Determining the Best Approach to Promote Change in Attitudes and Behaviors Towards Concussions

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Abstract

The following research sought to address the best source of information that could be used to influence an individual's attitudes and behaviors towards concussions. The hypothesis of the research was that those who read a narrative about concussions by a celebrity would be influenced more than those who had read one by a stranger or expert. The sample consisted of 69 college students from Stockton University who were asked to read one of three narratives by different sources. Following voluntary consent, they read one of the three narratives and were asked to answer a survey related to their attitudes and behaviors towards concussions. The results were scored to determine who would be least likely to participate in risky behaviors that would lead to concussion. No statistically significant results were related to the source of information the individual read. There was a significant difference in attitudes and behaviors based on age between those 19 (M = 27.82, SD = 2.30) and 20 (M = 24.60, SD = 3.27), p = .031, and for those who had no (M = 27.52, $SD,$ = 2.37) vs 3 or more (M = 23.50, SD = 5.20) previous concussions, p = .024. Lack of significance is likely due to the small sample size and further research is needed to understand what source of education would best impact an individual in relation to concussions.

Keywords: concussion, education, attitudes and behaviors

Introduction

Concussions are an epidemic that many people know about but ignore (Malcom, 2019 & Malcolm, 2021). The implications of having a concussion are either too scary for people to acknowledge or not scary enough to warrant a second thought. Despite this, concussions present as a severe issue.

Concussions are defined as "a type of traumatic brain injury, or TBI, caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth" (Concussion Legacy Foundation, What is a Concussion?, 2021, para. 1). While these are typically not life threatening, concussions cause cognitive, physical, and emotional symptoms that may not always dissipate after a few days or weeks (Centers for Disease Control and Prevention, 2010). In a study done by Gessel et al. (2007), it was estimated that annually 300,000 high school and collegiate athletes had sports-related traumatic brain injury (TBI) in the United States, with the majority of those being concussions. Breck et al. (2019) found that non-athlete students experienced a concussion rate of 121.5 concussions out of 10,000 students and the rate for athletes was 132.4 concussions per 10,000 students. The rate of sports related concussions is highest in August when academic years begin for both athletes and non-athletes, with the rate of concussions for non-athletes being higher than for athletes [81.0 concussions per 10,000 vs 51.5 concussions per 10,000] (Breck et al., 2019). For those between 15 to 24, the leading cause of TBIs was motor vehicle accidents with the second highest being sports (Gessel et al., 2007). Of the sports-related concussions, the highest rates were found in football and soccer with boys experiencing more concussions than girls and these sports-related concussions represented 8.9% of high school sports injuries and 5.8% of collegiate sports injuries (Gessel et al., 2007). Everyone is vulnerable to receiving a concussion even though there is more targeted

research aimed at identifying incidence and prevention more prevalently in athletes because their risk while they participate is higher.

If an individual is unaware of the risks of concussions or does not take them seriously, the likelihood of reinjury and long-lasting damage increases. Many of these athletes will return to play shortly after recovery, before they have finished recovering, and may even sustain another concussion because they are more susceptible to a second after they have sustained their first (Centers for Disease Control and Prevention, 2010). There is little research done on the prevention methods used to keep non-athletes from sustaining another concussion not long after their first. If any of these individuals do not take their recovery seriously, there is evidence of some long-term effects. Moser and Schatz (2002) found a possible similarity in coding, which includes immediate memory, visuoconstructional ability, language, and delayed memory, and attention scores between those who had received two or more concussions and those who had recently received concussions suggesting a long-term impact of cognition and memory from the injury. When they performed post-hoc analyses on the total scores, the combination of the participant's coding and attention scores on the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), there was no significant difference between the group with a history of no or one concussion and the group with two or more concussions or between the group with two or more and the group with a recent concussion. However, there was a difference between the group with one or no concussions and the group with a recent concussion. The group with a recent concussion had a lower total score on the RBANS, with both coding and attention being lower, than for the group with one or no concussions. While there appears to be no significant long-term effects of concussions even if an individual has had more than one concussion, there still appears to be some difference in coding and attention since the total scores

for individuals with 2 or more concussions were still lower than for individuals with one or no concussions. In a literature review by De Beaumont et al. (2012) found that, while Moser and Schatz (2002) found little significance of the impact of concussions shortly after receiving them, a week to six months, in late adulthood there was a cognitive decline in those who had experienced multiple concussions decades prior to evaluation. The individuals "could no longer maintain optimal performance levels on neuropsychological tests of episodic memory and executive functions selected for their sensitivity to early symptoms of MCI" (De Beaumont et al., 2012, p. 3). MCI refers to mild cognitive impairment, which is seen as being a part of transitional period before dementia (De Beaumont et al., 2012). Along with cognitive impairment, years later, these individuals have alterations in movement. Individuals with a history of multiple concussions tend to have a slowness of movement, dysarthria, pyramidal tract dysfunction, and tremors with age resembling those with early-stage Parkinson's disease (De Beaumont et al., 2012). The long-term effects of concussions are incredibly serious and could impact an individual's ability to function.

Besides long-term effects, an individual could have immediate issues if they have a second concussion before they fully recover from the first. This is known as second impact syndrome (SIS). The symptoms of SIS can mirror those of a first concussion. However, SIS has been proven to be fatal to some or lead to post-concussion syndrome (Cantu, 2005). While the risk of having SIS is not known yet, it is still dangerous and should be taken into consideration. Approximately 11.4% to 38.7% of individuals are diagnosed with post-concussion syndrome (PCS) (Voormolen et al., 2018); meanwhile, "many authors agree that the syndrome [SIS] is rare" (Bey & Ostick, 2009, p. 6). This makes PCS a higher concern for individuals who experience concussions, but diagnosis criteria are still under scrutiny for a diagnosis of PCS,

which leads to a large range in individuals being diagnosed versus not diagnosed. This is because there is no single test to prove an individual is experiencing PCS (Persistent post-concussive symptoms, 2020). Those who are diagnosed with PCS present with long-term symptoms of headache, dizziness, fatigue, irritability, insomnia, difficulty concentrating, memory problems, and/or intolerance of stress, emotion, or alcohol (Barlow, 2014). These symptoms are usually identified as PCS when they do not subside after three months and can persist for over a year or more (Persistent post-concussive symptoms, 2020). Concussions have the potential to cause issues immediately following injury and for a long time afterwards. The impact of multiple concussions can be debilitating in older age making it important to find a way to change an individual's attitudes and behaviors towards concussions.

Studies have shown that when an individual has an education about concussions, they are more likely to notify someone about a suspected concussion. Out of the participants 72% who had an education on concussions said they would notify their coach or trainer, whereas only 36% with no concussion education would (Bramley et al., 2012). Likewise, Register-Mihalik et al. (2013) found similar results when determining if knowledge and attitude influenced whether an individual would report concussion or bellringer events, events which individuals felt they had had their "bell rung" or been "dinged" (p. 647). During the study they surveyed students to see whether they had reported concussive or bellringer events and only 15% of their sample had done so during all of the events these occurred (Register-Mihalik et al., 2013). Of the total concussions recalled, only 48.8% of them had reported the event and of the 584 bell-ringer events, only 12.3% of the individuals reported the events (Register-Mihalik et al., 2013). During games only, the individuals only reported 22.8% of the events and during practice only 11.5% were reported (Register-Mihalik et al, 2013). At least 37.7% of the individuals indicated that

they had experienced signs or symptoms of the concussion during the practice or game, but chose not to report and kept playing (Register-Mihalik et al., 2013). The concern would be that the individuals who did not respond as such may have, but either did not remember or they did not want to disclose the information. Register-Mihalik et al. (2013) found their participants did not report the events because they did not think it was serious enough, did not want to be removed from a game, did not want to let down their teammates, and did not want to let down their coaches. There were very few who reported not knowing that the event was a concussion indicating that the individuals likely had adequate knowledge of concussions, but their possible injury was not their main concern (Register-Mihalik et al., 2013). When the individuals in the study had a more favorable attitude, one in which they would be more likely to be willing to report concussions, they did just as expected. The individuals with an increased athlete attitude total score, a more positive attitude regarding reporting possible concussions, were more likely to report recalled events with an individual 1 standard deviation higher than average being 1.38-times more likely to have recalled reporting the event during practice (Register-Mihalik et al., 2013). Overall, when an individual had a more positive attitude towards concussion reporting, there was an increased recall in reporting during games and practices, increased reporting of bell-ringer events, and they were less likely to participate after experiencing symptoms in games and practices (Register-Mihalik et al., 2013). The researchers were concerned with the overall attitude of the participants because they ranged widely. This led to the outcome that there was "only moderate agreement… with the statement on the questionnaire that concussion symptoms were serious" and "many believed reporting concussion may be somewhat embarrassing" (Register-Mihalik et al., 2013, p. 650-651). From the research by Register-Mihalik et al. (2013) and Bramley et al. (2013), it appears that individuals do have some knowledge of concussions,

but their attitudes towards concussions are not in line with the seriousness of the injury. The concern is then with changing an individual's attitude surrounding the seriousness of concussions to both prevent the injury from occurring and promote the proper care of oneself if the injury does occur.

Different types of statements about concussions from different sources may cause different changes in individuals' attitudes or behaviors. A study by Kroshus et al. (2014) gave athletes three different sources of information about concussions: *Heads Up Concussion in High School Sport: A Fact Sheet for Athletes*, *Concussions in Ice Hockey*, and *Head Games.* The *Heads Up Concussion in High School Sport: A Fact Sheet for Athletes* is a sheet with information about signs and symptoms of concussions. *Concussions in Ice Hockey* is an educational video on concussions and *Head Games* is a full-length documentary. Kroshus et al. (2014) found that the players who watched *Concussions in Ice Hockey* actually reported that they would engage in more unsafe behaviors than they had before watching the documentary. They believe this may be due to the fact that the athletes were sitting in the room in which they watch game film which in turn led to cheers when players collided on the screen and "when professional hockey players described their experiences with concussions in the video they in fact normalized playing through injury" (Kroshus et al., 2014, p. 157). When watching *Head Games*, the players watching the documentary were not in the room they watched game film and did not cheer following the collisions, which makes it likely that the area in which the players saw the video is important. While there were no cheers during the documentary, results still showed an increase in unsafe behaviors and beliefs in the behaviors following viewing, which occurred with the individuals who read *Heads Up Concussion in High School Sport: A Fact Sheet for Athletes* as well. The individuals may have had increased unsafe behaviors as well

because the data was collected during their playoff season, but this shows the information presented was not effective since it did not deter the unsafe behavior during a time it would have been most important to deter it. Through this research, the context in which an individual receives concussion information seems to be very important. If an individual is presented with the information about concussions in a way that seems to normalize the behaviors that are trying to be prevented, the individuals will continue to perform those behaviors themselves. The impact of information presentation is extremely important and so is who the information is delivered by.

Abd Aziz et al. (2020) studied millennials and the impact of celebrity endorsement on their intention to purchase certain health and beauty products. In this case, they rated the celebrity's good looks, stylishness, attractiveness, trustworthiness, expertise, and honesty. Abd Aziz et al. found that the most influential characteristics of the celebrity on the intention to buy were good looks, stylishness, and attractiveness. The results are believed to have occurred because "millennials that are extremely conscious about their look will imitate celebrity's style to express their self-confidence and to gain acceptance among peers" (p. 98). In the case of the following research, this study would imply that because the individuals will not see a photo of the individual the information is from they may not have a change in behavior. It is likely that if an individual does not see someone when they make a statement, they will not be influenced as much because they are relying on the expertise and honesty of the individuals. When comparing credibility versus attractiveness, Abd Aziz et al. found that, while it was ranked lowest, the participants were more likely to buy the product because they believed the celebrity would actually use the product. If an individual is forced to rely on what they are reading rather than an image of who they are reading the statement from, they may be swayed more by an expert's statement because they are forced to rely on credibility rather than attractiveness.

While the previous study included rating celebrity attractiveness as a variable in the study that would have an influence on decision making, the study done by Dixon et al. (2011) did not include an attractiveness element instead it simply included the celebrity on the packaging. The participants were asked to rank which foods they were more likely to buy between healthier food options or ones that were energy-dense and nutrient-poor (EDNP). The foods' packaging was manipulated to have a control with no nutritional facts, a nutritional fact, or a celebrity on the front. When compared to the healthier options, the individuals "exposed to nutrient claims… and sports celebrity endorsements… were more likely to prefer the EDNP product" (p. 1075). During the study, it was also found that 56% of the participants did not check the nutrition label before making a choice and this group was more likely to choose the EDNP product over the more nutritious option when there was a nutrition claim or celebrity endorsement. Dixon et al's study raises the concern that individuals are swayed by simply knowing an individual is a celebrity and believing what they are saying rather than listening to facts just because of the popularity behind the person. Individuals could reject an expert's opinion or statements regarding a subject just because someone more popular does not believe the same thing.

Prior studies have sought to exam what information will influence an individual's attitudes and behaviors to a product as well as concussions. In the aforementioned studies, when an individual was shown a product or video with a celebrity, the individuals were more likely to disregard other information or be swayed by the endorsement, such as in Dixon et al's (2011) study. Meanwhile, in Kroshus et al's (2014) study the effects of different types of information were used to try and influence concussion attitudes and behaviors specifically. In this study however, only athletes were used and there was no use of a source from an individual who was not a celebrity. Using only athletes in the study was limiting as they are not the only ones who

receive concussions and this may cause bias in the results. If non-athletes are also used, there may be a difference in who they respond to when viewing the information about concussions. The results may show that the non-athletes who are not as familiar with the celebrity, such as in Kroshus et al's (2014) study where the athletes were familiar with the players in the films, may be influenced more by an expert or anonymous source. The use of an anonymous source may serve as a point of comparison to see how much a celebrity versus a stranger's point of view may influence an individual. Previous studies have neglected to use anonymous sources when observing influences on changes in behavior as well as using non-athletes in concussion-based studies. The proposed study below seeks expand the knowledge on the influence on attitudes and behaviors toward concussions by using both an anonymous source and non-athletes as well as athletes. Theory must be used to determine how the effects of a source may or may not influence an individual's changes in attitudes and behaviors.

To explain the issues of unwillingness to change unhealthy attitudes and behaviors social psychology theories must be observed. Bloom and Caron (2019) stated that even when presented with rational information about concussions that state how dangerous concussions can be, individuals will continue to do the behaviors that put them at risk. The theory behind this is Theory of Reasoned Action (TRA), the "assumption that individuals will act on their pre-existing attitudes and behaviors" and "assumes that rational choices will be made based on the information that is available to them" (Conaghan, et al, 2020, p. 553).

Bloom and Caron (2019) sought to determine which theory would be best to create an intervention for concussions based on an analysis of existing attempts to change attitudes behaviors towards concussions. They found that social cognitive theory and theory of planned behavior are the most effective. Social cognitive theory focuses on various factors that are

personal, environmental, and behavioral; these concepts interconnect to explain the actions of human-beings. For social cognitive theory, they cited a study by Kroshus et al. (2015) which focused on whether social pressures from teammates, coaches, parents, and fans contributed to an individual's intentions to report concussion event. It was found that pressure from teammates, parents, and fans lowered intentions of reporting concussions. These results show that there may be a social aspect to understanding an individual's willingness to report concussions. Meanwhile, theory of planned behavior focuses on attitudes, subjective norms, and perceived behavioral control as determinants of intentions (Bloom & Caron, 2019). They cited both the aforementioned studies in this paper of Kroshus et al. (2014) and Register-Mihalik et al. (2013). Analysis showed this theory explained 58% of the variance in athlete intentions to report concussions in Register-Mihalik et al.'s (2013) study and 22% and 10% of intentions of reporting concussions and actually reporting concussions. Both theories have a social component to help explain the change in attitudes and behaviors.

When looking at the social component of the changes in behavior, Bandura's (1969) theory on social learning theory is incredibly important, particularly social models. Bandura states they are "indispensible means of transmitting and modifying behavior in situations where errors are likely to produce costly or fatal consequences" (p. 213) and that "mass media may play a more important role in shaping behavior and in modifying social norms than has generally been assumed" (p. 249). Bandura raised the point that mass media plays a large part in changing behaviors. In many ways this may be because of the popularity or prestige the person gets from being identified as being a popular individual on television. If mass media can influence a person's attitudes and behaviors because of notoriety, it is likely that attaching a celebrity's name to something may automatically cause some degree of influence over them. The celebrity then

becomes the model for individuals in society and if their influence is used in an appropriate manner, as Bandura stated, they could modify behaviors which have costly or fatal consequences.

The following research will be used to determine if there is an effect caused by the source of narrative a person reads. Celebrity, anonymous, or expert narratives are used to influence their attitudes and behaviors towards concussions. If the results show that one type is more effective than the others, then there may need to be consideration as to how individuals receive information about concussions. Determining which narrative is more effective may help to decrease the frequency of concussions because the individuals will receive information in a way, they are more likely to take into consideration.

Research Question and Hypothesis

The following study sought to determine whether the source of the narrative an individual reads related to concussion influences whether they will consider taking preventative measures to avoid concussions. The sources will be from a celebrity, an expert, or an anonymous source. The null hypothesis of this work is that there will be no difference between total scores based on the source of the narrative. The experimental hypothesis is that there will be a difference in the scores found based on the source of narrative. The study will seek to determine if there is a hierarchy of effectiveness of the narratives. It was believed that participants would be most likely to be influence by the narrative of the celebrity because as shown by Abd Aziz (2020) and Dixon et al. (2011), when an individual is shown information and a celebrity is involved, they will be swayed by the popularity and attractiveness rather than facts. If the two are combined, facts presented in an experiential manner by someone of celebrity status, it is more likely their

attitudes and behaviors will be swayed to prevent concussions. The expert narrative will then have the next most effective influence and finally the anonymous statement.

Methods

Sample

Participants for the study included students from Stockton University on a voluntary basis. The sample was based on convenience as they were Stockton students. The participants found the study through SONA. They also received credit in their courses for participating in the study.

The sample included 161 participants of which 69 produced useable data. Of these participants 82.6% were female, 15.9 % were male, and 1.4% preferred not to say with the mean age of the sample being 21 (SD = 4.48). Of the participants, 15 reported having had a concussion prior to the task, 9 having had 1, 2 having had 2, and 4 having had 3 or more. It was also found that 58 reported having an education related to concussions prior to the task.

The other 92 participants were not included for one of three reasons. Of the 92 participants, 68 were excluded because they completed the task, but not within an appropriate window of time. The remaining participants did not complete the task, of which 20 did not answer the post-survey and the other 4 consented but did not complete any other portion of the task.

Materials

The participants were asked to complete a demographics questionnaire asking questions about their concussion history and education (See Appendix B). The demographics survey

included 9 questions about their gender, age, and some information about their experiences with concussions. They also completed a questionnaire consisting of 10 questions related to their attitudes and behaviors on concussion after reading the precautionary narratives (See Appendix C). The questionnaire is a modified version used by Kurkowski et al. (2014) and Kurkowski et al. (2016) done by the researcher of this study. In the original studies, Kurkowski et al. (2014) and Kurkowski et al. (2016) used the questionnaires to observe whether there were any changes in the participants' attitudes and behaviors related to concussions after they were presented with a source of information regarding concussion prevention. The concern was to determine whether the athletes who took the questionnaire would be more likely to report concussion behaviors. Because the original questionnaire was geared towards a sample of athletes, the questionnaire used wording such as coach and athletic trainer when asked if they would tell someone if they experienced symptoms after a hit to the head. To be more inclusive of non-athlete participants in this study, the wording was modified to read medical professional or medical personnel.

The participants read one of three narratives related to concussions. One was a narrative from a professional athlete about their experience with concussions. The second narrative was a statement from an expert in the field on concussions. Finally, the third narrative was a statement from an anonymous stranger about their experience with concussions. The study was done through Qualtrics to allow for random assignment of the narrative. They responded electronically through multiple choice, with responses being "Never," "Sometimes," or "Always." These results were given numeric values following completion of data collection.

When participants finished the survey, they read a message that stated: "A debriefing email will be sent following the completion of data collection. Thank you for your participation." The email will state the following: "Thank you for your participation in the SONA study about

concussions. The purpose of the study was to see which informational format about concussions created the most change in attitude and behavior about concussions. If you would like a detailed report of the results of the study, please email me at pascalec@go.stockton.edu."

Procedure

Participants first read and completed a consent form on SONA (See appendix A). They then complete a demographics form prior to reading one of three personal narratives about concussions. Following their reading, they were be asked to complete a short survey on their attitudes and behaviors surrounding concussions. The demographics form and survey are adapted from ones used by Kurkowski et al. (2014) and Kurowski et al. (2016) during their studies on preseason concussion education on an athlete's knowledge, attitudes, and behaviors (see appendices B and C). Following completion of the survey, they were be thanked for their participation in the research and informed that they would receive a debriefing email following the data collection to explain the study. Then the participants were asked to close out the survey screen. Upon completion of data collection, an email was sent to all of those who participated in the study.

Analyses

Data Analysis Approach and Expected Findings

The answers to the questions were given a numeric value and the difference between their before and after scores were used to analyze their responses related to their attitudes and behaviors. The answers were coded as "1" for Never, "2" for Sometimes, and "3" for Always for questions 1, 2, 3, 6, and 9 on the Behavior and Attitudes survey because they are written in the

positive indicating use of precautionary behaviors towards concussions. Questions 4, 5, 7, 8, and 10 will be reverse coded as they are written in the negative, where an answer of "Always" would indicate use of risky behavior leading to concussions. The scores were summed for each individual to give them a total score. Once the total scores have been determined for each participant, the average total score was determined for each group. A higher score indicates more positive behaviors regarding concussion behaviors, indicating that an individual is more likely to report concussions and use more precautions. Then the factorial ANOVA test will be used to analyze the results of the test with post-hoc analyses if there is any significance between the effects of the precautionary information on attitudes and behaviors.

It was expected that the group which reads the statement from a professional athlete will have the highest post-survey scores showing more precaution in regard to attitudes and behaviors involving concussions. Research done by Abd Aziz (2020) and Dixon et al (2011) show how individuals may be swayed by a celebrity's status rather than by facts. If an individual is to read a statement by a celebrity that is also to some degree factual, the individual will be more likely to have a change in their attitudes and behaviors.

Results

Data that was incomplete or done within a timeframe that was not found to be acceptable to have completed the task were excluded from the sample. Participants who completed the task in fewer than 4 minutes were excluded from the analyses due to the time at which it should have taken to read the narrative and complete the survey. Tables 1 & 2 show the descriptive statistics and demographics of the sample.

Table 1.
Descriptive Statistics for Passage Read

	N	Minimum	Maximum	Mean	Std. Deviation
Passage	69	18.00	30.00	26.9710	2.76518
A	20	18.00	30.00	26.4000	3.88519
B	24	21.00	30.00	27.0000	2.34057
C	25	24.00	30.00	27.4000	2.00000
Valid N (listwise)	69				

Table 2.
Demographics for Sample

		Frequency	Percent
Sex		57	82.60
	Female		
	Male	11	15.90
	Prefer Not To Say	1	1.40
Age			
	18	14	20.30
	19	17	24.60
	20	10	14.50
	21	13	18.80
	22	9	13.00
	23	1	1.40
	25	1	1.40
	26	1	1.40
	29	1	1.40
	33	1	1.40
	51	1	1.40
Sports			
	No	59	85.50
	Yes	10	14.50
Prior Concussions			
	0	54	78.30
	1	9	13.00
	2	2	2.90
	3 or More	4	5.80

		Frequency	Percent
Prior Concussion Education			
	No	11	15.90
	Yes	58	84.10
Source of Prior Concussion Education			
	None	11	15.90
	Family	6	8.70
	School	24	34.80
	Coach	4	5.80
	Athletic Trainer	14	20.30
	Doctor	7	10.10
	Other	3	4.30

To examine the effects of the narratives read by the participants, an ANOVA was used to determine whether the individuals were impacted by one source of information rather than another. The ANOVA did not show any significant results, $F(2, 66) = .72$, $p = .49$, for any of the conditions, be it celebrity ($n = 20$), professional ($n = 24$), or anonymous ($n = 25$).

Table 3.
Means, Standard Deviations, and Confidence Intervals for Passage

			95% Confidence Interval	
	M	*SD*	*Lower Bound*	*Upper Bound*
Passage				
A	26.40	3.89	24.58	28.22
B	27.00	2.34	26.01	28.00
C	27.40	2.00	26.57	27.64

In a 3 X 3 factorial ANOVA to determine in there was any significance produced by the source of information from their passage read (celebrity versus expert versus anonymous) in relation to sex (male vs female vs prefer not to say) of the participant, it was determined that there was no significance. The main effect for passage read was not significant, $F(2, 62) = 1.27$, $p = .29$, $R^2 = .039$. The main effect for sex was also not significant, $F(2, 62) = 2.45$, $p = .095$, $R^2 = .073$. Finally, the interaction effect between passage read and sex was not found to be significant, $F(2, 62) = 1.63$, $p = .205$, $R^2 = .050$. The results suggest no significant relationship between the sex of a participant and from what source of information they receive concussion information from.

Table 4.
Means, Standard Deviations, and Confidence Intervals for Passages and Sex

Passage	A				B				C			
			95% Confidence Interval				95% Confidence Interval				95% Confidence Interval	
	M	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*
Sex												
Female	27.50	3.35	26.08	28.92	27.10	2.30	25.93	28.26	27.32	1.84	26.18	28.45
Male	24.40	4.34	22.02	26.78	26.33	3.06	23.26	29.41	28.00	3.46	24.97	31.07
Prefer Not to Say	21.00		15.68	26.33								

A 4 X 3 factorial ANOVA was also used to determine whether previous concussions (none versus one versus two versus 3 or more concussions) had an effect on someone's reception to the information on concussions depending on the source of information. However, there were also some significance found. The main effect for passage read was not significant, $F(2, 59) =$

.59, $p = .56$, $R^2 = .020$. The main effect for concussions did have a significant result, $F(3, 59) = 3.03$, $p = .036$, $R^2 = .13$. The effect size ($R^2 = .13$) produced by number concussions received prior to reading information on concussions is small. Those with no prior concussions ($M = 27.52$, $SD = 2.37$) have significantly higher scores than those with 3 or more prior concussions ($M = 23.50$, $SD = 5.20$) when it comes to having their attitudes and behaviors surrounding concussions ($p = .024$) compared to those who received 1 ($M = 25.22$, $SD = 2.44$) or 2 ($M = 27.00$, $SD = 1.41$) prior concussions. Those with no prior concussions would be less likely to perform risky behaviors leading to concussions and would be more likely to seek treatment following a concussion. While there was a main effect for the number of concussions an individual had received prior to the study, there was not a significant interaction effect between number of concussions and which source of information the individual read from, $F(4, 59) = .49$, $p = .75$, $R^2 = .032$. Prior concussions do seem to have a relationship with influencing an individual's concussion attitudes and behaviors, but not in relation to the source of information.

Table 5.

Means, Standard Deviations, and Confidence Intervals for Passages and Prior Concussions

Passage	A				B				C			
			95% Confidence Interval				95% Confidence Interval				95% Confidence Interval	
	M	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*
Concuss-ions												
0	27.64	2.81	26.23	29.06	27.26	2.53	26.05	28.48	27.67	1.96	26.51	28.82
1	24.00	4.00	20.94	27.06	26.33	1.15	23.28	29.39	25.33	1.53	22.28	28.39
2					26.00		20.71	31.29	28.00		22.71	33.29
3	23.00	6.25	19.94	26.06	25.00		19.71	30.29				

Prior concussion education was tested as well to determine if it influenced an individual's reception to the information on concussions. A 3 X 2 factorial ANOVA was used to determine if any education on concussions (had prior education versus no prior education) was influential on an individual's reception cause by the source of information, but no significance was found. The main effect for passage read was not significant, $F(2, 63) = .71$, $p = .50$, $R^2 = .022$. The main effect for concussion education was also not significant, $F(1, 63) = .94$, $p = .34$, $R^2 = .015$. There was no significant interaction effect between the two variables as well, $F(2, 63) = .1.09$, $p = .87$, $R^2 = .004$.

Table 6.
Means, Standard Deviations, and Confidence Intervals for Passages and Prior Concussion Education

Passage	A				B				C			
			95% Confidence Interval				95% Confidence Interval				95% Confidence Interval	
	M	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*
Prior Education												
No	26.67	4.16	23.42	29.92	27.67	1.21	25.37	29.96	29.00		25.02	32.98
Yes	26.35	3.97	24.99	27.72	26.78	2.60	25.45	28.10	27.26	2.03	26.09	28.43

A separate 7 X 3 factorial ANOVA was used to determine if the prior source concussion education (athletic trainer vs coach vs doctor vs family vs school vs other vs none) that was received had an influence on whether the source from the passage read was influential. There was no main effect for the passage, $F(2, 51) = 1.35$, $p = .27$, $R^2 = .050$. There was no main effect for prior education source either, $F(6, 51) = 1.211$, $p = .32$, $R^2 = .13$. Finally, there was no interaction effect between the passage read and prior source of concussion education, $F(9, 51) =$

10.16, $p = .186$, $R^2 = .205$. Prior education appears to have no relationship to current source of education on concussion attitudes and behaviors.

Table 7.
Means, Standard Deviations, and Confidence Intervals for Passages and Prior Concussion Education Source

Passage	A				B				C			
			95% Confidence Interval				95% Confidence Interval				95% Confidence Interval	
	M	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*	*M*	*SD*	*Lower Bound*	*Upper Bound*
Prior Education Source												
None	26.67	4.16	23.62	29.72	27.67	1.21	25.51	29.83	29.00		25.26	32.74
Family	29.00	1.41	25.26	32.74	25.50	.71	21.76	29.24	29.50	.71	25.76	33.24
School	28.40	1.67	26.04	30.76	28.33	2.07	26.18	30.49	26.46	1.90	25.00	27.93
Coach					26.00	1.41	22.26	29.74	28.50	.71	24.76	32.24
Athletic Trainer	26.20	3.49	23.84	28.56	25.86	3.29	23.86	27.86	25.50	2.12	21.76	29.24
Doctor	23.40	5.27	21.04	25.76					28.50	.71	24.76	32.24
Other					28.00		22.71	33.29	29.50	.71	25.76	33.24

Due to the limited number of participants, a factorial ANOVA was not reasonable to determine whether age in combination with the source type had an effect on the participants' attitudes and behaviors. A one-way ANOVA was run instead to see if there was any effect on attitudes and behaviors towards concussions, which could suggest a target age to do outreach for concussions. The results were approaching significance, $F(4, 58) = .2.51$, $p = .052$, and there appeared to be a significant difference between 19- ($M = 27.82$, $SD = 2.30$) and 20-year-olds (M = 24.60, SD = 3.27) when using a Tukey post hoc test, $p = .031$ compared to 18- ($M = 27.50$, $SD = 2.80$), 21- (M = 27, $SD = 2.71$), and 22-year-olds (M = 26.67, $SD = 2.55$). In this sample individuals who were 19 years old would be more likely to report concussions or avoid risky

behaviors that could lead to a concussion when compared to 20-year-olds. Overall, there was no significant results regarding the age of a participant in their reception of information source in relation to concussion attitudes and behaviors, but there appears to be a relationship between age and concussion attitudes and behaviors between 19- and 20-year-olds.

Table 8.
Means, Standard Deviations, and Confidence Intervals for Age

			95% Confidence Interval	
	M	*SD*	*Lower Bound*	*Upper Bound*
Age				
18	27.50	2.80	26.06	28.94
19	27.82	2.30	26.51	29.13
20	24.60	3.27	22.89	26.31
21	27.00	2.71	25.50	28.50
22	26.67	2.55	24.87	28.47

Discussion

The results do not support the hypothesis that if information on concussions were presented to an individual by a celebrity as a narrative there would be the greatest amount of change in risky attitudes and behaviors related to concussions. Because there were no significant results between the groups there does not appear to be one narrative that should be used to sway an individual's behaviors to be more precautionary regarding concussions. This would suggest that further research needs to be done into what should be used to change concussion related behaviors.

Useable Data and the Impact of COVID-19

More than half of the data collected in this study was not useable due to incompleteness or the study being done improperly, suggesting that there is an outside variable influencing the

participants involvement. One possible influence on the nature of this issue could be lingering distress caused by COVID-19. In a study done by Marler et al. (2021), the researchers found that as psychological distress and feelings of alienation increased during the pandemic, academic motivation decreased. Because most universities are now finally returning to in-person classes, students are still adjusting to the changes. The students may still be feeling distress over COVID-19 and other national issues (e.g. the war in Ukraine, political unrest). Students may also be adjusting to being around other students again because as Marler et al. (2021) states, "emerging adulthood is a time of identity formation especially through social connection." As students are coming back to school after almost two years, they may be finding it hard to adjust and make the same social connections they did in the past, leading them to feelings of alienation. Zaccoletti et al. (2020) found a decline in the amount of involvement among extracurricular activities as well as a lack of academic motivation. Both Marler et al. (2021) and Zaccoletti et al. (2020), have found issues with academic motivation. Zaccoletti et al. (2020) showed support for Marler et al.'s (2021) suggestion that alienation contributes to lack of academic motivation. If students are not participating in extracurriculars, they are not as academically motivated. Because of the distress and alienation students are not as motivated to participate in academics.

In relation to this study, the study may have been impacted two-fold. Students were given the opportunity to complete studies on SONA as a form of extra credit for their courses. The students are granted credit whether or not they have completed the task properly or fully. Because students may be lacking motivation to do their schoolwork, they may be going to SONA studies for extra credit to bolster grades in classes they may not be motivated to work on. On the other hand, the study is impacted because students may know the receive credit regardless of completeness or how well it is completed. Students appear to simply open the survey long

enough or answering the questions without properly completing the task for the program to register participation knowing they will receive credit. The students may lack the motivation to complete the task because they may be feeling lingering distress and alienation caused by COVID-19.

In this study, data was collected on whether participants participated in a sport, many of which did not. While the participation in sports was not meant to predict participation in this study, it would be interesting to see how participation may affect that. For future research it may be beneficial to collect data on other activities such as participation in clubs.

Limitations and Future Research

One such change could be using video rather than written narrative such as Kroshus et al. (2014) had done. Participants, such as those of college student age, may be more receptive to information in a more visually stimulating format rather than a literary one. Shatto and Erwin (2016) reported "[t]he average Generation Z individual has an 8-second attention span, down from 12 seconds for Millennials" and "this trend [is called] 'acquired attention deficit disorder'" (p. 253) by Dr. John Ratey from Harvard Medical School. The researchers gave suggestions on how to present educational information to students to combat the short attention spans. Instead of presenting younger individuals with reading material, a more visually stimulating presentation would be more effective. Suggestions geared toward this method include games such as Jeopardy, Kahoot, and Socrative, media including YouTube videos, and social media while reducing the amount of reading content to only what is necessary (Shatto & Erwin, 2016). With the suggestions from this research there are several different ways this study could be adapted to be more effective.

One adaptation could be to create videos presenting on concussion information. The delivery of the information could be done by the same type of individuals, celebrity, professional, or an anonymous source to see which source is more effective.

Potential future research could also include presentation of the information in video or other format and then a game to reinforce what they read. Then the follow up survey on attitudes and behaviors to determine if the combination of information and reinforcement by game could be more effective in changing concussion attitudes and behaviors.

Because the participants appeared to have a difference in concentration, many also did not complete correctly or at all the online survey. A possible change could be to have the participants complete the study in more controlled environment rather than at their own leisure. The study could be run in a lab where the participants could read or watch the material under the supervision of the research to ensure proper completion of the study. If the format were to remain as reading material, to combat incompletion or incorrect completion it may also be beneficial to add a reading check in the middle of the reading. The participants would not be able to continue to the rest of the reading or task unless they answered 90% of the reading check correctly. This would ensure that the material is being read to create an effect on the participant the way it was intended to.

Future research may look at different combinations of precautionary information sources to find the right pairing that may have the greatest effect on an individual. For example, it would be beneficial to determine if a combination including a celebrity and a professional would have more of an impact over a combination of a professional and an anonymous source.

A final alteration to the study would be adding a pre-survey as well as a more longitudinal post-survey. The survey would allow for comparison of attitudes and behaviors

before reading and after reading to know if the narrative did have an impact on the individual. By having an additional post-survey done later, there could be less bias to answers following the survey if there was a pre-survey. The individuals may feel obligated to have consistent answers when the take the survey immediately after since they may remember what they answered prior to reading the narrative. The additional post-survey would also allow to see how long the concussion education was effective. If one source of education is more effective and for a longer time, it would be better to use that source of education, especially if one was immediately effective while another had a more long-term effect. Additional pre- and post-surveys would give more insight into the effectiveness of concussion education.

Conclusion

While this study did not have any significant results, further research is vital to determine what source of precautionary information related to concussions is best. Lack of motivation and distress from the recent events in the world are likely to have impacted the completion of the task and therefore altering the results.

With the information obtained from studies done on younger generations, the format in which the information was presented should also be taken into consideration. Instead of a written format, one involving videos would likely be better suited to the audience of participants due to their shorter attention spans. If there are alterations within the study significant results may arise.

Determining what source of information to present an individual with to prevent concussions is crucial. Concussion can cause minor problems that may only have a short-term impact. However, for some the results of the concussion may be more long term, possibly permanent, or even in some cases deadly when not taken seriously.

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Appendix A
Consent Form

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2022

Consent Form

The following research is being conducted as a part of my senior research project for distinction in psychology. I am asking for your participation in the following study that is seeking information on attitudes and behaviors surrounding concussions. Keep in mind that your participation in this research is completely voluntary.

If you decide to participate, you will be asked to fill out a demographics form and questionnaire. Then read a passage about concussion and answer another questionnaire. The total time for the study, including survey completion and reading, should be about 10 minutes. As noted on the psychology website when you signed up for this study, you will receive one credit for your participation in this research.

There is minimal to no risk to you by participating in this study, but if you feel uncomfortable at any point you are welcome to stop without any penalty to you. If you decide to participate in this study, all results will remain anonymous. All data collected in conjunction with this project will be stored in the psychology laboratory and will be destroyed within 5 years.

If you have any questions or concerns about anything during the study, please do not hesitate to ask. If you have any further questions after completion of the study, please feel free to contact Carlie Pascale at pascalec@go.stockton.edu. The project is being supervised by Dr. Christine Gayda-Chelder; she can be contacted by email at Christine.Gayda@stockton.edu or by phone at 609-626-6075.

By selecting “I consent” below you indicate that you have read the above information and have agreed to participate. If you do not agree, please select “I do not consent” and exit the survey screen.

Appendix B
Demographics Survey

Please complete the following form regarding your demographics information.

1. Sex
    a. Male
    b. Female
    c. Transgender
    d. Prefer Not to Answer

2. Age: _____

3. What is your major? _____

4. Do you play a sport?
    a. Yes
    b. No

5. If yes, what sport? _____

6. Do you have a history of prior concussions?
    a. Yes
    b. No

7. If yes, how many concussions?
    a. 1
    b. 2
    c. >3

8. Have you had an education in concussions before?
    a. Yes
    b. No

9. Source of Concussion Education?
    a. Family
    b. School
    c. Coach
    d. Athletic Trainer
    e. Doctor

f. Other

Appendix C
Behavior and Attitude Questionnaire

Please complete the following survey pertaining to your current attitudes and behaviors regarding concussions.

1. I would immediately tell a medical professional that I had a headache, fogginess, or dizziness after getting hit in the head.
    a. Always
    b. Sometimes
    c. Never

2. I would report having a concussion to a medical professional if I knew it meant I would have to sit out of an event I wanted to attend.
    a. Always
    b. Sometimes
    c. Never

3. If someone told me they thought they had a concussion, I would report it.
    a. Always
    b. Sometimes
    c. Never

4. I would continue doing an activity while having a headache that resulted from a minor bump to the head.
    a. Always
    b. Sometimes
    c. Never

5. I would participate in an activity through any condition or injury for our team to win.
    a. Always
    b. Sometimes
    c. Never

6. I feel that it is important to be thoroughly evaluated by medical personnel after an injury to make sure I recover completely.
    a. Always
    b. Sometimes
    c. Never

7. I feel that getting a concussion is not a big deal and actually proves that I am tough.
    a. Always
    b. Sometimes
    c. Never

8. I feel that if a star athlete gets a concussion during a state tournament game they should return to the game since it could be their last one of the season.
    a. Always
    b. Sometimes
    c. Never

9. During a championship game, you get injured. It hurts but does not really hinder your ability to play. Knowing that it would result in a more severe injury, I would report the injury to a coach or athletic trainer.
    a. Always
    b. Sometimes
    c. Never

10. It is OK for an athlete to continue playing in a game in which they have suffered a concussion.
    a. Always
    b. Sometimes
    c. Never

11. Passage Read _____

Appendix D
Prevention Excerpts

Passage A – Celebrity**:**

The following piece is a reflection written by Dale Earnhardt Jr., a former NASCAR driver, who experienced multiple concussions during his career. Dale Earnhardt Jr. was a third-generation driver and was voted as NASCAR's Most Popular Driver for a record 15 consecutive seasons (Dale Earnhardt Jr. n.d.). He qualified for the NASCAR Cup, the highest level of NASCAR, playoffs eight times (Dale Earnhardt Jr., n.d.). Following his retirement from driving in NASCAR, Dale Earnhardt Jr. has become an NBC commentator for auto racing as well as hosting his own television show.

"I never wanted to be a concussion expert. I know some of the world's leading authorities on head injuries and I'm certainly not one of them, but "expert" is a relative term. My expertise comes from personal experience.

During my two decades behind the wheel as a full-time Nascar driver, I suffered more than a dozen concussions. For a long time, I managed to keep most of them a secret, but then my symptoms got too severe to keep up the charade and I was forced to get help. My battle with head injuries has given me a wealth of firsthand knowledge of the causes, symptoms, and types of concussions, and their treatments.

Racers get every injury you can think of, from broken legs to cracked collarbones. But it was concussions, not fractures, that forced me to retire as a full-time Nascar driver in 2017. Twice I was pushed out of the driver's seat because of concussion-related symptoms, missing two major races in 2012 and an entire half-season in 2016.

During the four years in between I had other injuries too, but I kept them hidden until doctors intervened and told me to get out of my car. In the days following a race, I would often feel disoriented and confused, detached from my body. Some people experience sharp headaches or ringing in the ears when concussed. For me, my balance was off and my mind felt swishy, lagging behind whatever my body was trying to do.

In 1998, at the Daytona 300, my Chevy was tossed into the air and slammed down so hard on its nose that my helmet dented the steel roll cage. Later that week when I was working inside a car at the shop, I suddenly felt the car rolling. I sat up and realized it hadn't moved an inch. I'd eventually find out my vestibular system — the communication lines between the brain, inner ear and body — had been damaged.

But at the time, driven by a will to win and a hardheaded racing tradition of never showing vulnerability, I concealed my suffering. I would usually rally by the time the next race weekend came around. Still, the stress chemicals produced by the anxiety of keeping my secret worsened my condition. And as I got older, I needed longer and longer to recover.

I persisted because it's what racecar drivers are supposed to do. You tough it out. I also believed then what so many still do now: that a concussion is permanent. I worried if I revealed how I really felt, my peers on the racetrack would see me as damaged goods.

Those same myths and fears affect football players and construction workers, kids playing youth sports and even people who get in the odd car accident on their way to the office. But these myths lead us to make uninformed decisions that harm our lives and livelihoods. A recent Harris Poll commissioned by the doctors who treated me at the University of Pittsburgh Medical Center's Sports Medicine Concussion Program found that 25 percent of parents prevent their children from playing contact sports because of concussion concerns.

I'm a parent now and I would never tell someone how to raise his child. And I don't deny the estimate that there are 1.7 million to three million sports-related concussions a year.

However, I am sure that there is a middle ground, that we can encourage our kids both to be active and competitive — and to be safe. Research shows that concussion risks can be reduced by playing smarter and using the proper equipment.

When concussions do occur, it's important to remember that brain injuries can be treated and healed like any other athletic injury — but only if the proper steps are taken, the right doctors are reached and the prescribed treatment is followed through to the end.

That treatment is not easy. I'd never been a gym guy, but I learned how to become one. My rehabilitation in 2016 was the hardest I have ever worked. I wasn't told to sit in a dark room, the stereotypical treatment for concussion. That's not how it works anymore. Instead, I was pushed mentally and physically through fine motor skill tuning, exhausting computer-based eye tests, and a lot of old-fashioned cardio. After months of work I could feel my brain, eyes, ears and body communicating properly again.

I also felt my life returning. The constant, dull feeling of fear lifted. I was smiling again.

Now, I tell my story to let people know they don't have to silently walk it off. I tell it to my racing friends who confess they've also been suffering in secret and to many others who've never raced a lap. I've given out the phone number to my doctor, Micky Collins at the University

of Pittsburgh, more times than I can count in the past few years. And when those people reconnect later to tell me that Micky and his team have given them their lives back, it feels like winning a race.

The advancements in brain science since my first major injury in 2012 are incredible. But all that science won't mean much if those of us who are hurting don't come out of hiding and allow it to be put to use.

I don't blame my sport for my suffering. Neither do the other professional athletes I know who love their sport every bit as much as I love mine. And people hurt on the job performing other tasks are likely just as passionate about what they do.

I will always wonder how many more races I could have won or how much longer I could have raced if not for my stubbornness.

Don't make the mistakes I made. Help is out there. You just have to ask."

(Earnhardt, 2018)

Passage B – Expert:

Dr. Vernon B. Williams is a Sports Neurologist and Pain Medicine Physician, who completed his Pain Medicine Fellowship at Johns Hopkins (Williams, n.d.). He is a consultant for the Los Angeles Lakers, Los Angeles Dodgers, Los Angeles Kings, Los Angeles Sparks, Anahiem Ducks, Loyola University, Fullerton College, and numerous high schools (Williams, n.d.).

"There has been a dramatic increase in published information regarding concussion in the last several years. But availability of more information has not necessarily resulted in effective knowledge transfer. E.O. Wilson once wrote, "**We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely."** This sentiment can be appropriately applied to the current state of affairs regarding concussion. Some of the most frequently asked questions about concussion (whether talking to physicians, athletes and their family members, or other stakeholders) remain very basic:

- "Exactly what is a concussion?"
- "What happens to the brain during a concussion?"
- "How long will it take to recover?"

Most people (even many physicians) thought until recently that a concussion is when you get knocked out. Massive education efforts have attempted to provide explanations definitions that correct that misinformation. Still, most of the information used to frame concussion and to educate others is either super technical or oversimplified. The scientific and medical education efforts (typically presented at medical conferences or in scientific journals) have been geared to improving fund of knowledge related to epidemiology, pathophysiology, anatomic assessments, and essentials of medical management. The public education efforts (typically presented in the lay press, and public service announcements) are usually meant to provide very basic warnings about the dangers of repeated concussions and returning to play too soon. In my experience as a Sports Neurologist evaluating and treating concussion at every level of competition (including youth/club leagues, high school and collegiate athletes as well as professionals) both kinds of efforts would benefit from further explanation of very basic concussion issues. I find it very useful to "translate" information we as concussion experts understand, into a form of

communication that all stakeholders (athletes, parents, and even non-concussion expert physicians) can use to understand the injury and make better decisions through improved insight.

What is a sports concussion?

- ***Medical Explanation:*** Concussion is a complex pathophysiologic process affecting the brain, induced by traumatic biomechanical forces. It is most commonly characterized by the rapid onset of a constellation of symptoms or cognitive impairment that is self-limited and resolves spontaneously.
- ***Translation:*** A concussion is a brain injury. Period. It does not require loss of consciousness. Any impact or force to the head or body that results in a change in how the brain works counts as a concussion. Symptoms typically come on quickly. But in some cases the symptoms develop and evolve over minutes to hours. They can involve headaches, dizziness, imbalance, visual disturbance, confusion, memory loss or a number of other symptoms. Fortunately, for the overwhelming majority of people, the symptoms normally improve on their own.

What happens to the brain? Can you see a concussion on imaging tests? How long does a concussion last?

- ***Medical Explanation*:** Concussions are felt to represent acute metabolic and physiologic changes in the brain that are not visible on traditional imaging studies. Using advanced imaging techniques there may be diffuse axonal damage from stretch injury visible as ultra-structural damage (Diffusion Tensor Imaging) or metabolic abnormalities noted (fMRI, MRS). The metabolic changes may last for days to weeks, despite resolution of clinical symptoms**.**
- ***Translation****:* You can't see a concussion on x-ray, CAT scan, or most MRI's. But the lack of abnormality on those tests does not mean the brain hasn't been injured. The injury occurs on a cellular level. When special methods are used, there is evidence of change in how the brain is working that last for days to weeks (evidence of persistent brain dysfunction) even when the injured athlete feels that they are back to 100% and the physical examination is normal. Newer tests even show abnormalities in the brain in individuals who have been exposed to repeated impacts without clinically diagnosed concussion.

What actually causes the headaches, confusion, imbalance, and other symptoms? Why can't I just return to play when I feel better?

- ***Medical Explanation*:** The metabolic mismatch related to alterations in blood flow and glucose metabolism may be the cause of post-concussion cognitive, affective, and physical signs and symptoms. Evidence indicates the highest risk for recurrent concussion is during the immediate several days after a concussion occurs. In addition, the duration of time needed for recovery from a second concussion is much longer, and symptoms are often far more severe. A complete and detailed assessment should be performed on concussed athletes with documentation of resolution of symptoms, normal examination, and return to baseline on any pre-concussion testing prior to return to play.
- ***Translation**:* After concussion, there is an increased need for fuel/energy so that the brain can heal and normalize intracellular and extracellular concentrations of key elements like potassium, calcium and magnesium. But there is a global decrease in blood flow (meaning there is also a decrease in fuel available to correct the abnormalities.) This has been called a "metabolic mismatch". It is felt that as long as this is the case, the athlete will likely have symptoms and be unable to perform at their best. In fact, attempts to return to play during this time of recovery will likely result in increased symptoms, prolong the duration of symptoms, and may increase the risk of another concussion or other musculoskeletal injury. Rarely, a severe and catastrophic complication called second impact syndrome may result from a second concussion that occurs prior to complete resolution of a previous concussion. For these reasons, it is critical to protect athletes by restricting return to play until all available signs indicate the brain is sufficiently healed and recovered.

Why do concussion symptoms vary from person to person in terms of how long they last? What is chronic post-concussion syndrome and how should it be handled?

Medical Explanation: Factors known to affect concussion symptom duration include age, sex, medical history, concussion history, presenting symptoms, and probably genetic predisposition. Concussed athletes with prolonged symptoms may require more specialized medical evaluation and management techniques as cervicogenic headache, vestibular dysfunction, and/or oculomotor dysfunction may contribute to chronicity and dysfunction. The development of

pathologic compensatory mechanism may significantly delay or prevent symptom resolution and contribute to further affective symptoms as well as negatively influence performance.

Translation: Each concussion is unique. Individual people will vary in terms of how quickly they improve. A specific individual will often have differences in how quickly they improve after one concussion compared to another. Concussion recovery tends to take longer in adolescents and children than in adults. Those with history of previous concussion, learning disabilities and/or migraine often take longer than those without those histories. If post-concussion dizziness and imbalance are present, it may take longer to recover. Females tend to take longer to recover than males. The take-home message is that of unique and individual concussions in unique and individual people.

In some cases, concussion symptoms will fail to improve on their own. This may indicate that an injury to the neck and spine, or problems of the visual and balance systems need more specific treatment (because they haven't healed on their own). Failure to recognize these kinds of issues can result in long-standing problems with physical performance and can contribute to depression and anxiety (further worsening an athlete's overall condition.) Early recognition and institution of appropriate treatment is a critical aspect of concussion management."

(Williams, n.d.)

Passage C – Anonymous Source:

The following piece is a reflection done by the author on their experience with concussions when they played college football. The author of this source no longer plays sports after being told that they could no longer play football or any other contact sport after his series of concussions.

I received a series of 4 concussions back in fall of 2017 due to football related activities. People were always talking about the harmful risks of concussions and the symptoms, but I had been fortunate enough to not have any serious head injuries throughout my football career. That is until somewhere between August and September.

I had finally moved into college and began my journey as a college athlete. One day, after some hits in training camp at my college, I walked away feeling sluggish and a little dizzy. The one hit I remember in particular is when I went to tackle the receiver and one of our safeties was attempting the same. As a result, the safety hit me in the back of the helmet instead of hitting the receiver.

I woke up the next day feeling sluggish, but I attributed it to fatigue and minor dehydration. I felt alright in practice, just a little slow. We ran some more defense drills and I don't remember any significant head impacts. Nothing more than the usual knocking of pads and helmets, but I started losing my bearing. Knowing something was up, I checked in with the trainers. Over the next hour, I would develop light and noise sensitivity and was unable to stay balanced standing up. Within that time, I was diagnosed with a concussion and was put on protocolled concussion watch.

After this concussion, my timeline kind of blurs. I can't quite remember the time of events. Sometime between that practice and the next day, the trainers informed me that my helmet was broken and that, based on what I had told them, I had incurred a two-part concussion. The first part was the day before and was surmised to be a very minor concussion. But because I incurred more hits the next practice, my head had sustained repeat trauma before it could heal. Apparently, I had been given a broken helmet for training camp and because I did not know the inner safety system, I had used a different brand of helmet in high school, this had gone unnoticed until my second concussion.

Over the next 4 weeks, I would go through a series of different symptoms and struggle in daily life. The first thing I remember is struggling with classes. I would have a hard time concentrating and my friends would have to help me with understanding concepts and

completing homework. For context, I had always done well in school. While I was no wiz, I had maintained straight A's in high school including in honors and college classes. The second thing I remember is struggling emotionally. I would go from my usual outgoing self, to wanting to be alone, having social anxiety. I had never struggled with this before.

As I said before, I cannot remember too much and the order of events is also a little mixed up. I would try to pass the concussion test, I believe, twice a week. Because I could not pass it, I was restricted from practicing. In film meetings, the repeated watching and rewinding of film caused shooting pain to my head, which the trainers had told me was common for those recovering with concussions and should be avoided.

Sometime in the first few days after my concussions, I went to see a brain surgeon, as was protocol for the program. She confirmed I had sustained multiple concussions and should sit out at least 3 weeks. She also explained to me that different people experience different side-effects, have different lengths of recovery, and that we don't truly know the long-term effects of concussions.

The following weeks are a bit of a blur, but I functioned pretty well all things considered. After about 4 weeks, I was able to pass the concussion test and return to the sport. The week of practice went well as did the game that weekend. Early in the next week, I broke my second helmet and was given a 3rd. Mid-week, I was practicing kick return drills when a blocker hit me with his shoulder to my helmet. From what I heard and experienced, the hit was solid but not anything brutal. The effect was much more devastating, however. When we made impact, my head felt like my skull got crushed like a tin can. I crumpled over in pain on the field. After about 30 seconds, I felt okay, but the trainers had me sit out of practice. In a few hours, my concussion symptoms would return, but with new side effects.

A few days later I was dealing with the news of a friend's passing and went to the gym to blow off some steam. I was instructed that this could be dangerous after sustaining a concussion, but I figured I'd be okay. I did a few exercises before feeling extremely light-headed. To cool off, I went to the restroom to splash cold water on my face and neck. I quickly threw up before cleaning up. The dizziness got worse however, and I ended up passing out. I woke up on the floor of the bathroom and when I got up, my whole vision was covered by these big black spots. Unbeknownst to me, I had been passed out somewhere between 7 and 10 minutes. After a while, the issues subsided, but from that point on, my symptoms got much worse.

This is the point in which my memory becomes very fuzzy. I think it was a period of 3 to 5 weeks. In this time, I experienced a slew of different side effects. Sometimes at the same time, but usually in phases of a few days or more. I experienced migraines, light and noise sensitivity, vertigo, panic attacks, slurred speech, stuttering, I would forget the ends of my sentences sometimes when I would speak or I would zone out. I had depression on and off, though this was most likely to do in part with circumstances. I had never experienced these symptoms prior to these concussions.

While it may seem hard to believe that I experienced all of this from concussions or that I was able to stay in school during this time, I had a ton of support from my friends, family, and the staff of the college. These symptoms also were prevalent only during certain parts of certain days. The only rhyme or reason I can make of it was the issues certainly got worse under stress.

Fortunately, I was eventually able to get help in the form of craniosacral therapy. This is when a specialist adjusts the bones of the skull and the top of the spine. As it turns out, somewhere in those concussions, my skull bones had been jammed together and my atlas had twisted out of place and cut off the fluid flow to my brain. After one adjustment session, I actually felt the atlas pushed back into place. Every aspect of my life drastically improved in only a week after the adjustments. But some symptoms lingered for around 6 months. These symptoms included almost a fog or sluggishness in mental processing. I would process slower and as a result, my typing was very slow compared to what it was before concussions or now. I also developed OCD over this period of time. Some effects of which I still experience. I also get headaches now with changes in barometric pressure and occasionally I will also get a migraine that begins behind the eyes. Both of which, I never had before my concussions either.

Now, people would never know I had ever had a series of head injuries. I rarely ever even think about the few minor issues I occasionally have. The worst 2 parts of the whole experience is that I have been instructed by doctors to never play football or any high-impact sports again and my friends will tell me stories of experiences and events that happened during that period of my concussions and some of it I have no recollection of. It is completely gone from my memory as if I was never there. Most of the time, I don’t dwell on the past experiences except in gratitude for how the adversity has helped me. It helped me experience, through various side effects, just a little bit of what others handle every day through various conditions. There is just one part of me, however, that wonders if any of these past side effects will come back later in my life.

(Anonymous, 2021)

Appendix E
SONA Description

You will complete a brief demographics survey before reading a passage pertaining to concussions. Following completion of the reading, you will complete a brief survey about concussion prevention.