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Exploring the Effects of Concussion on College Students Returning to Academic Demands

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EXPLORING THE EFFECTS OF CONCUSSION ON COLLEGE STUDENTS RETURNING TO ACADEMIC DEMANDS

A Dissertation Presented

by

Kathryn Vreeland

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ABSTRACT

While the media frenzy focuses on the physical risks of concussion, there is also growing concern about the academic repercussions for students who sustain the injury. We do not currently have a uniform evidence-based approach for optimally returning a student back to learning activities after a concussion. We also do not understand how the diverse consequences of a concussion may affect academic self-efficacy and performance. The purpose of this study is to explore the effects a concussion may have on college students who are navigating the return to learn (RTL) process. This research aims to inform whether there are measurable deficits in academic self-efficacy using the previously validated and abridged survey measure, the Self-Efficacy of Learning Form (SELF-A). Time of injury during the academic semester is also considered, as we hypothesize greater healing should negate the concussion’s effects on the measure of self-efficacy. In addition, the research explores students’ experiences with RTL using a semi-structured interview approach.

The results suggest that college students who suffer a concussion during an academic semester have lower measures of academic self-efficacy compared to a control group of their peers. In addition, results show that students are returning to learn while still suffering from the effects of their concussion. This study found no significant correlation between the healing time of a concussion and the scores on the SELF-A. The interviews served to underscore the diverse myriad physical and psychological challenges a student faces, as well as the precarious variance in RTL strategies.

This study highlights the challenges that students face while they RTL following a concussion, and begs the investigation of whether better RTL practices can help mitigate the negative effects. It underscores the necessity for further research, evidence-based medical care, instructor accommodations, and institutional policies to support students’ safe RTL and ability to perform at their maximal academic potential.
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CHAPTER I: INTRODUCTION

Concussion injuries are increasing in frequency and concern for athletes at all levels, including collegiate student athletes (Zuckerman, Lee, Odom, Solomon, Forbes, & Sills, 2012). Concussions are a subset of traumatic brain injury that can have significant consequences on a patient’s health and wellbeing. College student athletes that sustain a concussion are of particular concern due to the unique demands of participation in both cognitively demanding and physically active environments, both of which can be impaired by the effects of the concussion (McGrath, 2010; Harmon et al., 2013).

Recently, there is an increasing focus on appropriate strategies for returning a student to learning activities following a concussion, in a manner that best supports their health, wellbeing, and academic efficacy. Literature surrounding concussion has largely focused on returning to physical activity; there is at present a dearth of high quality studies addressing return to cognitive activities following a concussion, and most of the current resources are based on expert opinion (Eastman & Chang, 2015; Dreer, Crowley, Cash, O’Neill, & Cox, 2016). We are in a climate of media frenzy regarding concussions, especially as the National Football League is brought into the limelight with their previously flawed policies and ongoing challenges concerning the health and safety of the players (Fainaru-Wada & Fainaru, 2013). Information about concussion is convoluted for students, parents, teachers, and other stakeholders in the academic realm, as short-term effects have 100% variability, meaning they are displayed differently in each and every individual case (Harmon et al., 2013). In addition, the long-term effects are largely unknown but nascent research and media profiling is demonstrating the suggestion of significant detriments to health and wellbeing. The literature is constantly evolving, and
the return to learn (RTL) process requires due diligence in order to best serve and protect the health, wellbeing, and academic interests of students and the academic community.

A review of the literature emphasizes that there is much we still do not know about the functional effects of a concussion, and there is no uniform, evidence-based optimal management strategy for returning to learn. The consensus of the medical community is that rest from both physical and cognitive activity, at least in the acute stages of recovery, is necessary in the appropriate management of a concussion while allowing the brain to heal (Harmon et al., 2013; McCrory, Meeuwisse, Aubry, Cantu, Dvořák, Echemendia, … & Turner, 2013; Schneider, Iverson, Emery, McCrory, Herring, & Meeuwisse, 2013; Thomas, Apps, Hoffman, McCrea, & Hammeke, 2015; Halstead, McAvoy, Devore, Carl, Lee, & Logan, 2013). A recent spate of research is suggesting that, even when considered healed, there may be physiological effects due to the concussion that may not be distinguishable by the common clinical battery of examination, causing lasting deficits that may cause cognitive or emotional challenges far beyond a patient’s clinically established full recovery (Czerniak, Sikoglu, Liso Navarro, McCafferty, Eisenstock, Stevenson, King, & Moore, 2014; Pontifex, Broglio, Drollette, Scudder, Johnson, O’Connor, & Hillman, 2012; Vargas, Rabinowitz, Meyer, and Arnett, 2015; Albaugh, Orr, Nickerson, Zweber, Slauterbeck, Hipko, Gonyea, Andrews, Brackenbury, Watts, & Hudziak, 2015; Brown, Dalecki, Hughes, Macpherson, & Sergio, 2015). In addition to potential lasting indiscernible effects, studies also show that concussed participants who engage in physical and cognitive activity while still suffering from symptoms or neurocognitive deficits may prolong their symptoms and even cause adverse effects (Brown, Mannix, O’Brien, Gostine, Collins, & Meehan, 2014; Majerske, 2015).
Mihalik, Ren, Collins, Reddy, Lovell, & Wagner, 2008). In partial contrast, current literature is also suggesting that returning the student athlete to learn with modified instruction or academic adjustments while still symptomatic may ultimately serve the patient better during the recovery process (Halstead et al., 2013; Collins, Kontos, Reynolds, Murawski, & Fu, 2013).

Students in college, an overwhelming majority of whom are no longer dependents of their parents or guardians, have autonomy over their decisions regarding when and how to return to learning activities (such as classes, studying, or homework) even while still suffering from the effects of the concussion. This new independence is a challenge for a majority of these young adults as they learn to navigate the college system along with their own elevated responsibilities. College students have obligations to return to their classes and studies, and maintain minimum academic standards for college and program retention and promotion. Following a concussion, a student’s ability to be efficacious may be cognitively, emotionally, and/or physically impaired, and the support from their professors may not be adequate to help them progress appropriately back to their educational demands. Carson, Lawrence, Kraft, Garel, Snow, Chatterjee, Libfield, MacKenzie, Thorton, Moineddin, and Frémont (2014) found in a review of medical records that nearly half (44.7%) of concussion patients who returned to learn had consequential recurrence or worsening of their symptoms, whereas Thomas et al. (2015) found that too much strict rest may actually contribute to concussion-like symptoms. There is still so much the medical community does not know about the functional problems and optimal management strategy following a concussion, and the literature surrounding much of this information is nascent, constantly evolving and/or sometimes
conflicting. This illustrates the concern for college students who have sustained a concussion and begs the exploration of the effects of concussion on academic performance and self-efficacy of students.

Concussions are caused by direct or indirect head trauma, such as impact to the head or forces that cause the brain to move vigorously inside the skull. Those who participate in sports and activities such as football, rugby, soccer, cheerleading, and basketball, etc., are at risk of sustaining a concussion. Of particular concern are individuals who are college-age or younger, as they are vulnerable to potential life-threatening and catastrophic injury due to possible mismanagement, such as Second Impact Syndrome – characterized by herniation of the brain often resulting in death (Casa, Guskiewicz, Anderson, Courson, Heck, Jimenez, … & Walsh, 2012). A majority of colleges and universities in the United States offer opportunities for participation in physical activities that present a substantial risk of concussion, including varsity athletics, club sports, intramurals, or other recreational offerings. Examples of concussion symptoms include impairment of memory, slowed reaction time, difficulty concentrating, sleep disturbance, and physical symptoms such as headache and nausea (Harmon et al., 2013; Majerske et al., 2008). Fortunately, most concussions are short-term and are considered healed in a reasonable amount of time, often within seven to ten days, if managed appropriately (Harmon et al., 2013). However, returning to learn too soon or without appropriate accommodations may cause declines in academic performance due to the ongoing symptoms and cognitive impairments, and can also exacerbate the cognitive deficits causing the student to suffer for a longer period of time (Brown et al., 2014; Majerske et al., 2008; Halstead et al., 2013; Carson, et al., 2014).
The mental, emotional, and physical effects of a concussion can cause significant interference with both physical and cognitive activities (McGrath, 2010; Stewart, McQueen-Borden, Bell, Barr, & Juengling, 2012). Medical professionals understand that all symptoms related to the concussion must be absent prior to return to full physical activity (Harmon et al., 2013). However, deciding an individual’s return to cognitive activity is a challenging decision-making process that tends to be blurry and without clear uniform policy and procedures (Popoli, Burns, Meehan, & Reisner, 2013). The literature overwhelmingly recommends a period of complete rest immediately following a concussion (largely based on expert opinion), however for how long, and when and how to return to learn is still largely unknown (Thomas et al., 2015). Symptoms of a concussion vary in nature, intensity, and duration for each individual, causing predictable challenges to academic performance that require individualized prescriptions of rest and academic accommodations during the period of time the student is suffering (McGrath, 2010; Harmon et al., 2013). A recent study published by Dreer et al. (2016) revealed that fifty percent of responding teachers across all grade levels, including higher education, believed that a concussion does not affect the student as they return to school; less than half had received any training on concussion information. Heyer, Weber, Rose, Perkins, and Schmittauer (2014) further suggest that accommodations and resources may not be readily apparent or available to help guide the decision-making of the student who is suffering from a concussion, thus complicating the already complex process of determining the individual needs for each student while they are recovering. Collegiate students who have sustained a concussion often have to navigate this challenging process without knowledge of, or even access to, resources and accommodations that may be
necessary to ensure a healthy and safe return to learn. If college students are returning to learn while still suffering from the concussion, either from discernible or unknown symptoms, common sense would suggest potential consequences or repercussions on their academic self-efficacy.

**Statement of Purpose**

The purpose of this study is to evaluate the effect of concussion on academic self-efficacy in collegiate student athletes, as well as explore the experience of the RTL process. McGrath (2010) articulated that students suffering from a concussion will have varying degrees of neurocognitive impairment and therefore “may not be able to meet the usual expectations for class participation and homework completion until symptoms have cleared and neurocognitive function has returned to normal” (p. 493). Reiterated by Stewart et al. (2012), students suffering from a concussion report ongoing and significant difficulty with academic tasks such as simply participating. The dilemma that is illuminated by researchers and clinicians is that there is not a uniform procedure, nor evidence-based best practice, for returning a collegiate student to cognitive activity following a concussion. Furthermore, our understanding of the long-term physiological effects of a concussion continues to evolve through research suggesting previously unknown structural and functional changes. This study explores the effects of a concussion suffered by college students on their academic self-efficacy. It further delves into the students’ own perceptions and experiences with the RTL process and the various challenges that may be associated. Finally, the study will attempt to show whether there are measureable indicators of how a student’s academic self-efficacy may be affected based on their neurocognitive performance after the concussion.
There are two parts of the study that help address the questions at hand: one quantitative and the other qualitative in tradition. To measure academic self-efficacy, the study utilizes a validated and abridged version of a survey developed by Zimmerman and Kitsantas (2007)—the Self-Efficacy for Learning Form (SELF). The abridged SELF (SELF-A) is a 19-question survey that measures three constructs of academic self-efficacy in the collegiate setting: notetaking, studying, and test preparation. A qualitative approach is appropriate to investigate the process of returning to learn, thus lending insight and understanding into the participants’ experience and interpretations of the process (Creswell, 2013; Glesne, 2011). To explore the participants’ experiences of returning to learn, the study uses face-to-face semi-structured interviews that are recorded, transcribed, coded for themes and patterns, then discussed in a consensual review process. The interview attempts to explore the students’ experiences and challenges as they returned to learn, as they deem attributable to the physical, emotional, and/or cognitive effects of the concussion.

A commonly used clinical tool for measuring neurocognitive deficits of concussion is the computerized testing module called Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT). This program is widely used among medical professionals to assess cognitive factors that may be affected due to a concussion (Maerlender, Flashman, Kessler, Kumbhani, Greenwald, Tosteson, & McAllister, 2010). For example, Kerr, Snook, Lynall, Dompier, Sales, Parsons, and Hainline (2015) found that 77.1% of responding colleges in the National Collegiate Athletic Association (NCAA) employ ImPACT to aid in their concussion management strategy. ImPACT can be used to reveal deficits between baseline (pre-concussion) and post-concussion testing.
to help the medical professional in the evaluation of concussion and progression of healing. ImPACT can also be utilized for these purposes in the absence of a baseline test (Collins et al., 2013). Deficits to baseline or normalized scores can indicate dysfunction with visual and verbal memory, reaction time, attention, non-verbal problem solving, and processing speed, which are skills that are often necessary for success in the academic realm. ImPACT is commonly used for helping guide return to activity decisions for sport, however in this study it is used as an instrument to help determine whether the scores may be indicative of scores on the SELF-A.

The guiding hypothesis for this dissertation is that college students who returned to learn in the same semester that they sustained a concussion will exhibit declines in their academic self-efficacy, as compared to a control group who did not suffer a concussion during the semester. The results are tested for statistical significance, however due to a small sample size, effect size calculations will be a more useful metric, measured using Cohen’s $d$ (Cohen, 1988). For the other research questions, correlations are used to assess the relationships between ImPACT scores and survey results, and qualitative interview coding and consensual review are used for exploration into the experience of returning to learn following a concussion.
CHAPTER II: REVIEW OF THE LITERATURE

This dissertation explores the influence of concussion on academic self-efficacy and the experience of returning to learn, specifically for college students, using both survey and interview methods. The study also uses neurocognitive testing to investigate the relationship with the participant’s survey of academic self-efficacy. Literature shows that concussed students are at risk for further health concerns due to physical activity (Harmon et al., 2013), and recent studies suggest that cognitive activity while concussed may also increase the risk for health concerns such as sleep disturbances, prolonging or even the reemergence of symptom (Brown et al., 2014; Heyer et al., 2014; Kostyun, Milewski, & Hafeez, 2014; Carson et al., 2014). Another recent growing body of literature points to the ongoing challenges to cognitive and emotional function due to a history of concussion (Czerniak et al., 2014; Pontifex et al., 2012; Brown et al., 2015; Vargas et al., 2015; Albaugh et al., 2015). A consistent theme in the literature is the recommendation of making adjustments to the student’s schedule and workload for RTL (McGrath, 2010; Harmon et al., 2013; Brown et al., 2014; Moser, Glatts, & Schatz, 2012; Collins et al., 2013), however there are no uniform policies or procedures for returning a concussed student to learning activities (Harmon et al., 2013; Stewart et al., 2012; Popoli et al., 2014; Thomas et al., 2015; Eastman & Chang, 2015; Olympia, Ritter, Brady, & Bramley, 2016). This review of the literature will include concussion definition and etiology, prevalence, signs and symptoms, manners of diagnosis, and known complications. The neurocognitive measurement tools used for concussion diagnosis and research, primarily Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) tool will be reviewed within this section. This is followed by an examination
of the relevant nascent literature suggesting ongoing physiological impairments, even after the concussion is considered healed, especially as they may relate to effecting academic efficacy. Additionally, there will be a short review of literature addressing the research of academic self-efficacy in students. Finally, the literature surrounding RTL for students with concussion and other associated head trauma will be reviewed.

**Defining Concussion**

Harmon et al. (2013) compiled one of the most comprehensive reviews of recent concussion literature, published as the “American Medical Society for Sports Medicine Position Statement: Concussion in Sport”. This statement is endorsed by prominent sports medicine organizations, including the National Athletic Trainers’ Association and the American College of Sports Medicine. While there are many definitions of a concussion, the injury is defined in this report as “a traumatically induced transient disturbance of brain function” (Harmon et al., 2013, p. 16). Conussions can produce varying degrees of physical and cognitive dysfunction, including adverse effects on behavior, sleep and emotion (McCrory et al., 2013). Physiologically, the brain is in a vulnerable state while concussed; the cellular function in the brain is abnormal and ions become unbalanced, inhibiting normal neurobiological communication pathways (Giza and Hovda, 2001; McCrory et al., 2013). These metabolic events explain the presence of symptoms such as difficulties with memory, processing speed, concentration, and emotionality and sleep disturbance. Mismanagement of a patient with a concussion can have serious ramifications, the least of which may be prolonged dysfunction leading to negative repercussions on a person’s wellbeing both on and off the playing field (Brown et al., 2014). More serious complications can arise from returning to activity too soon; if head
trauma occurs while a student is still concussed it can put the individual at risk for a catastrophic and potentially fatal condition such as second impact syndrome, to be discussed in a later section (Casa et al., 2012; Harmon et al., 2013).

This review of literature raises the concern for the personal safety and wellbeing of college student athletes regarding the seriousness of concussion and the challenges of returning to their academic responsibilities. The overwhelming consensus of the expert community is that a patient with a concussion should have complete physical and cognitive rest, at least in the acute stage for one to two days, followed by a gradual and graded return (Harmon et al., 2013; McCrory et al., 2013; Schneider et al., 2013; Thomas et al., 2015; Halstead et al., 2013). However, there are potentially significant risks to academic performance and self-efficacy if a college student either fails to keep up with their work or even if they return to cognitive activity too soon or without appropriate progression (Halstead et al., 2013; Brown et al., 2014; Moser et al., 2012; Thomas et al., 2015). In addition, literature is now suggesting ongoing functional deficits that are not readily measureable, likely causing further academic ramifications (Czerniak et al., 2014; Pontifex et al., 2012; Brown et al., 2015; Vargas et al., 2015; Albaugh et al., 2015).

Cognitive impairment could likely cause a decline in grades and overall GPA (McGrath, 2010). For some student athletes, this could result in dismissal from their academic program, revocation of scholarships, or even dismissal from the collegiate institution. The following sections will explore the challenges a college student athlete faces when suffering from a concussion.
Prevalence of Concussions

A concussion is a common injury for athletes, with estimates of more than three million occurring annually due to participation in sports (Stewart et al., 2012; CDC, n.d.; Langlois, Rutland-Brown, & Wald, 2006). Stewart et al. (2012) explain that rates of concussion in sport are based on estimates rather than actual reported numbers; there is no universal pathway or requirement for reporting concussions across all levels of sport, including high school and college. Furthermore, studies have shown that athletes may underreport or even fail to recognize their concussion symptoms, therefore suggesting an even greater incidence of concussion. A review of literature by Register-Mihalik et al. (2013) suggests that a significant number of concussions are not reported or not recognized, potentially doubling the known rate of occurrence. In the US, reported concussions account for up to 10% of injuries sustained in sport related activity (Harmon et al., 2013, p. 17). Harmon et al. (2013) explains that rates of diagnosed concussions due to sports in the US are increasing, with a majority occurring in sports including: football, wrestling, soccer, and basketball. Injury rates during competition are significantly greater than in practice (Hootman, Dick, & Agel, 2007). Hootman et al. (2007) explored the epidemiology of injuries at the collegiate level for 15 common organized sports over the course of 16 years. The authors found that concussions increased significantly over their period of research at an average of seven percent annually. They caution that although there may likely be increases in absolute rates of concussion, this increase also “undoubtedly reflects improvements in the detection and management of concussion” (p. 315).
Darrow, Collins, Yard, & Comstock (2009) looked at the epidemiology of severe injuries in high school athletes over a three-year time period. They defined “severe” as losing more than 21 days of activity in their sport. Incidences of concussions were 8.5 percent of all severe injuries in their study. Although these are rates for high school age athletes, the implications should be considered in college athletes due to the close proximity and sometimes overlaps in ages. It is clear from the research that concussions affect all ages of athletic participants and in a variety of different sports. This highlights the importance of continued appropriate care for returning student athletes both to physical activity and to the demands of the classroom.

**Symptoms of a Concussion**

There are numerous signs and symptoms that can be present due to a concussion, and no two concussions will affect individuals exactly the same way. Due to the complexity of the neural mechanisms of the brain, every single concussion will affect each brain differently and will have a unique presentation in each individual and at each occurrence (Majerske et al., 2008, p. 271). A common saying in medical education is that “once you’ve seen one concussion, you’ve seen one concussion.” Symptoms are generally organized into four categories: cognitive, physical, emotional, and sleep disturbances (Harmon et al., 2013). Examples of cognitive dysfunction can include difficulty with mental tasks such as concentration, memory, and slow processing of information. Patients often complain of confusion and being in a mental fog. Physical ailments are common and often include headache, dizziness, sensitivity to light and noise, problems maintaining balance, and fatigue. Patients may also suffer from emotional distress such as irritability and agitation, sadness, apathy, or being more emotional than
usual. Finally, disturbances to sleep are common due to a concussion, often causing the patient to be drowsy, have difficulty sleeping, and sleep either more or less than usual (Harmon et al., 2013).

**Diagnosing a Concussion**

As mentioned above, no two concussions will affect individuals exactly alike. It is therefore imperative to be meticulous and thorough when a concussion is suspected, and that entails comprehensive evaluation of the brain’s functions. William Prentice (2013), in his fifteenth edition of the “Principles of Athletic Training”, discusses the processes and tools that medical professionals utilize to assess and diagnose a concussion. Qualified medical professionals utilize a variety of instruments and techniques to help aid in their comprehensive evaluation, including evaluation of signs and symptoms, neurocognitive dysfunction, vital signs, cranial nerves, and tests of physical balance, coordination and exertion. The following briefly explains the general process of evaluation. The medical professional will draw upon their clinical judgment of the signs and symptoms the patient is exhibiting after head trauma, asking questions about their general state and major complaints. Patients may commonly report of any number of symptoms such as headache, dizziness, ringing in the ears, or vision problems. There is no uniform consistency in the presence of or severity of these symptoms. The medical professional will evaluate the patient for any obvious signs of neurocognitive dysfunction, such as balance problems, changes in levels of consciousness, or emotional abnormalities (such as apathy, irritability, agitation, and heightened emotional responses). The patient is tested for any abnormalities and/or deterioration of their vital signs (such as heart rate and blood pressure), and of the cranial nerves, which are responsible primarily for sensory
and muscle function around the head and neck. Medical evaluation for a concussion also includes testing memory, concentration, coordination, and balance. If appropriate, the patient will be asked to perform tests of physical exertion to assess for effects from the head trauma. Further imaging such as an X-Ray or CAT scan is generally not used in concussion evaluations; a patient may be referred to these types of diagnostic tools if there is suspicion of morbidity to the structural tissue of and surrounding the brain, such as a skull fracture or intracranial hemorrhaging (Prentice, 2013).

To aid in the comprehensive evaluation of a concussion, medical professionals may also use other tools for neuropsychological testing. Common accessible tools include pen-and-paper testing batteries, such as the Standardized Concussion Assessment Tool 3rd iteration, or SCAT3 (SCAT3, 2013). The SCAT3 prompts the evaluator to rate the patient on their performance of tasks such as memory and concentration, and helps develop a symptom score. The score obtained by the patient can be assessed for significant differences compare to baseline testing, or be objectively used to determine whether a concussion is suspected (Prentice, 2013).

Computerized neuropsychological tests are also used by medical professionals for assessing neurocognitive function, and are lauded in their ability to capture many participants for baseline evaluation with much less logistical challenge than other methods (Prentice, 2013). Compared to paper-based tests, they may be more sensitive to some of the various deficits in neurocognitive activity, such as reaction and processing speed (Iverson, Lovell, & Collins, 2005). One testing battery that has been widely used in both the management of a concussion and in research is the Immediate Post-Concussion
Assessment and Cognitive Test, or ImPACT (ImPACT Testing & Computerized Neurocognitive Assessment Tools, 2015).

**Immediate Post-Concussion Assessment and Cognitive Test (ImPACT).** ImPACT is a computerized testing battery that measures “multiple aspects of cognitive functioning in athletes, including: attention span, working memory, sustained and selective attention time, response variability, non-verbal problem solving, reaction time” (ImPACT Testing & Computerized Neurocognitive Assessment Tools, 2015, About ImPACT section).

ImPACT can be used to measure individual baseline neurocognitive performance, then compare the results to post-concussion testing performance. ImPACT generates the reports, identifying clinically significant deficits in any of the five composite scores: verbal memory, visual memory, processing speed, reaction time, and impulse control. There is also a total symptom score that is developed based on self-reporting from the patient. Research shows that ImPACT is a reliable and valid computerized testing module used as a baseline and post-concussion to measure neuropsychological tasks such as memory, attention, reaction time, and information processing speed (Majerske et al., 2008).

In a study performed by Schatz, Pardini, Lovell, Collins, and Podell (2006), the authors tested the sensitivity and specificity of the ImPACT test for participants both with and without concussion. They found that ImPACT accurately classified 85% of the participants into their correct group (concussion versus control). The probability that a concussed patient scored a positive test result was 81.9% (sensitivity), and the probability that a non-concussed patient scored a negative test was 89.4% (specificity) (Schatz et al., 2006). The authors claim this “demonstrates that the ImPACT computerized test battery
is both a sensitive and specific instrument for the assessment of the neurocognitive and neurobehavioral sequelae of concussion” (p. 97).

Iverson, Lovell, and Collins (2005) tested the construct validity of ImPACT for measuring attention and processing speeds by comparing it with a traditional and well-developed measure used in psychology, the Symbol Digit Modalities Test (SDMT). The authors note that the SDMT has been widely used in the literature for decades and “in dozens of studies with diverse clinical groups” (p. 686). The authors harnessed this recognized validity to test the constructs of the composite scores of the ImPACT test. They performed an exploratory factor analysis with all the ImPACT composite scores as well as the SDMT, which revealed a component with strong loading (accounting for 55.1% of the variance) identified as speed/reaction time. This construct included the SDMT (loaded .87) and ImPACT composite scores of both processing speed (.85) and reaction time (.76). The authors interpreted that these two ImPACT measures correlated highly with the SDMT, suggesting that they are both measuring similar constructs and contributing to the validation of the ImPACT instrument (Iverson et al., 2005). The authors are careful to note that validation will continue to be an ongoing process for ImPACT. In closing, they agree that using ImPACT for baseline and post-concussive evaluation would be helpful for clinical diagnosis and management of a concussion (Iverson et al., 2005).

Finally, to speak to the general validation and use of ImPACT, the following statistics are reported on the company’s website. ImPACT boasts a large database of clinical research, claiming “more than 215 peer reviewed and 145 independent studies on concussion management” (ImPACT Testing & Computerized Neurocognitive
Assessment Tools, 2015, About ImPACT section, para. 3). The website also claims ImPACT has trained thousands of medical professionals and that ImPACT is used by numerous professional sport teams. ImPACT also reports that it is used by thousands of organizations including high schools, colleges and universities, clinics and hospitals, professional teams, and military units. Kerr and colleagues (2015) found that 77.1% of responding schools within the National Collegiate Athletic Association (NCAA) incorporate ImPACT testing as part of their concussion assessment and management.

There is a growing body of literature that suggests ImPACT may lack the sensitivity required for subtle deficits that may remain even after the student athlete has returned to ImPACT score baseline. A study performed by Pontifex et al. (2012) suggests continued deficits in attention that are not recognized as clinically significant through ImPACT testing. ImPACT is also subject to false positives due to factors that may decrease performance other than a concussion, such as poor sleep and lack of motivation to complete the test well. It may also reveal false negatives due to practice effects. Regardless of the scores and outputs of the ImPACT test, the National Athletic Trainers’ Association recommends that interpretation should be performed by an individual with concussion training such as a physician or neuropsychologist (Broglio, S. P., Cantu, R. C., Gioia, G. A., Guskiewicz, K. M., Kucher, J., Palm, M., & McLeod, T. C. V., 2014).

Managing a Student Following a Concussion

In addition to the wide range of symptoms, the time and nature of a healing concussion can vary significantly among individuals. In their review of literature, Harmon et al. (2013) found that “most studies report that 80-90% of athletes have symptom resolution by 7 days following their injury” (p. 17). They further cautioned that
this “may not always indicate a complete cognitive recovery as persistent deficits may be present on neuropsychological (NP) testing” (p. 17). Their report suggests that these 80-90% of patients may not fully heal within seven days, and therefore exposes a gap of knowledge for when full healing does in fact occur. In addition, their findings also imply that there may be a significant number of patients (10-20%) who do not have resolution of their symptoms within a week, therefore suffering from the effects for an extended amount of time.

The following studies confirm this extended time of neurocognitive deficit. In a study of thirty participants who sustained a concussion, age range 12-21 years, Iverson, Brooks, Collins, & Lovell (2006) found that even at ten days, 37% of the participants still had neuropsychological deficits, as measured by their ImPACT scores. Activity level, including cognitive activity such as schoolwork, was shown to prolong the resolution of symptoms. Majerske et al. (2008) studied 95 student athletes who suffered a concussion, and found clinically significant deficits in ImPACT scores for those students who maintained a high level of activity compared to moderate or low levels of activity. The authors suggest that cognitive activity can be an issue for students following a concussion and recommend further research into how these cognitive activities affect recovery.

Further research indicates that healing from a concussion may vary based on a variety of factors, including age, sex, and ethnicity. Zuckerman, Apple, Odom, Lee, Solomon, and Sills (2014) investigated whether there were sex-related differences in athletes returning to symptom baseline following a concussion. They used data of self-reported symptoms from ImPACT results from a database of 740 athletes, 208 of whom did not meet the inclusion criteria. The authors found an exact match for 244 of the
remaining eligible subjects based on number of prior concussions, age, and number of days between injury and first ImPACT post-concussion test. This resulted in matching 122 males and 122 females. Within these matched groups, the participants varied in age from middle school through college. The authors found that females took two days longer and with more variability to return to baseline in their symptom score compared to their male counterparts. In their review of literature, Zuckerman et al. (2014) also noted that females reported greater severity of their symptoms compared to males. Vargas and colleagues (2015) found that participants in their study who self-reported as nonwhite ethnicity had a higher prevalence of post-concussion depression symptoms compared to participants who reported as white. These authors suggest that the prevalence of depression symptoms can prolong recovery and adversely affect quality of life.

A recent study by Baker, Leddy, Darling, Reiger, Mashtare, Sharma, and Willer (2015) investigates the self-reported problems that students had when returning to learn following a concussion and whether there are specific factors that are associated with those problems. Their participant sample included 91 students ages 13 through 19, who had a history of concussion. The researchers conducted phone interviews an average of 14.4 months after the concussion event (SD = 9.6 months). The researchers obtained the patient medical history from medical charts, SCAT2, ImPACT, and one other computerized testing tool (Automated Neuropsychological Assessment Metrics—ANAM), in order to assign clinical factors that may be attributable to students who stated they had problems returning to learn. The results show that 38.5% of students reported problems returning to school. Those who had more overall and severe symptoms scores at their first clinical visit as well as a longer recovery time reported more difficulty with returning
to learn (all factors statistically significant at $p < .03$). In addition, students with recovery time of “less than 10 days were less likely to report problems and symptoms while at school” (p. 963). Contrary to previous research reviewed, the authors of this study did not find any significant differences between genders. This study again highlights the variable nature with healing time of a concussion and how returning to learn while still suffering from symptoms, or possibly returning to learn too soon, may exacerbate these symptoms thereby causing the student undue difficulty with the process.

A study of university level athletes by Brown et al. (2015) showed deficits in participants with a history of a concussion through use of a tool not currently utilized for concussion assessment. They employed seven visuomotor mapping tasks commonly used for assessment of dementia and Alzheimer’s disease, to assess performance with standard visuomotor tasks as well as decoupling tasks, meaning the eyes and the motor task (hand movements in this case) are not congruent in direction and surface plane. They recruited 18 participants with a history of concussion, 13 of whom were asymptomatic, and 17 healthy controls. As hypothesized, the researchers found that the participants with a history of concussion had significantly larger reaction and movement times across all conditions. Movement accuracy was significantly less in the test group across four conditions. In addition, the authors used a discriminant analysis that showed the task results could correctly classify the two groups, with or without history of concussion, with 94% accuracy (p. 9). The authors propose that the deficits in patients with concussion history may be in the “communication [authors’ italics] between the brain regions responsible for planning and executing skilled movement” (p. 9). These results provide further evidence that tasks commonly required for school, such as notetaking,
typing, and general activities of daily living, may be in deficit following a concussion. Further exploration is necessary to determine the extent to which they affect a student during the RTL process.

The previous studies examined the variable rates and some of the unique challenges in the nature of healing, which can undoubtedly affect a student as they attempt to progress back to their learning activities. Vargo, Vargo, Gunzler, and Fox (2016) found that optimal management of patients following a concussion often requires rehabilitation services beyond the typical prescription of rest. In their exploratory analysis of 262 patients, the authors found 46% were referred to care from one or more of the following therapeutic disciplines: physical therapy, speech therapy, neuropsychology, and occupational therapy. This is discussed as a relatively high proportion of patients. These patients were initially seen in a concussion clinic where the providers determined whether further rehabilitation was necessary, however a limitation of the study is the lack of clear categorization in the research of subsets of mild traumatic brain injury (mTBI), such as concussion versus an mTBI that may have structural changes (but as will be discussed in the next section, a spate of research is starting to show concussion may also have lasting functional and possibly structural damage as well). To show some control for this, there were no significant differences of referral rate due to the mechanism of injury whether from sports (25% of the population sample), vehicle, or other (Vargo et al., 2016). This study highlights the demand for further rehabilitation services that may benefit a student following the concussion as they progress back activities of daily living, including school.
A significant challenge with management of a concussion that differs from other severe injuries is that the symptoms are often not visible to other people. Where a broken leg or healing shoulder separation has visible markers of injury, such as a cast or a sling, a concussion often cannot be seen or recognized by professors, parents, or advisors. In fact, Dreer et al. (2016) found only 41.9% of responding teachers to their survey reported they received concussion training as part of their job, and 82% felt they required more. More than forty percent (and up to 70%) of their sample were not even aware of some of the symptoms that can be precipitated by a concussion (such as irritability or mood changes, depression, or lack of initiative), causing potential behavioral challenges while returning to learn (such as inappropriate behavior or social isolation, and difficulty with problem solving and returning to daily activities including school). This can further complicate the management of a concussed student, as professors may not grant coursework adjustments, or the student may be self-conscious about asking for help when there doesn’t visually appear to be anything wrong. We wouldn’t expect a student in a leg cast to walk normally, nor presume that a coughing, sneezing, and feverish pupil could perform adequately as a student; similarly, we should not expect an athlete with a subset of traumatic brain injury to be able to function normally and competently in their academic responsibilities.

**Health Risks Associated With Concussion for Collegiate Athletes**

The literature commonly addresses the question of various risks to the health and wellbeing of a patient following a concussion. Some physical health risks associated with college athletes who are suffering from a concussion are well documented. For example, athletes under the age of 23 are at greatest risk for the often fatal condition of second
impact syndrome (SIS), which is a rapid swelling of the brain following impact while still concussed (Casa et al., 2012). Other than age and a history of a concussion that may still be healing, researchers have not been able to discriminate who is predisposed to SIS. Although SIS is a rare event, nearly 50% of athletes who have suffered from it have died (Casa et al., 2012). Harmon et al. (2013) highlight the continued importance of considering age, explaining that “youth athletes may have a more prolonged recovery and are more susceptible to concussions accompanied by a catastrophic injury” (p. 18). Current literature also suggests that the recurrence and mismanagement of concussions may lead to neurological sequela, a term used to explain long-term and potentially irreversible disorders of the central and peripheral nervous system. Such conditions include chronic traumatic encephalopathy (CTE), a condition that symptomatically resembles mental and chronic illnesses such as depression and dementia (Harmon et al., 2013). Current research is suggesting CTE is responsible for many recent deaths by suicide from current and former football players (Korngold, Farrell, & Fozdar, 2013). Concussions can have grave consequences at any age, however youth and young adults pose a particular concern because inappropriate personal decision-making may lead to mismanagement.

Second Impact Syndrome and CTE are shown in the literature to be associated with repetitive trauma to the head. These conditions are largely avoided by not returning an athlete who is still concussed, or an athlete with a history of multiple concussions, back to activity that risks further head trauma. In addition, to avoid other complications and promote healing following a concussion, medical professionals recommend rest from physical activity followed by a graded or progressive return to activity based on athlete
symptoms and tolerance (Harmon et al., 2013). Based on the review of literature, there appears to be no conclusive evidence or consensus of whether returning an athlete to cognitive activity causes any structural damage to the brain. However, recent research is speculatively suggesting that there may indeed be long-term changes to brain structure and/or function. The following recent studies exhibit the case for this speculation.

Researchers Czerniak, Sikoglu, Liso, Navarro, McCafferty, Eisenstock, Stevenson, King, and Moore (2014) examined the neurocognitive function of brains of 9 collegiate student athletes who had sustained a concussion between three weeks and six months prior (to assume resolution of symptoms), and compared the results to 12 control subjects who had never sustained a concussion. Using functional magnetic resonance imaging (fMRI) the authors analyzed the levels of functional connectivity occurring in the brain. Consistent with the authors’ hypothesis, there were no statistically significant differences in functional performance. This is congruous with previous research, demonstrated by a meta-analysis in 2005 by Belanger and Vanderploeg, and corroborated in 2008 by Broglio and Puetz (as cited in Czerniak et al., 2014). These meta-analysis studies showed that while concussed athletes’ neurocognitive performance significantly decreased immediately post-injury, by 10 to 14 days after injury the impairments were significantly less.

However, the authors found a startling effect that demands pause and discussion for clinicians of concussion management. Czerniak et al. (2014) also examined the degree of connectivity and functioning of the brain while the participants were at rest rather than actively performing neurocognitive tasks. The study revealed that all the test participants who had previously sustained a concussion had higher scores and measures of
connectivity at rest than the control group who had never had a concussion. These findings suggest that college student athletes who have suffered from a concussion “may have to ‘work harder’ than their healthy peers to achieve similar neurocognitive results” (para. 2) for at least six months post-injury (the time boundary of their study). If students are simply having to work harder while at rest, expending more energy than their peers, how would that translate into their ability to put forth equal or adequate energy towards the challenging demands of their academics? A previously concussed patient, one that may appear to have full healing during the semester in which she was injured, may therefore have extended energy deficits throughout her semester or academic year.

Among other foreseeable challenges to this student’s daily life, these lingering effects of the concussion could potentially precipitate declines in self-efficacy, or performance markers such as grades on exams and homework, which both necessitate high levels of energy.

Researchers have investigated other facets of ongoing cognitive deficits due to a concussion. Pontifex, Broglio, Drollette, Scudder, Johnson, O’Connor, and Hillman (2012) examined attention vigilance in collegiate athletes who have previously suffered from a concussion. They recruited 80 collegiate subjects, 38 who had a history of concussion and 42 controls, who were symptom-free and healthy (as measured by no statistically significant differences in ImPACT scores) to perform a task that measured cognitive control. This task, called a modified flanker task, was validated through use in prior research and required participants to discriminate between target and peripheral stimuli. The results showed that participants who had a history of a concussion which was considered healed had more errors on the cognitive control task. In addition, a
history of multiple concussions was associated with an even greater number of errors. The authors believe these results suggest that concussions may cause extended deficits in attention vigilance. They further discuss the speculation that concussion may cause ongoing deficits or changes to brain structure and/or function, such as cellular death and decreased gray matter, neuroelectric deficits, and changes in the neurotransmitter dopamine. Pontifex and colleagues (2012) conclude that their findings add to the literature suggesting the effects of a concussion last significantly beyond the acute stage.

In an article published in 2014, Kostyun, Milewski, and Hafeez investigated disturbances in sleep during recovery from a concussion in 545 adolescent athletes. The researchers used pre-existing data from the participants’ ImPACT scores, including the self-reported symptom of hours of sleep. The authors found that disturbances in sleep, either excessive sleep or deprivation of sleep, correlated with worse ImPACT scores. The authors state that the problem of sleep disturbance on cognitive function “has been well established in the general population and has become a common concern for adolescents. Adolescents who self-report nightly sleep disturbances have been shown to perform poorly in school” (Kostyun et al., 2014, n.p.). Mihalik et al. (2013) investigated sleep disturbance in collegiate athletes, finding that the participants who reported low quantity sleep also self-reported more concussion symptoms. Together these findings suggest the associations among impairment in cognitive function, sleep disturbances, and decreased academic performance during recovery from a concussion.

**Academic Self-Efficacy**

There is a spate of research documenting the positive effects that self-efficacy can have on academic performance. Researchers have used different scales and instruments to
measure self-efficacy, investigated the effects on different measures of performance, and across different academic disciplines, level of education and ages. This section defines self-efficacy, and explains a few of these studies as related to these various factors, and all with similar results showing the positive effects of academic self-efficacy on academic tasks and measures.

Albert Bandura (1977) is often cited as the primary researcher contributing significantly to the rise of the concept and study of self-efficacy. He defines self-efficacy as the perception that one’s self can perform a task in a way that will successfully produce a desired result, within the confines of one’s capability. The magnitude of self-efficacy can influence levels of motivation and effort expended for the task, length of persistence, goal setting, reflective thinking, academic engagement, and the initiation of coping skills, thereby indirectly affecting academic accomplishment (Bandura, 1997; Zimmerman, Bandura, & Martinez-Pons, 1992; Li, 2012; Phan, 2014; Phan 2016). Researchers also found that academic self-efficacy can directly affect academic performance (Phan, 2016; Carroll, Houghton, Wood, Unsworth, Hattie, Gordon, & Bower, 2009; Fast, Lewis, Bryant, Bocian, Cardullo, Rettig, & Hammond, 2010; Pajares, 1996; Turner, Chandler, & Heffer, 2009; Zimmerman et al. 1992). Pajares (1996) cautions that academic effects should not be considered predictive, rather explanatory based on self-efficacy. In Bandura’s (1977) model, he found that performance-based accomplishments appear to effect the most psychological change (as compared to seeing others perform tasks, verbal persuasion, and states of emotional arousal), in his study of participants attempting to overcome phobias. When translating this to academic tasks and accomplishments, the literature is strongly suggesting a link between academic self-
efficacy and academic performance, such as grades and GPA. As well, accomplishing academic goals and tasks may also influence psychological states such as motivation, reflection, and persistence to learning tasks, traits that are instrumental to the learning process. Academic self-efficacy is therefore important to consider for the academic success and well-being of a student (Phan, 2016).

Research suggests that higher levels of academic self-efficacy are associated with better academic performance. Turner and colleagues (2009) recruited a sample size of 264 college students to study the influence of the individual and intersectional factors of parenting styles, motivation, and self-efficacy on grade point average. They measure self-efficacy using the Self-Efficacy and Study Skills Questionnaire (SESS), which was developed in 1997 and has 32 Likert-scale questions. Using regression, the authors found that self-efficacy was a significant predictor of GPA in their model ($p < 0.001$). As well, the correlation was positive but low at $r = .25$.

Phan (2014) completed a two-year study of 269 university-level students’ academic self-efficacy using the Motivated Strategies and Learning Questionnaire (MSLQ). The author measured how it relates to academic performance in a course using the final grade. The students were asked to complete the survey specifically referencing the answers for the field of educational psychology. The author found that final grades correlated with the MSLQ measures at the beginning of semester and middle of semester ($r = 0.40$ and 0.42 respectively, both $p < 0.001$). They also used a structural equation model to show indirect positive effects of academic self-efficacy with academic performance with the included factor of self-reflection. Effect size was not reported.
In 2012, Li published a study of attitude, self-efficacy and effort as they relate to academic achievement and performance in the discipline of research methods and statistics. The author recruited 153 university-level participants who completed the College Academic Self-efficacy Scale (CASES). Confidence level and actual grade in the course were used to measure academic achievement and performance respectively. Academic self-efficacy was positively correlated with both measures ($r = 0.475$ and 0.728 respectively, both $p < 0.01$), noting the strong correlation with performance. A multiple regression analysis also revealed that in their models, which included attitude toward course subject and effort, academic self-efficacy could predict performance in the final grade ($p < 0.01$). In these models, about 60% of the variance was accounted for ($R^2 = 0.611$ and 0.596 for performance in statistics and research methods respectively).

There are numerous studies that show similar results in grade-level education as well. For example, Carroll et al. (2009) surveyed 935 students ages 11-18 in Australia using the Children’s Self-Efficacy Scale, and found self-efficacy had a direct positive effect on academic achievement. Fast et al. (2010) surveyed math self-efficacy in 1163 elementary students, and found direct positive effects in their performance on the California Standards Test for Mathematics. Zimmerman and colleagues (1992) studied 102 high school students in schools that served lower-middle socioeconomic neighborhoods with racially diverse participants, adapting the Children’s Multidimensional Self-Efficacy Scale to fit their study of academic performance (final grade) in social studies class. These authors also found positive moderate correlations ($r = .39$, $p < 0.05$), and direct and indirect causal effects between the final grade and perceived efficacy for academic achievement. Recently in 2016, Phan et al. published
their study of 284 eleventh grade students where they found that academic self-efficacy had direct and indirect effects on both academic achievement and academic engagement, and direct effects on well-being at school. These are just a few of the many studies of grade-level students demonstrating positive effects of academic self-efficacy on academic performance measures.

The widespread literature is suggesting positive direct and indirect effects of academic self-efficacy, using many different surveys and scales, on many different measures of academic performance. This is true for college-level students as well as students in grade and secondary school. The effects were primarily explained through positive correlations and/or statistically significant regressions. In the studies discussed, the researchers often included other factors in their models to help explain the effects and decrease the level variance. It is not yet known if a concussion affects a student’s academic self-efficacy, but clinicians and researchers have begun to investigate how to best mitigate the possible effects the concussion may have while returning to learning activities.

One scale in the literature for measuring academic self-efficacy in college students is the Self-Efficacy for Learning Form (SELF), created by Zimmerman and Kitsantas (2005). This original scale was validated for high school students, using 57 items. The authors later abridged the scale to 19 items (SELF-A), and recruited 223 college students to validate it against seven other measures, including grade in educational psychology, quality and quantity of homework, the original SELF, the Perceived Responsibility for Learning scale, SAT scores (self-reported), and a teacher rated scale of the students’ self-regulation for learning (Zimmerman & Kitsantas, 2007).
The SELF-A positively correlated with all measures at values ranging from 0.32 to 0.67, all also statistically significant ($p < .01$). The 19 items represent focus on studying, notetaking, and test preparation, and a factor analysis revealed one factor accounting for 67% of the variance. All 19 items loaded at 0.70 or above for the factor labeled self-efficacy for learning, and Cronbach’s $\alpha$ reliability coefficient was 0.97. The authors also note a very good fit for confirmatory factor analysis, although they performed both exploratory and confirmatory FA on the same sample. The authors contend that “students’ scores on the SELF are significantly predicative of the quality and quantity of homework, acceptance of responsibility for adverse academic outcomes, and course grades” (p. 162). These are all important factors that may be essential to a college students’ education. The SELF-A will be the scale used for measurement of academic self-efficacy for the following dissertation study.

**Returning a Concussed Student to Academics**

Although there is general agreement among medical professionals as to the process for returning an athlete to sport and physical participation after a concussion, there are no uniform policies or procedures for returning a student to their academic studies (Harmon et al., 2013; Popoli et al., 2014). The review of the literature clearly illuminates the ongoing challenges that student athletes face while returning to cognitive activities, such as exacerbation and prolongation of symptoms, and the necessity of greater effort for cognitive tasks compared to peers. Experts from the Fourth International Conference on Concussion in Sport contend that activities requiring concentration and attention may be a cause of exacerbated symptoms and delayed recovery (McCrory et al., 2013), and studies have suggested that returning to learn too soon or without appropriate
accommodations can exacerbate concussion symptoms, prolong recovery, and ultimately have adverse implications on both academic performance and quality of life. For example, in a study of 335 patients who suffered concussions (age range 8-23 years old), Brown, Mannix, O’Brien, Gostine, Collins, and Meehan (2014) found that the patients who self-reported higher levels of cognitive activity had a prolonged duration of the concurrent concussion symptoms compared to lower levels of cognitive activity. Carson et al. (2014) took this concept to the classroom, finding that 44.7% of participants who returned to learn following a concussion had consequential recurrence or worsening of their symptoms. Czerniak and colleagues (2014) found that collegiate student athletes who have sustained a concussion may have to work harder than their peers in order to perform even basic physiological tasks. As studies show these physical and cognitive challenges with returning to learn, researchers have found that at both the high school level and higher education a significant number of responding institutions did not have policies or assistance surrounding RTL following a concussion (Kerr et al., 2015; Olympia et al., 2016). The following section will investigate the recent research addressing the RTL process following a concussion.

Cognitive rest is strongly recommended as the staple of the early stages of recovery from a concussion. Schneider et al. (2013) reviewed the literature on how various levels of rest effects the progression of a concussion. They found very few quality studies that have been published, ultimately suggesting that there needs to be more high-level studies in order to make empirically based decisions surrounding the prescription of rest. In their review of literature, the authors found evidence that indirectly supports rest after a concussion, however many studies used animal subjects.
For student athletes who are slow to recover, exercise as a form of treatment may be prescribed following a period of rest. For example, researchers Gagnon, Galli, Friedman, Grilli, and Iverson (2009) studied the effects of exercise on 16 participants with concussion symptoms that lasted more than 4 weeks after the initial injury. They did not perform initial treatment for these participants, however the authors agree with the expert consensus that all patients must be asymptomatic at rest prior to beginning exercise. A more recent randomized control study performed by Schneider, Meeuwisse, Nettel-Aguirre, Barlow, Boyd, Kang, and Emery (2014) found beneficial effects of exercise for participants with prolonged concussion symptoms, however the experiment began only after all treatment and control participants were asymptomatic at rest. These participants initially received the treatment of cognitive and physical rest until they met the criteria for beginning exercise.

Although there is some evidence that suggests exercise in the post-acute stage may help facilitate recovery, there is consensus that exercise should not be introduced until asymptomatic at rest (Schneider et al., 2014; Schneider et al., 2013; Gagnon et al., 2009). In addition, researchers note that the literature on exercise as treatment is sparse and low quality (Schneider et al., 2013). In an attempt to sum up their review of the effects of rest, Schneider et al. (2013) caution that “in the absence of evidence-based recommendations, a sensible approach involves the gradual return to school and social activities… in a manner that does not result in a significant exacerbation of symptoms” (p. 306). The Journal of Pediatrics published an original article by Moser, Glatts, and Schatz (2012), researchers who studied the efficacy of rest following a concussion. They found that participants who were prescribed rest improved their neurocognitive testing
scores and reported fewer symptoms. However, the authors report significant limitations to their study, including lack of randomization and no control group. One benefit of this study is that the authors put forward their operational definition of rest:

1. time off from school or work;
2. no homework;
3. no reading;
4. no visually stimulating activities, such as computers, video games, texting, or use of cell phones, and limited or no television;
5. no exercise, athletics, chores that result in perspiration/exertion;
6. no trips, social visits in or out of the home; and
7. increased rest and sleep. (p. 922)

As this review of literature continues to show regarding the collegiate student athletes, Moser and colleagues (2012) caution that “there also may be negative effects or consequences of imposed rest, such as affective reactions, academic consequences, or social implications” (p. 926).

In 2015, researchers Thomas, Apps, Hoffman, McCrea, and Hammeke published their findings of a randomized controlled study on the effects of rest during the early acute stage of a concussion. Their intervention required five days of strict rest, versus the control subjects who adhered to the more traditional care of one-to-two days of rest following by a graded reintroduction to activity. All participants were between the ages of 11 and 22. At time periods three and 10 days post-concussion, the participants completed ImPACT testing, an assessment of balance, and completed a symptom scale based on the symptoms they were still experiencing. The authors found that participants who were prescribed five days of strict rest did not have statistically significant differences in either their neurocognitive scores on ImPACT and their balance score compared to the control treatment group. Of even more interest, the authors report the
unexpected results that strict rest resulted in more symptoms reported during the study. The authors discuss these findings within the context of the current literature, stating that the “current usual care endorsing modest physical and cognitive rest after injury is an effective strategy for recovery” (p. 220). They suggest that the increased reporting of symptoms in the strict rest group may be a result of other emotional or psychological factors, including the negative social and academic effects of missing school and peers.

This article presents original research that requires more investigation, however it helps frame the conversation around the duration of rest as a treatment. Prolonged strict cognitive and physical rest may be more detrimental than the traditional recommendation of only one-to-two days strict rest followed by a gradual and graded return.

While the literature and common clinical practice clearly suggests physical and cognitive rest following a concussion, at least for one day and until symptom free at rest, the next challenge is determining optimal timing and protocol for returning a student to cognitive activity. In a clinical report from the American Academy of Pediatrics, Halstead, McAvoy, DeVore, Carl, Lee, and Logan (2013) affirm the ongoing difficulties that students recovering from a concussion will have while attempting to return to learning activities. These authors also maintain that adequate cognitive rest is a staple in the early stages of recovery from a concussion. “The goal during concussion recovery is to avoid overexerting the brain… determining the appropriate balance between how much cognitive exertion and rest is needed is the hallmark of the management plan during recovery” (p.949). Ideally, a management team would consist of the patient’s family, physician or school nurse, and staff member responsible for facilitating adjustments and accommodations. It is important to note, however, that none of these
resources may be readily available or sought after by the student athlete in a collegiate setting. The American Academy of Pediatrics recommends that the student return to classes when they can tolerate 30 to 45 minutes of cognitive activity without worsening symptoms; it is suggested that the student receive adjustments or accommodations as necessary based on their symptoms during this transition (Halstead et al., 2013). Examples of these adjustments include support with note taking, tutoring, and postponing or easing of assignments and exams. At a collegiate institution however, these adjustments are often informal and at the discretion of the instructor.

Stewart et al. (2012) also point to the sparse literature available for guiding the management and decision-making of a student athlete’s return to their academic studies. They review a pilot investigation of this task of returning a student athlete with a concussion to cognitive activity. In the study, students returned to cognitive activity based on a graduated increase of duration and intensity with the goal of no symptoms arising during 60 minutes of activity, which is the reported average length of classes. Students that experienced symptoms of their concussion during the activity were to reduce their cognitive activity including load and duration, and the clinicians shifted the focus to ameliorating their symptoms. The subjects continued this as a cycle until full return to activity was allowed. While the authors note that while there are no confirmatory studies to support their process, the protocol is similar to that from the American Academy of Pediatrics.

The National Collegiate Athletic Association (NCAA) referenced some of the studies discussed above when it developed concussion RTL guidelines in early 2014 (NCAA, 2014). These guidelines are developed to educate and guide collegiate student
athletes back to their studies following a concussion, based on current best practice. One benefit of these newly developed NCAA guidelines is the focus on collegiate level student athletes, including the structure and unique challenges of this specific population. Summarizing the findings, the NCAA notes the paucity of research on the topic but recommends guidelines based on the consensus of current literature and experts. Of significance is the consensus recognition that immediate rest must follow a concussive event. As recommended for the college student, this includes at least one full day of not going to classes. It also recommends avoiding activities such as texting, watching screens, reading and doing homework. The NCAA recommends that the concussed student should not return to the classroom until they can tolerate 30 minutes of cognitive activity; once they are symptom free during cognitive activity they can follow a graded return to learning. The recommendations further suggest no more than 30 to 45 minutes of continued activity (NCAA, 2014). This is similar to the previous study discussed by Stewart et al. (2012), however the time allowed for cognitive activity appears to be more conservative. These time limits can pose challenges for course adjustments as many classes run longer than 30 minutes, and the student will often have more than one class each day. In addition, the preparation for these classes, such as reading and homework, will increase the time needed for cognitive activity.

The NCAA guidelines for returning to learn following a concussion may be a good step towards introducing some of the literature and expert opinion on the subject, however a study by Kerr and colleagues (2015) reveal that 36.7% of NCAA institutions in their sample still lacked policies addressing returning to learn. This was determined by survey to all NCAA institutions, with a 29.4% response rate (327 schools). Information
about RTL policies for all higher education institutions in the U.S. is unknown, however this sample reveals that even with expert guidelines and recommendations in place, policy has not yet followed for many institutions. A study of RTL policy in high schools revealed similar results, showing only 53% of the 1033 surveyed schools reported having RTL policies (Olympia et al., 2016).

Dreer et al. (2016) recently investigated teacher knowledge of and classroom management policies for students returning to learn following a concussion. They employed a 30-question survey of 130 teachers of education levels from elementary to college (the latter only 1.5% of the sample, or 2 completed surveys). The striking findings showed teachers may have a significant lack of appropriate knowledge of concussion-related symptoms and how they could affect behavior and in school-related responsibilities. For example, more than a third of the sample did not recognize that a concussion could cause changes in sleep, energy deficit, irritability or changes in mood. More than half of the sample did not recognize that a concussion could cause a lack of initiative, depression, or impulsivity. When related to behavior at school tasks, 50% of the sample was not aware that a student could have difficulty returning to school or schoolwork following a concussion. Up to 70% of the respondents were not aware a concussion could cause difficulty with decision-making and/or problem solving, and inappropriate behavior and social isolation. Likely recognizing their deficits in the matter, 82% of the teachers indicted they wanted more information about what to do for students following concussion. Of this sample, 37.5% of teachers knew they had a student with a concussion in their class, and 83% of those adjusted their classroom management practices for the student.
As discussed previously, some researchers believe that after the acute phase of healing (1-2 days of rest), providing appropriate accommodations and adjustments while allowing moderate amounts of cognitive activity may be beneficial for the students (Collins et al., 2013; Thomas et al., 2015; Majerske et al., 2008; McGrath, 2010; Moser et al., 2012). In other studies, we have seen that returning to learn while still suffering from symptoms may prolong recovery, although it is unclear whether this may be due to the absence of appropriate accommodations (Brown et al., 2014; Heyer et al., 2014; Kostyun, Milewski, & Hafeez, 2014; Carson et al., 2014). Some studies have shown that many institutions do not have RTL policies, and other researchers found that teachers lack the knowledge and awareness to make appropriate accommodations. Vargo et al. (2016) also suggest that many patients may not get the required rehabilitation services for optimal recovery, such as from physical therapist, speech therapist, neuropsychologist, and/or occupational therapist. These studies, among the others discussed above, highlight the dearth of literature providing consensual and evidence-based models for returning a student to learning activities following a concussion.

A consensus of the literature recommends a multidisciplinary team approach for determining RTL progression and appropriate accommodations. Examples of team members include a team physician, athletic trainer, coach, psychologist, neurophysiologist, school nurse, physical therapist, parents, and faculty members, among others. Returning to learn will require ongoing education and communication with classroom faculty to help support the student with adjustments or accommodations. Heyer et al., (2014) define adjustments as schedule modifications without changes to the students’ standard curriculum, such as decreasing coursework, postponing or extended
time on exams, help with note taking, and excusing absences or early dismissal. Researchers such as Heyer et al. (2014) and Collins et al. (2013) suggest accommodations may be necessary depending on the length of time the student is symptomatic, and include arrangements that are unique to the student’s needs, such as changes to the student’s course load or schedule. Colleges and universities have varying levels of resources available, such as not having appropriate medical staff for club or intramural athletes. In addition, faculty and staff may have limited or varying degrees of education regarding concussions, and may be unwilling to provide adjustments or accommodations for their students, especially in the absence of an institutional policy guiding RTL decisions, or in the absence of a “visible” injury as discussed previously. Faculty may also not be knowledgeable of appropriate and unique RTL classroom management strategies. Student athletes who have suffered a concussion may be required to advocate for themselves, not knowing who to turn to for support, and may be at the mercy of each individual faculty to determine whether or not they can receive unique help (NCAA, 2014; McGrath, 2010; Heyer et al., 2014; Halstead et al., 2013). It is unknown if a student who returns to learn following a concussion may suffer from declines in their academic self-efficacy. The following study explores this question.
CHAPTER III: RESEARCH METHODOLOGY

This study attempts to determine whether a concussion may affect a college student’s academic self-efficacy by performing three independent studies. First, I explored the effect of a concussion on participant responses on the SELF-A. Then I analyzed neurocognitive scores on ImPACT with responses on the surveys of test participants, to see if ImPACT scores can be predictors of, or correlate with, specific deficits on the SELF-A. These sections of the study will be performed using quantitative methods. To further explore the experiences of returning to learn by some of the test participants, the study also has a qualitative component in the form of semi-structured interviews. This chapter describes the methods used to gather and analyze the data for each part of this study.

Research Study I: The SELF-A Survey

Methods

The primary research query attempted to measure academic self-efficacy following a concussion. This was performed in the quantitative tradition. The primary hypothesis of this study is that a concussion affects college students’ academic self-efficacy. Wright (1979) states that experimental research is used to produce evidence to support a hypothesis, however experimental research requires randomization to account for threats to internal validity. Randomization was not possible for this study simply because we cannot ethically randomly assign the “treatment” of a concussion to a student athlete. The design of this study is therefore considered quasi-experimental, or observational, suggested by Wright to be used when the treatment has already taken place and assignment is outside the control of the investigator. In this study the “treatment” is
the concussion. This study will compare end-of-the-semester SELF-A scores from college students who suffered a concussion during the semester and students who did not suffer a concussion.

**Participant Selection**

A land-grant university in the northeastern U.S. was the site for research. This university has seven undergraduate schools and colleges, and is home to approximately 10,000 undergraduate students. I am employed by this university as a clinical associate professor. My clinical appointment is the role of athletic trainer for the Student Government Association sponsored club sports. There are currently 54 club sports and over 1,700 student participants, none of whom have access to the medical care provided by the athletic trainers who provide care for the Varsity-level athletes. In the case of injury or illness to any of the club student athletes, I may be contacted to perform medical evaluation and consultation. I am a certified athletic trainer, qualified and competent in the evaluation, diagnosis, and management of a patient with a concussion or other physical injury. Due to ease of access, I used convenience sampling for the pool of participants, targeting only club sport athletes. Recruiting this sample was not representative of the entire population of college student athletes. For each participant that consented to be a part of the study, I completed a Consent Process Documentation form (appendix E), helping me keep track of ensuring the appropriate processes of consent were performed.

**Treatment participants.** Targeting of participants occurred over a period of three collegiate semesters. After a student athlete from the target pool was evaluated with a concussion injury by me or another qualified medical provider, I approached the patient
to ask if they were willing to participate in the study. This approach occurred either face-to-face or using e-mail communication. Upon statement of interest, I provided them with an informed consent form (see Appendix A) providing information about the study, including the participant’s involvement and any benefits or compensation. The participants were required to give verbal consent in order to participate in the study. As outlined in the informed consent form, the participants could choose to withdraw at any time at no cost or detriment to him or her. These selection methods resulted in recruiting 21 treatment participants (8 men, 13 women) who completed the study. A variety of sports were represented, including rugby, ice hockey, soccer, snowboarding, Brazilian Jujitsu, volleyball, equestrian, and football. All participants confirmed they were 18 years of age or older.

**Control participants.** Club sport athletes were the pool of participants for the survey control group as well. The control subjects were selected with the criteria of having suffered an injury, excluding head trauma, during that academic semester. The goal of surveying a group of students without concussion injury was to attempt to recruit a group of students similar to the treatment group. I chose students with non-head injuries because of the consideration that students with injuries might be different than those without. I targeted these club sport student athletes who have suffered a non-head injury based on my previous medical evaluation, and approached them through either e-mail or face-to-face to ask their interest in participating in the study. If the patient expressed interest, I provided them with the informed consent form for the control group (see Appendix B). The participant provided verbal consent to continue in the study. As outlined in the informed consent section, the participants could choose to withdraw at any
time at no cost or detriment to him or her. Twenty-two control participants were recruited for this study (12 men, 10 women). A variety of sports were represented, including rugby, ice hockey, soccer, Tae Kwon Do, climbing, and crew. All participants confirmed they were 18 years of age or older.

Measures

The instrument used to measure the academic self-efficacy was created and validated for college student use by Zimmerman and Kitsantas (2007): the abridged Self-Efficacy for Learning Form (SELF-A). The SELF-A can be found in Appendix D. I used this instrument for several reasons. First, the reliability of the scale was high as tested by Zimmerman and Kitsantas, with Cronbach’s alpha = .97. SELF-A requires only 19 questions, which I hoped led to increased compliance during a time when college students are often overloaded and overwhelmed with final exams and end of the semester responsibilities. It was also one of the few measures of self-efficacy discussed in the review of the literature that was validated with the college student population, where many of the others were used with secondary school or younger children. The SELF-A also uses three subscales (note taking, studying, and test preparation) that are common among all disciplines of academia. Some instruments reviewed were discipline specific, such as for students in research statistics coursework (Li, 2012). Finally, the SELF-A requires answers in “percentage” format rather than Likert scale, which at face value makes the available answers more easily interpretable (e.g. “I feel 80% prepared for ______” is a more common way we communicate than “I feel 8 out of 10 prepared…”).
Data Collection

The SELF-A survey was administered by two methods: face-to-face and email. Some of the participants completed the SELF-A in a private, closed office with no supervision or distraction in order to encourage honest responses. Other participants requested email delivery of the SELF-A, and completed the survey in a setting of their choosing. Both groups of participants completed the SELF-A survey at the end of the semester in which they were injured, within a 3-week time period spanning 2 weeks before to 1 week after final exams. This range of time was chosen as a common reflection of their academic self-efficacy, whether or not the injury was healed, and when the survey subscales of note taking, studying, and test preparation was still active or fresh in their mind. Measuring at this point in time would give an indication of the whether the concussion had effects that lasted until end of the semester. When necessary, I sent out reminders for the participants to complete the survey.

Confidentiality and protection of personal information was ensured by removing identifying information such as names. A random identifier was assigned to the participant’s survey. The master record of identifiers was kept separate from the data and analysis, locked in an independent drawer in a locked office of the university. I ensured protection of the data and all materials by storing digital data on a password-secured and encrypted laptop, and all physical data in my locked office. Surveys returned online were submitted by email to my university server which is protected through security measures as deemed necessary by the university, such as password protection. Paper surveys were used for ease of access for some students, and transferred to digital form to be stored on my university computer.
Data Analysis

I used SPSS software version 23 for statistical analysis of the survey data. The data was screened for missing values, outliers, and errant entries by looking at descriptive and exploratory statistics. I identified no missing data and no problems with data entry. There was one participant with nine items identified as outliers out of the 19 SELF-A questions, and another participant with only one item identified as an outlier. The latter participant did not fall as an outlier in the exploration of the treatment group’s mean SELF-A and therefore appears to be valid data. However, the other participant with nine outliers did present as an outlier for the treatment group’s mean SELF-A, and I therefore chose to run all the SELF-A analyses both with and without this case to see the effects it may have had on the analysis.

Using SPSS, I created four variables representing the means of the SELF-A items. One variable represents the mean SELF-A scores (all 19 questions) for the treatment and the control groups, and the other three variables represent the mean score of each of the subscales: notetaking (six questions), studying (six questions), and test preparation (seven questions). I tested the SELF-A full scale as well as each of the subscales for reliability using Cronbach’s $\alpha$. The results will show that the alphas indicted good reliability of all four scales for this sample.

In their study of the reliability and validity of the SELF-A, Zimmerman and Kitsantas (2007) presented the mean and standard deviation data from 223 participants. We do not know the medical history of these students, and therefore cannot assume they represent a cohort of controls that match the characteristics I recruited (injured but no concussion). However, it is a larger sample size that represents data from a collegiate
sample, and we can make some assumptions based both on common research procedures and statistics of students with concussion that none or very few of these participants suffered from a concussion during their academic semester. All participants were 18 years of age or above, 25% men and 75% women, which conveniently has sexes closer to matching my treatment group (33% men and 67% women) than my own control (55% men and 45% women). I tested the scores of both my treatment and controls to this sample group as an additional comparison.

The primary analysis performed on the SELF-A scores tested for differences between the treatment and control groups. My hypothesis was that the concussion “treatment” group would score lower than the control group. The hypothesis was tested using Cohen’s $d$, an analysis that measures the standardized mean difference between two groups and can categorize it into effect sizes considered trivial (less than 0.2), small (0.2 to less than 0.5), medium (0.5 to less than 0.8), and large (0.8 or greater) (Cohen, 1988). These categories are independent of statistical significance, and give us more interpretable information about the data when there is a small sample size such as we have in this study.

To help further explore and explain the results, I also ran a linear regression to explore whether having a concussion is predictive of scores on the SELF-A, using each of the four scales (full and three subscales) as my independent variables.

**Research Study II: Analyzing ImPACT Scores**

**Methods**

The second research query attempted to explore associations between neurocognitive test scores following a concussion and that participant’s academic self-
efficacy. This was performed in the quantitative tradition as an observational experiment. The study assessed for associations of the two tests in an attempt to aid in the assessment of a concussed patient and identify specific problems with academic self-efficacy when returning to learn. Shadish, Cook, and Campbell (2001) caution that we rarely know all the factors that cause an effect to occur, and therefore this research is exploratory rather than deterministic. The following explains the methods used in an effort to produce the desired data, with the final section discussing the problems identified with the final data collection and analysis. Due to these concerns, a majority of the proposed analyses for this section were not regarded as valid results.

**Participant Selection**

The participants targeted for this study are from the same pool as the first study (the SELF-A survey). As the athletic trainer assessing students that may have suffered from a concussion, I have access to the Immediate Post-concussion Assessment and Cognitive Testing instrument (ImPACT Testing & Computerized Neurcognitive Assessment Tools, n.d.). Many of the participants who were recruited as treatment participants for the SELF-A survey study also completed an ImPACT test. During their voluntary consent for the SELF-A study, these participants also consented to me accessing their medical records and ImPACT data if available (refer again to Appendix A). Of the 21 treatment participants recruited, 17 had ImPACT scores (6 men, 11 women) that were used for analysis. Of those 17, nine also had baseline (pre-concussion) ImPACT that was considered during the analysis. For each participant that consented to be a part of the study, I completed a Consent Process Documentation form (appendix E), helping me keep track of ensuring the appropriate processes of consent were performed.
Measures

This study used the composite and symptom scores from the computerized cognitive testing battery ImPACT, as well as participant scores on the SELF-A. ImPACT generates reports based on baseline (if available) and normative data, identifying clinically significant deficits in any of the five composite scores: verbal memory, visual memory, processing speed, reaction time, and impulse control. There is also a total symptom score that is developed based on self-reporting from the patient. The ImPACT instrument also allows for self-report of descriptive factors including demographic information (age, sex), diagnoses, problems, and treatments of some common confounding conditions (speech therapy, learning disability, ADD/hyperactivity, repeated years of school, special education, headaches and migraines, seizures, meningitis, substance/alcohol abuse, psychiatric condition, brain surgery, dyslexia, autism). The participant also self-reports their history of previous concussions and whether they have performed strenuous exercise in the 3 hours prior to taking the ImPACT. Finally, any relevant data in the participants’ medical notes was recorded, such as date of concussion and information that could help explain results.

Data Collection

During the medical care of patients, I routinely record medical notes as appropriate for ongoing assessment of their condition. For many patients who suffer from a concussion, I have them take an ImPACT test to aid in the assessment and management of their concussion. This test is taken within a wide range of time following the concussion event, which is dependent on a variety of factors based on their unique medical assessment. The original proposal suggested this ImPACT test could be
performed at a specific time period following the concussion, namely when the student returned to learning activities. However, as will be discussed further on in this section, this collection method was not feasible for two main reasons, the first being it may not have been appropriate medical procedure based on the participant’s unique progression of symptoms. For example, a patient with acute sensitivity to screens may not be advised to perform an ImPACT test due to excessive exacerbation of symptoms. The second challenge with collecting data by the process from the original proposal is that there is no operative procedure identified in the literature for determining when a student has returned to learn. Therefore, the ImPACT tests were taken at a time deemed appropriate during medical assessment, rather than a controlled and uniform testing procedure.

The medical notes and ImPACT test results are kept securely in my possession, either in pen-and-paper format in my medical kit or on my password-secured computer (with the exception of when the patient approves my sharing of the notes with the university’s student health center). Upon consent from the participant, I made a copy of the participants’ ImPACT scores and recorded relevant information from the medical note. Confidentiality and protection of personal information was ensured by removing identifying information prior to data reporting. This includes identifiers such as names and other non-essential identifying demographics on the ImPACT and medical records. I developed random identifiers to match the ImPACT data with that participants’ SELF-A responses. The master record of identifiers was kept separate from the data and analysis, in an independent locked cabinet in a locked office of the university. I ensured protection of the data and all materials by storing digital data on a password-secured and encrypted laptop, and all physical data in my locked office.
ImPACT scores and results as medically relevant are analyzed by myself as an ImPACT Trained Athletic Trainer (ITAT). The ITAT certification was earned from the completion of professional development program designed to help athletic trainers serve as competent and knowledgeable ImPACT administrators. Information about the educational courses can be found on the ImPACT website, specifically on the informational page for becoming an ImPACT Trained Athletic Trainer (ITAT), at https://www.impacttest.com/training/events/page/itat_yr_1. This program was instrumental in improving my ability to analyze the ImPACT scores appropriately, and my ability to recognize how the ImPACT scores can be used to help assess and manage a concussion patient’s condition and prognosis. As an ITAT I am also competent at identifying potentially invalid tests, which could be due to factors such as poor testing environment, misunderstanding of directions, technical difficulties, and purposeful sabotage of the test.

ImPACT provides guidelines and recommendations for appropriate testing procedure, which were followed for the club sport athletes. The post-concussion test is taken in a quiet area in the office suite of the researcher, where traffic and commotion is minimal, decreasing the distraction to testing participants. In addition, Kuhn and Solomon (2014) found that participants who were supervised while undergoing ImPACT testing demonstrated better overall composite scores for two of the factors. All baseline and post-concussion tests performed by the club sport athletes were supervised by myself, an athletic training student, or a coach. Research by Schatz, Moser, Solomon, Ott, and Karpf (2012) showed that the online version (versus the desktop downloadable version) of ImPACT had significantly more valid baselines for college students. All
ImPACT tests for this study used this online version. For baseline testing, the students were recruited as members of specific club sport teams (including rugby, ice hockey, lacrosse, and football), to take the ImPACT during preseason, in the absence of any incident of concussion. Unfortunately, there has been some evidence to suggest baselines taken in a group setting may result in less valid tests as well as lower scores for some of the individual data points that make up the participants’ composite scores (Moser, Schatz, Neidzwski, & Ott, 2011). An artificially low score in the baseline would affect the test’s ability to flag a low score in the post-concussion test that could be caused by the concussion. In the present study, most baseline tests were performed in group settings, with as many as 15 student athletes in the room. Many participants in the present study play sports that did not require baseline testing, due to factors such as cost and unfeasible administration of the test for all athletes (as a reminder, clubs sports for this university boosts more than 1,700 athletes). Therefore, I do not have pretest baseline data for all participants for this portion of the analysis.

**Data Analysis**

This study investigates whether there exists an association of specific ImPACT and medical record factors with the SELF-A survey, particularly whether there are correlations with the subscales of note taking, studying, and test preparation. Data analysis for the study utilized the following from ImPACT: normative data for composite scores, deficits in post-concussion from baseline composite scores, and self-reported descriptive data as explained above. For this study, however, not all participants performed a baseline assessment as explained above. Therefore, the ImPACT study participants were considered in two separate analyses, first using normative data and
descriptive data as a full group (all 17 participants) and then as the baseline available group (9 participants). As will be discussed, there were concerns and issues with the baseline scores that made analyzing them problematic.

Lovell et al. (2006) and Iverson et al. (2003) provided evidence showing that the age and sex normative data provided by ImPACT can be used to help identify possible deficits. While this is not a valid predictor of a participant’s deficit from their personal neurocognitive baseline, it is one more instrument, among many others, used by clinicians to help consider whether there may be neurocognitive deficit. Using normative data can also be reliable in targeting potential trajectories for which the concussion is affecting the patient, especially when used in tandem with the medical records showing symptom development and provocation, and performance by the patient on special tests.

The determination of deficits from baseline relies on the ImPACT testing software’s provision of an internal analysis of each participant’s baseline and post-concussion tests. Areas of statistically significant deficit in composite scores compared to their individual baseline are red-flagged on the software (called the RCI, or Reliable Change Index), and the deficit is based on one standard deviation below that participants’ baseline. As mentioned, Moser et al. (2011) illuminated the risks to validity of baseline testing when taken in a group setting. In this study, all baseline tests were performed in group settings, and analysis of the study participants’ baselines will show that there were very few I considered valid based on both (or either) the normative percentages and post-concussion performance. For example, one participant recorded a baseline reaction time composite of .63, which puts her in the 22nd percentile for other ImPACT scores from people her age and sex. Her post-injury reaction time composite score was 0.5, which
puts her in the 82nd percentile. This suggests an invalid baseline for this composite score, a circumstance that notably occurs for five of the study participants. In addition, this study had only four participants flagged with post-concussion ImPACT composite scores exceeding the RCI, and for two composite scores, only one participant was represented. These factors together drastically decreased the reliability of the analysis for the question of whether deficits from baseline could predict SELF-A scores.

I used SPSS software version 23 for statistical analysis of the data. The data was screened for missing values, errant entries and variables that didn’t make sense by looking at descriptive and exploratory statistics. I identified no missing data for the groups and no problems with data entry. I used a correlation analysis of each ImPACT composite score and the total symptom score with the individual survey results, both full SELF-A and each of the mean survey subscales (note taking, studying, test preparation). I then ran regression analyses to explore whether the descriptive data could predict the SELF-A mean score. I chose to use only the descriptive data that was represented by at least 20 percent of the sample, which included the following: sex, age, number of previous concussions, and diagnosis of ADD. All other data were only represented by 3 or less of the sample participants (such as diagnosed with a learning disability, repeated years of school, treatment of migraines or substance abuse, to name a few). To determine if time was a factor in SELF-A scores, I used regression to test for relationships among the survey score and ImPACT score, accounting for the time delays between concussion event and ImPACT, and ImPACT to taking the SELF-A. Finally, I ran a correlation analysis to see if there is an association of the full survey score with the number of days between the concussion event and the completion of the SELF-A.
Discussion of the Limitations in Data Collection

As noted a number of times in the previous sections, there were many conditions causing limited validity of the collection of the ImPACT data, and therefore these analyses will not be reported in the results section. To review, the baseline tests were performed in group settings, which the authors Moser et al. (2011) found is a threat to their validity. Upon examination of the ImPACT scores, many were indeed deemed to be invalid for at least one of the four composite measures. These were often identified by finding baseline pre-injury test scores that were markedly lower than the participant’s post-injury scores. The reasons for these invalid baselines could be due to a number of factors, such as the group setting effect, the time of day most baselines were taken (which was often in the late evening when participants may have been exhausted from the day), misreading of test instructions, and/or lack of motivation to perform well, to name a few.

Another limitation to the ImPACT score analyses was the small sample size, caused not only by the invalid baselines but also the lack of the participants recruited who indeed had a baseline. Although there are a number of contact and collision club sports that all team members do perform baselines prior to participation, a majority of the sample for this study recruited athletes who suffered a concussion that played in sports that did not do baseline testing. The number of athletes recruited from the sports that do require baseline testing was lower than anticipated. A wide range of sports were represented in this sample, including: rugby, football, ice hockey, snowboarding, volleyball, equestrian, cycling, Taekwondo, and Brazilian jiu-jitsu. Only the first three sports of this list required baseline testing, due to limits such as cost of the test and barriers and challenges regarding administration of the test.
The invalid baselines rendered faulty the assessment of associations with SELF-A scores. I was unable to run adequate analyses determining the comparison of baseline ImPACT test scores and post-concussion SELF-A scores. Therefore, I will not be reporting these analyses in the results section of this study.

Another notable limitation to the proposed analysis of the data was the inadequate assessment of the concept “return to learn”. As mentioned in the literature review, there is no uniform operational definition for determining when a patient has indeed returned to learn, what qualified as “returned”, or to what magnitude. This study did not set out to create that model. In the absence of clear RTL definition, I was unable to quantify this data point. When I set out for the study I planned on the RTL point to be evident (such as an easy situation where the patient missed class one day, and returned the next). Unfortunately, the point that the participant RTL was complicated. For example, many participants were instructed to return to classes that did not aggravate symptoms, therefore attending some classes but not others. Some returned to class, but did not complete homework assignments. Participants also often attempted studying or assignments after their concussion, but found they had to cease after a short time. Does ten minutes qualify as returned to learn, or twenty? There is currently no operational definition for this concept. The only valid data points concerning time that will be reported in the results is the interval of days between the concussion event and the completion of the SELF-A.
Research Study III: Interviews of Participants

Methods

For the third study, I explored some of the treatment participants’ experience with returning to learn following their concussion. This was performed in the qualitative tradition using semi-structured interview sessions with the participants. I explored the participants’ processes as they navigated RTL and the meanings they made of the experience. Qualitative research is appropriate for this portion of the study, as Glesne (2011) explains how the qualitative tradition is used by researchers seeking understanding of experiences.

Participant Selection

For the interviews, I approached four select people from the pool of treatment participants to ask their willingness to take part in an interview of their experience returning to learn. Four participants responded affirmatively, and were given a new informed consent form for this section of the study (see appendix C). For each participant that affirmatively consented to be a part of the study, I completed a Consent Process Documentation form (appendix E), helping me keep track of ensuring the appropriate processes of consent were performed.

Measures

Semi-structured interviews were used, allowing the interviewer to follow-up on and explore the participants’ answers to try to gain more detail for the research (Creswell, 2013). The interview questions were developed by the researcher after the review of the literature did not present interview questions concerning the scope of this study. The semi-structured interview questions can be found as Appendix F. The questions were
created with the intention of supplementing the analysis of the SELF-A, to explore some individual experiences with returning to learn after a concussion. The interview addresses questions of academic efficacy, such as engagement with the material and perception of performance. The literature also exposes a lack of uniform medical management as well as institutional policies for returning a student to learning activities following a concussion. The interview explored the participant interactions and recommendations from medical personnel, as well as the procedures followed for their RTL experience.

**Data Collection**

The interviews were conducted by two research assistants. These assistants were upper level (one junior and one senior) undergraduate students in the athletic training education program at the university. They were both trained in the management of concussion through the education program, and successfully completed testing showing proficiency of this matter. The site selection for the interviews was determined by the interviewer and interviewee, using a location that was conducive to uninterrupted discussion and recording. Consequently, all interviews were performed in a quiet, reserved study room in the library of the university. A note was taped outside the door indicating that recording was occurring, instructing those outside for privacy and silence. Interviews were recorded using a voice recorder on a smartphone.

Interviews began with the structured questions (such as: “after the concussion when you first returned to academic demands, how well could you engage in the material?”; “How do you feel your concussion affected your academic performance throughout the semester?”), and the researchers were able to ask clarifying questions and seek elaboration of participant responses. The interviews lasted on average 10.7 minutes.
(range 8.92 to 13.1 minutes). This was found to be an adequate amount of time for the participants to describe their experiences based on the interview questions. The researchers reached out to participants for clarification of their answers where necessary. One interview participant voluntarily contacted the lead researcher to provide clarification for an answer, as well as to expand on one of her previous responses.

Confidentiality and protection of personal information was ensured by removing identifying information such as names. The participants each chose a pseudonym prior to the interview, and was referred to by this name. I ensured protection of the data and all materials by storing digital data on a password-secured and encrypted laptop, and all physical data in my locked office.

Data Analysis

The interviews were transcribed (see Appendix G for full transcriptions), then cleaned to remove any identifying information. Creswell (2013) strongly suggests backing up the data and keeping a master copy, so I kept a digital copy of the audio recording and the transcribed written text on my password secured laptop. The transcriptions were reviewed individually by each member of the research team, initially for general familiarization and flow, then more specifically to gain more intimate sense of the interview. This began a spiral of data analysis, which is a constant process of engagement in the data to start making sense of it (Creswell, 2013). During the review of data, the researchers wrote notes in the margin to help document thoughts and any noticeable initial patterns or questions. This exploration helped with the organization of the data and led to early general categorization. These notes were then summarized to create a general order of the thoughts, and the researchers created a list of questions and
other ideas that surfaced. The researchers coded information and phrases from the interviews, such as similarities of answers and patterns of thought, to identify relationships among the participants (Glesne, 2011). I produced a-priori codes from the review of the literature, and in-vivo, or emergent, codes were generated from the interview transcription and memo notes. These codes were used to begin “describing, classifying, and interpreting the data” (Creswell, 2013, p. 184). The codes helped aid in the search for the underlying meanings in the data. They were labeled and described in order for other researchers and reviewers to understand the context and reasons why I created the relevant classifications. See Appendix H for a list of codes and their meanings.

After I reviewed the data and officially assigned the codes, I diligently re-reviewed the assignments to prevent coding drift and to make sure the categorizations continued to be appropriate. In order to recognize data drift, I organized the same codes together and reviewed them as a group to determine if they all made sense to be classified within their specified code. These codes were then clustered according to themes and patterns in order to interpret the meanings inherent in the data. This is a process of de-funneling; I took the few remaining codes and searched for the larger meanings, themes, and patterns imbedded within. There were several ways to make sense of the data. Creswell (2013) discussed that interpretation of the codes may be “based on hunches, insights, and intuition” (p. 187). My knowledge of the discipline of sports medicine and expertise of concussions helped guide the intuitive interpretation of meanings. The literature also provided context for interpretation, where meaning-making aligned with
previous evidence-based theories or themes. These interpretations were described and grounded within the literature in order to substantiate the findings. The results from each member of the research team were then validated through a process of consensus; the research team collaborated their information and interpretations of the qualitative data, looking for shared meaning, patterns and outstanding quotes and perspectives. After collaboration, I pursued follow-up contact with the participants when necessary to clarify questions of interest that surfaced from the analysis of the data. This follow-up member check was short and performed either face-to-face or by email, and provided the participant an opportunity to agree or disagree with my initial memoing and themes.
Chapter IV: Results

This chapter presents the results of the data analyses for each of the three studies. First, the results of the SELF-A survey study, followed by the ImPACT data description and relevant analyses, and lastly the results from the analysis of the interviews.

Research Study I: The SELF-A Survey

The reliability of the scales was tested using Cronbach’s $\alpha$, which indicted good reliability of all four scales for this sample. Cronbach’s $\alpha$ for the full scale is .921. Cronbach’s $\alpha$ for the notetaking subscale (consisting of 6 items) is .796. Cronbach’s $\alpha$ for the studying subscale (consisting of 6 items) is .855. Cronbach’s $\alpha$ for the test preparation subscale (consisting of 7 items) is .840.

The analysis of effect size between the treatment and control means using Cohen’s $d$ was conducted for each of the scales—the full SELF-A and each of the SELF-A subscales. Assessing for statistical significance is difficult given the small sample size. The means and standard deviations used for the analysis of this study’s data are found in Table 1. Cohen’s $d$ for the full mean survey is -0.28, classified as a small effect size. The interpretation is that the treatment (concussion) group had lower scores on average. For the notetaking subscale, Cohen’s $d = 0.03$, considered a trivial effect size. For the studying subscale, Cohen’s $d = -0.47$, considered a small effect size. For the test preparation subscale, Cohen’s $d = -0.31$, considered a small effect size.

These results were then tabulated excluding the one outlier case in the treatment sample. These results are slightly different but still revealed a couple small effects. Cohen’s $d$ is considered trivial for the full SELF-A, and small for the notetaking,
studying, and test preparation subscales, noting that the notetaking subscale effect size is again in the opposite direction (Cohen’s $d = -0.19$, $0.37$, -0.43, and -0.21 respectively).

Table 1

<table>
<thead>
<tr>
<th>Scale</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Cohen’s $d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full SELF-A</td>
<td></td>
<td></td>
<td></td>
<td>-0.28</td>
</tr>
<tr>
<td>No Concussion</td>
<td>22</td>
<td>73.56</td>
<td>11.31</td>
<td></td>
</tr>
<tr>
<td>Yes Concussion</td>
<td>21</td>
<td>69.83</td>
<td>15.17</td>
<td></td>
</tr>
<tr>
<td>Note taking</td>
<td></td>
<td></td>
<td></td>
<td>0.03</td>
</tr>
<tr>
<td>No Concussion</td>
<td>22</td>
<td>65.11</td>
<td>12.21</td>
<td></td>
</tr>
<tr>
<td>Yes Concussion</td>
<td>21</td>
<td>65.66</td>
<td>18.47</td>
<td></td>
</tr>
<tr>
<td>Studying</td>
<td></td>
<td></td>
<td></td>
<td>-0.47</td>
</tr>
<tr>
<td>No Concussion</td>
<td>22</td>
<td>77.46</td>
<td>14.64</td>
<td></td>
</tr>
<tr>
<td>Yes Concussion</td>
<td>21</td>
<td>70.01</td>
<td>17.27</td>
<td></td>
</tr>
<tr>
<td>Test preparation</td>
<td></td>
<td></td>
<td></td>
<td>-0.31</td>
</tr>
<tr>
<td>No Concussion</td>
<td>22</td>
<td>77.47</td>
<td>13.22</td>
<td></td>
</tr>
<tr>
<td>Yes Concussion</td>
<td>21</td>
<td>73.25</td>
<td>13.96</td>
<td></td>
</tr>
</tbody>
</table>

Note: Cohen’s $d$ is calculated using the pooled equation.

A linear regression analysis was run to assess for statistical significance. Likely due to the small sample size, none of the effects were significant. The linear regression analysis, using data from this study’s participants, shows that the treatment of having a semester history of a concussion may be predictive of almost 4 points lower on the full SELF-A ($b = -3.74$, SE = 4.07, $p = .36$). Regression analyses indicate results in the same direction for the study subscale (7.5 points lower) and test preparation subscale (4.2 points lower) (respectively, $b = -7.45$, SE = 4.87, $p = .13$; and $b = -4.22$, SE = 4.14, $p = .32$). The notetaking subscale regression shows a trivial (less than 1 point) increase in SELF-A for the concussion participants ($b = 0.55$, SE = 4.75, $p = .91$).

For further exploration, Zimmerman and Kitsantas (2007) data was used as a comparison group (n = 223). Cohen’s $d$ was calculated for all four scales for both this
study’s control and treatment groups, also using a pooled equation due to the larger differences in sample sizes (see Table 2). In comparison to this study’s control group, the full SELF-A, study subscale, and test preparation subscale all have trivial effect sizes. The note taking subscale from the control group has a medium effect size. The effect size of this study’s treatment sample for the full SELF-A, study subscale, and test preparation subscale is small. The note taking subscale from the treatment group has a medium effect size. The interpretation of these results is that the treatment (concussion) group from my study scored lower on average than the Zimmerman and Kitsantas comparison group. (The treatment group scored lower on two of the three subscales). This study’s control group does not have notable effects on average to the comparison group.

Table 2

<table>
<thead>
<tr>
<th>Scale</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Control</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full SELF-A</td>
<td>223</td>
<td>76.07</td>
<td>13.69</td>
<td>-0.19</td>
<td>-0.45</td>
</tr>
<tr>
<td>Note taking</td>
<td>223</td>
<td>75.34</td>
<td>14.18</td>
<td>-0.73</td>
<td>-0.66</td>
</tr>
<tr>
<td>Studying</td>
<td>223</td>
<td>75.76</td>
<td>13.82</td>
<td>0.12</td>
<td>-0.41</td>
</tr>
<tr>
<td>Test preparation</td>
<td>223</td>
<td>76.97</td>
<td>13.16</td>
<td>0.04</td>
<td>-0.28</td>
</tr>
</tbody>
</table>

Note: Cohen’s $d$ is calculated using the pooled equation. ZK = Zimmerman and Kitsantas (2007) sample data. Control and Treatment considerations used this study’s means and SDs, which are found in Table 1.

Seventeen participants had data calculating the time lapse from the day of the concussion event to the day they completed the SELF-A. Correlation analysis indicates trivial negative effects on mean SELF-A scores based on the number of days delayed between concussion and SELF-A completion (see Table 3).
Table 3

*Correlations of mean scale SELF-A scores with the number of days delay from the concussion event to completing the SELF-A*

<table>
<thead>
<tr>
<th>Days delay</th>
<th>Mean SELF-A</th>
<th>Mean notetaking subscale</th>
<th>Mean study subscale</th>
<th>Test preparation subscale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-.09</td>
<td>-.17</td>
<td>-.02</td>
<td>-.04</td>
</tr>
</tbody>
</table>

Note: No correlations are significant at the 0.05 level (2-tailed)

Research Study II: Analyzing ImPACT Scores

Seventeen participants had ImPACT score data following their concussion (11 women, 6 men). The ages ranged from 19 to 23 years old. Nine participants had a pre-injury baseline, and only four of these had post-tests that exceeded the RCI (indicating a score that was significantly lower than the baseline). The mean scores and SD of each of the four post-concussion composite scores, as well as for the respective normative percentages, are presented in Table 4. These descriptors give a sense of the participants’ levels of functioning during their post-concussion ImPACT. No analyses using the ImPACT scores are reported because of their questionable validity as well as the small sample size.

Table 4

*Means and SDs for ImPACT participants’ composite scores and respective normative percentage*

<table>
<thead>
<tr>
<th>Composite score</th>
<th>Normative %</th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Memory</td>
<td></td>
<td>89.53</td>
<td>10.76</td>
<td>67.18</td>
<td>32.75</td>
</tr>
<tr>
<td>Visual Memory</td>
<td></td>
<td>76.12</td>
<td>14.64</td>
<td>57.51</td>
<td>34.19</td>
</tr>
<tr>
<td>Visual Motor Speed</td>
<td></td>
<td>40.41</td>
<td>6.21</td>
<td>51.94</td>
<td>29.85</td>
</tr>
<tr>
<td>Reaction Time</td>
<td></td>
<td>0.59</td>
<td>0.07</td>
<td>42.82</td>
<td>26.48</td>
</tr>
</tbody>
</table>

Note: n=17. This is describing post-concussion statistics.
Research Study III: Interviews of Participants

Snapshot of the Interviewees

The four participants interviewed for this study had different stories but with many similar themes as they related their experience returning to learn following their concussion. The first interviewee, Patricia, was a female rugby player who had suffered from multiple concussions during her time in college. She was unique from the others in that she was studying nursing as her undergraduate major, and therefore had more initial medical training than the other three, as well as many professors with superior understanding of the medical consequences of a concussion. Her experience was marked by many missed classes, challenges with memory and recall, and she reflected that the concussion exacerbated her existing pre-concussion academic challenges.

Shaw, also a female rugby player, was initially unaware of her diagnosis, and returned to learning activities as well as rugby practice for a couple days before seeking medical evaluation. She reports struggling primarily with focusing and attention vigilance, as well as class participation. Numerous times in the interview she talks about how she would “push through” her symptoms while continuing to go to classes, complete assignments and work. Her experience of RTL had ups and downs for a couple of months, with varied levels of support from her professors.

The third interviewee, who chose to be identified as Puff, was a male football player who was quite terse in his interview. His initial complaints about his symptoms from the concussion were vestibular-ocular in nature, meaning he suffered in his ability to coordinate and stabilize his vision and his movement. Therefore, movement of things and people around him, as well as moving his own self, aggravated symptoms. He reports
spending a lot of time in a dark room or wanting to have his head down, not wishing to be
around people and lights. Puff was happy about the accommodations he received from
most of his professors, but felt the concussion continued to affect him even after he was
cleared and professors were no longer giving him accommodations for support.

Gabriella, the final interviewee, was a female volleyball player who was very
vigilant about her symptoms and progress. She stated that she was a “pretty good
student”, but felt “like a fourth grader” after the concussion. She many times related her
fear of the potential physical and cognitive consequences of the concussion, but recounts
that she was proactive with communication to her professors and felt they were “so
understanding”. She reported receiving a fair amount of accommodation for her
classwork, and although she was able to get caught back up on her work, she stated it
“took me three weeks of hell to get caught back up and it was the most time consuming,
stressful, anxious period.”

Nine codes were identified both a priori, derived from the subscales of the SELF-
A, and in vivo. Three themes emerged from the analysis of the codes: psychological and
physical effects on the RTL process, academic skills affected by the concussion, and
institutional circumstances and consequences.

**Theme I: Psychological and Physical Effects on the RTL Process**

The following codes clustered together to suggest this theme: focus and attention,
motivation and frustration, and physical symptoms. All four interviewees recounted
similar experiences of affected psychological and physical states, which caused strain
during the RTL process. The initial attempts to engage in academics caused some
amounts of frustration for the participants. Puff reported that when he tried to concentrate
in class, he “got upset because [he] couldn’t retain anything and [he] wasted [his] time.”

Shaw also struggled with the retention of the material, and her frustration was evident in the length of time it took to complete tasks. She stated,

It was just hard to focus, so just answering a question that would have maybe taken 5 minutes before, was taking me like twice as long, maybe 10 minutes, just for a single question. I had to keep going back to it because I just couldn’t retain it and just like I would get a headache the more I tried to focus on it.

Gabriella’s frustration was evident as she stated that the concussion effects “took a toll on pretty much my sanity… I knew I was falling behind and I’m a pretty good student and it just made me upset that I couldn’t do anything.”

All four interviewees attributed their missed classes and difficulties with assignments to some extent their physical symptoms. Headaches were a common ailment that made learning activities difficult. Patricia experienced pain in the eyes when trying to focus, especially “looking at the screen”. Gabriella reported that her three main symptoms affecting her RTL were headaches, nausea, and sensitivity to lights. She said her long classes, such as one lasting three hours, were “too much for me to stay in… I did actually go to one of those classes once with a concussion and it was terrible.”

Shaw stressed that “symptoms were just making it almost impossible to function at the same level that I had before… It made it hard to even engage with anything outside my own body.” Regardless of this, Shaw reported that there were times she “would push through her symptoms no matter what.” She continued to attend all her classes even after finding out she had a concussion, but her “symptoms flared up a lot.” Shaw also recalled the impact of the concussion on her effort and motivation.
I definitely felt that the work that I put into the semester was not the same effort or same level that I had put in in previous semesters. Even though my grades didn’t reflect it, I felt myself doing less, even though I wanted to do more. It was just making an impact on my motivation, having all this sensitivity to reading, sensitivity to noise.

The effects of physical symptoms and the psychological consequences on the participants’ RTL process clearly demonstrated individual experiences within a uniform theme of difficulty and disappointment.

**Theme II: Academic Skills Affected by the Concussion**

The codes that formed this theme included memory, notetaking, studying, and test preparation. The participants related similar experiences with these hard skills necessary for academic performance. Memory retention and recall was a common difficulty reported by the participants. This affected Patricia’s ability to engage in the material. “When I first started trying to go back, a lot of nursing is memorizing stuff, and I couldn’t even remember. I’d read the same sentence like 10 times.” She reported that this is one reason she “missed a lot of classes. There’s no point in going when you can’t remember anything and can’t read.” This had a palpable effect on her studying and test preparation. She recounted that in one of her classes she received an exam grade of 20-point below her norm. “Because its finals week, you’re just studying for so long, for so many exams, I think I was just gassed by the end, in a way that my brain usually can handle.” Gabriella also noted that her inability to prep for exams significantly affected her. Since she was able to postpone a couple assessments, she felt less prepared for her
first assessment, which for the rest of the class was their third. She reported that she “had a panic attack” because she didn’t know what to expect.

Screens and computers also affected the participants’ experience with being able to do their academic tasks while RTL from the concussion. Puff specific stated that “reading off of a computer, not so much a textbook, but a computer was really hard because that hurt my head a lot… I couldn’t do anything.” Puff’s notetaking ability was affected by his need to have his head down in lecture as a way of coping with symptoms and avoiding screens. Patricia explained that she missed a lot of classes because “all my teachers use PowerPoint.” She had a lot of trouble transitioning from taking notes on her paper to looking up at the screen, “so trying to take notes was impossible.” Shaw mentioned that screens aggravated her symptoms, and that it negatively affected her notetaking and therefore course participation grade in one of her classes. Gabriella also vocalized her difficulty with taking effective notes due to her symptoms, but did not mention trouble with screens.

All four participants experienced individual and unique difficulties with the skills of notetaking, studying, and test preparation. These are based on numerous factors such as memory and recall deficits, and/or sensitivity to screens and computers, which are reported as primary means of presentation and communication for many university professors.

**Theme III: Institutional Circumstances and Consequences**

This theme was derived from the codes professorial support and grades. This theme reflects the numerous circumstances within an institution, such as the policies, staff, or faculty, that can and do affect an individual’s experience with RTL following a
concussion, as well as the reported performance-based consequences. Considered an institutional circumstance due to the wide range and varied levels of support are the accommodations offered from the college professors. It was easy to glean from the interviews that the participants had largely a very positive experience, that their teachers were very understanding and most offered accommodations that the students were at least partially satisfied with. For Puff and Patricia, their initially strategy was dictated by medical advice, recommending they not attend classes for a few days. Both received postponement for exams and homework, but also that they took exams before they felt fully ready. Patricia struggled with a concussion that occurred close to final exams, and although she was able to take them all, she “did pretty poorly” on one that ultimately “brought [her] grade down a lot”. Puff said he had about two weeks of time after he was no longer receiving accommodations that he was “just not comfortable with things” but that he “managed to get through it well”.

Gabriella also had a positive experience with the accommodations from her professors. She missed a few classes, and was granted postponement for exams, quizzes, and homework assignments. She reports her own proactive initiative as instrumental to receiving the accommodations, as well as the advocacy from her athletic trainer who sent an informative email to her professors. While she reports “3 weeks of hell to get caught back up… [she] got back on top of [her work] and ahead in all [her] classes.”

Shaw received medical advice from separately an athletic trainer and the student health center staff, and reported that the latter cleared her before the AT. She said,

At one point I did try and get back into doing things a little too early and it prolonged my recovery—I wasn’t the best patient. But then once I found out that
it prolonged my recovery I was a good patient and did what my athletic trainer
told me to do.

Shaw’s experience with the level of support from professors was mixed. She reported
getting extensions for some exams and assignments from some professors, but having to submit homework for others who maintained “very strict deadlines”. One of her professors provided accommodations in a manner that aggravated her symptoms. She was instructed by her AT to avoid screens, however this one professor required that she submit written assignments to an online forum in lieu of missed classes. She wished she had more agency or shared agreement for the type of accommodations she received.

All participants reported that it took weeks of time following the concussion to feel back at their normal academic abilities, with a range of two weeks (Gabriella) to about six weeks (Shaw). Three of the four participants were confident that their academic grades suffered in some part because of the concussion. Puff’s estimation was “a letter grade in like two classes”. Shaw said she dropped a full letter grade “B+ to a C+” due to her inadequate accommodations, and although she was happy with her other grades, she believed most of them were slightly lower too. Patricia reported at least one grade that suffered as a result of poor performance on an exam. Gabriella was confident that her overall academic grades did not suffer.

All four interviewees reported that they received medical advice and support from the club sport athletic trainer, even when the recommendations varied from the student health center staff. The advocacy from medical personnel was helpful for making their professors aware of their condition, however the level of accommodations the received from those professors was varied and not always appropriate for their condition. Patricia
received proactive support from her professors “who are all nurse practitioners” but
Gabriella and Shaw both had to take their own personal initiative to get support from
professors, regardless of the email sent by the athletic trainer. Puff believes there should
be a set policy for managing students that are suffering from a concussion during the
academic year.
CHAPTER V: DISCUSSION

The three studies undertaken for this dissertation sought to explore the academic effects a concussion may have on college students as they return to learn (RTL). The analysis of the study provides insight for specifically these three main questions: whether the concussion had effects on measures of academic self-efficacy using the abridged Self-Efficacy of Learning Form (SELF-A); whether the time interval since the concussion injury is a factor when measuring academic self-efficacy; and what the patients’ experiences with the RTL process looked like, using interviews as the tool for exploration. The original proposal for this study also included an exploration of whether there were associations among neurocognitive testing scores (using Immediate Post-concussion Assessment and Cognitive Testing, or ImPACT) with the SELF-A subscales, however this portion of the study was not effective due to limited validity of the data and small sample size. This discussion will address the study’s findings as it addresses these questions, how the findings inform the literature, and suggestions for further research, including the consideration of neurocognitive testing to inform RTL clinical decisions. In the final sections, the discussion will consider how the findings inform clinical practice, and note some of the relevant limitations associated with the study.

The Effects of a Concussion on Academic Self-Efficacy

This study suggests that a concussion has negative effects on a college student’s academic self-efficacy. Students who sustained a concussion injury at any point during an academic semester, by the close of the semester when their academic self-efficacy was measured their mean scores were lower than a group of students who did not have a
concussion that semester. This effect was small, and appears to affect the scales of self-efficacy concerning studying and test preparation, but not notetaking.

In corroboration with the effect size testing of Zimmerman and Kitsantas’ (2007) data, we saw these same three scales (full, study subscale, and test preparation subscale) from the concussion group also result in lower scores than the comparison group (with the same small effect). As hypothesized, when the Zimmerman and Kitsantas comparison group was tested against the non-concussed control group, these effects were negated, meaning without a concussion our controls acted very similar to the comparison group for these scales. Even when we removed the potential outlier to test our treatment against the controls, the test preparation and studying subscales had the same lower scores on the SELF-A. (Caution should be used against removing the outlier. This one participant suffered a concussion two weeks prior to final exams, and although her responses are considered statistical outliers, it is reasonable to include her experience as a student navigating RTL while recovering from the concussion.) These results help to support this study’s findings that a concussion appears to have a negative effect on a college student’s self-efficacy.

The notetaking subscale did not appear to be affected by the concussion. Interestingly, when compared to Zimmerman and Kitsantas’ data, the notetaking subscale for both our control and treatment groups were much lower. The effect size of the difference between even our control group was considered medium, where we would hypothesize these groups as acting very similar (as they did for the other scales). While this could be a result due to the injury that each participant in our control group had, I caution against this justification because we do not have enough information about the
type of injury, nor about the comparison group, to make an educated hypothesis. The fact that our control group acted differently leads me to speculate that this may be an abnormality, possibly due to the small sample size. Another potential consideration is the timing of the SELF-A, which was administered within a 3-week time period during final exams. The skill of notetaking may be less employed compared to studying and test preparation. We do not know the timing of administration for the comparison group.

**Academic performance.** The findings concerning lower scores of self-efficacy are notable as we consider the abundance of evidence suggesting associations between academic self-efficacy and performance. As noted in the review of literature, Zimmerman and Kitsantas (2007) found the SELF-A scores to be “significantly predicative of the quality and quantity of homework, acceptance of responsibility for adverse academic outcomes, and course grades” (p. 162). Numerous other authors came to similar conclusions, where many different measures of academic self-efficacy positively correlated with various measures of performance (Phan, 2016; Carroll, Houghton, Wood, Unsworth, Hattie, Gordon, & Bower, 2009; Fast, Lewis, Bryant, Bocian, Cardullo, Rettig, & Hammond, 2010; Pajares, 1996; Turner, Chandler, & Heffer, 2009; Zimmerman et al. 1992). Schools and academic programs have minimum standards of performance that must be attained to stay enrolled or in good standing. Grants and scholarships are often dependent on marks of performance and merit. Varsity athletic programs adhere to various association policies that require a minimum grade point average in order to remain on the team. These are just a few examples of how a decline in performance may significantly affect a college student’s status as a student, financial means and access, and student experience. The concerns of a concussion in a college
student extend beyond the physical—we need to be aware of the potential repercussions on their academic success and well-being.

**Lingering effects of the concussion.** In addition, it does not appear to matter when the concussion was sustained—there was no significant association between the SELF-A scores and the interval of the time between the concussion event and when the SELF-A was completed. Whether a student sustained a concussion at the beginning of the semester or at the end, therefore having a delay of a couple months versus a few weeks until they took the SELF-A, both answered similarly. We initially expected that the longer delay from the time of concussion would allow for more physical healing, and therefore we hypothesized that they would feel more on par with the students who have not sustained a concussion. However, this study suggests there may be lingering effects of the concussion on a student’s academic self-efficacy, even when clinically they are considered physically healed.

Our understanding of the physical healing of a concussion is constantly evolving. There is a recent spate of research that suggests a concussion may actually have lingering or altered physical effects beyond our current understanding (Vargas et al., 2015; Albaugh et al., 2015; Brown et al., 2015). The review of literature addresses some of these findings, such as potential deficits in attention vigilance and energy, as well as changes in brain structure and functions (Czerniak et al., 2014; Pontifex et al., 2012). These are effects that are not measured by common clinical tools available to medical professionals guiding the progression of return to activities for a concussed patient. Based on this study’s findings, it appears possible that the negative effects on academic self-efficacy may actually be caused (or contributed) by these lingering physical effects that
are starting to be more understood. This could explain why time of the concussion event during the semester was not a factor. Further study may help elucidate this intersectionality of a concussion patient’s physical effects and academic self-efficacy. Questions such as when is a patient fully healed from their concussion, whether or not there will be lasting physical effects, and whether those effects are permanent, need more evidence to support the search for best practice of returning a patient to these cognitive activities where academic potential relies on self-efficacy.

**Academic accommodations and adjustments.** The findings from this study also strengthen the evidence that students are returning to learn while still suffering from effects of their concussion. While some research suggests that this may prolong symptoms and be detrimental (Brown et al., 2014; Majerske et al., 2008; Carson et al., 2014), other researchers are recommending returning to learn with a concussion can be done with appropriate accommodations and modified instruction (Halstead et al., 2013; Collins et al., 2013). The participants we interviewed reported receiving academic accommodations from professors, however the degree and effectiveness of these accommodations were mixed. Some professors provided accommodations that exacerbated symptoms, and others were medical professionals themselves that were very understanding of the needs of the student. The literature confirms this knowledge gap of professors, citing that a majority of them did not know a concussion could cause many of the known cognitive consequences (Dreer et al., 2016). All participants received some level of medical advice, but with varying degrees of compliance. This helps shed light on the challenges that we face with the processes guiding RTL. At present there are no uniform policies or procedures for returning a student to learning activities, nor is there
strong consensus among experts. While we pursue further study to address this gap, the adverse effects on academic self-efficacy must be considered as an undesirable outcome that will need more exploration and intervention in an attempt to avoid.

Considering the medical care and advice that is available to students, currently we are relying largely on evolving expert opinions to guide our RTL recommendations, the foundation of which was formed even prior to the recent revelations about concussions and the healing process. For example, many medical professionals are still recommending ‘dark room therapy’, a technique of attempting to shut down the use of much of the brain, as depicted in an interview. Research, however, suggest this therapy can be very detrimental to the patient, citing primarily the collateral damage to the social, academic, and general wellness of the student (Thomas et al., 2015; Moser et al., 2012). Other professionals support exercising the brain, citing how we exercise our other soft tissue as it heals during rehabilitation (Albaugh et al., 2015). We need more concrete evidence about the processes and prediction of healing timelines, how to best encourage and create an environment conducive to healing, and how not to interfere with the body’s natural physiological healing process, in order to determine an evidence-based best practice for RTL.

**Future directions for research about RTL.** This study provides some evidence that there may be detrimental effects from a concussion on academic self-efficacy in the college student population, specifically club sport athletes. These participants all had some level of medical advice and advocacy, a fact I can state based on the process of participant recruitment. Arguably, varsity-level athletes may have greater levels of medical intervention and advocacy due to the higher levels of access and intimacy with
their athletic trainer and team physician. On the other side of the spectrum, the general population that does not participate in a university-sponsored organized sport may arguably have less access to medical care for their RTL process following a concussion. Without uniform policies, with medical professionals that are using different paradigms to help guide their advice for RTL, and with professors that have a wide range of knowledge (or lack thereof) about how to effectively manage a concussion patient, each patient’s experience with RTL will be vastly different. Studying these effects on academic self-efficacy across different populations and in other subsets of college populations, as well as secondary and grade level students, would be informative.

In addition, since every concussion presents with different progressions of symptoms and healing times, it would be beneficial if we could find or develop a tool to help determine what specific deficits need intervention in order to guide our practice as a clinician, returning the patient back to activities including learning. This study initially sought to investigate whether ImPACT could reliably predict a trajectory that indicated deficits to the subscales of self-efficacy, however due to the study design and data collection, valid results could not be obtained. Collins et al. (2013) has found ImPACT to be useful in identifying trajectories of clinical symptoms, which can help guide the rehabilitation of the patient, including recommendations for RTL without exacerbation of the symptoms. ImPACT is a simple tool to use and administer, and already pervasive in medical practice, and therefore I recommend future investigation into whether there are associations between the ImPACT scores and measures of self-efficacy, as it may further enlighten our current clinical practices of RTL.
Clinical implications. It is important to use the tools and evidence currently available to best inform our clinical practice of caring for students who have sustained a concussion. Just as important is to acknowledge that there is so much about concussion healing, progression, and other effects that we do not know. Recommendations for medical practice will continue to evolve with the research, and there will be potential for significant changes to our current practice. Medical providers must continue to keep up-to-date on the research and emerging best clinical practices.

How can we do better in light of the dearth of evidence-based recommendations? I think we must ask ourselves as medical providers, as teachers and administrators, parents and community members, what are our responsibilities for ensuring that students are supported academically while considering their health and wellbeing. I am not convinced that we have a good understanding of how to marry these priorities. The qualitative evidence from this study, as well as current literature, indicates our reliance on students and professors to take on a majority of the responsibilities for toiling through this RTL process. Professors are not the source of medical advice that a student should rely on for help determining appropriate accommodations and progression back to learning and other activities. Students certainly do not have adequate medical knowledge, and often juggle their health and academic responsibilities while cognitively impaired as they trying to make decisions about RTL, a dangerous responsibility we are charging them with.

Medical professionals who have the most educated understanding of concussions—athletic trainers, sport physicians, physical therapists and neurologist to name a few—have the clinical knowledge and practice to make competent and high
quality recommendations based on the patients’ clinical examination and the current research. Some evidence is suggesting we can use tools, such as ImPACT, to help guide these processes, but trained medical providers must be the professionals reviewing these tests. When considering the responsibility to the students, I believe it is in the best interest of our educational institutions to ensure appropriate medical care is provided to the students, and education for parents and teachers is paramount for ensuring a team effort of focus on our student’s health and education.

Finally, one step beyond just the need for available medical professionals, is the recommendation that the medical and education communities consider policies and procedures in place at the institutional level. There are no uniform policies in place, although we do see a number of high school with individual policies, as well as the NCAA provides a recommendation for RTL. Developing a uniform educational policy is a big step to ensure that we catch these students suffering from this injury to the brain, and legally provide them with adequate medical care that includes supporting the students as they return back to their learning activities.

**Limitations of the Study**

The intention of this study is to explore the effects of a concussion on academic self-efficacy in the collegiate population. The scale of this study is limited due to a small sample size. The scope of the study is limited to college students, especially those who participate in club-level athletics. This excludes large subsets of college populations, such as the varsity-level sport participants and the general student population that is not participating in university-sponsored organized sport. Many varsity-level participants have recommended guidelines to follow for RTL, but Kerr et al. (2015) found the scope
of adoption to be very low. The results of this study also cannot be generalized to secondary or grade school students, especially as noted in the review of the literature, the processes for returning to learn are often very different than that in the college setting. In addition, there are many factors that are unaccounted for that can reasonably affect academic self-efficacy, such as conditions of mental health, previous head trauma, and learning disabilities, among others. While this study did recruit a control sample, future studies would benefit from an attempt to control more of these factors, as an example using pre- and post-concussion SELF-A measures.

**Conclusion**

We do not know how to best return students back to their academic studies following a concussion, but we do know the process can be physically and psychologically challenging, neurocognitive functions are affected, and medical advice and accommodations can be conflicting and unpredictable. This research provides evidence that the concussion may cause lasting effects on the students’ sense of self-efficacy for their academics. This may translate as a decline in their academic performance and all the ramifications that can accompany a student feeling less than their potential. We have to do better as researchers and clinicians to address these gaps in the literature, to be evidence-based in our decision-making, to create policies that guide the recommendations for accommodations and other school-based systems of support, and to enhance the dissemination of knowledge for both instructors and students about the effects of a concussion, in order to protect and provide high quality care for our vulnerable youth and next generations of citizens.
REFERENCES


APPENDIX A

Research Information Sheet
UVM Club Sport Athletes

Title of Research Project: Exploring the effects of concussion on college students returning to academic demands.

Principal Investigator (PI): Kit Vreeland, ATC, MBA

Faculty Sponsor: Sean Hurley, Ph.D
Department of Leadership and Developmental Sciences
499b Waterman.

Introduction
You are being invited to take part in this research study because you are a collegiate student athlete who has recently sustained a concussion. This study is being conducted by Kit Vreeland at the University of Vermont in partial fulfillment of the Doctorate of Education in educational leadership and policy studies degree.

Purpose
This research is being conducted to explore how your concussion may have affected you academically during and after your return to the demands of your academic work (such as classes, homework and studying). This data will be compared to a group of student athletes who have not experienced a concussion in order to analyze how academic effects may differ.

Study Procedures
If you take part in the study, you will be asked for verbal consent for Kit Vreeland, the principal investigator, to access and analyze the following records for research purposes:

• your ImPACT records from the semester in which you sustained the concussion; and
• your medical evaluation and progress notes pertaining to the concussion, as maintained by Kit Vreeland in her role as athletic trainer for club sports. These notes have been stored in her medical documentation notebook and/or on her work-issued, password protected laptop. No information will be accessed from the UVM Medical Center for Health and Wellbeing.

In addition, at the end of the semester you will be asked to fill out a short survey about how you believe the concussion may have affected your performance for the semester.

The survey will require about 10 minutes and can be taken anywhere you have online access. You may also choose to take it in pen-and-paper form if preferable. Your participation in this study will be complete at the end of the semester after final grades have been reported, and you have completed the survey.

Benefits
As a participant in this research study, there will not be any direct benefit for you; however, information from this study may benefit other college students who suffer a concussion in the future.

Risks
We will do our best to protect the information we collect from you during this study. While there are risks of a breach of confidentiality, the following steps will be taken to help avoid these risks. Your information will be coded, removing identifying information. The list of codes will be kept independently of the data, in a separate and secure location.

Costs
There will be no costs to you for participation in this research study.
Compensation
You will not be paid for taking part in this study.

Confidentiality
Any information that is obtained in connection with this research study that can be linked to you will remain confidential and will be disclosed only with your permission. When you enroll in the study you will be assigned a personal code number that will be placed on all documents. Other identifying information will be removed. This personal code number will be kept separate from all identifying information; only research personnel will have access to a master list that links the personal codes to identifying information.

Questions
If you have any questions about this study now or in the future, you may contact me, Kit Vreeland, at the following phone number: 207-730-0144 or email: kathryn.vreeland@uvm.edu. If you have questions or concerns about your rights as a research participant, then you may contact the Director of the Research Protections Office at (802) 656-5040.

Participation
Your participation is voluntary, and you may refuse to participate without penalty or discrimination at any time.

Statement of Consent
You have been given and have read, or have had read to you, a summary of this research study. You verbally agree to participate in this study. You agree to grant the PI access to your ImPACT records and your medical evaluation notes to use for purpose of research. You affirm that you are at least 18 years of age. You understand that you will receive a copy of this form.
APPENDIX B

Research Information Sheet
Control Group Participant

Title of Research Project: Exploring the effects of concussion on college students returning to academic demands.

Principal Investigator (PI): Kit Vreeland, ATC, MBA
Faculty Sponsor: Sean Hurley, Ph.D
Department of Leadership and Developmental Sciences 499b Waterman.

Introduction
You are being invited to take part in this research study because you are a collegiate student athlete who has suffered from an injury, other than a concussion, that removed you temporarily from practice or competition during an academic semester. This study is being conducted by Kit Vreeland at the University of Vermont in partial fulfillment of the Doctorate of Education in educational leadership and policy studies degree.

Purpose
This research is being conducted to explore how a concussion may have affected a students’ academics during and after their return to the demands of academic work (such as classes, homework and studying). Your role would be to provide a control sample as a participant who has not sustained a concussion. This data will be compared to a group of student athletes who have suffered from a concussion in order to analyze how effects to academics may differ.

Study Procedures
If you take part in the study you will be asked for verbal consent for Kit Vreeland, the principal investigator, to access your medical evaluation and progress notes as they pertain to your injury and for research purposes. These notes have been stored in her medical documentation notebook and/or on her work-issued, password protected laptop. No information will be accessed from the UVM Medical Center for Health and Wellbeing.

In addition, at the end of the semester you will be asked to fill out a short survey about how you believe the concussion may have affected you academically for the semester.

The survey will require about 10 minutes and can be taken anywhere you have online access. You may also choose to take it in pen-and-paper form if preferable. Your participation in this study will be complete at the end of the semester after final grades have been reported, and you have completed the survey.

Benefits
As a participant in this research study, there will not be any direct benefit for you; however, information from this study may benefit other student athletes in the future.

Risks
We will do our best to protect the information we collect from you during this study. While there are risks of a breach of confidentiality, the following steps will be taken to help avoid these risks. Your information will be coded, removing identifying information. The list of codes will be kept independently of the data, in a separate and secure location.
Costs
There will be no costs to you for participation in this research study.

Compensation
You will not be paid for taking part in this study.

Confidentiality
Any information that is obtained in connection with this research study that can be linked to you will remain confidential and will be disclosed only with your permission. When you enroll in the study you will be assigned a personal code number that will be placed on all documents. Other identifying information will be removed. This personal code number will be kept separate from all identifying information; only research personnel will have access to a master list that links the personal codes to identifying information.

Questions
If you have any questions about this study now or in the future, you may contact me, Kit Vreeland, at the following phone number: 207-730-0144 or email: kathryn.vreeland@uvm.edu. If you have questions or concerns about your rights as a research participant, then you may contact the Director of the Research Protections Office at (802) 656-5040.

Participation
Your participation is voluntary, and you may refuse to participate without penalty or discrimination at any time.

Statement of Consent
You have been given and have read, or have had read to you, a summary of this research study. You verbally agree to participate in this study. You agree to grant the PI access to your medical evaluation and progress notes to use for purpose of research. You affirm that you are at least 18 years of age. You understand that you will receive a copy of this form.
APPENDIX C
Research Information Sheet
UVM Club Sport Athletes

Title of Research Project: Exploring the effects of concussion on college students returning to academic demands.

Principal Investigator (PI): Kit Vreeland, ATC, MBA

Faculty Sponsor: Sean Hurley, Ph.D
Department of Leadership and Developmental Sciences
499b Waterman.

Introduction
You are being invited to take part in this research study because you are a collegiate student athlete who has recently sustained a concussion. This study is being conducted by Kit Vreeland at the University of Vermont in partial fulfillment of the Doctorate of Education in educational leadership and policy studies degree.

Purpose
This research is being conducted to explore your experience with returning to learn while recovering from a concussion.

What is Involved in the Study
The research will explore your decision-making process and progression of how the concussion affected you while you were returning to learning activities (such as classes, homework and studying). It will also investigate what effects the concussion may have had on your academic self-efficacy and performance based on your personal experience and perception.

If you consent to take part in the study, the principal investigator or a research assistant will conduct a short interview with you (30 minutes or less), using a semi-structured format. During the interview, we will ask you about your experience after your concussion event with returning to academic activities, such as attending classes and doing homework, and your perceptions of your academic performance following the concussion.

The interview will be conducted at a private and secure location, most likely on campus, at a day and time that is agreed upon and convenient for you. The interview will be recorded, however you will be using a pseudonym to protect your privacy.

If applicable, the researcher may contact you for a short follow up after analyzing the data in order to review for accuracy.

Benefits
As a participant in this research study, there will not be any direct benefit for you; however, information from this study may benefit other college students who suffer a concussion in the future.

Risks
We will do our best to protect the information we collect from you during this study. We will not collect any information that will identify you to further protect your confidentiality and avoid any potential risk for an accidental breach of confidentiality. A pseudonym will be used to protect your identity and the recorded transcripts will be transferred to and kept on a password protected, UVM issued laptop.
Costs
There will be no costs to you for participation in this research study.

Compensation
You will not be paid for taking part in this study.

Confidentiality
All information collected about you during the course of this study will be stored without any identifiers (using pseudonyms if appropriate). No one will be able to match you to your answers other than the PI and research assistants during data analysis.

Your information will be kept secure and protected. Interviews will be recorded using 2 devices to account for potential error of one device. Recorded interviews will be then transferred and stored on a password protected computer, and deleted from any unsecure recording device. The recorded interviews will be stored on this device until the study has concluded, then will be deleted and purged. The written transcription of the recording will remain anonymous, and will be stored on the password protected and encrypted computer even after the close of the study, unless otherwise requested.

Voluntary Participation/Withdrawal
Taking part in this study is voluntary. You are free to not answer any questions or free to withdraw at any time. You may choose not to take part in this study, or if you decide to take part, you can change your mind later and withdraw from the study.

Questions
If you have any questions about this study now or in the future, you may contact me, Kit Vreeland, at the following phone number: 207-730-0144 or email: kathryn.vreeland@uvm.edu. If you have questions or concerns about your rights as a research participant, then you may contact the Director of the Research Protections Office at (802) 656-5040.

Participation
Your participation is voluntary, and you may refuse to participate without penalty or discrimination at any time.

Statement of Consent
You have been given and have read, or have had read to you, a summary of this research study. You verbally agree to participate in this study. You agree to be interviewed by the PI or research assistant, and to have that interview recorded. You affirm that you are at least 18 years of age. You understand that you will receive a copy of this form.
APPENDIX D

SELF-EFFICACY FOR LEARNING FORM (SELF) - Abridged
(Zimmerman and Kitsantas, 2007)

<table>
<thead>
<tr>
<th>Definitely Cannot Do It</th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
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<th>Percentage</th>
<th>Choose a percentage from the above scale to indicate your answer.</th>
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<tbody>
<tr>
<td>1.</td>
<td>When you miss a class, can you find another student who can explain the lecture notes as clearly as your teacher did?</td>
</tr>
<tr>
<td>2.</td>
<td>When your teacher’s lecture is very complex, can you write an effective summary of your original notes before the next class?</td>
</tr>
<tr>
<td>3.</td>
<td>When a lecture is especially boring, can you motivate yourself to keep good notes?</td>
</tr>
<tr>
<td>4.</td>
<td>When you had trouble understanding your instructor’s lecture, can you clarify the confusion before the next class meeting by comparing notes with a classmate?</td>
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<tr>
<td>5.</td>
<td>When you have trouble studying your class notes because they are incomplete or confusing, can you revise and rewrite them clearly after every lecture?</td>
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<tr>
<td>6.</td>
<td>When you are taking a course covering a huge amount of material, can you condense your notes down to just the essential facts?</td>
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<tr>
<td>7.</td>
<td>When you are trying to understand a new topic, can you associate new concepts with old ones sufficiently well to remember them?</td>
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<tr>
<td>8.</td>
<td>When another student asks you to study together for a course in which you are experiencing difficulty, can you be an effective study partner?</td>
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<tr>
<td>9.</td>
<td>When problems with friends and peers conflict with schoolwork, can you keep up with your assignments?</td>
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<tr>
<td>10.</td>
<td>When you feel moody or restless during studying, can you focus your attention well enough to finish your assigned work?</td>
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<tr>
<td>11. When you find yourself getting increasingly behind in a new course, can you increase your study time sufficiently to catch up?</td>
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<tr>
<td>12. When you discover that your homework assignments for the semester are much longer than expected, can you change your other priorities to have enough time for studying?</td>
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<tr>
<td>13. When you have trouble recalling an abstract concept, can you think of a good example that will help you remember it on the test?</td>
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<tr>
<td>14. When you have to take a test in a school subject you dislike, can you find a way to motivate yourself to earn a good grade?</td>
<td></td>
</tr>
<tr>
<td>15. When you are feeling depressed about a forthcoming test, can you find a way to motivate yourself to do well?</td>
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<tr>
<td>16. When your last test results were poor, can you figure out potential questions before the next test that will improve your score greatly?</td>
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<tr>
<td>17. When you are struggling to remember technical details of a concept for a test, can you find a way to associate them together that will ensure recall?</td>
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<tr>
<td>18. When you think you did poorly on a test you just finished, can you go back to your notes and locate all the information you had forgotten?</td>
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<tr>
<td>19. When you find that you had to cram at the last minute for a test, can you begin your test preparation much earlier so you won’t need to cram the next time?</td>
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APPENDIX E

Consent Process Documentation

Protocol: Exploring the effects of concussion on college students returning to academic demands

Participant Name:

Unique Study ID:

Consent Date:

PI/Designee:

Participant, ______, gave verbal consent to participate in the above name protocol. (study participant’s initials)

Prior to providing verbal consent the participant:

- Confirmed that they were 18 y/o or older
- Read the information sheet
- Discussed the protocol participation with researcher including:
  - Purpose of the study
  - Risks/benefits
  - Alternatives
  - Who to call with questions
  - Withdrawal rights
- Asked and answered questions

The participant was provided with a copy of the information sheet.

Other Comments:

PI/Designee Signature:__________________________ Date:_________________
APPENDIX F

Semi-structured Interview Questions

“These questions will explore your experience with returning to academic demands following your concussion. As a reminder, this interview should take only 30 minutes and will be recorded. After the research team reviews the data, you may be contacted for clarification or accuracy. For confidentiality, we will use a pseudonym to address you – what name would you like to be addressed by? ___________________.

“For clarifying purposes, academic demands or activities refer to any task that you normally complete in order to perform as a student, such as homework, studying, reading textbooks, attending classes, taking notes, etc.”

“Do you have any questions or concerns before we begin?”

1. After the concussion when you first returned to academic demands, how well could you engage in the material?

2. How long after your concussion did it take for you to feel ready to return to learning activities, regardless of whether you were still suffering from symptoms?  
   a. How long did it take for you feel 100% when tackling your academic challenges?

3. What factors influenced your decisions around participating in or deferring academic activities?

4. What kinds of medical assistance, if any, did you receive in deciding how and when to return to learning activities? (Interviewer: Clarify ATC, MD, nurse, etc.?)  
   b. How attentive were you to this advice?

5. How amenable were your professors and advisors to granting accommodations?

6. If you decided to miss any classes because of the concussion, can you explain why you chose to do so?

7. How do you feel your concussion affected your academic performance throughout the semester?

8. Do you believe your academic performance suffered, such as lower grades, as a result of the concussion?

9. Is there anything else related to your concussion experience that you feel is important to share?
APPENDIX G

Interview Transcripts

*Italicized* = interviewer speaking

G1: Patricia interview transcript
G2: Shaw interview transcript
G3: Puff interview transcript
G4: Gabriella interview transcript

Appendix G1: Patricia interview transcript

1.) After the concussion, when you first returned to academic demands, how well could you engage in the material?
   a. Is this, which concussion? I’ve had 3, so is it any of them or?
      i. I would go with your most recent one. Or most severe one. Did you have one in the past semester?
   b. Last semester, I had one. Sorry what was the question?
      i. [Question repeated]
   c. Well, I tried to go to class like the first day, but I have nursing professors so they all know it’s a traumatic brain injury. So they kind of all sent me away. They told me really not to come back.
      i. After you first returned to class though, did you feel like you could focus in class or engage in the material?
   d. I didn’t have trouble focusing; I keep getting mine in my occipital lobe, which is the back of my head, and I have trouble looking at the, going from looking at papers to looking at the screen. It really hurts my eyes a lot. Or it gives me a headache in the back of my eyes.

2.) How long after your concussion did it take for you to feel ready to learning or activities regardless of whether you were still suffering from symptoms?
   a. Mine… mine happened pretty close to exams I think. So I tried to go back like right away, but I, I think I went back like, 2 or 3 days later. But then like, I took a lot of breaks and stuff. So I don’t know if it was like, really going back, or like, cause I take like… do work for an hour then like, take them.
      i. So when you were in that first few days after, on a scale of 0% to 100%, how well did you feel like you engaged in the material?
   b. Like 50%? It’s hard to, because you like can’t remember anything. When I first started trying to go back, a lot of nursing is memorizing stuff, and I couldn’t even remember. I’d read the same sentence like 10 times.
i. How long did it take for you to feel 100% when tackling your academic challenges?
c. I mean. Probably 2 weeks, it is usually. That was pretty baseline for all 3 of them was around 2 weeks I stopped having headaches and stuff. Sometimes now I have trouble remembering words. You know when they’re on the tip of your tongue but you can’t like... *laughs*

3.) So I know that it was pretty close to exam time, but besides that, what other factors influenced your decisions around participating in or deferring academic activities?
   a. It was really helpful how supportive my teachers were, you know. They all kind of know the consequences. And I know for others of my teammates, when they’re like, when their teachers are like, “Oh! Well you can still do work when you’re supposed to be resting.” But you’re really just supposed to be resting, so that was really helpful, and my past concussions kind of helped me know what to do and what I could do. My last one wasn’t as bad as the other ones that I’ve had; in the past I really could not do anything for a week.

4.) What kinds of medical assistance, if any, did you receive in deciding how and when to return to learning activities? (Clarify: ATC, MD, nurse, etc.?)
   a. Well, I don’t think I went to a doctor for the last one. I talked to Kit, athletic trainer, and I talked to my professors who are all nurse practitioners. So I guess I had some medical advice, but most of what they told me was “do what you can, symptom depending”.
      i. Did you feel that you were pretty attentive to this advice?
   b. Yeah, to some extent. The first incident I got a headache, I didn’t stop because sometimes the headaches aren’t that bad and when it first happens, you really can’t focus at all so I was kind of.... Like you can’t focus so it makes learning impossible. Like you basically feel drunk, sorry, for a week. The last time it happened, my headaches weren’t really that bad, I mostly just felt pretty drunk.
      i. With each one were your symptoms pretty different?
   c. They’re all in the same place. With the first two, I had more headaches. The last one I had wasn’t as bad, I just like felt kind of weird.

5.) How amenable were your professors in granting accommodations?
   a. They were pretty awesome. They were pretty amendable. They all have pretty extensive brain injury knowledge.

6.) If you decided to miss any classes because of the concussion, can you explain why you chose to do so?
a. I mostly didn’t go to class because of the PowerPoint thing, all my teachers use PowerPoints. So trying to take notes was impossible. I did go a couple times to just sit there and listen, but when you have a concussion you don’t get much from just sitting and listening and my second concussion was so bad I couldn’t even read. So I missed a lot of classes. There’s no point in going when you can’t remember anything and can’t read.

7.) With this past concussion, how do you feel that it affected your academic performance throughout the semester? Such as grades, attention, focus, and the amount you learned?
   a. I didn’t think it was that bad, I had kind of gotten through the harder learning material for the semester, so it wasn’t that hard.
      i. Would you say it was different for your past concussions?
   b. Yeah. My past concussions... it was pretty hard. The second one definitely came right around finals and they were talking about giving me ... you know when they just like, put a hold or something. When they don’t close the class for you, so you can take the exam after a while, when you feel better. I forget what it was called, not a withdrawal or anything, just when your grade doesn’t get put in yet. I was able to take all my exams. The first two I did really well on and the very last one I did pretty poorly on. In that class I’ve been getting 94’s and 96’s, and the last exam I got a 76. It kind of brought my grade down a lot. Because its finals week you’re just studying for so long, for so many exams, I think I was just gassed by the end...In a way that my brain usually can handle.
      i. Throughout the periods where you had your concussions, did you feel like still remember or learned a lot of what was taught in the classes?
   c. Oh no, I don’t remember any of that! If I did go to class, I don’t... I cant. Honestly if this interview is a little hard for me because it’s like a leap in my life that I don’t remember. Like I have some memories, like oh yeah I was sitting with my friends in the Davis Center.

8.) Do believe your academic performance suffered, such as low grades, as a result of the concussion?
   a. With my second concussion, my exams definitely could have gone better. The last one, I actually think didn’t fall during exams, so it wasn’t as big of a problem. I passed pharmacology, which is like one of the hardest nursing classes. And Kit, I took those baseline tests, and I actually did better on the baseline test after my last concussion than I did when I initially took the baseline test.
      i. So with the last concussion, it was kind of mid semester? So from beginning of semester to end of semester, do you feel anything
9.) Is there anything else related to your concussion experience that you feel is important to share?
   a. I definitely think overall, I don’t think mine has affected my memory as much. But I definitely know when I get tired, my brain is done. I’ll be talking to my housemates and I’ll totally mess up pronouncing a word. And it’s a word that you totally should know how to pronounce. Or it goes back to that feeling of kind of being drunk, you know? Which my first concussion happened my senior year of high school, so I don’t know if that’s just baseline who I am but I definitely feel like it’s gotten worse. And the parts of my academic areas that I’m already not very good at, like remembering certain words and stuff, that’s definitely just gotten worse. So the places where I already struggle are just harder, if that makes sense.
Appendix G2: Shaw interview transcript

1. *After the concussion, when you first returned to academic demands, how well could you engage in the material?*
   a. Do you mean after the concussion was healed, or after I found out I had the concussion?
      i. *After you found out.*
   b. It was difficult to pay attention in class and take notes... I'm sorry can you repeat the question one more time?
      i. *[Question repeated.]*
   c. Not as well as I could before, like I said note taking and paying attention to professors in my lectures was very difficult. Homework took twice as along and it was just hard to focus on any subject in class or out of class for longer than like 20 minutes or 30 minutes depending on the subject it took longer.
      i. *Was the homework taking longer due to your symptoms?*
   d. It was due to headaches, it was just hard to focus, so just answering a question that would have maybe taken 5 minutes before, was taking me like twice as long maybe 10 minutes just for a single question because I had to keep going back to it because I just couldn’t retain it and just like I would get a headache the more I tried to focus on it.

2. *How long after your concussion did it take for you to feel ready to return to learning activities, regardless of whether you were still suffering from symptoms? How long did it take for you to feel 100% when tackling your academic challenges?*
   a. It took a couple weeks. I think I had the concussion in like September, I don’t think I felt 100% physically until like October or early November.
      i. *Physically being?*
   b. No more headaches, like no more symptoms. Getting back to academics was a lot faster than getting back to athletics. I think I was doing better in classes maybe at like the end of October. And I had the concussion around mid-to-late September, so it took a couple weeks.

3. *What factors influenced your decisions around participating in or deferring academic activities? So was it your symptoms?*
   a. Basically if the assignment or the thing I had to do for class was 100% mandatory, I would push through my symptoms no matter what and did them. But if I could get away with it and my symptoms were being very mean to me, if they were being aggressive, um, I would hold off or ask the professor for like an extension. If I was finding that I had 2 days to do an assignment along with all my other assignments and it was taking longer than I thought I would ask the professor for an extra day or so,
based on the ability to focus, depending on how pressing the assignment was. I got an extension for one of my tests because, um, to take it with ACCESS because I just couldn’t study the way I could before, so she gave me an extension there. But things that were like papers and project proposals that had very, very strict deadlines based on the course schedule, I had to just push through those.

i. **So essentially it was your symptoms?**

b. It was depending on how accessible the homework was to me based on how my head was feeling.

4. **What kind of medical assistance, if any, did you receive in deciding how and when to return to learning activities? (Interviewer: Clarify ATC, MD, nurse, etc.?)**

   a. Most of my advice came from Kit, the rugby athletic trainer. She was just more accessible to me seeing her at practice and all of that. I think I did go to student health services, and they didn’t tell me anything different, rest, time. They actually cleared me before Kit did though, so I thought that was interesting. But, I tried to do my best to listen to Kit, even though it was very frustrating. I think at one point I did try and get back into doing things a little too early and it prolonged my recovery—I wasn’t the best patient. But then once I found out that it prolonged my recovery I was a good patient and did what my athletic trainer told me to do.

5. **How amenable were your professors and advisors to granting accommodations?**

   a. Most of them were very accessible or very helpful, um, I, for example, my Chinese professor as I mentioned gave me an extension on my test. My creative writing professors would give me an extra day to type up my essays. One professor said he was very accessible in the way that he understand I wouldn’t be able to participate as much, it was a discussion based class. However, when the grades came in he had basically given me an F for participation at the end of semester, even though I had talked with him several times about not being able to take notes, keep up with the discussion, or participate for that amount of weeks. So that was interesting.

6. **If you decided to miss any classes because of the concussion, can you explain why you chose to do so?**

   a. I don’t think I missed many classes because of the concussion. In the first week after I found out I had a concussion I went to all of my classes. But the second week, my symptoms flared up a lot because I had not taken any time off from my schedule. I, like, going to class, going to practice, going to work, doing my normal routine, trying to push through it. And so I took two days off because my trainer told me it was a good idea. I e-
mailed my professors and they said it was okay first ahead of time, and I did so because my symptoms were just making it almost impossible to function at the same level that I had before.

i. *Do you remember what symptoms specifically?*

b. Mostly headaches and just inability to focus. It made it hard to even engage with anything outside my own body.

7. *How do you feel your concussion affected your academic performance throughout the semester?*

a. It definitely had an impact. Most of my professors were very accommodating so my grades didn’t suffer too much. But I definitely felt that the work that I put into the semester was not the same effort or same level that I had put in, in previous semesters. Even though my grades didn’t reflect it, I felt myself doing less, even though I wanted to do more. It was just making an impact on my motivation, having all this sensitivity to reading, sensitivity to noise.

i. *So did grades suffer at all, or was it more of just, you not being able to perform at the level you wanted to? [Here I (the interviewer) sort of ask question 8 combined with question 7 to keep the flow of conversation going because she already talks about lower grades.]*

b. The one class that my professor flunked me for participation, that grade went down drastically which it would not have if I had actively participated in class. That grade significantly suffered. I went from a B+ to a C+ in that class by the end of the semester. Most of my classes were around the B range whereas I usually would have gotten a B+ so I don’t see that much of a difference, but for me a B is still a win in some of these classes. But that one English class with the participation was the only one that had a very drastic grade drop. Everything else was minor despite my feelings about my own effort being less.

8. *Is there anything else related to your concussion experience that you feel is important to share?*

a. I wish I knew now to listen to Kit more. I didn’t even know I had a concussion for the first 3 or 4 days and I definitely didn’t take it easy, so listen to your trainers.

i. *Do you think it is important for professors to recognize how serious a concussion is and make accommodations to that?*

b. Absolutely. Absolutely. I almost wish that my professors, when I told them I had a concussion, that I would still be coming to class, that they had said please take a day off or something. While they were very accommodating with my assignments, it is difficult when you have a class schedule that you’re supposed to keep and grades, and it is very, very
good that professor understand that it’s an academic setting, academics means brain, brain is what’s not functioning at the same level right now, so I wish I had taken those 2-3 days off beforehand and I’m also very grateful that most of my professors were accommodating in giving me extension on my assignments. I wish that other professor had been more understanding, or somehow made another accommodation for participation that we agreed on. We could not figure out something to do because the only thing he offered up was write on our discussion board on blackboard, but Kit didn’t want me to be on the internet and screens with a concussion which also aggravated my eyes and my head, so that wouldn’t have worked. Anyway, it’s nice, it’s really nice when teachers make accommodations.
Appendix G3: Puff interview transcript

1. After the concussion, when you first returned to academic demands, how well could you engage in the material?
   a. Not as well as I used to. It was really hard to get back into my old self. It took a long time.
      i. What did that look like? Were you not able to read, trouble concentrating?
   b. Mostly, concentrating in class, sitting in lectures was really hard because I just wanted to sleep. I couldn’t focus on what the professor was saying so I would start thinking about something else. Reading off of a computer, not so much a textbook, but a computer was really hard because that hurt my head a lot.
      i. So you were there, but not there?
   c. I couldn’t do anything.

2. How long after your concussion did it take for you to feel ready to return to learning activities, regardless of whether you were still suffering from symptoms? How long did it take for you to feel 100% when tackling your academic challenges?
   a. After I got cleared, maybe a week or week and a half. But then I started feeling back into it.
      i. So how long did it take until you were normal, from the day it happened.
   b. It took a good month. A solid month of me just grinding through little things, and then eventually getting back to my original self.

3. What factors influenced your decisions around participating in or deferring academic activities?
   a. My headache, and my inability to concentrate on anything. So, if I just sat there and listened I wouldn’t retain anything so I got upset because I couldn’t retain anything and I wasted my time.
      i. Any other symptoms? Or really just that headache and concentration? Did you feel, you know, being around people, was it kind of anxiety producing or irritated?
   b. I didn’t like being around people too much, I just liked being in a dark room by myself.
      i. And that’s where you were comfortable?
   c. Uh-huh [yes].

4. What kind of medical assistance, if any, did you receive in deciding how and when to return to learning activities? So, ATC, MD, nurse, etc.? And how attentive were you to this advice?
a. I listened to the trainer’s advice from football practice a lot, I followed her, what she said completely to the letter, and it made me very comfortable with the way things were progressing. I also followed what, I had another doctor in the student health center and he guided me through too. But I mostly listened to the trainer because I felt like she knew what she was doing. It definitely speeded the process.

5. How amenable were your professors and advisors to granting accommodations?
   a. Most my professors were open. I only had one who really wasn’t open I still had to take an exam, but it really didn’t go that badly, it was after the 3-week period it just, I wasn’t comfortable yet. I couldn’t concentrate the last two weeks of lecture. But most of the professors were pretty accommodating.
      i. Did they give you extensions for assignments?
   b. They gave me extensions and make ups.
      i. Do you think that took some stress of of the whole situation?
   c. It let me focus on recovery instead of school.
      i. So you felt like they were really understanding?
   d. Uh-huh [yes].

6. If you decided to miss any classes because of the concussion, can you explain why you chose to do so?
   a. I chose to do so because my headache was too much for me to go outside and deal with the sun and other people. And I couldn’t, I didn’t want to go to a class and be a distraction to the professor by having my head, cause occasionally I would have to put my head down in lecture because I couldn’t concentrate and I had a headache and the lights were bothering me. So I decided just not be a burden to other students and professor.
      i. If I remember correctly, you missed a couple days. Were you able to do any work outside of class? And I know 5 days especially in college is a lot, I know you said your professors were accommodating so you were probably stressed out a little bit but overall it wasn’t that bad?
   b. After 3 days I could read from a textbook, I just couldn’t do anything on a computer.

7. How do you feel your concussion affected your academic performance throughout the semester?
   a. It took me a solid month to get back to where I was. So I was cleared and my professors were no longer accommodating after that but I still had like 2 weeks left of me just not comfortable with things. So I guess its affected me a little bit, but I managed to get through it well.
8. Do you believe your academic performance suffered, such as lower grades, as a result of the concussion?
   a. Yeah, definitely. I definitely got lower grades than what I normally would have gotten without the concussion.
      i. Do you feel that it was significant?
   b. A letter grade in like two classes, but that’s about it.
      i. Do you feel that if you didn’t have the concussion, that wouldn’t have happened?
   c. No.

9. Is there anything else related to your concussion that you feel is important to share? Do you think it’s really important for professors to understand what a concussion is? And for there to be policies set in place in terms of being accommodating and really just understand what you went through? You know because it’s not something you see, like a fracture.
   a. Yeah, I wish there was a policy set that actually talked about people with concussion and how to handle them.
Appendix G4: Gabriella Interview Transcript

1.) After the concussion, when you first returned to academic demands, how well could you engage in the material?
   a. Um, pretty well, it was really hard at first. Um, it took a lot to get back into it because it hurt my head a lot. But it was pretty easy just a few weeks afterwards I was able to fully put my mind into stuff.
      i. When you say it took a lot, what do you mean by that?
   b. It just, it took a toll on pretty much my sanity just to not be able to do work because I know, I knew I was falling behind and I’m a pretty good student and it just made me upset that I couldn’t do anything. But my teachers were understanding so it was ok for me to take time off for my head to heal, and then I was, I was capable of getting back into stuff pretty easily.

2.) How long after your concussion did it take for you to feel ready to learning activities, regardless of whether you were still suffering from symptoms?
   a. Um, after feeling symptoms, or once Kit said the symptoms were good, you’re good to go back in?
      i. So, how long did it take, Once you got the concussion how long did it take for you to feel like you were normal again?
   b. So let’s see, I Did probably 3 weeks of meeting with Kit and then my symptoms subsided so probably 5 weeks.

3.) What factors influenced you decisions around participating in or deferring academic activities?
   a. Can you repeat the first part?
      i. Question repeated
   b. Um, having a headache, feeling nauseous, if it was too bright outside, it would make me too sick to go to class. Um, if my classes were 3 hours long because I have one of those on Mondays, and that was too much for me to stay in. Um, I did actually go to one of those classes once with a concussion, and it was terrible, but I, I didn’t do much in it. Pretty much just if my symptoms, if my head was hurting I couldn’t do homework, uh I tried to push it. But then one of my speech teachers was like, oh yea I had a kid with a concussion and he tried to work through it and he’s got permanent brain damage now, and so that scared me into really making sure that I was ok before starting anything.

4.) What kind of medical assistance, if any, did you receive in deciding how and when to return to learning activities? So ATC, MD, nurse, etc.? And how attentive were you to this advice?
   a. Um I had Kit a ATC and I really paid attention. Cause this was my first concussion and it was a really sucky concussion, um, yea I paid close
attention. Except for when I wasn’t sure, if I had like a slight headache I
would keep working, but besides that I was pretty on top of it.

5.) How amenable were your professors and advisors to granting accommodations?
   a. They were so understanding. I think it’s because of that new movie by Will
      Smith Concussion that came out, but they were very understanding, um,
      they allowed me to turn in all of my work late for full credit, they let me
      post pone any quizzes and exams for at the end of the semester, um, that’s
      pretty much it, they were pretty good about it.

6.) If you decided to miss any classes because of the concussion, can you explain
    why you chose to do so?
   a. Um, yea, I, basically missed classes because the lights were too much or if
      they were too long or if I wasn’t feeling well and had a headache or if, um,
      if some of, I have one class that all the teacher does is talk at you and she
      doesn’t write anything down and that takes a lot of mental work for me to
      write down all of my work, so I would choose not to go to those classes
      too. Or if it was just like a class where I just had to put down a lot of writing
      because during my concussion and a little afterwards I couldn’t um, form
      sentences well I didn’t know how to like be coherent and not sound like a
      fourth grader.
         i. And um, your professors were OK with all of that?
   b. Mhm, yeah, as long as I gave them an e-mail saying that I was sick and
      couldn’t work that Kit had sent me, and then I had to go through the dean
      in order to get some of that done but they were all very good about it too.

7.) How do you feel your concussion affected your academic performance
    throughout the semester?
   a. Um, so at first it really hindered me. I got really um behind in a poly-sci
      class and it freaked me out because I missed the first quiz and the first
      exam, and so I didn’t know what to expect for the other ones. And I had a
      panic attack after the second quiz which was the first I took, and but then I
      ended up doing extremely well on it, so it kind of subsided my feelings and
      I feel more confident in that class. Uh, all of my other classes, I feel really
      good about, um, it really only messed me up for the time period I had a
      concussion and the time period after, but I was able to gain most of my
      mental clarity back and not have headaches, so I, it took me three weeks of
      hell to get caught back up and it was the most time consuming, stressful,
      anxious period but I got back on top of it and I’m ahead in all of my classes,
      and I see no issues now.

8.) Do you believe your academic performance suffered, such as lower grades, as a
    result of the concussion?
a. Um, not really, um, yeah no.

9.) Is there anything else related to your concussion experience that you feel is important to share?
   a. Um, it’s very important to, it’s very important to actually take the rest and not push it cause it’s gonna hurt you later on, and my teachers were so understanding and I loved that, um, can you repeat the question another time.
   i. Question repeated
   b. Um well I really felt like a fourth grader afterwards. I was really scared I wouldn’t be able to write anymore, because I could not do any writing assignments. Um, but yeah that’s pretty much it, nothing really extreme. Oh besides don’t jump over a bed and hit your head on a bed post.
   i. Yeah, don’t do that!
   ii. So it seems like your experience with your teachers went fairly well, but if you were to take away some key points, how do you think colleges could do a better job for students that are suffering from a concussion?
   c. I don’t know, my teachers were really, really understanding, the completely um, I mean I think it depends on the student too, you have to take initiative. I met with all of my teachers I talked to all of my teachers, I gave them all of the e-mail, um, I met with them afterwards to see how I can make up all of my work. So as long as you’re on top of it and you like, actually care about how you’re going to do because of the concussion then I think you’ll be fine and your teachers will be really understanding, they will probably like it if you do that too.
## APPENDIX H

List of Codes and Meanings

<table>
<thead>
<tr>
<th>Focus and attention</th>
<th>Participant identifies when the concussion affected the ability to focus or sustain attention.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation and frustration</td>
<td>Participant comments reflect a theme of affected motivation and/or frustration with returning to learn.</td>
</tr>
<tr>
<td>Physical symptoms</td>
<td>Participant relates his or her physical symptoms as affecting the RTL process.</td>
</tr>
<tr>
<td>Professorial support</td>
<td>Participant notes the different levels and types of support offered by their professors and instructors.</td>
</tr>
<tr>
<td>Memory</td>
<td>Participant comments on challenges with memory retention and/or recall.</td>
</tr>
<tr>
<td>Grades</td>
<td>Identifies specific marks of performance that may have been affected by the experience of the concussion.</td>
</tr>
<tr>
<td>Notetaking</td>
<td>A subscale of the SELF-A, this code was used when the participant made reference to their notetaking.</td>
</tr>
<tr>
<td>Studying</td>
<td>A subscale of the SELF-A, this code was used when the participant made reference to their studying.</td>
</tr>
<tr>
<td>Test preparation</td>
<td>A subscale of the SELF-A, this code was used when the participant made reference to their test preparation.</td>
</tr>
</tbody>
</table>