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Trinity return-to-learn post-concussion protocol assessment

Anna Hackett
anna.hackett@trincoll.edu

TRINITY COLLEGE

TRINITY RETURN-TO-LEARN POST-CONCUSSION PROTOCOL ASSESSMENT

BY

ANNA HACKETT

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ANNA HACKETT

Honors Thesis Committee Approved

Approved:

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Sarah Raskin, Thesis Advisor

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Molly Helt, Thesis Committee

_____

Sarah Raskin, Director, Neuroscience Program

Date: _____

Abstract

Return-to-learn protocols after concussion have received less attention than return-to-play protocols. Return-to-learn protocols are step by step guidelines for students and teachers to help ease concussed students back into their academic work. At Trinity College, faculty are given information on common effects of concussion and suggested academic accommodations. This study aimed to assess the entire return-to-learn protocol currently in place at Trinity College, with a specific focus on how well known the program is to students and how helpful they have found it, in an attempt to ascertain what aspects of the protocol work well and what could be improved. Faculty were surveyed to gain their input on how the protocol has worked and how cumbersome it was for them; and coaches were surveyed to assess if they had any role in helping their athletes return to the classroom as well as the playing field. Students who have been concussed were also given a series of cognitive measures to determine if particular cognitive profiles led to greater difficulty returning to the classroom. A majority of surveyed students and approximately half of the faculty and coaches were unfamiliar with the protocol. A deficit in executive function was found to correlate with current concussive symptoms. Severity of current concussive symptoms was found to correlate with severity of depressive symptoms. The results of this study suggest that the Trinity College community needs to be better educated on the return-to-learn protocol, extra care should be taken to account for potential rises in depressive conditions of concussed students, and accommodations for executive functions should be regularly provided.

Introduction

Concussions have received increased attention over the past decade as news stories and movies have turned the public eye towards the potential short- and long-term effects associated with them (Harrison, 2014). Minor traumatic brain injuries (mTBI), such as concussions, have been labeled a "silent epidemic," (Mollayeva et al, 2018, p. 2) as many cases go undiagnosed and untreated (Harmon et al, 2013). In 2011, it was estimated that 1.6 to 3.8 million people annually in the United States sustain a concussion, with numbers steadily increasing (Harmon et al, 2013). Despite this surge of interest in concussions the lack of support for those who have sustained them is of concern. While there has been considerable recent work on return-to-learn for school aged children (Children's Hospital of Chicago, 2020; Committee on Sports-Related Concussions in Youth; Board on Children, Youth, and Families; Institute of Medicine et al, 2014; Wing, et al, 2016), there is currently no standardized return-to-learn protocol for college students following a concussion. It is also unknown whether the presence of potential cognitive deficits in attention, executive function, or memory following a concussion have a correlation with a college student's perceived difficulty returning to the classroom.

A concussion is a mild traumatic brain injury resulting from a blow to the head or a rotational force (Guskiewics et al, 2004), such as whiplash. They are so common that it is postulated that every physician will at some point encounter a patient with concussion (Mann, 2017) and for this reason, knowledge on their treatment and diagnosis must be universal. According to the American Congress of Rehabilitation Medicine definition, a concussion can be clinically diagnosed based on the presence of at least one symptom such as any period of loss of consciousness, any loss of memory for events immediately before or after the accident, any alteration in mental state at the time of the accident, or focal neurological deficits (Kay et al, 1993). The severity of these symptoms does not exceed loss of consciousness of approximately thirty minutes or less, after thirty minutes an initial Glasgow Coma Scale of thirteen to fifteen, and posttraumatic amnesia not greater than twenty-four hours (Kay et al, 1993). Neuropsychological testing such as the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) test, a battery of

neuropsychological tests such as Digit Symbol Substitution and Digit Span, as well as sideline evaluations of symptomology by physicians, athletic trainers, or coaches are common diagnostic tools for concussion (Committee on Sports-Related Concussions in Youth; Board on Children, Youth, and Families; Institute of Medicine et al, 2014). Approximately thirty-three percent of concussed individuals will experience symptoms beyond the usual recovery period of seven to ten days, forming a condition known as post-concussion syndrome (Leddy et al, 2012). Diagnosis for post-concussive syndrome can be defined as cognitive deficits in attention or memory and at least three symptoms including: fatigue, sleep disturbance, headache, dizziness, irritability, affective disturbance, apathy, or personality change (Leddy et al, 2012). Diagnosis for both concussion and post-concussion syndrome can be difficult as manifestation varies significantly per individual and given its frequent occurrence in athletes, concussed patients can be motivated to underreport their symptoms (Register-Mihalik et al, 2013).

Children and young adults are at greatest risk of sustaining a concussion (Giza & DiFiori, 2011) and collegiate athletes sustain higher levels of concussion than high school athletes (Gessel et al, 2007). This elevated risk is important as factors such as stronger identity relation to their sport, peer acceptance, and coach support have been shown to influence a collegiate athlete's motivation to report symptoms (Register-Mihalik et al, 2013). For this reason, students, coaches, and faculty need to be well-informed on the risks associated with concussion.

A collision of the brain and skull during concussion causes shearing of nerve fibers and possible contusions (Guskiewics et al, 2004) noticeably in the deep internal structures of the brain (Meaney & Smith, 2011). Swelling can be seen in the inferior frontal, superior frontal, and supracallosal white matter subcortical regions, which is correlated with executive function and behavioral changes (Barkhoudarian, Hovda, & Giza, 2011). Concussions can trigger an acute metabolic cascade in the brain (Giza & DiFiori, 2011). Following trauma there is a paired reaction of glutamate release and depolarization of neurons, which requires transmembrane ionic pumps using adenosine triphosphate (ATP) to work overtime in an attempt

to return ionic concentrations to homeostasis (Giza & DiFiori, 2011). Given that so much ATP must be used, there is a substantial increase in glucose metabolism leading to a seven to ten-day glucose metabolic depression, which usually correlates with cognitive deficits (Barkhoudarian, 2011; Giza & DiFiori, 2011; Meaney & Smith, 2011). For example, working memory impairments have been seen following head trauma with increased tissue water content in the cortex, diffuse neurodegeneration in the retrosplenial cortex and dentate gyrus, and traumatic axonal injury in the corpus callosum and cingulum causing traumatic axonal injury (Creed et al, 2011). Cells within the brain are at substantial risk of long-term damage or even apoptosis, programmed cell death, during the acute recovery stage as the brain works to regain equilibrium (Meaney & Smith, 2011). Premature exercise and uncontrolled activity too soon after a concussion impairs recovery (King & Kirwilliam, 2011). For this reason, proper care following concussion is imperative.

The cognitive deficits that are primarily seen are in attention, executive function, and memory (Irvine et al, 2017; Ryan & Warden, 2003; Smith-Seemiller et al, 2003). Studies have found less activation in the prefrontal cortex of concussed individuals during cognitive tasks than healthy individuals (Chen et al, 2007). Executive function and attention are mediated by the prefrontal cortex (Kesner & Churchwell, 2011), meaning less activation in this area could correlate with deficits in these cognitive processes. The deficits in attention and memory seen after a TBI have been described to mimic those seen in Alzheimer disease (King & Kirwilliam, 2011). Difficulties with concentration and attention in post-concussive subjects are enhanced by tiredness and fatigue (Mittenberg et al, 2001). Underperformance and reduced processing speed on verbal and visuo-spatial short-term memory and executive function tasks is found in subjects with post-concussion symptoms (King & Kirwilliam, 2011; Richardson, 2000). It is not well established, however, if any of these cognitive deficits have a greater effect on a student's academics as compared to the others. These deficits can appear in the presence of stress following injury and can cause emotional distress as people with concussions can form inaccurate expectations of recovery due to inadequate awareness of their limitations (Wood et al, 1984).

When hypothesizing the effect of certain deficits on a student's ability to return to the classroom, it is important to understand how these deficits might be compensated for by individual students. Multiple compensatory approaches are available for memory and executive function such as paging systems for memory impairments (Fish et al, 2008) and goal setting and planning for executive function (Rossignoli-Palomeque et al, 2019). Attention deficits can be targeted using the compensatory strategy of visuospatial cueing (Barman et al, 2016), however people with these deficits often need to resort to restorative approaches of prolonged practice with programs like Attention Process Training given the lack of availability of compensatory strategies for attention (Barman et al, 2016). While working memory is an integral component of executive functioning (Anderson et al, 2008), attention is a fundamental process for many cognitive functions including both memory and executive function (Loetscher & Lincoln, 2013). Studies show children with attention deficits experience difficulties remaining on-task and completing work in school (Busch, 1993) and thus the lack of compensatory strategies viable for attention along with the chain reaction in further cognitive functions attention deficits could cause may increase difficulty with a concussed student's return to the classroom more so than executive function or memory impairments.

Although there is much more research on return-to-play protocols following a concussion than return-to-learn protocols (Wing et al, 2015), there are many well established return-to-learn protocols for high school students currently in place. The purpose of a return-to-learn protocol is to guide a student back into the classroom as well as educate faculty and students on concussions and recovery. These protocols are important as a premature increase in cognitive activity can prolong recovery time (Wing et al, 2015) and cognitive deficits can exist even when students claim they are symptom free (McGrath, 2010). Not only do students often overestimate their capabilities, but parents often do not understand concussions and push kids back too soon (Wing et al, 2015). Also, the teachers interacting with concussed students could unknowingly expect too much of them as standardized testing controls their practice and they may not understand what concussion rehabilitation limits mean (Wing et al, 2015). For this reason, a team of

academic and athletic professionals as well as a student's family work together to facilitate a concussed student's recovery. In most programs a specific person, usually a school nurse or primary care physician, is appointed the responsibility of case manager to oversee the child's recovery, with whom the child must report to daily as their symptoms persist. Most protocols consist of five phases: no school/ complete cognitive rest, part-time school attendance with accommodations, full-day attendance with accommodations, full-day attendance without accommodations, and full school and extracurricular involvement (Children's Hospital of Chicago, 2020). Schools also often have meetings with students one week following full academic clearance to assure their symptoms have not returned (Children's Hospital of Chicago, 2020). A priority of high school return-to-learn protocols is to educate faculty and nurses on exact guidelines for helping a student by providing examples of accommodations, explaining concussive symptoms, and instilling the importance of proper care for concussed individuals. While many high schools have defined protocols in place, they have much longer school sessions than the twelve to thirteen-week semesters of college students and thus are better able to accommodate the three months that are typically needed for total recovery (Leddy et al, 2007). This shortened time frame requires a different approach as deadlines and assignments hold more weight and a student's stress is often much greater. Given the many incidents of concussion seen in college students, attention must be given to a return-to-learn protocol that helps students meet their academic goals as opposed to only focusing on returning collegiate athletes to their sport.

It is postulated that students who are given academic adjustments without penalty for missed work are better able to return to school and be successful following a concussion (ORCAS, 2013). Limited school attendance can cause anxiety and depression in students and these anxiety and depressive symptoms can mimic concussive symptoms making proper recovery harder to achieve (Irvine et al, 2017). It has also been found that a gradual return in normal activity is more beneficial to cognitive function than strict periods of rest showing the importance and previous success of a stepwise protocol for returning concussed students to the classroom (Irvine et al, 2017). The protocol at Trinity College follows similar guidelines as high

school protocols (Olympia et al, 2016) and comprises four steps: no class, maximum accommodations, minimal accommodations, and full return to classes with no accommodations. A chart of suggested schoolwork modifications is provided for professors to utilize dependent on multiple factors such as cognitive/thinking impairments, fatigue/physical impairments, or emotional impairments of the student. This chart can be seen in Appendix IV. The goal is to gradually return students to a normal level of intensity of academic engagement while staying below a threshold that would trigger symptoms (Irvine et al, 2017). This threshold is known as the sub-symptom threshold cognitive activity (NESCAC Aspects in Sports Committee, 2014). Students are asked to self-assess their abilities throughout recovery following an online guide listing the series of steps for returning to school. Providing students and professors with lists of potential modifications allows for continuity between the aid given by the faculty and requested by the students. Students are also expected to work closely with the health center for support during recovery. Student-athletes are then expected to work with the athletic training staff once academic clearance has been obtained through the health center. Any student whose symptoms persist longer than three weeks is recommended further medical management (Leddy et al, 2007; NESCAC Medical Aspects in Sports Committee, 2014). This is due to the trend that the majority of concussed individuals see a resolution of symptoms after a week (Giza & DiFiori, 2011). Ten to fourteen percent of people with concussive brain injuries experience prolonged symptom recovery (Giza & DiFiori, 2011), and these students will require more attentive rehabilitative care to aid in their return to school.

This study aims to assess the efficiency of the return-to-learn protocol at Trinity College as well as assess if deficits in either attention, executive function, or memory correlate with a greater self-reported difficulty returning to the classroom.

Methods

Inclusion and Exclusion Criteria:

The study inclusion criteria stated students must be at least 18 years old and have had a diagnosed concussion while enrolled at Trinity College. It was necessary that students had their concussion while at Trinity to have had potential experience with Trinity's return-to-learn protocol. Faculty and coaches must currently work at Trinity College. Exclusion criteria stated any student who was below 18 years old, had not been concussed at Trinity, and/or whose concussion was not diagnosed by the Health Center or athletic training staff could not participate. Any faculty or coach currently not employed at Trinity were not contacted.

Participants

The recruitment for previously concussed students was a total of 36 participants: 15 males, 20 females, and one student who did not identify their gender. Age of participants ranged from 18 to 26 years (mean: 20.6, standard deviation: 1.6) and years of education ranged from 12-16. Of the subjects who noted their race and ethnicity, there were 20 White, 1 Japanese, 1 Black, 2 Middle Eastern, and 2 Hispanic students. The average number of concussions experienced by the students was 2 (standard deviation: 1.5), 64% of the subjects' most recent concussions occurred while participating in athletics, and the clearance time ranged from 1 to 93 days (mean: 20 days standard deviation: 20.1).

Table 1: Sport Demographics

Sport	Athletes	Males	Females
Football	4	4	0
Field Hockey	4	0	4
Soccer	3	3	0
Volleyball	1	0	1
Ice Hockey	7	2	5
Basketball	1	1	0
Softball	2	0	2
Lacrosse	2	0	2
Baseball	3	3	0

The distribution of represented sports is listed in Table 1 above.

Twenty-four Trinity professors responded to the survey. Faculty member's years of education ranged from 16-38 (mean: 19.6, standard deviation: 5.4). Of the subjects who noted their race and ethnicity, there were 15 White professors and 1 Black professor.

Twenty head/assistant coaches responded to the survey. Coaches' years of education ranged from 16 to 38 (mean: 19.6, standard deviation: 5.4). Of the subjects who noted their race and ethnicity, there were 15 White coaches and 1 Black Coach.

Materials:

- Beck Depression Inventory (BDI): subjects complete a 21 question, self-reported rating inventory that measures symptoms of depression (Beck et al, 1961).
- Concussion Symptom Inventory (CSI): subjects self-report their current symptoms on a seven-point Likert scale from zero to six (Randolph et al, 2009).
- Wechsler Adult Intelligence Scale (WAIS) digit span: subjects are asked to repeat a sequence of numbers read to them in order (forward) or in reverse order (backward). Forward span assesses

attention capacity while backward span is an executive task involving working memory (Wechsler, 2008).

- Wechsler Adult Intelligence Scale, 4th edition (WAIS-IV) similarities: subjects are given two words and are asked to explain how they are alike. The test involves verbal reasoning (Wechsler, 2008).
- Wechsler Adult Intelligence Scale, 4th edition (WAIS-IV) digit-symbol: subjects are shown rows of numbers and are asked to substitute the corresponding symbol from a key presented above. The task is timed, and subjects are to complete the task as quickly as possible. This test involves sustained attention and working memory (Wechsler, 2008).
- Cambridge Neuropsychological Test Automated Battery (CANTAB) spatial span: subjects are shown nine blocks and are asked to remember and reproduce a pattern tapped on the blocks by an administrator, first in series with the taps presented (forward) and in the second phase they are asked to tap a pattern in the reverse order (backward). This assesses working memory (Teixeira et al, 2011).
- Animal Naming Test (ANT): subjects are asked to list the names of as many animals as possible in one minute. This test is sensitive to cognitive functions of the prefrontal cortex (Goodglass et al, 2000).
- Stroop color and word test: subjects are asked to read three different tables as fast as possible: one listing colors in black and white font, one listing font colors of clusters of X.s, one reading the color of the ink of written colors of a different name such as red font for the word green. This test assesses executive function and the ability to inhibit cognitive interference (Scarpina & Tagini, 2017).
- Qualtrics Return-to-Learn Student Survey (See Appendix I)
- Qualtrics Return-to-Learn Faculty Survey (See Appendix II)
- Qualtrics Return-to-Learn Coach Survey (See Appendix III)

Research/Study Design:

This research study was approved by the Trinity College Institutional Review Board (IRB 2019-1405). This study was a prospective, non-randomized study designed to compare long-term cognitive deficits with greater perceived difficulty returning to the classroom as well as evaluate Trinity's preexisting return-to-learn protocol. This study was conducted at Trinity College using surveys and cognitive tests. Students, faculty, and coaches were surveyed and students willing to complete cognitive testing were given the tests listed above.

Procedure:

Students, faculty, and coaches were contacted through Trinity's Trinity Today online news board, personal emails from referrals, posted flyers, and word of mouth.

Students

Consenting participants were sent a five-minute Qualtrics survey assessing their personal experience returning to the classroom following their concussion. Questions addressed any potential lasting post-concussive symptoms, symptoms at the time of the concussion, what resources on campus were most helpful, what currently works well with the established protocol, and what could be improved. Questions can be found in Appendix I. Students who consented to further testing were also given a series of cognitive tests in a thirty-minute lab session to assess any lasting cognitive effects following their concussion. In each session, students filled out a background form, consent form, CSI form, BDI form, and were then tested using the Stroop Color and Word Test, ANT Animal Naming, CANTAB Spatial Span, WAIS Digit Span, WAIS-IV Similarities, WAIS-IV Digit-Symbol (detailed above).

Faculty

Consenting subjects were sent a five-minute Qualtrics survey assessing their personal experience teaching a student who had sustained a concussion. Questions addressed how long the student was absent, what measures the faculty member took to aid in their recovery, what frustrations faculty may have experienced, and what improvements to the protocol could be made. Questions can be found in Appendix II.

Coaches

Consenting subjects were sent a five-minute Qualtrics survey assessing their personal experience coaching a student who had sustained a concussion. Questions addressed what the coach's usual procedure was following a concussion, what accommodations they make for their athletes, whether they believe student athletes are more motivated to return to the classroom, if they prioritize return-to-play or return-to-learn, and what improvements to the protocol could be made. Questions can be found in Appendix III.

Results

Each student, faculty member, and coach who participated in this study was asked if they were familiar with the return-to-learn protocol in place at Trinity College. These responses were then totaled and converted to percentages displayed in Table 2 below.

Table 2: Familiarity with the Return-to-Learn Protocol

	Students (n=36)	Faculty (n=24)	Coaches (n=20)
Yes (%)	39	54	55
No (%)	61	46	45

Each student was asked which resource was helpful to them in providing information and aid following their concussion. Options included coaches, faculty, health center, off campus professionals, and the student accessibility resource center (SARC). Responses can be seen in Table 3 below. Of the thirty-six respondents, twenty-five received information from the health center and seventeen of those twenty-five found this information helpful. Of the thirty-six total respondents, three received information from the SARC and only one found this information helpful.

Table 3: Who Was Most Helpful

	Response Number and Percentage
Coach	13, 36%
Health Center	15, 42%
Faculty	3, 8%
Off-Campus Professional	4, 11%
SARC	1, 3%

To assess long-term effects of concussion, students were asked to scale each of their current symptoms from zero to six (zero – symptoms absent; six – symptoms severe). Symptoms included headache, nausea, balance problems/dizziness, fatigue, drowsiness, feeling in a fog, difficulty concentrating, difficulty remembering, sensitivity to light, sensitivity to noise, blurred vision. Of the thirty-six total respondents, eight reported zero current symptoms and twenty-eight reported lasting symptoms (mean: 14.7; standard deviation: 13.1). Students were asked if they were still experiencing symptoms from their concussion. Of the thirty-six respondents, twenty-two stated that they were no longer experiencing symptoms. However, when comparing the response of these twenty-two students to their current concussive symptoms score, only eight had a scaled score of zero with the remaining sixteen responses having symptom scores ranging from one to forty-nine (mean: 10.2; standard deviation: 15.0). A total of students who reported symptom severity above zero for each possible current symptom can be seen in Table 4 below.

Table 4: Incidence of Current Symptoms

Symptom	Reported Incidence From Total 36 Respondents
Headache	20
Nausea	7
Balance Problems/Dizziness	12
Fatigue	16
Drowsiness	14
Feeling Like in a Fog	16
Difficulty Concentrating	22
Difficulty remembering	16
Sensitivity to Light	15
Sensitivity to Noise	16
Blurred Vision	7

The eighteen students who reported still experiencing concussive symptoms were asked to state whether these lasting effects were primarily seen cognitively, emotionally, or physically. Responses to this question can be seen below in Table 5.

Table 5: Type of Lasting Effect of Concussion

Deficit Category	Number of Responses (n=18)
Cognitive	12
Emotional	2
Physical	4

Students were also asked to report their symptoms at the time of their concussion. The results of these responses can be seen in Table 6 below. The total number of concussions experienced by surveyed students ranged from one to eight (mean: 2.42; standard deviation: 1.52).

Table 6: Reported Symptoms at Time of Concussion

Symptoms	Reported Incidence From Total 36 Respondents
Headache	34
Dizziness	29
Difficulty Concentrating	29
Difficulty Remembering	20
Difficulty Reading	19
Writing	19
Calculating	19
Difficulty Performing Your Job/School Work	18
Poor Problem Solving	13
Anxiety	12
Change in Relationships with Others	3
Poor Judgement	1

Students were asked a series of questions regarding their experience returning to the classroom while recovering from a concussion. Responses were given on a scale of one to four (one – definitely no; two – not much; three – somewhat; four – definitely yes) and can be seen below in Table 7.

Table 7: Students' Experience Returning to the Classroom

	Student Response Totals (n=36)			
Survey Question	**1 Definitely No**	**2 Not Much**	**3 Somewhat**	**4 Definitely Yes**
Are you confident at this time that you can perform at your previous academic level?	2	2	11	21
Are you nervous about your academic ability following your concussion?	10	10	10	6
Are you confident your symptoms will not return while doing schoolwork?	4	6	13	13
Did you experience frustration in attempting to complete schoolwork following concussion?	1	4	13	18
Do you feel relaxed when thinking about your current cognitive ability following concussion?	4	8	10	14
Did you experience increased pressure from faculty to complete your work?	11	10	7	8
Did you feel ready to return to the classroom when you did?	2	11	14	9

A Pearson correlation was run to assess the relationship between BDI test score and current concussive symptom score and it was found that greater concussive symptom severity correlated with greater depressive symptom severity (p= 0.03875). A Pearson correlation was run to assess the relationship between current concussive symptom and each measure within the cognitive test battery. Significance was seen in the relationship between current concussive symptom score and the animal naming score (p=0.03120). Results of the Pearson correlations can be seen in Table 8 below.

Table 8: Correlations of Cognitive Tests and Current Concussive Symptoms Score

Test	P-value
Digit Span	0.72767
Spatial Span	0.14526
Similarities	0.65254
Stroop 1	0.20294
Stroop 2	0.16747
Stroop 3	0.15267
Symbol-Digit	0.18135
Animal Naming	0.03120

Qualitative Data:

- Of the thirty-six students, twenty-four professors, and twenty coaches, one student, three faculty members, and one coach voiced concern that student athletes likely receive more support for their concussions than non-athletes.
- Ten of the thirty-six students expressed feeling overwhelmed trying to catch up on work/classes missed as well as new material when returning to the classroom. When asked to comment on their experience returning to the classroom, one student stated, "My professors' help made all the difference. It could have been much harder which is why professors need to be aware of the impact."
- One student, four faculty members, and two coaches expressed that it would be helpful if faculty members more reliably received email updates about the status of their student's concussions as well as guidelines as to best accommodate them. This aligns with the six professors who had stated they received emails about their student's concussion and that they were helpful.
- Three faculty members claimed the accommodations required for a concussed student were burdensome. One stated that it was difficult to help a student make up a lab. Another stated that it is hard to know how not to overwhelm students by giving them new assignments along with the ones they are making up.

Discussion

It was hypothesized that most students who have been concussed at Trinity College were not fully aware of the resources available to them through the return-to-learn protocol. This hypothesis was supported, as the majority of students and approximately half of the faculty and coaches who participated in this study were unfamiliar with the return-to-learn protocol in place at Trinity College. It is clear that the Trinity College community needs further education on the protocol in order for it to be effectively utilized. Our data suggests that students received the most information about their concussion from the health center,

followed by coaches, off-campus professionals, faculty, and the SARC. Only seventeen of the twenty-five students who received information from the health center and one of the three students who received information from the SARC found it helpful meaning students might need further guidance from the resources on campus. The implication of the support given by coaches leads to the discussion of support received by non-athlete students. A member of each demographic (students, faculty, and coaches) voiced that student-athletes are likely at an advantage by receiving more support than non-athletes. Proper education and attention must be given to students not as readily informed on the seriousness of concussions as student-athletes with the support of well-established return-to-play protocols (Wing et al, 2015).

Though there were twenty-two students who reported no longer experiencing concussive symptoms, only eight students had scores of zero when later asked to scale the severity of each of the symptoms they still experienced. The remaining students had scores ranging from one to forty-nine. This would follow the finding that deficits can exist even when students claim they are symptom free (McGrath, 2010). The most common symptom students still experienced was difficulty concentrating, an important deficit to note when aiding a student in their return to the classroom. It was hypothesized that students with a primary deficit in attention would have the greatest self-reported difficulty returning to the classroom. Though difficulty concentrating, a symptoms associated with a deficit in attention, was the most common symptom still experienced by students, our hypothesis was disproved as the only significant correlation found between a cognitive deficit and one of the survey questions asked was found between the animal naming test of executive function and current concussive symptoms. This suggests that accommodations for executive functioning, which involves planning, organizing, and multitasking should be made readily available to students (Rossignoli-Palomeque et al, 2019). This could consist of helping students reschedule assignments or giving them notetaking aids. Of the students who claimed to have lasting effects of concussion, the most common deficits were cognitive in nature, followed by physical, then emotional. The most common concussive symptoms reported at the time of their concussion was headache followed by dizziness and difficulty concentrating.

Most students claimed to be somewhat or definitely confident that they could perform at their previous academic level. Approximately half of the students were either somewhat or definitely nervous about their academic ability following their concussion while the other, slightly larger half responded not much or no nervousness. Most students were somewhat or definitely confident their symptoms would not return while doing schoolwork. Most students experienced frustration in attempting to complete schoolwork following their concussion. Most students felt relaxed when thinking about their current cognitive ability following their concussion. Most students did not experience increased pressure from faculty to complete work though fifteen students claimed they somewhat or definitely experienced pressure. Finally, most students stated they felt ready to return to the classroom when they did though thirteen students claimed they were either not very or definitely not ready. This data suggests that concussed students returning to the classroom are being supported, however there is still room for improvement.

Though the frustration involved with recovering from a concussion likely cannot be avoided, support for students struggling with the process should be available. A follow-up meeting should be in place a week after a student's clearance to assure no symptoms have returned as is customary in many high school return-to-learn protocols (Children's Hospital of Chicago, 2020). Students are under elevated stress when trying to return to the classroom and this cannot go unnoticed as this study found a positive linear relationship between current concussive symptoms and severity of depressive symptoms. This supports the previous finding that limited school attendance can cause depression and depressive symptoms in students (Irvine et al, 2017). Both symptoms of concussion and depression are linked to impaired cognitive function (Creed et al, 2011; Irvine et al, 2017) making the return to the classroom more difficult for students. Thus, emotional support as well as a clearer guideline on what academic accommodations are available as options for students could be helpful. Students could be given contact information for the counseling center on campus and a student's advisor could maybe be informed of the concussion and be asked to check in on the

student week by week as they recover to assure the student has outlets to voice concerns. The support of faculty and coaches can be greatly beneficial for a student returning to the classroom.

Faculty members may unknowingly be impairing a student's recovery as students noted that they experienced increased pressure from faculty members to return. Students were asked to provide whatever comments they wanted about their experience returning to academics and many students expressed feeling overwhelmed while trying to catch up on work/classes missed as well as new material when returning. One student stated, "My professors' help made all the difference. It could have been much harder which is why professors need to be aware of the impact." Members of all three demographics expressed that faculty members should reliably receive email updates about the status of their student's concussions as well as guidelines to best accommodate them. This aligns with the comments from six professors who had stated they received emails about their student's concussion and that they were helpful. Only a few faculty members claimed the accommodations required for a concussed student were burdensome. One stated that this was because it was difficult to help a student make up a lab implying that lab professors should be given more specific guidelines on how to accommodate missed sessions. Another stated that it was hard to know how to not overwhelm students by giving them new assignments along with the ones they were making up. These claims agree with the finding that many teachers are unfamiliar with the rehabilitation limitations of a concussion (Wing et al, 2015) and would benefit from further help. It seems both students and faculty are in need of greater guidance in regard to the return-to-learn protocol at Trinity College.

This study highlights the return-to-learn protocol as a promising tool for students, faculty, and coaches to help guide concussed students back to the classroom. The Trinity College community is in need of further education on the existence and enforcement of the protocol. It might be helpful if faculty and students could more formally discuss what accommodations will be made available as suggested by the protocol guidelines, which should be made available to both faculty and students upon diagnosis of a concussion. Extra care should be taken for deficits in executive function as the data of this study suggests current

concussive symptoms most strongly correlate with this cognitive profile. Finally, aid should be made available for students who may be experiencing depressive symptoms as this study showed that severity of current concussive symptoms correlated with severity of depressive symptoms. Concerns were voiced by all three demographics regarding the proper way to help a student return to the rigor of collegiate classes within the short time constraints of a thirteen-week semester which is why further discussion and research into the best way to accelerate the collegiate return-to-learn process without overwhelming either students or faculty is required.

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Appendix I: Return-to-Learn Student Survey

1. What is your age in years? Optional
2. What is your gender? Optional
    a. Male
    b. Female
    c. Nonbinary
    d. Other
3. What is your total years of education? Optional
4. What is your race and ethnicity? Optional
5. Other than this most recent concussion, have you ever been diagnosed with any other neurological or psychiatric disorder? Optional
6. How many total concussions have you been diagnosed with?
7. Were you part of a Trinity College athletic team (varsity, intramural, club, etc.) prior to your concussion? If yes, what team?
8. Was your concussion caused from participating in athletics?
9. If your concussion occurred during an athletic event, what sport were you playing?
10. If your concussion was not from athletics, how did it occur?
    a. Fall
    b. Auto accident
    c. Bike, skateboard, scooter accident
    d. Blow to the head during violent event
    e. Other
11. Were you intoxicated at the time of your concussion? (Reminder: all information in this survey is confidential)
12. If you were injured in a sport, how long after your concussion were you cleared to play (in days)?
13. If you were injured in a sport, after you were cleared, did you return back to your sport?
14. If no, why not? (if yes, write N/A)
15. Are you familiar with Trinity's return-to-learn protocol? This is the procedure used to get students back into academics after a concussion.
16. Did you receive information on return-to-learn options from your coach, trainer, the health center, the SARC, or a professor?
17. Are you confident at this time that you can perform at your previous academic level?
    a. Definitely yes
    b. Somewhat

c. Not much
d. Definitely not

18. Are you nervous about your academic ability following your concussion?
    a. Definitely yes
    b. Somewhat
    c. Not much
    d. Definitely not
19. Are you confident your symptoms will not return while doing schoolwork?
    a. Definitely yes
    b. Somewhat
    c. Not much
    d. Definitely not
20. Did you experience frustration in attempting to complete schoolwork following concussion?
    a. Definitely yes
    b. Somewhat
    c. Not much
    d. Definitely not
21. Do you feel relaxed when thinking about your current cognitive ability following concussion?
    a. Definitely yes
    b. Somewhat
    c. Not much
    d. Definitely not
22. Did you experience increased pressure from faculty to complete your work?
    a. Definitely yes
    b. Somewhat
    c. Not much
    d. Definitely not
23. Did you feel ready to return to the classroom when you did?
    a. Definitely yes
    b. Somewhat
    c. Not much
    d. Definitely not
24. How was the decision made to return to the classroom?
25. Did you receive any accommodations? If so, what?

26. Did you have any faculty member refuse to honor any accommodations?
27. Did you receive any information from the Health Center? If so, was it helpful?
28. Did you receive any information from the SARC office? If so, was it helpful?
29. Were you able to complete the semester with the other students in the class?
    a. Yes
    b. I had to take one or more incompletes
    c. I had to drop one or more classes
    d. I took a leave of absence
30. Is there any support you did not receive during your recovery that you wish you had?
31. Is there anything Trinity could improve on in terms of returning students to the classroom?
32. Who, if any, was most helpful in guiding you back to the classroom after your concussion?
    a. Coach or trainer
    b. Health center
    c. Student Accessibility Resource Center
    d. A faculty member
    e. An off-campus professional
33. Are you still experiencing concussion symptoms?
34. If you are still experiencing symptoms, which are the worst in terms of return to the classroom?
    a. Physical symptoms (dizziness, fatigue, nausea, vision changes
    b. Cognitive symptoms (trouble concentrating, trouble with distraction, memory difficulties, difficulties with planning or problem solving)
    c. Emotional changes (depression, anxiety, anger)
35. Please tell us anything else at all about your experience of trying to catch up on your classroom work and finish out the semester after having a concussion.
36. If you have experienced a concussion, please fill out the following questions regarding your symptoms at this moment on a scale of 0-6 (0=symptoms absent, 6=symptoms severe).
    a. Headache
    b. Nausea
    c. Balance Problems/Dizziness
    d. Fatigue
    e. Drowsiness
    f. Feeling like “in a fog”
    g. Difficulty concentrating
    h. Difficulty remembering

i. Sensitivity to noise
j. Blurred vision

37. Now please fill out your symptoms at the time of your concussion:
    a. Did you hit your head or get hit on the head?
    b. Were you seen in the emergency room, hospital, or by a doctor because of an injury to your head?
    c. Did you ever lose consciousness or experience a period of being dazed and confused because of an injury to your head?
    d. Did you experience any of the following symptoms after hitting your head?
        i. Headaches
        ii. Dizziness
        iii. Anxiety
        iv. Depression
        v. Difficulty Concentrating
        vi. Difficulty Remembering
        vii. Difficulty reading, writing, calculating
        viii. Poor problem solving
        ix. Difficulty performing your job/schoolwork
        x. Change in relationships with others
        xi. Poor judgement (being fired from job, arrests, fights)

Appendix II: Return-to-learn Faculty Survey

1. What is your age in years? Optional
2. What is your gender? Optional
    a. Male
    b. Female
    c. Nonbinary
    d. Other
3. What is your total years of education? Optional
4. What is your race and ethnicity? Optional
5. Are you familiar with Trinity's return-to-learn protocol?
6. Have you taught a student who received a concussion while enrolled in your course? (if no, please skip to the end of the form and submit)
7. About how long was the student absent? If there has been more than one, please answer for the most recent student.
8. What classroom accommodations were made, if any, once the student returned to the classroom?
9. Did you speak personally with the student about their concussion?
10. Did you experience the accommodations as burdensome on you as a teacher or inappropriate in any way?
11. Was it difficult working with a student who had a concussion?
12. How motivated did the student seem to do well in the classroom following the concussion?
13. How far behind the rest of the class did the concussed student seem to be upon returning to the classroom?
14. Do you feel that communication between you and the student was adequate?
15. Are there any aspects of the return-to-learn protocol you think work well?
16. Are there any aspects of the return-to-learn protocol you think could be improved?
17. Is there anything Trinity is not doing for concussed students that you think it should?
18. Are there any ways you, as a faculty member, could be better supported in providing accommodations to students after concussion?
19. Would you like to learn more about concussion or return-to-learn research findings?

Appendix III: Return-to-learn Coach Survey

1. What is your age in years? Optional
2. What is your gender? Optional
    a. Male
    b. Female
    c. Nonbinary
    d. Other
3. What is your total years of education? Optional
4. What is your race and ethnicity? Optional
5. Are you familiar with Trinity's return-to-learn protocol?
6. Have you coached a student who received a concussion on your team? (if no please skip to end of survey and submit)
7. What is your standard procedure when a student is diagnosed with concussion?
8. Did you speak personally with the student about their concussion?
9. What accommodations were made, if any, for the athlete in terms of practice, lift, or team requirements to aid in their academic success following the concussion?
10. How motivated did the athlete seem to return to the classroom?
11. Do you think student athletes would be more motivated to return to the classroom than non-athlete students?
12. How much do you personally prioritized return to classroom over return to play when working with students?
13. Are there any aspects of the return to learn protocol you think work well?
14. Are there any aspects of the return-to-learn protocol you think work well?
15. Are there any aspects of the return-to-learn protocol you think could be improved?
16. Is there anything Trinity is not doing for concussed students that you think it should in terms of returning to academics?

Appendix IV: Academic Adjustments Following Concussion

ACADEMIC ADJUSTMENTS FOLLOWING CONCUSSION

Following concussion, students who receive academic adjustments without penalty for missed work are more successful and better able to reintegrate into school. Attached are some examples of the kinds of adjustments that might be suggested. The student will bring you the specific list of adjustments that have been deemed appropriate. Please feel free to speak with the concussion management team if the adjustments are just not possible in your class.

GENERAL	COGNITIVE/THINKING	FATIGUE/PHYSICAL	EMOTIONAL
No school until specified To be reviewed on:	Reduce class assignments and homework to critical tasks only. Exempt non-essential written classwork or homework. Base grades on adjusted work.	Allow time to visit school nurse/counselor for treatment of headaches or other symptoms.	Develop plan so student can discreetly leave class as needed for rest.
Adjust class schedule (alternate days, shortened day, abbreviated class, late start to day).	Provide extended time to complete assignments/tests. Adjust due dates.	Allow strategic rest breaks (e.g., 5-10 minutes every 30-45 minutes) during the day.	Keep student engaged in extra-curricular activities. Allow student to attend but not fully participate in sports practice.
No physical activity (Including weight training, aerobics, yoga, dance) until cleared by a healthcare professional.	Once key learning objective has been presented, maximize cognitive stamina (e.g., assign 5 of 30 math problems).	Allow extra time to move between classes	Encourage student to explore alternative and appropriate activities of non-physical nature.
Avoid noisy and over-stimulating environments (e.g., large classes with individual group work) if symptoms increase.	Allow student to respond to assignments online or in other ways as an alternative to in class assignments	Allow student to wear sunglasses indoors. Control for light sensitivity (e.g. draw blinds, sit away from window, hat with brim).	Develop an emotional support plan for the student (e.g., identify adult to talk with if feeling overwhelmed).
Allow student to drop non-major classes without penalty if accommodations go on for a long period of time.	Provide written instructions for homework/classwork that is deemed essential.	Allow student to study or work in a quiet space away from visual and noise stimulation.	Provide quiet place to allow for de-stimulation.
Allow student to audit class (i.e., participate without producing or grades).	Provide class notes by teacher or peer. Allow use of computer, smart phone, tape recorder.		
Remove or limit testing (e.g., midterms, finals, standardized) or high stakes projects.	Allow utilization of notes and/or word banks for test taking due to memory issues.	Provide a quiet environment to take tests.	
Alternate periods of mental exertion with periods of mental rest.			