guskiewicz et al., 2003). However, there are other signs and symptoms of concussion, which can be classified as physical, behavioral, cognitive and emotional symptoms. For example, physical symptoms may include headache, dizziness, blurred vision, sensitivity to light and/or noise, nausea/vomiting, or balance difficulty. Behaviorally, symptoms can include lethargy, sleep difficulty, or poor appetite. Cognitively, an individual may have difficulty thinking clearly, or experience memory problems. Emotional symptoms include irritability, sadness, or anxiety. Individuals experience symptoms differently depending on the concussion event itself (severity, physical location of impact), pre-existing medical or psychological conditions, history of concussion, and other individual factors. In some cases, symptoms may be prolonged. Furthermore, since SRC is oftentimes an evolving injury, signs and symptoms may not present until after a delay. Concussion resolution time varies based on the individual, but on average, college-aged student-athletes show cognitive recovery in five to seven days, and symptom recovery in six days (Williams, Puetz, Giza & Broglio, 2015).

Incidence by Sport

The epidemiology of SRC among student-athletes at the collegiate level was most recently reported by Zuckerman, Kerr, Yengo-Kahn, Wasserman, Covassin & Solomon (2015), spanning five years (2009-2014). An understanding of concussion rates based on sport will facilitate a better understanding of the results later on in this study, especially for football players. Data for this study were obtained from the National Collegiate Athletic Association (NCAA) Injury Surveillance Program (ISP), a prospective surveillance program managed by the Datalys Center for Sports Injury Research and Prevention (an independent nonprofit research organization). The ISP utilized a convenience sample of NCAA varsity teams from 25 sports with certified athletic trainers reporting injury data. The number of programs that provided data to the ISP varied by sport and year.

The largest concussion rates were found in men's wrestling, men's ice hockey, women's ice hockey, and men's football. While men's football and women's soccer had the largest annual estimate of reported SRCs, men's football also had the highest annual participation count. A linear trend did not exist nationally across time, however certain sports displayed increases in concussion prevalence, including men's football, women's ice hockey, and men's lacrosse. Research on sex differences indicates women have a higher concussion rate than men in baseball/softball, basketball, and soccer (Zuckerman et al., 2015; Marar, McIlvain, Fields & Comstock, 2012; Lincoln et al., 2011). Reasons for the higher likelihood of concussion in women has been explored in respect to soccer, and it was found that men have larger and more muscular necks which likely gives them an advantage over women when heading the ball (*i.e.,* purposeful use of the head to impact the ball), and women also tend to verbalize symptoms of concussions more frequently than men do (Davis-Hayes et al., 2017). Furthermore, female collegiate athletes take longer to recover from SRC than their male counterparts (Covassin, Moran & Elbin, 2016).

Gessel, Fields, Collins, Dick & Comstock (2007) reported that competition-related concussion rates are highest among full-contact sports (e.g. football and wrestling), and partial-contact sports in which player-to-player contact occurs (e.g. soccer and basketball). These data were collected from two injury surveillance systems: High School Reporting Information Online (RIO) and the NCAA Injury

Surveillance System (NCAA ISS). Table 1 displays concussion incidence per 10,000 athlete-exposures in the 19 sports that athletes' who participated in this study played, spanning five years (2009-2014). This table was adapted from Zuckerman et al. (2015), and "athlete-exposures" refers to the number of times an athlete participated in practice or competition. Sports that were not listed in the ISS program are denoted as such in the table. In the next section, the mechanisms for concussion will be described for high contact collision sports including football, men's basketball, women's basketball, men's soccer, women's soccer, men's lacrosse, women's lacrosse, softball, women's volleyball and cheerleading. Mechanisms of concussion in sports such as rowing, tennis, cross country, track and field, swimming, and golf will not be described due to the low contact, low collision nature of these sports.

Table 1

Rate of Concussion per 10,000 Athlete-Exposures (95% CI) in NCAA sports 2009-2010 to 2013-2014

Sport	**Competition**	**Practice**	**Overall**
Football	30.07 (26.43-33.71)	4.20 (3.76-4.64)	6.71 (6.17-7.24)
Women's Soccer	19.38 (15.60-23.16)	2.14 (1.43-2.85)	6.31 (5.25-7.37)
Women's Basketball	10.92 (7.89-13.95)	4.43 (3.36-5.50)	5.95 (4.87-7.04)
Women's Lacrosse	13.08 (8.15-18.02)	3.30 (2.08-4.52)	5.21 (3.84-6.59)

Men's Basketball	5.60 (3.45-7.75)	3.42 (2.54-4.31)	3.89 (3.06-4.72)
Women's Volleyball	5.75 (3.54-7.96)	2.69 (1.73-3.65)	3.57 (2.64-4.51)
Men's Soccer	9.69 (6.39-13.00)	1.75 (1.02-2.48)	3.44 (2.53-4.35)
Softball	5.61 (3.77-7.44)	1.75 (0.92-2.58)	3.28 (2.40-4.17)
Men's Lacrosse	9.31 (5.66-12.96)	1.95 (1.20-2.69)	3.18 (2.31-4.05)
Women's Tennis	2.55 (0.00-6.09)	0.84 (0.00-2.00)	1.26 (0.03-2.50)
Women's Outdoor Track and Field	0.00	0.51 (0.00-1.09)	0.42 (0.00-0.90)
Men's Tennis	1.82 (0.00-5.39)	0.00	0.39 (0.00-1.15)
Women's Swim & Dive	0.89 (0.00-2.64)	0.27 (0.00-0.58)	0.33 (0.01-0.65)
Women's Cross Country	0.00	0.25 (0.00-0.73)	0.22 (0.00-0.67)
Men's Outdoor Track and Field	0.00	0.13 (0.00-0.40)	0.12 (0.00-0.34)
Men's Cross Country	0.00	0.00	0.00

[1] no data available for Men's and Women's Rowing, Women's Golf, and Cheerleading

Football. In collegiate American football, the overall incidence rate of concussion is 6.71 per 10,000 athlete-exposures (Zuckerman et al., 2015). Data from the NCAA for the 2004/05- 2008/09 seasons indicate concussions accounted for 7.4% of all collegiate football injuries, while lower limb injuries accounted for 50.4% of injuries (NCAA Datalys Center). The intensity of play at the collegiate level may lend itself to a higher rate of concussion, but it also increases the risk of other injuries, which decreases the proportion of those injuries that are classified as concussions (Gessel et al., 2007). The risk of concussion is much higher in football games than in practice across all levels of competition. However, due to a higher frequency of practices than games during football season, the total number of concussions sustained in practice is greater than the number sustained in games. More specifically, the preseason has the highest injury rate compared to in-season and post-season (NCAA Datalys Center). The risk of sustaining a concussion varies based on position played, with offensive and defensive linemen receiving the greatest number of impacts, but skill positions receiving the highest magnitude impacts (Broglio, Sosnoff, Shin, Alcaraz & Zimmerman, 2009). Playing position has been identified as a key risk factor for concussion in football, and offensive linemen have reported significantly more post-impact symptoms compared to other positions. Furthermore, these players reported having returned to play while still experiencing symptoms more frequently, and participating in more full-contact practices than other groups of athletes (Baugh et al., 2015). Guskiewicz et al. (2003) suggested football players with a history of previous concussions are more likely to have future concussive injuries than those with no concussion history, and one in 15 players with a concussion may have additional concussions in the same playing season. This conclusion has been reported in many other subsequent reports (Kontos, Elbin & Collins, 2006; Abrahams, Mc Fie, Patricios, Posthumus & September, 2014). Moreover, previous concussions may be associated with greater symptom reporting post-injury and slower recovery of neurological function (Brooks et al., 2016; Iverson et al., 2017).

Men's Lacrosse. While football typically receives the most attention for SRC, there is increasing awareness that SRC is a problem in other high impact sports, including lacrosse. Concussions in men's lacrosse are more likely to occur during games than in practices, with an overall incidence rate of 3.18 per 10,000 athlete-exposures (Zuckerman et al., 2015). The majority of player concussions were associated with player contact and ball contact. Dick, Romani, Agel, Case & Marshall (2007) explained that the higher risk for concussion during games was due to more contact within the 25-yd line, where players have less room to move and the game is slower and more confined. Furthermore, a recent study by Reynolds et al. (2016) reported that lacrosse is one of the most rapidly growing contact sports in the United States, and that while most head impacts in lacrosse do not result in a clinical diagnosis of concussion, evidence indicates that subconcussive head impacts may increase an athlete's susceptibility to concussion and contribute to long-term neurodegeneration.

Women's Lacrosse. In women's lacrosse, concussions are more likely to occur during games than in practices, with an overall incidence rate of 5.21 per 10,000 athlete-exposures (Zuckerman et al., 2015). The mechanism of injury is very different between the men's game (which permits contact) versus the women's game (which prohibits contact). For women, contact with an object (*e.g.,* the stick) is the sole mechanism of concussion (Marshall, Guskiewicz, Shankar, McCrea & Cantu, 2015). Although female collegiate lacrosse players are not required to wear a helmet because the sport is classified as noncontact, unintentional collision with opponents' heads or sticks happens very frequently and may contribute to the high incidence of concussions. Furthermore, while women's soccer players have the highest rate of concussion in women's sports, it has been reported that women's lacrosse has the highest inherent risk of sustaining a concussion during a game. Curiously, coaches have commented that if safety equipment is worn by female lacrosse players, the athletes may become more aggressive, causing the game to be more dangerous (Covassin et al., 2003).

Men's Soccer. Similar to lacrosse, soccer is a very popular and rapidly growing sport in the United States. Concussions in men's soccer are more likely to occur during games than in practices, with an overall incidence rate of 3.44 per 10,000 athlete-exposures (Zuckerman et al., 2015). "Heading," or purposeful use of the head to impact the ball, is unique to this sport. The nature of the sport makes soccer players particularly vulnerable to various types of head and neck injuries, including lacerations, abrasions, contusions, fractures and concussions. These injuries typically occur as a result of player-to-player contact, but can also occur due to heading, which allows the athlete to control the ball during play. Furthermore, players can be vulnerable to sustaining concussions when engaging in heading duels, goaltending, and defending. Similar to football, player position appears to be an important factor in concussion risk assessment, with defensemen and goal-keepers at the greatest risk. Additionally, history of concussion also appears to increase the risk of sustaining subsequent concussions in soccer (Maher, Hutchison, Cusimano, Comper & Schweizer, 2014).

Women's Soccer. Similar to men's soccer, concussions in women's soccer are more likely to occur during games than in practices, with an overall incidence rate of 6.31 per 10,000 athlete-exposures (Zuckerman et al., 2015). Women's soccer players experience significantly more concussions during soccer games than their male counterparts (Covassin et al., 2003). Concussions account for 8.6% of major injuries in women's soccer (Dick, Putukian, Agel, Evans & Marshall, 2007). In women's soccer, the mechanisms for injury are very similar to men's soccer. The most frequent injury mechanism is collision between two players, followed by contact with the ball and contact with the ground (Marshall, Guskiewicz, Shankar, McCrea & Cantu, 2015). Unfair use of the upper extremely is most commonly associated with concussion in women's soccer, followed by heading duels. Dick et al. (2007) emphasized that researchers have failed to identify purposeful heading as a primary cause of concussion in this sport.

Men's Basketball. In men's basketball, concussions are more likely to occur during games than in practices, with an overall incidence rate of 3.89 per 10,000 athlete-exposures (Zuckerman et al., 2015). Dick et al. (2007) reported concussions are typically occurring during "accidental/incidental" contact with another player, but the authors noted that basketball is becoming an increasingly physical contact sport that favors size and strength over finesse. Furthermore, evolving trends indicate more acute injuries are affecting the head and face rather than the hand and wrist. This is interesting considering the hand and wrist are "in play" at all times and are integral to participation in the game, indicating the head should not technically be considered "at risk" during play, in comparison with sports involving collisions.

Women's Basketball. In women's basketball, concussions are more likely to occur during games than in practices, with an overall incidence rate of 5.95 per 10,000 athlete-exposures (Zuckerman et al., 2015). Women's basketball players are more likely to sustain concussions than male basketball players, and player-to-player contact is the most common mechanism of injury (Noble & Hesdorffer, 2013). It has been suggested that the use of elbows becoming more prevalent is possibly leading to more concussions as basketball evolves from a finesse sport to a high-risk contact sport (Covassin et al., 2003).

Women's Softball. In softball, concussions are more likely to occur during games than in practices, with an overall incidence rate of 3.28 per 10,000 athlete-exposures (Zuckerman et al., 2015). In comparison to men's baseball players, women's softball players are twice as likely to sustain concussions. Contact with equipment, such as the ball, is a common mechanism of injury, and helmets help to reduce the risk of concussion (Noble et al., 2013). Historically, softball has been considered a much lower risk sport for concussion than women's soccer, lacrosse and basketball players (Covassin et al., 2003).

Women's Volleyball. In volleyball, concussions are more likely to occur during games than in practices, with an overall incidence rate of 3.57 per 10,000 athlete-exposures (Zuckerman et. al, 2015). Player-to-surface contact is the most common mechanism of injury, but player-to-equipment contact (*e.g.,* ball or goal post/wall) also occurs. Protective barriers covering walls and posts have been suggested in reports to diminish concussion risk (Noble et. al, 2013).

Cheerleading. While Zuckerman et al. (2015) did not report on concussion incidence in cheerleading, other authors have addressed concussion incidence and mechanisms of injury. It has been suggested that cheerleading may be the only competitive sport with concussion incidence equivalent between practice and competition (Schulz, Marshall, Yang, Mueller, Weaver & Bowling, 2004). Cheerleading has one of the higher proportions of concussion per injury, with concussion constituting 20% of all cheerleading injuries (Marar et al., 2012). Concussion risk is highest among collegiate competitive cheerleading teams (compared with younger squads and recreational groups), perhaps relating to the increasing difficulty of attempted stunts at this level, particularly pyramid formations (Noble et al., 2013). Spotting or basing another cheerleader during stunting is the most common mechanism of action for concussion, as this involves catching, lifting or tossing another cheerleader. A spotter is a person in direct contact with the performing surface and who may help control the building of and dismounting from a stunt. A base is a person with at least one foot on the floor who is in direct, weight-bearing contact with the performing surface, providing primary support for another person (Shields, Fernandez, & Smith, 2009).

Sport-Related Concussion Risks and Long-Term Consequences

Sport-Related Concussion is now recognized as a public health concern and there is an awareness of the dangers and potential long-term consequences associated with concussion. Langlois et al. (2006) reported that post-injury, a minority of cases may have long-lasting effects such as changes in cognitive processing speeds and emotional changes. Moreover, as noted previously in the discussion of each sport in this review, a history of previous concussions increases the risk of sustaining additional future concussions (Guskiewicz et al., 2003; McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004; Kontos, et al., 2006; Abrahams et al., 2014; Maher et al., 2014). Guskiewicz et al. (2005) reported that a history of recurrent concussions, and probably sub-concussive contacts to the head, may be risk factors for the expression of late-life memory impairment, mild cognitive impairment (MCI), and Alzheimer's Disease (AD).

Additionally, there is a growing body of evidence for a condition known as Chronic Traumatic Encephalopathy (CTE). McKee et al. (2016) defined CTE as a neurodegeneration characterized by an abnormal accumulation of hyperphosphorylated tau (p-tau) protein within the brain. A consensus panel (2015 NINDS-NIBIB Consensus Conference) of neuropathologists found that the p-tau pathology of CTE is clearly distinct from other tauopathies. "The panel concluded that there is a pathognomonic lesion of CTE that consists of an accumulation of abnormal tau in neurons and astroglia distributed around small blood vessels at the depths of sulci in the cortex in an irregular spatial pattern" (McKee et al., 2016, p.80). Symptoms of CTE may include memory loss, impulse control difficulty, erratic behavior, impaired judgment, aggression or depression, balance difficulty, and a gradual onset of dementia. Extreme cases of CTE have been reported in the news, including the suicide death of NFL player Junior Seau, and professional wrestler Chris Benoit (who committed suicide after murdering his wife and son). CTE can only be diagnosed upon autopsy, and the incidence and prevalence of CTE is still largely unknown. Therefore, it should be noted that the literature on long-term consequences of recurrent head trauma is inconsistent and incomplete, and there is still much to be learned regarding potential cause-and-effect relationships of repetitive head trauma and concussions. Furthermore, it is critical to remark that recent studies and news reports have biasing concerns in their samples. The brains being studied are from athletes who displayed clinical symptoms, and engaged in publicly "odd" behaviors. In other words, a serious limitation is that there is no comparison group of individuals with recurrent head trauma who did not present with clinical symptoms. There may also be cases of individuals who do not have a history of head trauma, but have the occurrence of CTE pathology in the brain. To conclude the current status of CTE research, it is important to be mindful that there is potential for long-term problems such as cognitive impairment, depression, etc. following repetitive head trauma (McCrory et al., 2017).

Best Practices for Prevention and Detection of Sport-Related Concussion

Prevention of Concussion. Increased prevention of concussion is a critical component of best practices for concussion management to promote student-athlete health. Zuckerman et al. (2015) reported a trend of increases in concussion incidence in particular sports (e.g. men's football and men's lacrosse), which could represent a more dangerous style of play. It is also possible the increases are due to increased clinical sensitivity to SRC diagnosis. In order to keep athletes safe, protocols have evolved, including rule changes, player education about the rule changes and the effects of multiple concussions, and implementation of equipment standards. Additional safeguards include alternative assessment techniques, a marked reduction of physical contact time in practice sessions, and a heightened awareness among clinicians of the dangers involved with returning an athlete who is still symptomatic to competition (Guskiewicz, Weaver, Padua & Garrett, 2000). Navarro (2011) suggested that a combination of appropriate equipment and non-equipment-based protective methods will create an environment that promotes athlete safety. Furthermore, McCrory et al. (2017) suggested that biomechanical research (e.g. video-analysis) to better understand injury risk behaviors and mechanisms of injury associated with rules will better inform practice and policy.

Protective Equipment. Historically, helmets are the primary and most effective defense against Traumatic Brain Injury. However, recent evidence suggests players who wear helmets do not have better relative clinical health outcomes and protection against concussion (Sone, Kondziolka, Huang, Samadani, 2017). While helmets have gotten bigger and heavier over the years, the incidence of concussion has not decreased. Helmets will not likely be a solution for concussions in the future, but evolution of helmet technology and development may lessen the chance for concussion. Similarly, there is currently no evidence that standard or fitted mouth guards decrease the rate or severity of concussions in athletes, although mouth guards have been shown to be effective in preventing dental and oro-facial injury (Winters, 2001). Daneshvar et al. (2011) indicated that while the majority of evidence appears to indicate that helmets and mouth guards are beneficial in protecting against many catastrophic head, neck, and orofacial injuries, there is not yet significant evidence to advocate their effectiveness in preventing concussion.

Policies. Baugh and Kroshus (2016) examined progress and pitfalls in concussion management in American college football. League-based policies are avenues in which athlete health is protected, and concussion policies in the NCAA were enacted in 2010, requiring all member-schools to have a concussion management plan. Components include annual athlete concussion education and athlete acknowledgement of this information, removal from play for symptomatic athletes, preclusion from return-to-play for concussed athletes for at least one calendar day, and requirement of medical clearance before return to play. Additionally, other sports leagues such as the National Association for Intercollegiate Athletics (NAIA) and National Junior College Athletics Association (NJCAA) have similar rules related to concussion as the NCAA, though their guidance is less robust. Despite these improvements, Baugh and Kroshus (2016) cautioned that while policies regarding concussion management in collegiate football have advanced in recent years, there is still room for improvement. Empirical evaluation of implementation and effectiveness of such policies is needed.

Guidelines. In terms of recommended guidelines, the football practice guidelines by the NCAA were most recently updated in February, 2017. These updated recommendations are supported by the NCAA Committee on Competitive Safeguards and Medical Aspects of Sports and endorsed by the NCAA Division I Football Oversight Committee and 20 other scientific, medical and football organizations. Taking into account that the risk of concussion is greater in tackling practices relative to contact practices without tackling, and greater risk of head to head contact (versus head to ground contact), guidelines are continuously evolving. Several key changes to the recommendations were made, including discontinuation of two-a-day practices during preseason, and permitting only one live contact tackling and thud practice per week in-season (Burnsed, 2017).

Detection of Concussion. Improved detection of concussion in the student-athlete population is necessary, but treatment options are limited. Diagnosis of SRC is challenging, although there have been promising reports of potential blood-based biomarkers, and other objective diagnostic methods to be used in diagnosis (Papa, 2016). Best practices for the identification and management of SRC currently involve neuropsychological assessment (McCrory et al., 2017). In most cases, cognitive and symptom recovery overlap, but sometimes cognitive recovery may precede or lag behind clinical symptom resolution. Cognitive function is an important component of SRC assessment and return-to-play protocol. While the current consensus statement on SRC (McCrory et al., 2017) stated baseline (pre-season) testing is not required as a mandatory aspect of every assessment, it provides helpful information to the overall interpretation of neuropsychological tests performed post-trauma. Baseline testing is the practice of assessing an individual's neurocognitive functioning when all brain functions are working well, and this is completed during preseason medical evaluation at most institutions for all athletes. Baseline assessments in college sport contexts are generally employed in group sessions, since large numbers of athletes must be tested in a rather short period of time (Moser, Schatz, & Lichtenstein, 2014).

A variety of baseline neurocognitive assessments are employed to assess and manage SRC. Typically, baseline testing includes a brief neurocognitive test battery, which measures memory, cognitive processing speed, working memory, and/or executive function (Lovell, Iverson, Collins, McKeag, & Maroon, 1999). Furthermore, computerized neurocognitive testing (CNT) is a commonly utilized, brief, time-efficient evaluation method for large groups of athletes tested during pre-season medical evaluation. However, CNT is not a substitute for a complete neuropsychological assessment (McCrory et al., 2017).

Procedures for Diagnosis and Return-to-Play. In terms of procedure, McCrory et al. (2017) recommended that when a player shows symptoms or signs of an SRC, he or she should immediately be removed from play. The athlete should be evaluated by a licensed healthcare provider, have first aid issues addressed, and a prompt assessment made using the Sport Concussion Assessment Tool- 5th edition (SCAT5) or a sideline assessment tool. Typically, these assessment results are then compared to the athlete's baseline scores. The athlete is diagnosed with a concussion based on symptom presentation and if neurocognitive test scores are deemed to be significantly lower in any domains measured. Overall, physical and cognitive rest are recommended until the athlete becomes symptom free. A brief period of complete rest for 24-48 hours following injury is currently recommended, with a gradual reintroduction of physical and mental activities so long as symptoms are not aggravated. Concussed athletes can be re-evaluated for return-to-play no sooner than seven days following concussion diagnosis. When the athlete presents for follow-up testing, he or she must be asymptomatic. To be cleared for graded exertion testing to begin, cognitive abilities must not be significantly lower than baseline levels.

Effort, Motivation, and Suboptimal Performance

Obtaining a valid baseline score is critical due to pre-injury differences in an individual's processing speed, memory, and attention and concentration. The ability to compare an individual's pre and post-injury performance potentially allows for improved detection of concussion versus post-injury evaluation alone. However, if athletes are not providing adequate effort during baseline testing, their obtained scores may grossly underestimate their true ability. This would likely invalidate the entire test battery, and the implication could be an undetected concussion. Schatz, Elbin, Anderson, Savage & Covassin (2017) emphasized that the deleterious effects of suboptimal performance at baseline testing have been recognized in consensus statements and empirical literature including papers by: Green, Rohling, Lees-Haley, & Allen, 2001; Bush et al., 2005; Broglio, Ferrara, Macciocchi, Baumgartner, & Elliott, 2007; Heilbronner et al., 2009. Despite these concerns, the incidence of suboptimal effort has not been widely reviewed, resulting in an incomplete literature.

Identification of Poor Effort. Historically, effort has been described as the extent to which the participant is actively involved in test taking. The test taps the level of both cognitive and behavioral engagement in a task (Bigler, 2012; Bigler, 2014). If an individual does not put forth optimal effort to perform at the best of his ability, assessment cannot accurately evaluate the individual's true ability to function when brain regions are working normally. Two decades ago, symptom validity tests (SVT) were introduced to neuropsychological test batteries to bring greater objectivity in reporting test validity. These tests may be free-standing, and used to infer validity, or embedded within a standardized battery. The term "malingering" has often been loosely used by many publications in association with SVT failure. The Diagnostic and Statistical Manual of Mental Disorders, 5^{th} edition (DSM-5) defines malingering as "differentiated from factitious disorder by the intentional reporting of symptoms for personal gain (e.g., money, time off work). In contrast, the diagnosis of factitious disorder requires the absence of obvious rewards" (p. 326). Malingering requires intentionality, and performance on SVT measures tap test-taking behaviors that have relevance to issues of secondary gain, deception and illness behavior (Bigler, 2014). Larrabee (2012) recommended that the terms performance validity testing (PVT) and SVT be adopted, rather than use of the terms "effort" or "response bias." Performance validity describes the degree to which an individual's test performance is reflective of true cognitive ability, while symptom validity describes the degree to which a person's symptomatic complaint via self-report is reflective of true symptom experience. Van Dyke, Millis, Axelrod and Hanks (2013) aimed to determine the best factor model describing the relation between cognitive performance, symptom self-report, performance validity and symptom validity. They concluded that the strongest model was a three-factor model in which cognitive performance, performance validity, and self-reported symptoms (including both standard and symptom validity measures) were separate factors. The findings suggest failure in one validity domain does not necessarily invalidate the other domain. Thus, the authors suggest performance validity and symptom validity should be evaluated separately.

Clinical practice and meta-analysis over the past decade support the use of PVTs, accumulating evidence that several PVTs correctly identify poor effort or feigning during neuropsychological assessment (Sollman & Berry, 2011). Hence, PVTs allow insight into valid versus invalid neuropsychological test scores. However, it is important to note at this point that malingering cannot be diagnosed based on PVT scores alone, since these tests only measure effort, rather than providing reasons why effort may be poor. PVTs cannot inform clinicians of someone's motivation. In addition, while passing a PVT may signify valid performance, this may not address the range of test performance, or if optimal effort was given throughout. Moreover, failed performance might be a reflection of underlying neuropathology (i.e., intellectual disability, neurological injury such as traumatic brain injury (TBI)), versus poor effort (Bigler, 2012). Several studies have demonstrated that PVTs successfully predict good versus poor effort in college students (Hunt, Ferrara, Miller & Macciocchi, 2007; Williamson et al., 2014). These tests include the Rey Word Recognition Test (WRT) and Rey Dot Counting Test (DCT), both of which are used in the current study. There are relatively few *very* brief external PVTs, and the WRT and DCT are brief PVTs in the public domain, making them cost-effective when baseline testing many student-athletes.

Furthermore, the Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) is a computerized neurocognitive test (CNT) typically included during preseason testing, enabling clinicians to compare baseline and post-injury scores to better identify neurocognitive impairment. ImPACT provides a validity index based on an algorithm designed to aid in identifying invalid baseline examinations. ImPACT was designed specifically to simultaneously measure response speed and accuracy (Lovell, 2013). Despite the use of these quick, psychometrically sound tools, there is limited research on suboptimal effort during baseline testing, and the research on the frequency of sandbagging behaviors is even more scant. Furthermore, motivations for executing such a behavior are understudied.

Sandbagging. Research now reveals that athletes may underreport their concussive symptoms so they can return to play more quickly (Echemendia & Cantu, 2003; Reilly, 2011). Athletes may also attempt to “sandbag” their baseline evaluations, purposefully lowering their baseline results without invalidating the test to appear less impaired following an impact and avoid exclusion from play altogether. While several batteries now include validity indicators to detect invalid performance, it is possible to under-perform without triggering validity indicators

(Erdal, 2012). Reports and interviews with players have appeared in the news with athletes seemingly gloating that they "sandbagged" their baseline testing (Reilly, 2011). Sandbagging behavior threatens to limit the validity and utility of neurocognitive assessments. At this point in time, it is difficult to make statements regarding sandbagging because the incidence of this behavior is unknown.

Current Status of Sandbagging Research. Media reported claims of sandbagging behavior (Reilly 2011; Marvez, 2012) have been challenged by researchers who investigated the ability to successfully sandbag on the ImPACT test in a non-athlete sample of college students (Schatz & Glatts, 2013). However, it is important to note that the research is variable on how successful athletes are in sandbagging their test results. Nevertheless, researchers tend to agree that using multiple measures for suboptimal performance makes sandbagging more difficult (Erdal, 2012; Schatz & Glatts, 2013). Schatz and Glatts (2013) indicated that built-in invalidity triggers in ImPACT identified 70% of naive and 65% of coached sandbaggers, and utilizing certain ImPACT battery subscales, identified 90% and 95% of naïve and coached sandbaggers, respectively. Erdal (2012) reported that 11% of college athletes were able to intentionally score "poorly" on baseline CNT without triggering ImPACT invalidity triggers. In summary, these authors found that sandbagging behavior on baseline CNT is more difficult to achieve, without detection, than is reported in the media. Furthermore, a computer-based measure developed by Higgins, Denney and Maerlender (2017) predicted suboptimal effort using neurocognitive scores in a sample of high school athletes. Invalidity triggers built into the ImPACT test identified 99.7% of high school athletes providing “best effort” and “sandbag” behaviors (Higgins et al., 2017). Although there is an apparent relationship between optimal effort and performance on baseline CNT, the factors that predict and influence effort are not empirically confirmed.

Most recently, Schatz et al. (2017) found that six-percent (N=178) of collegiate male and female athletes reported a history of sandbagging behavior on a survey, with nearly one-third of their sample reporting they did not provide maximal effort on their CNT baseline test. The authors suggested athletes who perceived very high utility of the baseline CNT assessment were 4.94 times more likely to provide maximal effort on their CNT baseline. They also indicated factors such as history of concussion, sex, or first-time test taker status were not predictive of athletes providing maximal effort on the CNT baseline. While the Schatz et al. (2017) study was the first to include a survey involving the admittance to sandbagging behaviors to be distributed, there are serious limitations to this study. These limitations include an inability to match up survey responses with CNT assessment results, as well as responses being solicited from current student-athletes who might have had incentives to not be forthcoming with honest information. Furthermore, that study did not include football players, which is the sport with the highest incidence of concussion for males, and also the sport of athletes in the news who have publicly admitted to sandbagging behaviors. Despite these authors' findings that the prevalence of sandbagging is not as common as previously reported, sandbagging remains a behavior that some athletes employ in baseline testing, and it warrants further examination and identification of variables that might contribute to a propensity to engage in sandbagging behaviors or suboptimal effort.

Factors Influencing Effort. Injuries that leave collegiate athletes sitting out of games or practices are often a source of frustration and stress (Cantu, 2014). Schatz et al. (2017) tested different empirically derived factors that could influence an athlete's effort on baseline testing, including history of concussion, sex, previous test exposure, and perceived utility of the test. Iverson, Gaetz, Lovell and Collins (2004) reported that between two groups of athletes (one group with a history of three or more concussions, and one group with no previous concussions), athletes with a history of multiple concussions reported more symptoms and scored significantly lower on memory testing two days post-injury. This study indicated athletes with multiple concussions might have cumulative effects, and these athletes appear to be at increased susceptibility to sustaining more severe injuries in the future. Additionally, athletes who have been concussed previously and exposed to neurocognitive testing may be more appreciative of baseline assessment for ensuring safe return to play, hence providing their best effort at baseline testing. Alternatively, an athlete with a history of concussion may believe their testing kept them from returning to play following their concussion, increasing the likelihood that the individual might provide suboptimal effort. Previous test exposure in this case might negatively impact the athlete's performance on testing, and it is not clear in the literature if repetitive exposure to an assessment battery is linked to suboptimal effort, despite practice effects associated with repeat neurocognitive assessments being well-documented (Schatz et al., 2017). With respect to sex, Schatz, Moser, Solomon, Ott and Karpf (2012) found no significant difference in invalidity indicators in the ImPACT test in collegiate athletes.

In addition to the aforementioned variables, this study considered additional motivational and environmental factors, including scholarship status, lack of awareness/understanding of concussion, fear of losing playing time, fear of disappointing teammates or coaches, coercion by other teammates or coaches, feeling ill at baseline, preoccupation by other factors, misconception that one is immune to concussion, and test environment.

Scholarship as a Moderating Variable. This study introduced scholarship status as a potential moderating variable on suboptimal effort given during baseline testing. The NCAA has 1,123 college and university members, and is comprised of three divisions (ncaa.org, "Our Three Divisions"). All three divisions emphasize both athletics and academic excellence, as the overall mission of the NCAA is to make athletics an integral part of the educational atmosphere. Differences between divisions that emerge involve how schools choose to fund their athletics programs, and in the national attention raised. Most Division I institutions choose to devote more financial resources to athletics programs, and this is allowed because of large media contracts that Division I conferences attract. Primarily, this is done to showcase the publicly popular sports of football and men's basketball. Annually, NCAA Divisions I and II schools provide more than $2.9 billion in athletic scholarships to more than 150,000 student athletes (ncaa.org, "Scholarships"). Division III does not provide any athletic scholarship aid. Roughly two percent of high school athletes are awarded athletic scholarships to compete in college. Full scholarships cover tuition and fees, room and board, and course-related materials (e.g. books). Division II has adopted a partial-scholarship model in which very few athletes receive full scholarships, and the majority of student athletes who receive athletics scholarships instead receive an amount that covers a portion of the aforementioned costs. Therefore, these athletes receive some athletic financial aid, and a combination of other sources to help fund the college experience, including need-based grants, academic scholarships and student loans. In Division II, each sport is allotted a number of full scholarships to offer, and schools frequently divide their full scholarship equivalencies among athletes until they reach the established number of full-time equivalency scholarships for each sport (ncaa.org, "Division II partial-scholarship model"). Historically, the scholarship awards have been single-year commitments. However, in 2015, Division I bylaws were amended to allow multiple year award commitments. Division II continues with annual awards. Table 2 provides current scholarship equivalency limits per sport in

Division II. Squad size was determined by averaging the number of players per team at five NCAA Division II schools selected at random. Football receives the highest number of equivalencies, but also has the largest squad size.

Table 2

Equivalency Limits per Sport in Division II

Sport	**Equivalency limits**	**Team Size**
Men’s Basketball	10	14
Women’s Basketball	10	16
Cheerleading	N/A[1]	23
Men’s Cross Country/Track	12.6	11
Women’s Cross Country/Track	12.6	6
Football	36	117
Women’s Golf	5.4	9
Men’s Lacrosse	10.8	44
Women’s Lacrosse	9	14
Men’s and Women’s Rowing	20	48 (29 male, 19 female)
Men’s Soccer	9	30
Women’s Soccer	9.9	36
Softball	7.2	20
Women’s Swimming	8.1	19
Men’s Tennis	4.5	10
Women’s Tennis	6	6
Volleyball	8	12

[1] Cheerleading at FIT is not considered a competitive sport

For some students, a college education is the most rewarding benefit of the student-athlete experience. Huffman and Cooper (2012) revealed that the majority of football and basketball student-athletes competing at the Division I level come from low socioeconomic backgrounds. For these students, their athletic scholarship aid (along with other types of financial aid in some cases) allows them the opportunity to attend college that they otherwise would not likely be afforded. The increasing cost of tuition nationally has likely resulted in an increase in the demand for athletic scholarships, especially for athletes originating from lower socioeconomic classes. For student-athletes lacking financial resources, loss of athletic scholarship aid could jeopardize their college education. Furthermore, since scholarships are single-year commitments, student-athletes have strong motivation to ensure they are able to renew their scholarship. However, in some cases, student-athletes may lose their scholarship entirely, or receive differing amounts of aid. Athletes who are perceived to have the greatest talent at their position typically receive scholarship offers from Division I universities, and are offered higher levels of partial or full scholarships at Division II institutions. Just because an athlete is considered one of the most valuable players one season does not ensure the athlete will maintain the same value the next season. For example, the athlete may become injured, or a new player with stronger skills may join the team, creating a competitive atmosphere.

Literature on Survey Research

Wright (2005) discussed the advantages and disadvantages of online survey research. Advantages included access to individuals in distant locations, the ability to reach difficult to contact participants, and the convenience of having automated data collection, which in turn reduces researcher time and effort. Disadvantages of online survey research included uncertainty over the validity of the data and sampling issues, and concerns surrounding the design, implementation, and evaluation of an online survey. Thirteen years later, Evans and Mather (2018) reported an analysis of the evolution of online survey research since 2005. They found that online survey research is used more frequently and better accepted by researchers than in 2005. Furthermore, survey techniques are continually being transformed by new technologies. These authors listed major strengths of online surveys as global reach, flexibility, speed and timeliness, convenience, ease of data entry and analysis, question diversity, forced completion of survey questions, and large samples that are easy to obtain. Weaknesses included possible perception as junk mail, skewed sampling, unclear answering instructions, an impersonal feel, privacy issues, and low response rates. It was emphasized that low response rates continue to be a concern. Based on a meta-analysis, Manfreda et al. (2008) found that the average response rate was 11% for online surveys and that the 95% confidence interval was 6–15%. That low rate has dropped even further since then, causing researchers to investigate reasons for low response rates with suggestions on how to improve them (Evans et al., 2018). Fan and Yan (2010) concluded that online survey response rates are influenced by factors such as the sponsoring organization, survey topic, survey length, question wording, question order, question display (such as screen-by-screen or scrolling, backgrounds, logo display, graphics and progress display, navigational instructions and question format), sampling methods, contact delivery modes, pre-notification, design of invitation and incentives. As survey response rates have fallen, the issue of incentives has become much more debated. SurveyMonkey (2018) commented on the use of incentives:

> "Incentivizing surveys may seem like a no-brainer. But consider this: Your reward may be attracting the wrong kind of respondent. By offering everybody a reward to take your survey, it can encourage satisficers—people who misrepresent themselves or rush through surveys to the detriment of your survey results—just to collect a reward. However, incentivizing isn't all bad. Offering survey rewards can help you encourage hard-to-reach audiences to take your survey. You can even offer indirect rewards to your respondents to benefit a third party, like a charity. Decide whether or not to incentivize your survey by carefully considering the circumstances."

In 2010, SurveyMonkey conducted a study analyzing data from 100,000 surveys from 2009-2010 to determine the impact on response rates if an individual sends out a survey on Monday versus Friday (or any other day of the week). They found that response rates were highest for survey invitations sent out on Monday, and lowest for invitations sent on Friday. Compared to the daily average, surveys sent out on Monday received 10% more responses, and surveys sent out on Fridays received 13% fewer responses (SurveyMonkey, 2018).

Goals and Objectives

All Florida Tech student-athletes are required to participate in a concussion management program as part of the overall medical assurance that they are fit and safe to participate in intercollegiate athletics. It is imperative to obtain valid test scores that are representative of the athletes' true cognitive abilities. Because the management of sport concussions and return-to-play following concussion is guided empirically by ongoing research, it is to the benefit of student-athletes that research is conducted to identify potential motivating factors determining why athletes might perform poorly on baseline testing. If athletes do not provide adequate effort during the pre-injury baseline testing, their obtained scores may vary widely from what would be considered normal for them. If the scores are lower than their true ability, then that entire test battery would likely be invalid, and could later result in clinicians erroneously missing a diagnosis of concussion.

Failure to identify a concussion may result in lifelong changes in cognitive processing speeds and emotional change. Accordingly, the current study had a two-fold purpose; (a) to describe the incidence of self-reported sandbagging behaviors on baseline neurocognitive testing at this institution and (b) to identify the factors predicting suboptimal effort on baseline neurocognitive assessments.

The current study was novel in that it went a step further to describe the relationship of athletics scholarship aid to effort given on baseline testing. When addressing this study's research questions of how many total individuals sandbag, and their reasons for committing such a behavior, scholarship status was explored as a potential motivating factor. Additionally, the current study went beyond the recent study completed by Schatz et al. (2017) because this study allowed for the matching of survey responses with neuropsychological assessment results. The only recent data on sandbagging was done relative to the ImPACT test. This study determined how both suboptimal effort and sandbagging appeared on other measures (*i.e.,* performance-based and effort-based measures). This added to the research questions posed, aiming to determine how performance and effort-based test scores looked for individuals who sandbagged compared to individuals who did not sandbag. Moreover, responses were solicited from graduated students-athletes who would be more likely to be forthcoming with honest information than current student-athletes might be. Furthermore, the current study included football players, which corrected a major limitation of the Schatz et al. (2017) study. This was critical because football is the sport with the highest incidence of concussion for males, and also the sport of athletes in the news who have publicly admitted to sandbagging behaviors.

Based upon previous studies, the research suggests that sandbagging is a behavior that occurs in an unknown percentage of student-athletes. Motivations that student-athletes have for engaging in this behavior are largely unknown and understudied. This study hypothesized that it would be reasonable that players with "more to lose" might have more of an inclination to sandbag. Players who fear they might lose their starting position, playing time, or even membership on the team might have higher motivation to sandbag. This perception of loss could have devastating consequences for an athlete who values his athletic capability and identification as a valued player. Similarly, student-athletes who are heavily reliant on their athletics scholarship aid money to finance their college education might be more inclined to sandbag. If an individual needs athletics scholarship aid to maintain enrollment at the university, he may fear his education could be in jeopardy. For example, if the athlete were to sustain a concussion, he might lose playing time, which could translate to either losing the position on the team or the value the coach places on the player. This is where the athletic scholarship aid loss might occur.

Methods

Participants

All student-athletes who participate in intercollegiate sports must participate in the Concussion Management Program as part of the compliance process established by the University with the NCAA Division II. This means that approximately 600 student athletes (65% male) are tested each year. As approved by the Florida Tech Institutional Review Board, the participants consented to the use of their baseline testing data after being informed of the CMP's research aspects during the concussion education session. This study solicited survey responses from male and female student-athletes who graduated and no longer reported to the athletics department. Three hundred and forty nine athletes were identified as having graduated between 2013-2018. Two hundred of these athletes were male (57%).

Materials

All participants completed an online brief survey questionnaire. A 15-question survey was distributed as a self-report measure to parse out athletes who intentionally performed poorly at baseline. The demographics section of the survey included items such as sport played, recruitment status, starting player status, ethnicity, current age, the last year the athlete played at FIT, and concussion history. Scholarship status was self-reported for each year the athlete played at FIT. Then, the student-athlete reported if he or she would have been financially unable to attend FIT in the absence of any athletics scholarship aid. This survey asked athletes how they believed they performed at baseline testing, and they rated their level of effort on a 7-point Likert scale (1- "I did not perform to the best of my ability" to 7-"I did perform to the best of my ability"). If an effort score of 6 or less was reported, the athlete was asked for reasons why he or she did not give best performance in a given year. If for one or more years the athlete did in fact give best effort, that was an answer choice. Then, the athlete was directed to a page that asked if he or she intentionally gave suboptimal effort. If the athlete responded that he or she intentionally tried to lower his or her score, he or she was asked about motivations for performing poorly in a given year. The survey also inquired about an awareness of teammates reporting poor effort given during testing. Responses to survey items were gathered via multiple choice, text entry, and a 7-point Likert scale. The survey is presented in Appendix A.

Participants had completed a battery of assessments for concussion baseline testing each year they participated in their sport at FIT. These instruments included three versions of the Sport Concussion Assessment Tool (2^{nd} Edition (SCAT-2), 3^{rd} Edition (SCAT-3), 5^{th} Edition (SCAT-5), Rey Word Recognition Test (WRT), Rey Dot Counting Test (DCT), Patient Health Questionnaire (PHQ-9) and the Immediate Post-Concussion Assessment Test (ImPACT). Student-athletes completed both performance-based and effort-based measures. Objective performance measures included the SCAT, and ImPACT. The PHQ-9 was utilized to determine if any mood-related difficulties were present. The objective measures to identify effort in this study included the Rey WRT and Rey DCT scores, and ImPACT's invalidity index. Established normative values for the Rey WRT and a combination score for the Rey DCT were utilized to identify athletes performing with suspect effort, while the ImPACT test contains an algorithm that was used to determine if the results were of questionable validity. Once suboptimal performance was admitted on the questionnaire, the researchers had the ability to determine how poor effort appeared on both the performance-based and effort-based measures administered. It is important to note that the number of participants with data for each instrument varied based on the year the athlete played, and the year the instrument was implemented into the FIT concussion battery. ImPACT was introduced at Florida Tech beginning in January, 2015. The DCT was introduced in June, 2015. The SCAT-3 was introduced in 2013, replacing the SCAT-2, and the SCAT-5 was introduced in August, 2017, replacing the SCAT-3.

The SCAT is a comprehensive screening measure for the immediate post-trauma evaluation of injured athletes (McCrory et al., 2009). The 2nd edition of the tool includes a 22-item symptom report, the Glasgow Coma Scale, a Maddocks scale that assesses an athlete's current awareness and immediate memory, the Standardized Assessment of Concussion (SAC; McCrea et al., 1998), a brief coordination test, and balance testing. The 3rd edition of the tool extends the overall validity of the instrument, including a tandem gait assessment. Other than this addition, no significant update was made regarding symptom, cognitive or balance components of the SCAT (Zimmer, Marcinak, Hibyan & Webbe, 2014). The 5th edition of the tool clarified instructions on administration of the symptom checklist, and an option to use 10 words instead of 5 words on the immediate and delayed word recall lists to minimize ceiling effects. Additionally, a rapid neurological screen was included (Echemendia et al., 2017). Student-athletes in this study completed one of the SCAT measures, depending on the date the student-athlete was enrolled at FIT.

The PHQ-9 is a self-administered screening instrument for making criteria-based diagnoses of depression and other mental disorders that are commonly encountered in the primary care setting. This screening tool has nine items, on a scale of zero (not at all) to three (nearly every day), which can establish a depressive disorder diagnosis, while grading depressive symptom severity. Major depression is diagnosed if five or more of the nine depressive symptoms have been present at least "more than half the days" in the past two weeks, and one of the symptoms is depressed mood or anhedonia. The ninth item inquires about suicidal ideation. A 10th item at the end of the screener asks how pervasive endorsed problems have been (Kroenke, Spitzer, & Williams, 2001).

Rey (1941) explained that the WRT requires only the immediate recall of 15 simple words that have just been read to the examinee (as cited in Frederick, 2002). The standard instructions for the examiner were followed, and they were: *"I am going to read you a list of words that I would like you to remember. Are you ready?"* Five seconds after reading the words, the examiner handed a sheet of 30 words to the examinee, and instructed: *"Please circle the words that are ones that I just read to you."* The page handed to the examinee had the 15 target words intermixed with 15 other words similar in length and structure. Intrusion responses were any words circled by the participant that were not read aloud by the examiner. Administration time was typically about two minutes. Three dependent measures were scored: 1) total correct words circled; 2) total correct of the first eight words; and 3) number of intrusions. A derived measure used by Nitch et al. (2006) was also employed. Termed the "combination score" by Nitch and colleagues, this measure gives added weight to the correct words of the first eight in the list and is calculated as follows: total words correctly recognized minus false positives (intrusions) plus the correct words recognized from the first eight. A study by Goworowski, Vagt, Salazar, Mulligan and Webbe (2018) established normative values for the Rey WRT in a college-athlete population. Results indicated that mean total words correct was 10.47, mean correct of the first eight words presented was 6.01, mean number of intrusions was 0.89 and mean combination score was 15.59.

The DCT, developed by Andre Rey, consists of two sets of six 3×5 cards. Cards 1–6 contain 11, 19, 15, 23, 27, and 7 dots, respectively, arranged in a random configuration. Cards 7–12 contain 12, 20, 16, 24, 28, and 8 dots, respectively, arranged in the following groupings (1) two 5-dot squares and two separate dots; (2) four 5-dot squares; (3) four 4-dot diamonds; (4) four 6-dot rectangles; (5) four 5-dot squares and two 4-dot squares, and (6) two 4-dot squares. The cards were presented in order and the patients were instructed as follows: "*I will show you a series of cards with dots on them. Count the dots on each card as quickly as you* *can, then tell me how many dots you counted on each card. Try not to touch or pick up the card if possible*." Answers and response time were recorded for each card. The scores derived from the test include grouped time (the average time per card to count grouped dots), ratio (the average time per card to count ungrouped dots divided by mean grouped dot counting time), and errors (total number of errors committed; Lezak, 1995; Boone et al., 2002). Results from a study conducted by Salazar, Mulligan and Webbe (2017) supported the use of the DCT as a valid measure of suboptimal performance when using modified norms established from collegiate populations. These authors discussed the value of using a combination score that was proposed by Boone et al. in 2002 (*i.e.,* the sum of average grouped and ungrouped counting times plus errors). While several scores were useful in determining suboptimal effort, the combination score was found to have the best sensitivity and specificity. The authors suggested the use of a combination score cutoff of 15, classifying baselines with a combination score that meets or exceeds 15 as suspicious.

ImPACT is a computerized neuropsychological test battery designed specifically for the assessment of SRC. The ImPACT test (Lovell, 2011) includes a demographic section, symptom inventory, and six subtests measuring attention, memory, processing speed, and reaction time. These subtests yield composite scores in the areas of Verbal Memory, Visual Memory, Visual Motor Processing Speed, and Reaction Time. The Impulse Control composite score, however, is used for the purpose of detecting poor effort and is not traditionally used as a clinical scale to measure effects of concussion (Iverson, Lovell, & Collins, 2003). ImPACT provides a validity index designed to aid in identifying invalid baseline examinations. This index is based on the following algorithm: X's and O's Total Incorrect > 30 OR Impulse Control Composite > 30 OR Word Memory Learning Percent Correct < 69% OR Design Memory Learning Percent Correct < 50% OR Three Letters Total Letters Correct < 8 (Lovell, 2011).

Procedure

This study was approved by the Institutional Review Board (IRB) of the Florida Institute of Technology in 2017, prior to obtaining consent and beginning survey distribution with the first student-athlete participants. All student-athletes participated in the Concussion Management Program (CMP). When the baseline testing occurs in the preseason (or later for students who join teams after the school year begins) there is a mandatory education session. At the end of the session, the research aims of the CMP are described, and students are provided with the forms for informed consent. All questions are answered during this session. Students are informed that they may withdraw participation in the research aspects of the program at any time without impacting their athletic eligibility.

For the current study, email addresses of graduated student-athletes were obtained from ARMS software, which is an application that allows the collection of information about athletics teams, the students that comprise them and compliance information. An email was sent to participants with a link to an online survey powered by Qualtrics. Subsequent requests were sent up to two months following the initial request. As an incentive to participate, participants were informed that they would be entered in a lottery for two Amazon gift cards upon survey completion. On the online Qualtrics survey, the first page asked the athlete to select "I consent," and informed the athlete that continuing on to the next page indicated consent for research had been granted. Athletes then completed the brief online survey, which took each athlete approximately five minutes.

Results

Survey Results

Three hundred and forty-nine athletes were identified as student-athletes who had graduated from 2013-2018, and emails were sent to their Florida Tech email addresses. 74 athletes completed the survey, with a response rate of 21%. The date that each round of surveys was sent, along with how many responses were received following each request is shown in Table 3. Surveys were sent on Mondays, Tuesdays or Wednesdays, over a two-month period. The majority of survey responses were returned the same day, but some athletes responded the day after the request was sent. None of the athletes returned a survey more than two days following the date the request was sent. As noted via an asterisk in the table, the last two rounds of surveys were only sent to graduated football players, as their representation in the sample was not what was initially expected or hoped for. The final round of emails was sent to alternative email addresses for football players provided by one of the Florida Tech athletic trainers who had been recently in touch with these athletes. As a favor to this researcher, the athletic trainer reached out to these athletes to ask if they had received the email soliciting responses. Most of these football players indicated they had not received the questionnaire request because they no longer accessed their FIT email, and at that time provided their alternative email addresses.

Table 3

Survey Results

Date Email Sent *(day of the week)*	Number of same day responses	Number of responses the day after
6/25/18 *(Monday)*	35	6
7/3/18 *(Tuesday)*	12	2
7/18/18 *(Wednesday)*	9	1
8/14/18 *(Tuesday)**	2	0
8/27/18 *(Monday)**	7	0

*football players only

Participant Demographics

Demographic characteristics of the participating athletes appear in Table 4, including sex, age, last year played at FIT, concussion at FIT endorsement, transfer status, recruitment status, starting player status, team and ethnicity. For some of the tabled variables, figures are presented to demonstrate more clearly the characteristics of the sample. All 74 participants in the study were graduated student-athletes from FIT. Fifty-four percent of those included were male, with 46% females. Ages ranged from 21 to 26-years-old, with the majority of participants (91%) falling between the ages of 22 to 25-years-old. Last year played at FIT ranged from 2013-2017, with the majority of the sample (97%) graduating in 2015 or later. Twenty-seven percent of the sample had sustained a concussion while participating in their sport at FIT. Lifetime concussion prevalence is shown graphically in Figure 1. The majority, 43 athletes (58%) had never suffered a concussion, while 13 athletes (18%) had suffered one concussion. Some outliers are noted; specifically, five athletes (7%), had suffered more than five concussions.

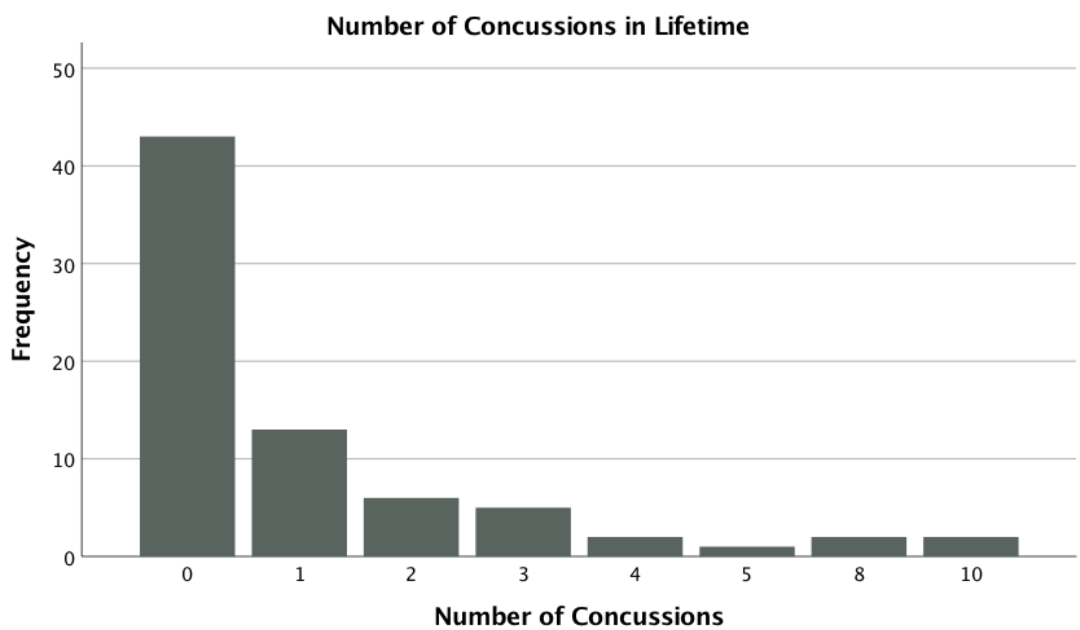

Figure 1

Lifetime Concussion Prevalence

Twenty percent of the sample identified as transfer students. Eighty-seven percent of the sample indicated they were recruited players, and curiously, with a complete overlap, the same percentage stated they were starting players as well. According to the NCAA (2017), recruiting occurs when a college employee or representative invites a high school student-athlete to play sports for his or her college. Recruiting can occur in many ways, including face-to-face contact, phone calls or text messaging, through mailed or emailed material or through social media. A “contact” happens any time a college coach says more than hello during a face-to-face meeting with a college-bound student-athlete or his or her parents off the college’s campus. An “evaluation” occurs when a college coach observes a student-athlete practicing or competing. A “verbal commitment” is when a college-bound student-athlete verbally agrees to play sports for a college before he or she signs or is eligible to sign a “National Letter of Intent.” The commitment is not binding on the student-athlete or the school and can be made at any time. When a student-athlete officially commits to attend a Division I or II college, he or she signs a National Letter of Intent, agreeing to attend that school for one academic year. Number of athletes per team appears in Figure 2. As is clear among the nineteen teams that were represented, the majority of participants played football (27%).

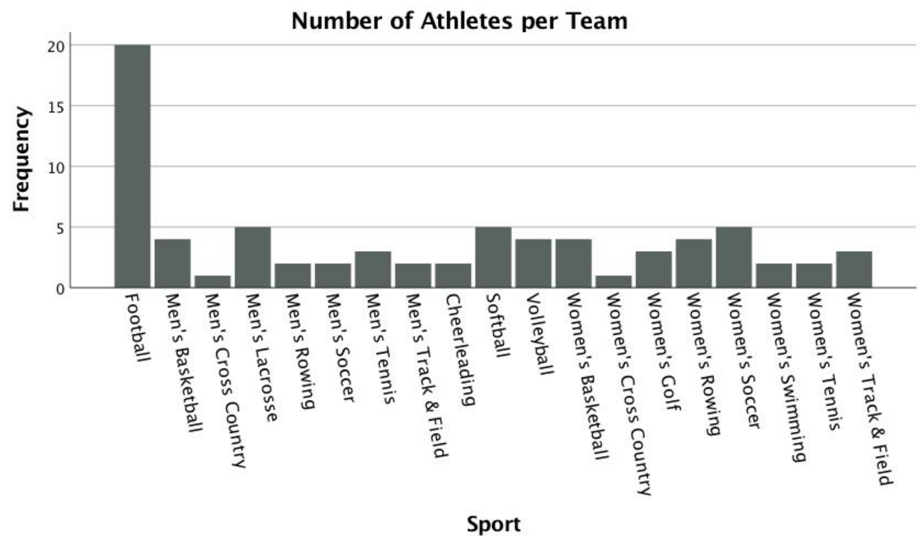

Figure 2

Number of Athletes per Team

Participants' ethnicities are displayed in Figure 3, with the majority of athletes identifying as white (64%), followed by black (21%), two or more races (12%), and Hispanic/Latino (3%).

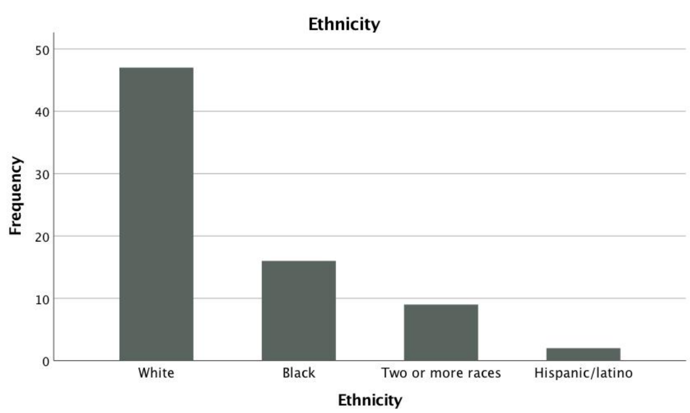

Figure 3

Ethnicity

Table 4

Student-athlete Demographics

Variable	Participating athletes n (%)
Sex	
Male	40 (54%)
Female	34 (46%)
Age	
21	5 (7%)
22	17 (23%)
23	17 (23%)
24	16 (21%)
25	17 (23%)
26	2 (3%)
Last Year Played at FIT	
2013	1 (1%)
2014	2 (3%)
2015	11 (15%)
2016	22 (30%)
2017	18 (24%)
2018	20 (27%)
Concussion at FIT	
Yes	20 (27%)
No	54 (73%)
Transfer Status	
Transfer Student	15 (20%)
Not a Transfer Student	59 (80%)
Recruitment Status	
Recruited Athlete	64 (87%)
Not a Recruited Athlete	10 (13%)
Starting Player Status	
Starting Player	64 (87%)
Not a Starting Player	10 (13%)
Team	
Football	20 (24%)
Men's Basketball	4 (5%)
Men's Cross Country	1 (1%)
Men's Lacrosse	5 (7%)
Men's Rowing	2 (3%)
Men's Soccer	2 (3%)
Men's Tennis	3 (4%)
Men's Track & Field	2 (3%)
Cheerleading	2 (3%)
Softball	5 (7%)
Volleyball	4 (5%)
Women's Basketball	4 (5%)
Women's Cross Country	1 (1%)

Women's Golf	3 (4%)
Women's Rowing	4 (5%)
Women's Soccer	5 (7%)
Women's Swimming	2 (3%)
Women's Tennis	2 (3%)
Women's Track & Field	3 (4%)
Ethnicity	
White	47 (63%)
Black	16 (22%)
Two or More Races	2 (3%)
Hispanic/Latino	9 (12%)

Scholarship Status. Fifty-two athletes (70%) reported that they could not have attended FIT without athletics scholarship aid. Three categories of scholarships were examined: full scholarship (100% tuition remission and room and board), partial scholarship (some percentage of tuition remission and/or room and board costs), and no athletics scholarship aid. The number of each type of scholarship per year played appears in Table 5. Trends demonstrated that by the fourth year an athlete participated in his or her sport, there was a higher likelihood of receiving athletics scholarship aid. For some athletes, they did not have any scholarship aid initially, but obtained a scholarship later in their playing career. Of note, 2% of the sample did not play more than one year, 15% of the sample did not play more than two years, 31% of the sample did not play more than three years, and 80% of the sample did not play more than four years. This likely takes into account that transfer students typically play for two academic years at FIT. Additionally, athletes who played a fifth year were red-shirted for a year. This means that they were on the team, but due to injury or other reasons they did not participate that year. They did not lose eligibility during that time since they did not participate in actual games.

Table 5

Distribution of Scholarship Aid by Year Played

Year Played	Number of athletes who played that year n (%)	Full Scholarship n	Partial Scholarship n	No Athletics Scholarship Aid n
First Year	74 (100%)	16	39	19
Second Year	72 (98%)	16	43	13
Third Year	63 (85%)	13	39	11
Fourth Year	51 (69%)	11	37	3
Fifth Year	15 (20%)	4	9	2

Table 5 shows the scholarship distribution for all respondents. Figure 4 breaks down these yearly scholarship totals by sex. Each successive year of scholarship support appears in panels A through E. Overall, the same scholarship distribution pattern for males and females was seen year by year. The majority of males and females had partial scholarship aid. The overall pattern of scholarship distribution (full, partial, none) for females was higher than for males, and while more males than females were likely to have full athletics scholarships, more males also had no scholarship aid. Additionally, trends demonstrated that more females were likely to have partial athletics scholarships, suggesting females have more total support. Of note, more males were included in this sample than females, and not all athletes from FIT were included in this analysis, rather just the sample of 74 participants from this study. Patterns were very similar between males and females and nothing bespoke any gender bias for this sample.

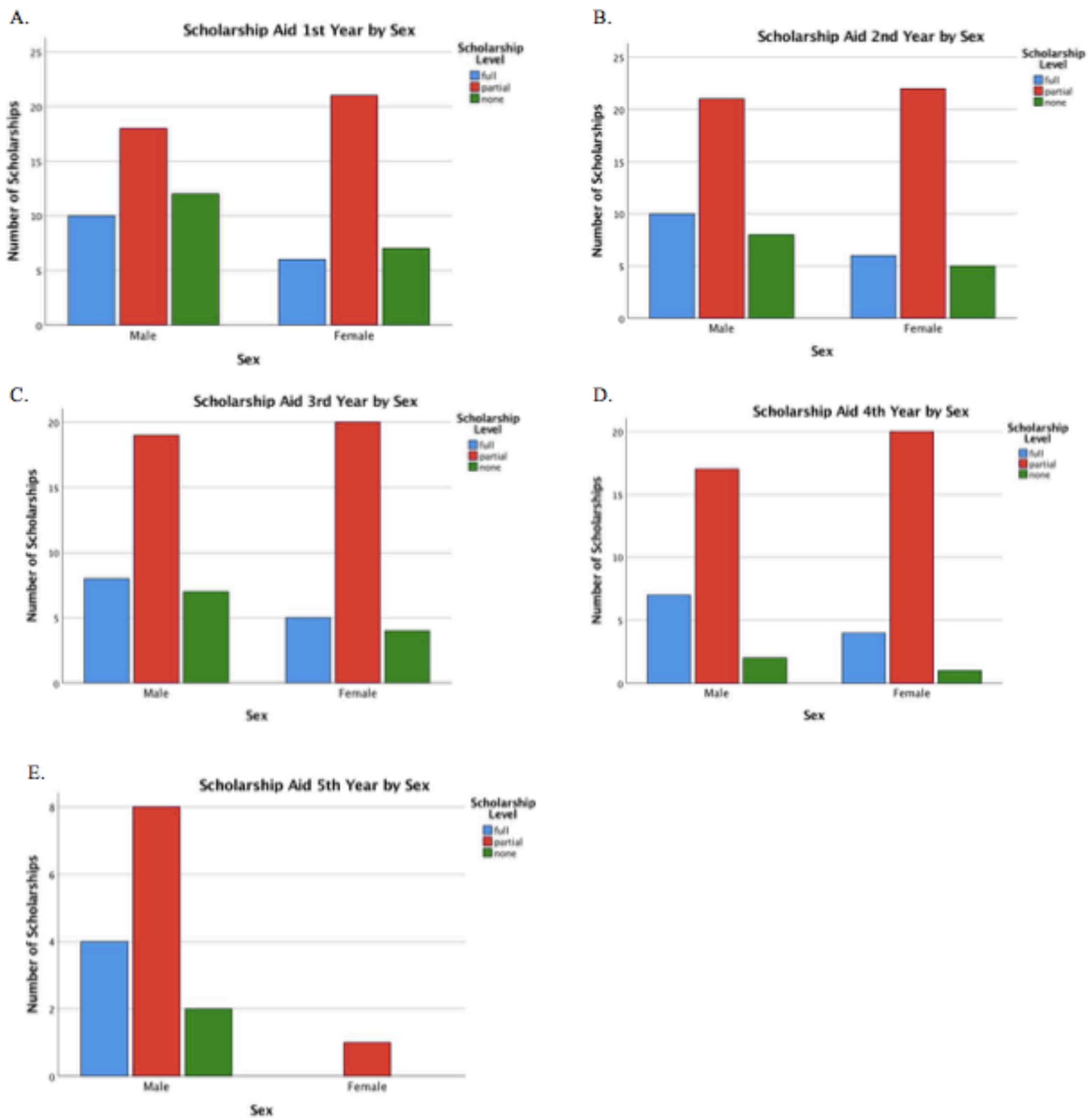

Figure 4

Distribution of Scholarships by Sex for Each Year Played

Tests of Research Questions

Effort. The effort item, which was a Likert-scale question, read, "At baseline testing you were asked to perform to the best of your ability. Did you do that? Rate how true this would be for you on a scale from 1 (*'I did not perform to the best of my ability')* to 7 (*'I did perform to the best of my ability').*" Fifty-nine athletes (80%) reported they gave their best effort, a score of 7. Eight athletes (11%) rated their effort as a score of 6. Four athletes (5%) rated their effort as a score of 5, and three athletes (4%) rated their effort as a score of 3. Taken together, this means that fifteen athletes (20%) gave themselves scores lower than 7. Reasons individuals gave for scoring below a 7 are described next.

Factors Predicting Suboptimal Effort. One of the purposes of this study was to identify factors predicting less than optimal effort on baseline neurocognitive assessments. All athletes who gave a score of less than 7 on the effort statement were directed to a new page. This page asked them to look back and identify the reason for each respective year they participated in their sport that they gave suboptimal effort (*i.e.,* a score less than 7). If the athlete gave his or her best effort for a specific year, he or she was instructed to select the "I gave my best effort this year" option. Table 6 displays the frequency of each reason selected for providing suboptimal effort. Reasons varied based on the year, and included fatigue/not feeling well, preoccupation with other factors (*i.e.,* personal matters, family concerns, etc.), did not think a concussion could happen to them, did not think a concussion was likely to happen in their sport, wanting a low score so concussion could not be detected, just did not care, or "other." Reasons reported for "other" included consuming alcohol the night before/being "hungover," the "test taking too long and making me lose interest," and not getting enough sleep the night before.

Table 6

Self-reported Reasons for Providing Suboptimal Effort by Year

Year 1	Reason Given	Frequency (n)
	Fatigued/not feeling well	1
	Preoccupied by other factors	2
	Concussion cannot happen to me	1
	Concussion is not likely to happen in my sport	1
	Concussion is not a serious injury	0
	Bothered by distractions in the testing room	0
	Wanted a low baseline score so potential concussion could not be detected	3
	Just did not care	0
	Other	3
	I gave my best effort this year	3
Year 2	Reason Given	Frequency (n)
	Fatigued/not feeling well	1
	Preoccupied by other factors	0
	Concussion cannot happen to me	1
	Concussion is not likely to happen in my sport	1
	Concussion is not a serious injury	0
	Bothered by distractions in the testing room	0
	Wanted a low baseline score so potential concussion could not be detected	3
	Just did not care	1
	Other	3
	I gave my best effort this year	4
Year 3	Reason Given	Frequency (n)
	Fatigued/not feeling well	2
	Preoccupied by other factors	2
	Concussion cannot happen to me	0
	Concussion is not likely to happen in my sport	0
	Concussion is not a serious injury	0
	Bothered by distractions in the testing room	0
	Wanted a low baseline score so potential concussion could not be detected	0

	Reason Given	Frequency (n)
	Just did not care	2
	Other	4
	I gave my best effort this year	2
Year 4	Reason Given	Frequency (n)
	Fatigued/not feeling well	2
	Preoccupied by other factors	1
	Concussion cannot happen to me	0
	Concussion is not likely to happen in my sport	0
	Concussion is not a serious injury	0
	Bothered by distractions in the testing room	0
	Wanted a low baseline score so potential concussion could not be detected	3
	Just did not care	5
	Other	2
	I gave my best effort this year	1
Year 5	Reason Given	Frequency (n)
	Fatigued/not feeling well	0
	Preoccupied by other factors	0
	Concussion cannot happen to me	0
	Concussion is not likely to happen in my sport	0
	Concussion is not a serious injury	0
	Bothered by distractions in the testing room	0
	Wanted a low baseline score so potential concussion could not be detected	2
	Just did not care	0
	Other	1
	I gave my best effort this year	0

Test Performance of Individuals Based on Effort Statement Scores. Scores on cognitive testing for individuals who gave an effort score of 7 (optimal group, n = 59) were compared to scores of individuals who gave effort statement scores less than 7 (suboptimal group, n = 15). These comparisons appear in Tables 7 and 8. Differences noted in these comparisons represent only numerical differences and not statistically significant differences. Scores for individuals in the optimal and suboptimal groups were averaged across five years. However, in the suboptimal group not all participants provided suboptimal effort each year. For example, an athlete who answered “5” on the effort statement question might have provided suboptimal efforts in years one and two, but provided his best effort in his third year. Since athletes clarified for each year whether they gave suboptimal effort in that respective year, only data from the years where an individual admitted to not providing best effort were included in the analyses. Table 7 displays performance measure scores across groups, including means, standard deviations and ranges for SCAT and ImPACT variables, and the PHQ-9 as well. Of note, scores for immediate and delayed memory on the SCAT-2/SCAT-3 and SCAT-5 were calculated separately, since the SCAT-2/SCAT-3 had a 5-item word list, and the SCAT-5 had a 10-item word list. Overall, individuals in the optimal group had scores that trended higher on the PHQ-9, and across measures on the SCAT. Individuals in the suboptimal group committed fewer balance errors, and scores trended higher on coordination. Similarly, individuals' scores in the optimal group trended higher on the ImPACT measures of verbal and visual memory, and reaction time, while individuals' scores in the suboptimal group trended higher on visual motor speed and impulse control.

Table 8 displays effort measure scores across groups, including means, standard deviations and ranges for Rey WRT, Rey DCT and ImPACT invalidity index variables. As a reminder, the ImPACT invalidity index is based on the following algorithm: X's and O's Total Incorrect > 30 OR Impulse Control Composite > 30 OR Word Memory Learning Percent Correct < 69% OR Design Memory Learning Percent Correct < 50% OR Three Letters Total Letters Correct <

8 (Lovell, 2011). Overall, individuals' scores in the optimal group trended higher on all measures of the Rey WRT. On the Rey DCT, individuals in the suboptimal group had combination scores that trended higher (more suspect). Of the ImPACT invalidity triggers, individuals' scores in the optimal group trended higher on Word Memory Percent Correct, Design Memory Percent Correct, and Three Letters Total Correct, and their scores trended lower on X's and O's Total Incorrect. Individuals' scores in the suboptimal group trended higher on the impulse control composite.

Table 7

Performance Measure Scores Across Groups

Performance Variable	**Optimal Group**			**Suboptimal Group**		
	Mean	**Standard Deviation**	**Range**	**Mean**	**Standard Deviation**	**Range**
PHQ-9 Total Score	2.04	3.20	0-17	1.73	2.84	0-17
SCAT Total Symptoms	2.31	3.67	0-22	1.51	1.89	0-7
SCAT Symptom Severity	4.04	8.28	0-85	2.19	2.66	0-11
SCAT Orientation	4.96	0.16	4-5	4.94	0.22	4-5
SCAT-2, SCAT-3 Immediate Memory	14.82	1.31	2-15	14.14	0.58	13-15
SCAT-5 Immediate Memory	16.21	3.18	13-27	16.05	3.04	14-22
SCAT Concentration	3.82	0.95	1-5	3.69	0.93	1-5
SCAT-2, SCAT- 3 Delayed Memory	4.17	1.07	0-5	3.92	1.17	2-5
SCAT-5 Delayed Memory	4.63	1.72	0-10	4.42	2.68	1-8
SCAT BESS Errors	4.89	4.79	0-20	4.82	3.87	0-14
SCAT Coordination	0.86	0.36	0-1	0.97	0.61	0-1
ImPACT Verbal Memory Composite	87.13	10.13	62-100	82.40	10.95	62-99
ImPACT Visual Memory Composite	79.31	9.20	52-100	73.42	5.94	71-94
ImPACT Visual Motor Speed	42.02	6.05	23.82-52.63	42.76	4.51	35.45-48.63
ImPACT Reaction Time Composite	0.58	0.08	.46-.87	0.56	0.06	0.51-0.74
ImPACT Impulse Control Composite	5.16	3.84	0-22	6.66	4.33	0-16

Table 8

Effort Measure Scores Across Groups

Effort Variable	**Optimal Group**			**Suboptimal Group**		
	Mean	**Standard Deviation**	**Range**	**Mean**	**Standard Deviation**	**Range**
Rey WRT Total Correct	10.76	2.04	4-15	10.15	1.63	6-14
Rey WRT Correct of the First Eight	6.29	1.33	2-8	5.83	1.13	3-8
Rey WRT Intrusions	0.83	1.04	0-5	0.85	0.78	0-2
Rey WRT Combination Score	16.22	3.93	6-23	15.19	2.75	8-22
Rey DCT Combination Score	5.37	4.55	0-14.5	5.41	4.77	0-14
X's and O's Total Incorrect	4.91	3.76	0-22	6.08	4.06	0-16
Impulse Control Composite	5.16	3.84	0-22	6.66	4.33	0-16
Word Memory Learning Percent Correct	97.36	4.26	79-100	95.92	3.49	88-100
Design Memory Learning Percent Correct	85.33	12.93	50-100	84.21	9.54	67-100
Three Letters Total Letters Correct	14.11	3.45	9-15	13.63	4.22	11-15

Self-reported Sandbagging. A major objective of this study was to describe the incidence of self-reported sandbagging behaviors on baseline neurocognitive testing. Of the athletes who did not give themselves a score of 7 on the effort question, a follow up question was then asked to directly determine if an athlete *intentionally* lowered his or her score. Of the 18 athletes who gave themselves a score lower than 7 on the effort measure, three athletes reported that they intentionally tried to lower their scores, while 15 athletes reported that they had not intentionally tried to lower their scores. However, two athletes admitted to sandbagging indirectly, reporting their reason for giving less than their best effort as “I wanted a lower score so that a concussion could not be detected.” This totals to five athletes who sandbagged, or seven percent of the sample. The five athletes who admitted to sandbagging both directly and indirectly will be referred to as Athletes A, B, C, D and E. Each athlete is described in Table 9 below. The majority of sandbaggers were white males (n = 4), while one sandbagger was a female who identified as being two or more races. The female athlete was a transfer student, while the other sandbaggers were not. The majority (n = 4) of sandbaggers reported an effort score of five.

Table 9

Descriptive characteristics of sandbaggers

	Athlete A	**Athlete B**	**Athlete C**	**Athlete D**	**Athlete E**
Method of admitting to sandbagging	Directly	Directly	Directly	Indirectly	Indirectly
Effort statement score	5	3	5	5	5
Sex	Male	Male	Female	Male	Male
Transfer student	No	No	Yes	No	No
Ethnicity	White	White	Two or more races	White	White
Team	Football	Football	Softball	Football	Football
Last year played at FIT	2015	2016	2017	2017	2016
Number of lifetime concussions	5	10	1	1	2
Recruited athlete	Yes	Yes	Yes	Yes	Yes
Starting player	Yes	Yes	Yes	Yes	Yes

Scholarship aid by year	None (1st year) None (2nd year) None (3rd year) Partial (4th year)	Partial (1st year) Partial (2nd year) Partial (3rd year) Partial (4th year) Partial (5th year)	Full (3rd year) Full (4th year)	Partial (1st year) Partial (2nd year) Full (3rd year) Full (4th year) Partial (5th year)	Partial (1st year) Partial (2nd year) Partial (3rd year) Full (4th year) Partial (5th year)

Of the five athletes who admitted to sandbagging, reasons given for sandbagging by three of those athletes are demonstrated in Table 10. All three athletes reported fear of losing playing time as a reason that they sandbagged at some point. The latter two athletes did not answer “yes” to the question that asked if they intentionally tried to lower their score, so they were not directed to the next page where reasons for committing that behavior were asked. This is why only three athletes’ reasons for sandbagging were explored.

Table 10

Self-reported Reasons for Sandbagging by Year

	Athlete A	**Athlete B**	**Athlete C**
Sex	Male	Male	Female
Effort statement score	5	3	5
Year 1 (scholarship status)	Fear of losing playing time *(no scholarship)*	*Gave best effort this year *(partial scholarship)*	N/A
Year 2 (scholarship status)	Fear of someone else taking your position *(no scholarship)*	*Gave best effort this year *(partial scholarship)*	N/A
Year 3 (scholarship status)	Fear of disappointing coaches or teammates (*no scholarship*)	*Gave best effort this year *(partial scholarship)*	Fear of losing playing time *(full scholarship)*

Year 4 (scholarship status)	Fear of disappointing coaches or teammates *(partial scholarship)*	Fear of losing playing time (*partial scholarship*)	Fear of losing playing time *(full scholarship)*
Year 5 (scholarship status)	N/A	Fear of losing playing time (*partial scholarship*)	N/A

Test Performance of Individual Sandbaggers. Mean scores for performance and effort-based measures were computed by averaging each athlete's scores with his or her other scores for the years the individual admitted to sandbagging. Each athlete's individual averages were compared to the optimal effort group's average scores, and results appear in Table 11 (performance) and Table 12 (effort). Please, note again that differences seen in these comparisons represent only numerical differences and not statistically significant differences. Also of note, for the immediate and delayed memory scores on the SCAT, each of the five individuals completed either the SCAT-2 or SCAT-3, and not the SCAT-5, so the five-word list score average for the optimal effort group was used for comparison.

For Athlete A, immediate memory and concentration scores trended lower than the optimal effort group mean. He made more BESS balance errors, and his coordination score trended lower than the optimal effort group. Additionally his scores trended lower across all ImPACT measures, with the exception of impulse control. In terms of effort measures, Athlete A's scores trended lower on all Rey WRT measures; his Rey DCT combination score trended higher, he had more X's and O's total incorrect, and had a lower word memory total percent correct and three letters total letters correct.

Athlete B's PHQ-9 score trended higher in comparison to the optimal effort group. His performance testing scores trended higher than the optimal effort group for most measures. On the SCAT, his scores only trended lower than the optimal effort group in delayed memory. On ImPACT, his scores only trended below the optimal effort group in reaction time. On the effort measures, Athlete B's scores trended lower on all Rey WRT measures with the exception of intrusions. On the Rey DCT, his combination score trended higher than the optimal effort group. He also had more X's and O's total incorrect, and lower word memory percent correct, design memory percent correct, and three letters total letters correct.

Finally, Athlete C's PHQ-9 score trended higher in comparison to the optimal effort group. On the SCAT, her scores trended lower on immediate and delayed memory, concentration and coordination. On ImPACT, her scores trended lower than the optimal effort group on visual memory, reaction time and impulse control. On the effort measures, her scores trended lower than the optimal effort group on words correct of the first eight on the Rey WRT as well as the Rey WRT combination score. Her Rey DCT combination score also trended higher. Her impulse control composite, word memory percent correct, design memory percent correct and three letters total letters correct trended lower than the optimal effort group.

Table 11

Performance Measure Scores for Individual Sandbaggers.

Variable	Athlete A Mean	Athlete B Mean	Athlete C Mean	Optimal Effort Group Mean (Standard Deviation)
PHQ-9 Total Score	0.50	8	2.50	2.04 (3.20)
SCAT Total Symptoms	1	2	0.50	2.31 (3.67)
SCAT Symptom Severity	2	3	0.50	4.04 (8.28)
SCAT Orientation	5	5	5	4.96 (0.16)
SCAT Immediate Memory	14.50	15	14.50	14.82 (1.31)
SCAT Concentration	2.75	4.50	1.50	3.82 (0.95)
SCAT Delayed Memory	5	3	3.50	4.17 (1.07)
SCAT BESS Errors	5.50	2	2.50	4.89 (4.79)
SCAT Coordination	0.75	1	0.50	0.86 (0.36)
ImPACT Verbal Memory Composite	66	89	88	87.13 (10.13)
ImPACT Visual Memory Composite	76	83.50	71.50	79.31 (9.20)
ImPACT Visual Motor Speed	39.8	46.43	43.14	42.04 (6.05)
ImPACT Reaction Time Composite	0.51	0.57	0.51	0.58 (0.08)
ImPACT Impulse Control Composite	14	7	4.50	5.16 (3.84)

Table 12

Effort Measure Scores for Individual Sandbaggers.

Variable	**Athlete 1 Mean**	**Athlete 2 Mean**	**Athlete 3 Mean**	**Optimal Effort Group Mean (Standard Deviation)**
Rey WRT Total Correct	9.5	8	11	10.76 (2.04)
Rey WRT Correct of the First Eight	6	5	6	6.29 (1.33)
Rey WRT Intrusions	1	0.50	0.50	0.83 (1.04)
Rey WRT Combination Score	14.50	12.50	16.50	16.22 (3.93)
Rey DCT Combination Score	8.85	6.42	8.42	5.37 (4.55)
X's and O's Total Incorrect	12	6.50	4	4.91 (3.76)
Impulse Control Composite	14	7	4.50	5.16 (3.84)
Word Memory Learning Percent Correct	88	85.50	92	97.36 (4.26)
Design Memory Learning Percent Correct	92	73	77	85.33 (12.93)
Three Letters Total Letters Correct	13	13.50	13	14.11 (3.45)

Teammate Sandbagging. At the end of the survey, participants were asked if they had ever heard a teammate say he or she intentionally tried to lower his or her score. Twenty-three participants (31%) reported they had heard a teammate admit to sandbagging behavior. The participants then selected the reason(s) why their teammate indicated he or she engaged in this behavior. These reasons are displayed in Figure 5. The most common reason for sandbagging was fear of losing playing time, followed by fear of someone taking his or her position.

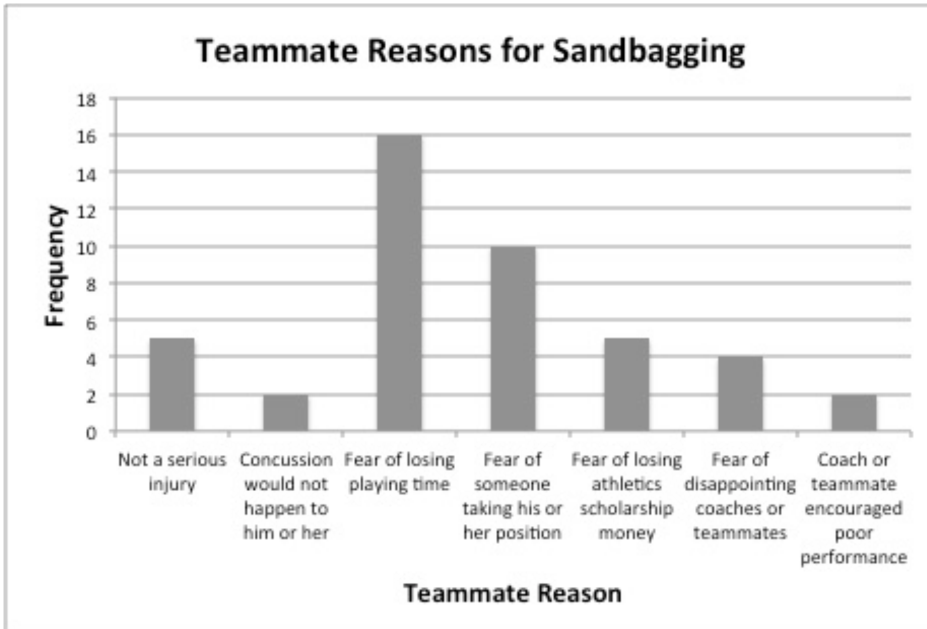

Figure 5

Teammate Reasons for Sandbagging

Discussion

Overall, it is encouraging that there were a very small number of athletes admitting to sandbagging behavior, and even then, they did not engage in this behavior during every year of participation. In regard to the study's purpose of trying to identify performance efforts to know who sandbagged in real time, having so few people report that they engaged in this behavior limited any conclusions that could be made. However, this study posed questions, and collected information that is not well known or discussed, and therefore significantly added to the incomplete literature that currently exists on sandbagging, how it might be measured most accurately, and the conditions that drive participants to the behavior.

Seventy-four athletes out of 349 potential respondents completed the survey, a 21% response rate that was higher than the average response rate of 11% for online surveys that Manfreda et al. (2008) reported. This is in agreement with Fan and Yan (2010) in their conclusion that online survey response rates are influenced by factors including the sponsoring organization, survey topic, survey length, question wording, question order, question display, sampling methods, contact delivery modes, pre-notification, design of invitation and incentives. Participants were possibly enticed by the short five-minute average length of completion time and opportunity to win one of two gift cards. These two points were emphasized (bolded and underlined) in each successive participation request email. Additionally, while email addresses were obtained via ARMS software, not all of those email addresses were current or still being accessed. The FIT athletics trainer who assisted indicated she sent requests to updated email addresses she had for the athletes, and that the football players she reached out to were receptive to the participation request and very willing to complete the survey. For athletics departments, and future researchers, this signals a need to take extraordinary measures to keep up-to-date contact information for all graduated student-athletes.

This survey was, in a way, a surveillance tool for the Concussion Management Program to learn more information about their athletes and check in on how seriously athletes viewed concussion testing. This study corrected for a limitation of the Schatz et al. (2017) study, which was the first to include a survey involving the admittance to sandbagging behaviors. The Schatz et al. (2017) study solicited responses from *current* student-athletes who might have had incentives to not be forthcoming with honest information. All of this study's respondents had graduated and therefore likely had less of an incentive to not be forthcoming. The majority of participants were football players (24% of the sample), followed by men's lacrosse (7% of the sample) and softball (7% of the sample). Because the representation of each sport was quite small, despite being more representative of the student-athlete population as a whole, it was not possible to draw any cogent conclusions regarding sport-related factors in sandbagging or effort given on baseline testing. Eighty-seven percent of the sample were recruited athletes and starting players, reasonably suggesting these were players who received a substantial amount of playing time.

One critical gateway question on the survey asked participants to rate the effort they gave during baseline testing on a scale from one (poor effort) to seven (best effort). While eighty percent of participants reported they gave their best effort, twenty percent of the sample admitted they did not give their best effort. Most recently, Schatz et al. (2017) concluded that nearly one third of their sample reported they did not provide maximal effort on their concussion baseline test. While lower than Schatz and colleagues, the 20% figure for less than maximal effort may well be within the normal distribution that could be identified across institutions and programs. Factors that could predict suboptimal effort were examined in this study. Individuals were asked why they did not perform to the best of their ability. Reasons for providing suboptimal effort included: feeling fatigued, being preoccupied by other factors, being bothered by distractions in the testing room, wanting a low baseline score so concussion could not be detected, or just not caring. Additionally, some athletes reported being "hungover" at the time of testing. Thankfully, none of the participants endorsed poor performance due to belief that concussion is not a serious injury. This suggested that the FIT Concussion Management Program was doing a sufficient job of educating athletes on concussion and the associated risks, and most athletes were providing their best effort during testing.

In terms of self-reported sandbagging, this is the second study (following Schatz et al., 2017) to ask athletes directly if they engaged in this behavior. Our study found that five athletes (seven percent of the sample) admitted to sandbagging in some form. This was similar to Schatz et al. (2017), who found that six percent of collegiate male and female athletes reported a history of sandbagging behavior on a survey. Therefore, this may suggest that having graduated does not in fact impact self-reported sandbagging.

The present study corrected another limitation of the Schatz et al. (2017) study, which did not include football players. Despite this correction, the same percentage of self-identified sandbaggers was found. It is reasonable to surmise that if the Schatz et al. (2017) study had included football players they might have identified more sandbaggers, since the majority of this study's sandbaggers were football players. Football was more represented in the current study's sample, so it was no surprise that football players comprised the majority of sandbaggers.

No studies to date have asked athletes reasons why they sandbagged, so this study was an original contribution in that regard. The self-reported sandbaggers who directly admitting to engaging in this behavior (n = 3) reported they did so out of fear, whether it be due to fear of losing playing time, fear of someone else taking their position, or fear of disappointing coaches or teammates. Student-athletes who are both intrinsically and extrinsically motivated to perform well in their sport take their playing time and success on the field seriously, and loss of playing time or position could be devastating to a student-athlete. While this study hoped to identify more sandbaggers for the purpose of understanding sandbagging better, the low number of sandbaggers we found was welcome news for the FIT Concussion Management Program. However, concern was raised when considering the number of participants who reported they heard a teammate say he or she sandbagged. Thirty-one percent of the sample endorsed hearing a teammate say he or she sandbagged. The most common reason participants heard teammates endorse for sandbagging was fear of losing playing time, followed by fear of someone taking his or her position and fear of losing athletics scholarship aid. These reports are troubling because having more teammates who sandbagged than people who directly admitted to it in this survey suggested that there were more sandbaggers out there. It cannot be known if they would have identified themselves. The specter of unidentified sandbaggers raised the question of whether people did not respond because they did not want to admit to engaging in this behavior.

The discussion of scholarship support and the role it may or may not have played in motivation during baseline testing was an original contribution of this study. The role of scholarship support in effort given was conceptually important because many athletes could not have attended FIT without their scholarship aid, and this could have been an understandable motivating factor for poor performance. The focus on financial assistance demonstrated that 70% of the sample could not have attended FIT without their athletics scholarship aid. Furthermore, while none of the self-reported sandbaggers endorsed fear of losing scholarship as a motivating reason for sandbagging, five participants reported they heard a teammate admit to sandbagging due to fear of losing scholarship aid.

Another purpose of this study was to see how sandbagging appeared on the test measures the CMP employs, including both performance and effort-based measures. This would have corrected another limitation of the Schatz et al. (2017) study, which did not allow for the matching of survey responses with neuropsychological assessment results. The analyses that were initially planned could not be conducted because there were only the five self-reported sandbaggers, and this is to be expected when working with only the data that is presented from conducting survey work. Conducting a regression analysis to determine if variables were predictive of effort, and independent samples *t*-tests to determine any mean differences in the different measures for sandbaggers versus non-sandbaggers had been desired. In addition, conducting a 2x3 factorial analysis of variance (ANOVA) to analyze interaction, and main effects of scholarship status and suboptimal performance was hoped for. However, data could still be analyzed qualitatively. Side by side comparisons of a few individuals' scores showed that scores on performance and effort-based measures trended lower for individuals who sandbagged, but there was no confidence in the meaning or reliability of the data because of the very small sandbagging sample. However, scores also trended lower across the board for individuals in the suboptimal effort group (sandbaggers and non-sandbaggers; 20% of the sample) compared to the optimal effort group (80% of the sample), and there was more confidence in this outcome due to larger group sizes. It should be noted that this was an observation that the raw numbers were numerically different, versus a statistical comparison with a significant outcome. This observation suggested that athletes who reported they did not give their best effort did in fact have scores that trended lower on average than individuals who did give their best effort. Moreover, the trends observed in differences between scores of sandbaggers versus non-sandbaggers suggests that statistical differences may in fact be found with a larger sample size of sandbaggers. If a statistical difference was found in this case, implications could include more effectively identifying sandbaggers using this battery of tests at baseline.

In terms of poor-effort identifiers on the Rey WRT, Rey DCT and ImPACT, it was reasonable to pose the question of whether sandbaggers could have been caught by identifiers. Goworowski et al. (2018) established normative values for the Rey WRT in a college-athlete population. Results from that study indicated that mean total words correct was 10.47, mean correct of the first eight words presented was 6.01, mean number of intrusions was 0.89 and mean combination score was 15.59. The two male sandbaggers in the present study scored below these normative values, while the female sandbagger did not. In addition, in comparison to the Rey DCT combination score ≥15 suggested for detection of suspect effort by Salazar et al. (2017), sandbaggers all scored well below 15 on this measure. Lastly, the ImPACT invalidity index, which is based on the following algorithm: X's and O's Total Incorrect > 30 OR Impulse Control Composite > 30 OR Word Memory Learning Percent Correct < 69% OR Design Memory Learning Percent Correct < 50% OR Three Letters Total Letters Correct < 8 (Lovell, 2011) was examined. None of the sandbaggers met any of these criteria. When considering how sandbaggers did not necessarily raise any red flags on embedded effort measures, preliminary data suggests one should not be complacent about sandbagging being difficult to hide, as was reported in past studies; specifically Erdal (2012) and Schatz and Glatts (2013), who found that sandbagging behavior on baseline concussion testing is more difficult to achieve, without detection, than is reported in the media.

Limitations

A limitation of this study included small sample size, but as a pilot study it set the stage for this research to be continued and the sample size to grow. There is not much confidence in saying sandbaggers' scores meaningfully suggested what athletes' test materials should be looked at a second time for accuracy because of the very small number of sandbaggers identified. A larger sample size will correct for this limitation, as data needs to continue to be collected since this is the only way to identify more sandbaggers. Moreover, existent record keeping of contact information for graduated students leaves a lot to be desired. For this type of research one is dependent on other offices, and can only take what is given. Unfortunately, this study found that their records are not overly accurate or up to date.

Future Research Directions

Suggestions for practice that we make include keeping track of students and how to contact them after they graduate. In future studies that attempt to solicit responses from former athletes, it will be necessary to take extraordinary measures to find up-to-date contact information. Asking for an updated email address confirmation at the time of graduation, and then an email address update request every year for the first five years after an athlete has graduated would be a possible solution. It would also be useful to build in a feedback system when athletes graduate to inform programs of how well the information they presented was received and other relevant program outcomes. However, it is suggested to wait until the athletes have graduated so they do not feel threatened to answer and will be willing to talk more freely. Another direction would be to make responses anonymous with the hope that more sandbaggers would come forward, but this would create a new limitation since individual's scores on testing could then not be linked to survey responses. Lastly, it is possible that soliciting responses from current student-athletes might not in fact taint participant's responses as initially suspected, and they may well answer honestly. This would likely make it easier to increase the sample size.

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Appendix A

Florida Tech Concussion Management Questionnaire

This is a brief survey asking you about your experience during concussion baseline testing while you were an athlete at Florida Tech. The researcher and her supervisor are the only individuals who will see this data. Please, read each question carefully and answer to the best of your ability. By continuing past this page, you are consenting to participate in this survey. Please check the box below confirming your consent.
(I consent)

1. What sport did you play at FIT?

____

2. Were you a recruited athlete?
____ Yes
____ No

3. Were you a starting player at any point?
____ Yes
____ No

4. What is your ethnicity?
_____ White
_____ Black/African American
_____ Asian
_____ Hispanic/Latino
_____ Native Hawaiian/Other Pacific Islander
_____ American Indian/Alaska Native
_____ Two or more races

4. What is your current age?

____

5. What was the last year you played for FIT?

____

6. Did you ever experience a concussion while playing your sport at Florida Tech?
______ Yes
______ No

7. How many times total, if any, have you had a concussion in your lifetime?

____

8. During the years that you played at FIT, how much scholarship money did you have from athletics? Please enter either 1= *full athletic scholarship*; **2=** *partial athletic scholarship*; **or 3=** *no athletic scholarship aid* **for each year.**
1st year _____
2nd year _____
3rd year _____
4th year _____
5th year _____ (if applicable)

9. If you received athletics scholarship money, would you have been able to attend FIT without this financial aid?
___ Yes
___ No
___ I did not receive any athletics scholarship aid

10. Please consider the following statement.
At concussion baseline testing, you were asked to perform to the best of your ability. Did you do that?

Rate how true this would be for you on a scale from 1 (*"I did not perform to the best of my ability")* to 7 (*"I did perform to the best of my ability").*

1 2 3 4 5 6 7

Condition: If 7 is selected, skip to **question 14.

11. Looking back, in the years that you played at FIT**,** if you realize you did not give your best effort at concussion baseline testing, which of the following reasons was the **MOST** responsible? Please, select **ONE** response for each year. If you gave good effort in that year, check the response at the bottom.

Year ONE:

____ I was fatigued or not feeling well.
____ I was preoccupied by other factors (i.e. personal matters, family concerns, etc.).
____ I did not think a concussion could happen to me.
____ I did not think a concussion was likely to happen in my sport.
____ I did not think concussion was a serious injury.
____ I was bothered by distractions in the testing room.
____ I wanted to have a low baseline score so a potential concussion could not be detected.
____ I just did not care.
____ Other (please specify): ____
____ *I gave my best effort this year.*

Year TWO:

____ I was fatigued or not feeling well.
____ I was preoccupied by other factors (i.e. personal matters, family concerns, etc.).
____ I did not think a concussion could happen to me.
____ I did not think a concussion was likely to happen in my sport.
____ I did not think concussion was a serious injury.
____ I was bothered by distractions in the testing room.
____ I wanted to have a low baseline score so a potential concussion could not be detected.
____ I just did not care.
____ Other (please specify): ____
____ *I gave my best effort this year.*

Year THREE:

____ I was fatigued or not feeling well.
____ I was preoccupied by other factors (i.e. personal matters, family concerns, etc.).
____ I did not think a concussion could happen to me.
____ I did not think a concussion was likely to happen in my sport.
____ I did not think concussion was a serious injury.
____ I was bothered by distractions in the testing room.
____ I wanted to have a low baseline score so a potential concussion could not be detected.
____ I just did not care.
____ Other (please specify): ____
____ *I gave my best effort this year.*

Year FOUR:

____ I was fatigued or not feeling well.
____ I was preoccupied by other factors (i.e. personal matters, family concerns, etc.).
____ I did not think a concussion could happen to me.
____ I did not think a concussion was likely to happen in my sport.
____ I did not think concussion was a serious injury.
____ I was bothered by distractions in the testing room.
____ I wanted to have a low baseline score so a potential concussion could not be detected.
____ I just did not care.
____ Other (please specify): ____
____ *I gave my best effort this year.*

Year FIVE *(if applicable):*
____ I was fatigued or not feeling well.
____ I was preoccupied by other factors (i.e. personal matters, family concerns, etc.).
____ I did not think a concussion could happen to me.
____ I did not think a concussion was likely to happen in my sport.
____ I did not think concussion was a serious injury.
____ I was bothered by distractions in the testing room.
____ I wanted to have a low baseline score so a potential concussion could not be detected.
____ I just did not care.
____ Other (please specify): ____
____ *I gave my best effort this year.*

12. If you said you did not give 100% effort, did you ever *intentionally* try to lower your score?
_____ Yes
_____ No

***Condition: if **No** is selected, skip to **question 14**.*

13. If you **intentionally** gave poor effort in a year, which reason was the **MOST** responsible? *If you did give your best effort in a certain year, please check the good effort response at the bottom.*

Year ONE:
___________ Did not think concussion was a serious injury.
___________ Fear of losing playing time if a concussion was detected.
___________ Fear of someone else taking your position if a concussion was detected.
___________ Fear of losing athletic scholarship money if a concussion was detected.
___________ Fear of disappointing coaches and teammates if a concussion was detected.
___________ A coach or teammate encouraged me to perform poorly.
___________ Other (please specify): ________________________________
___________ *I gave my best effort this year.*

Year TWO:
___________ Did not think concussion was a serious injury.
___________ Fear of losing playing time if a concussion was detected.
___________ Fear of someone else taking your position if a concussion was detected.
___________ Fear of losing athletic scholarship money if a concussion was detected.
___________ Fear of disappointing coaches and teammates if a concussion was detected.
___________ A coach or teammate encouraged me to perform poorly.
___________ Other (please specify): ________________________________
___________ *I gave my best effort this year.*

Year THREE:
____________ Did not think concussion was a serious injury.
____________ Fear of losing playing time if a concussion was detected.
____________ Fear of someone else taking your position if a concussion was detected.
____________ Fear of losing athletic scholarship money if a concussion was detected.
____________ Fear of disappointing coaches and teammates if a concussion was detected.
____________ A coach or teammate encouraged me to perform poorly.
____________ Other (please specify): ____________________________________
____________ *I gave my best effort this year.*

Year FOUR:
____________ Did not think concussion was a serious injury
____________ Fear of losing playing time if a concussion was detected during the season
____________ Fear of someone else taking your position if a concussion was detected
____________ Fear of losing athletic scholarship money if a concussion was detected
____________ Fear of disappointing coaches and teammates if a concussion was detected
____________ A coach or teammate encouraged me to perform poorly
____________ Other (please specify): ____________________________________
____________ *I gave my best effort this year*

Year FIVE *(if applicable):*
____________ Did not think concussion was a serious injury.
____________ Fear of losing playing time if a concussion was detected.
____________ Fear of someone else taking your position if a concussion was detected.
____________ Fear of losing athletic scholarship money if a concussion was detected.
____________ Fear of disappointing coaches and teammates if a concussion was detected.
____________ A coach or teammate encouraged me to perform poorly.
____________ Other (please specify): ____________________________________
____________ *I gave my best effort this year.*

14. Have you ever heard a teammate suggest that he or she *intentionally* gave poor effort on baseline testing?
______ Yes
______ No

15. If you heard a teammate suggest that he or she *intentionally* gave poor effort at baseline, did he or she state any of these reasons as responsible?

____________ Did not think concussion was a serious injury.
____________ Fear of losing playing time if a concussion was detected.

____________ Fear of someone else taking your position if a concussion was detected.
____________ Fear of losing athletic scholarship money if a concussion was detected.
____________ Fear of disappointing coaches and teammates if a concussion was detected.
____________ A coach or teammate encouraged them to perform poorly.
____________ Other (please specify): ________________________