

Media Portrayal of Concussions in Sporting Matches: Influence on Observers'  
Perception, Knowledge and Attitude Towards Concussion

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## Abstract

**Objective:** The purpose of this study is to examine how the media portrayal of potential head injuries in sporting contexts could affect observer's judgments and perceptions of concussion. First, this study examined whether providing guidelines regarding returning to play after suffering a concussion could affect the likelihood of participants to identify an athlete's likely concussion. Secondly, this study also examined whether providing feedback on how the concussed athletes were treated after the likely event would change participants' responses on reporting concussion. Knowledge and attitude towards concussion were also assessed in this study. Finally, personality traits were examined to see if any personality traits have associations with concussion reporting behaviour.

**Participants and measurements:** A total of 828 participants recruited online were randomly divided into two groups ( $n = 414$  each). Participants were asked a series of questions on concussion knowledge and attitude (cautiousness) and viewed a series of short videos of rugby matches which a concussion may have occurred. Participants were asked whether they think the athletes experienced a concussion. Participants were given feedback on how the athletes were treated (remove, stay or return to play) and asked again if they think the athletes experienced a concussion. Personality traits were measured by the Eysenck Personality Questionnaire-Revised (EPQ-R) (S. Eysenck, Eysenck, & Barrett, 1985) at the end of the questionnaire.

**Conclusion:** How athletes were treated after suffering a concussion significantly changed participants' response to whether or not they think an event of concussion had occurred. The return-to-play guideline did not influence participants' ability to identify concussions. Psychoticism and Extraversion were negatively correlated with concussion

knowledge and attitude. Overall, this study shows that media portrayal of concussions significantly affects individuals' behaviour towards the management of concussion.

*Keywords:* concussion, media portrayal, knowledge, attitude, return-to-play guidelines, personality traits

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## **1 Introduction**

Although concussion is a common type of injury in contact sport, its severity is often misunderstood (Hinton-Bayre, Geffen, & Friis, 2004; McKinlay, Bishop, & McLellan, 2011). Although medical guidelines recommend patients to seek immediate treatment following concussion, a general understanding of it is lacking. Research found that only 20% of the public can successfully identify the post-concussive symptoms (PCS), such as headache and memory problems. Amongst general medical practitioners, only 60% were able to identify more than 5 PCS (Mackenzie & McMillan, 2005). The misunderstanding of concussion management contributes to such injuries being underreported, and the consequences overlooked. The goal of the present study is to examine how such misunderstandings could be disseminated through media and its consequences, specifically in terms of how sporting events, specifically rugby, are portrayed. This is important because people make decisions based on what they know. If they are given incorrect messages through media, then this will likely influence their health-seeking behaviour if they experience a concussion themselves, or for someone in their care.

The organization of this thesis is as follows. First, the problems associated with concussion will be conferred in the literature review. The review will also look at the influence media has on shaping individuals' opinions and knowledge. Secondly, the methods and measurements used in this study will be described. In this section, detailed information regarding participants, questionnaires used, and procedure of this study will be outlined. Thirdly, results found by this research are reported. Lastly, results found by this research will be discussed. Future direction and limitations of this study are also considered.

Each year, an estimated 57 million people suffer from a mild traumatic brain injury, also known as concussion (Langlois, Rutland-Brown, & Wald, 2006). Of these injuries, 20%



are caused by physical activity and sports (H. J. McCrea, Perrine, Niogi, & Härtl, 2013).

Concussions are most often reported in contact sport, with American football accounting for more than 60% of concussions in organized high school sports (Powell & Barber-Foss, 1999).

Another contact sport that involves many mechanisms of injury is rugby, which is played worldwide but is especially popular in New Zealand, Australia, and the United Kingdom.

There are two major types of competitive rugby, 'league' and 'union'. Both types are highly collisional and are quite similar to American football in that two teams compete in full body contact. Players most often suffer injuries caused by being tackled. A tackle is a defence mechanism used to bring a player of the opposite team down to the ground and prevent him from scoring. The forces induced on the bodies of players involved in the tackles has been identified to be the most common cause of concussion in rugby league (Gardner et al., 2015; O'Connell & Molloy, 2016). Compare to other types of injuries such as fractures and contusions, concussion injuries are less commonly reported in rugby, but a recent systematic review pointed out it is possible that concussion injuries are less often reported because they are more difficult to identify (Noble & Hesdorffer, 2013). Overall, the review identified that concussion injuries occur roughly between 8.0 and 17.5 injuries/1000 playing hours in rugby league (Gardner et al., 2015).

However, studies on the incidence of injuries in rugby league are hampered by inconsistencies in how concussions are defined. The lack of clear definition makes identification during games difficult, and no standardized intervention protocols are implemented when an injury occurs. Although concerns over athletes' health have prompted the development of concussion management guidelines, most of these guidelines are controversial and lack a scientific foundation. Sports athletes are frequently publicized through televised media to return to play within minutes of an injury occurring (McLellan & McKinlay, 2011).

How potential concussions in rugby matches are portrayed on media can have an effect on how people evaluate these injuries. As previously noted, athletes are frequently publicized as returning to play within minutes of a potential concussion having occurred. Such behaviour is often viewed through mass media by millions of people, with over 3.1 million individuals attending matches across the 26 rounds of the rugby league season in Australia and New Zealand (NRL, 2012). An estimated 330,000 regular television viewers watch the matches across the season weekly, with over 1 million viewers during the finals week (McLellan & McKinlay, 2011). The media are projected to have substantial potential for impact on the opinions of individuals by disseminating information on issues and outcome (Rahman, 2014). The media is a powerful tool of forming and shaping public opinion and information can be portrayed in a way that sways or shapes people's attitudes, for example by shifting the less socially-desirable features to the background (Nelson, Lecheler, Schuck, & De Vreese, 2012). These authors reported that the frequency with which information are displayed and also the manner they are displayed in influence how people would interpret the information given.

Females may be particularly susceptible to influences in their social network (Aral & Walker, 2012). Females are usually more sensitive to physical discomfort (Wiesenfeld-Hallin, 2005) and, perhaps more importantly, are usually the dominant carer for their children making decisions about when to seek medical treatment following injury. Studies have found females have significantly stronger roles in prevention for their children's health (Nathanson, 1977) . If females are more easily influenced by the incorrect media messages, the consequences could affect not just themselves but those under their care.

In the sporting context, , the Return To Play (RTP) guidelines suggest that players should not return to the game whilst still experiencing symptoms of concussion (Canty & Nilan, 2015). Sports leagues do not always follow the RTP guidelines following an event of

concussion (McLellan & McKinlay, 2011) even though players should not return until they are completely symptom free (Schatz & Moser, 2011). This visual information may influence understanding of concussion. McLellan and McKinlay (2011) found that many concussion cases were not treated by the standard RTP criteria and players were often sent back to the game shortly or even immediately after the injuries. Many examples of incorrect concussion-management behaviours are shown on TV and this has the potential to undermine the general public's understanding of concussion and appropriate interventions. The current study used a questionnaire with experimental manipulation to examine the effect of media portrayals of concussion on people's real life concussion managing behaviour.

Participants, recruited online from New Zealand, Australia, and the UK, were asked a series of questions on their knowledge regarding the preceding topic of how media influence public's understanding of concussion. They are divided into two groups provided with different experimental conditions to examine how these conditions affect concussion managing behaviour. Participants also answered questions from the Eysenck Personality Questionnaire-Revised (EPQ-R) that allows the current study to gain insights to the connection between personality traits and factors regarding concussion managing behaviour.

Topics reviewed by this study include general information regarding concussion, the negative impact of concussion, current measures of concussion, the appropriate interventions of concussion, current problems in concussion and most importantly the media portrayal of concussion. Theories of media portrayal include the agenda setting theory and the hegemonic masculinity theory. Lastly, this thesis will review the personality traits paying specific attention towards Psychoticism and Extraversion. These topics are important because it starts off by informing people the severity of concussion and give some background information about it. The media portrayal section will demonstrate how easily it is for general public to gain inaccurate information on concussion management. Personality traits could contribute to

the extend people are swayed by media influence and also their attitudes towards concussion therefore this study decided to include personality traits as potential factors.

## **2 Concussion**

Concussion, also known as mild traumatic brain injury or head injury, is a brain injury caused by external forces. In the United States, over 1 million individuals are affected by concussion every year (Pluta, Lynn, & Golub, 2011). Concussion is particularly common amongst players of active sports such as boxing, mountain biking and contact sports such as football and rugby. Current recommendations are that symptoms of concussion should be addressed immediately following injury and that postconcussion clinical assessment should be repeated until symptoms fully recover due to the complexity of the injury. However, health seeking behaviour following a concussion relies on the injured individuals recognising potential symptoms, but a number of factors may influence understanding of concussion. For example, the individual's personal history with concussion may influence health seeking behaviour, but also information from other sources such as friends, family or media. Media representations of concussion are particularly important because they reach a large audience and are often inaccurate downplaying the seriousness of the injury (Kennard, McKinlay, McLeallan, 2017). However, little is known regarding how these different sources may influence the understanding of concussion. An understanding of the factors that influence recognition of concussion is essential to ensure appropriate management of this injury and prevent ongoing problems

### **2.1 Concussion Symptoms**

Concussion is a trauma induced alteration in cerebral status that may or may not cause loss of consciousness (Kelly & Rosenberg, 1997). It was concluded more than 30 years ago that loss of consciousness was not necessary for a brain injury to take place rather the defining symptoms involves an alteration of mental status (Cook et al., 1996). The most reported symptom of concussion is headache followed by fatigue and cognitive problems

(Fazio, Lovell, Pardini, & Collins, 2007). Other common symptoms include sleep difficulty, nausea and personality change (Lovell et al., 2006). Concussion symptoms can manifest immediately after injury but can also have a postponed onset. Elevated symptoms such as memory deficit and disorientation can be experienced even after 72 hours post-injury (Fazio et al., 2007). McCrea et al found that concussed athletes continued to report symptoms of concussion up to 7 days post-injury (McCrea et al., 2003). See Table 1 for the list of symptoms that are experienced acutely (minutes to hours) and symptoms that are experienced days after the initial injury.

Concussion symptoms can be very subtle at the onset. Symptoms such as headache or foginess are often neglected because they are very indistinct visually but studies have found that disturbances to mental acuity are highly associated with other concussion related symptoms and worsened performance on memory, reaction time and processing speed (Iverson, Gaetz, Lovell, & Collins, 2004). Athletes who reported headache were significantly more likely to have on-field anterograde amnesia (loss of ability to create new memories after injury) and five times more likely to demonstrate mental status change (Collins et al., 2003). See Table 1 for acute symptoms of concussion and Table 2 for common features of concussion.

Table 1: Acute symptoms, onset minutes to hours concussive injury (from Kelly & Rosenberg (1997)).

<b>Early (Minutes to hours)</b>
Headache
Dizziness or vertigo
Lack of awareness of surroundings
Nausea and vomiting
<b>Late(Days to weeks)</b>
Persistent low grade headache
Light-headedness
Poor attention and concentration
Memory dysfunction
Easy fatigability
Irritability and low frustration tolerance
Intolerance of bright lights or difficulty focusing vision
intolerance of loud noises, sometimes tinnitus

\*Symptoms athletes reported with frequent onset, although should not be confined into said categories.

Table 2: Frequently observed features of concussion (from Kelly & Rosenberg (1997)).

Vacant stare
Delayed verbal and motor responses
Inability to focus attention
Disorientation
Slurred or incoherent speech
Gross observable incoordination
Emotionality out of proportion to circumstances
Memory deficits

## 2.2 Unreported Injury

Unlike physical injuries, concussion is difficult to identify and manage (Decq et al., 2016). Many players continue to play in the game while experiencing concussion-related symptoms (McLellan & McKinlay, 2011). Past research suggested that more than 50% of concussions are unreported. McCrea, Hammeke, Olsen, Leo, and Guskiewicz (2004) asked

1532 American football players to complete a questionnaire that assessed the number of concussion both before and during the football season. The survey also assessed athletes' concussion reporting behaviour. The results suggested that only 47.3% of the athletes who experienced concussive symptoms reported their injury. Of the unreported injuries, 66.4% of the athletes did not think it was serious enough. 41% did not want to leave the game. 36% did not know it was a concussion and 22.1% did not want to let down teammates. Similar results were found in Delaney et al.'s study that examined concussion reporting behaviour amongst university football or soccer players. Delaney's found that more than 60% of the football and soccer players had experienced concussion symptoms but only approximately 23% recognize they had suffered a concussion (Delaney, Lacroix, Leclerc, & Johnston, 2002). Amongst youth athletes, a 2014 survey reported that 25% of young athletes had never received education about concussions. Similarly, Register-Mihalik et al. (2013) used a cross-sectional design to examine concussion reporting behaviour among high school athletes between 2008 and 2010, and found that almost 83% of the 167 high school participants failed to report potential concussive events.

It is clear that despite the frequency with which concussion occurs in sports, symptoms of concussion are often not recognized by many players and players are often not provided information about symptoms or management. Due to such a lack of identification and understanding about proper concussion management, ongoing issues exacerbated by poor management will continue to be a problem.

### **2.3. Reasons for Underreporting Concussion**

The complex nature of concussion is often why such injury often goes undiagnosed and underreported (McAllister-Deitrick, Covassin, & Gould, 2014). But there are also other reasons why concussion may be underreported. For example, McCrea et al. (2004) found



that 66.4% of athletes surveyed did not think the injury was severe enough to require medical attention, 41% reported being concerned about being withheld from further competition, and 36.1% of athletes lacked awareness of the symptoms of probable concussion. Another study suggested that many participants failed to recognize confusion, nausea, and sleep disturbances as concussion-related symptoms (McAllister-Deitrick et al., 2014). 22.6% of participants from this study agreed that it was okay to return to play with concussive symptoms as long as they did not lose consciousness at any point. Only 37.5% disagreed completely with this statement. These studies demonstrated that misconception can lead to athletes returning to the field with concussive symptoms. However, some other studies suggested that there is a difference between knowing the proper management and actually executing this. For example, a 2015 study reported discrepancies between written knowledge in a questionnaire and misconceptions revealed in face-to-face interviews (Williams, Langdon, McMillan, & Buckley, 2015). O'Connell and Molloy (2016) found a mismatched situation between concussion knowledge and concussion management behaviour and reported that while some players have high knowledge (up to 90.8% of participants reported to be familiar with the return to play guideline), 70% reported that they will continue to play even if they were concussed. It is possible this discrepancy can be explained by attitude and personality and could suggest an alternative route to why concussion injuries are frequently underreported.

Concussion is not a highly visible injury. Unlike physical injuries, there are no bruises or blood, or other visual signs that dictate conventional injury. It is difficult for the audience and players themselves to accept concussion as an injury that should be taken as seriously as a broken limb (Bloom, Horton, McCrory, & Johnston, 2004; Brewer, Van Raalte, & Linder, 1991). Further, symptoms of concussion may be misattributed to other causes (for example, headache could also be attributed to the result of dehydration). Many symptoms of

concussion are also not able to be observed by others which allows athletes to conceal problems. To summarise, the reasons for the underreporting injury rate are primarily because a) players do not recognise symptoms of concussion; b) players conceal symptoms to avoid negative consequences such as being removed from a sporting event; and c) lack of understanding about appropriate management of concussion.

### **2.3 Negative Impact of Concussion**

There are risks of both biological and psychological impairments in an event of concussion (Broshek, De Marco, & Freeman, 2015; Fazio et al., 2007). Some of the consequences of concussion may not emerge until days after the initial injury. Concussion can disrupt a number of areas of cognitive functioning such as attention, working memory, processing speed and planning (Belanger, Spiegel, & Vanderploeg, 2010; Belanger & Vanderploeg, 2005; Fazio et al., 2007; Langlois et al., 2006). For example, professional players with a history of concussion were found to be five times more likely to experience mild cognitive symptoms (Belanger et al., 2010; Guskiewicz et al., 2005), and some post-concussive symptoms even overlap with the symptoms of PTSD (Bloom et al., 2004; Vasterling & Dikmen, 2012). Repetitive concussion events may result in more severe symptoms in later life. Immediate treatment can prevent long term damages but has been largely neglected in professional leagues.

#### **2.3.1 Chronic traumatic encephalopathy (CTE)**

Chronic traumatic encephalopathy (CTE) is a neurodegenerative disease commonly believed to be caused, at least in parts, by concussive or sub-concussive trauma (Baugh et al., 2012; McKee et al., 2009; Terrell et al., 2014). CTE is believed to result in executive dysfunction, memory impairment, depression, apathy, poor self-control, and eventually cognitive degradation such as dementia (Baugh et al., 2012). CTE is not an acute disease but

rather a slow trajectory of neurocognitive degeneration. Usually the symptoms start off by deteriorations in attention, concentration and memory, as well as confusion accompanied by headaches and dizziness. As the condition progresses, symptoms such as poor judgements and overt dementia become noticeable (McKee et al., 2009). CTE is often associated as a long term consequences of single or repetitive head trauma (Jordan, 2015). Concussion has been identified as a risk factor for CTE. CTE was first recognised in boxers at the beginning of the last century (Kids & Summit, 2013), and have recently been identified post-mortem in professional athletes with a history of concussion (McKee et al., 2009; Saulle & Greenwald, 2012). One problem with CTE is that it can only be diagnosed post-mortem, which is why identifying possible biomarkers and risk factors are an important step to eliminating the possible damage of CTE. See table 3 for a list of common symptoms of CTE.

Table 3: Symptoms of CTE (Baugh et al., 2012).

<b>Domain</b>	<b>Symptoms</b>
Cognitive	Memory Impairment
	Executive dysfunction (problems with planning judgement, organization etc)
Mood	Depression
	Apathy
	Irritability
	Suicidality
Behaviour	Impulse control problems
	Disinhibition
	Substance abuse and other addiction
	Aggression and increased violence

McKee et al. (2009) provide an example of a CTE case, describing a 45 year old male died from a gunshot wound while he was cleaning his gun. He was a retired American football player who has played professionally for more than ten years as a linebacker. His wife reported he was concussed a total of 11 times during his football career but only one was medically documented. At age 40, his family noticed minor impairment in his short term

memory, attention, and other cognitive abilities. He became angrier and verbally aggressive over minor issues and was emotionally unstable. Towards the end of his life, these symptoms progressed gradually (McKee et al., 2009).

Of the 51 neuropathologically confirmed cases of CTE reviewed by McKee et al, 2009, 90% occurred in athletes including the case above. 85% were boxers and 11% were American football players. All the American football players had a neuropathologically verified CTE at autopsy and they all died suddenly in middle age (mean 44 years, four out of five died of tragic deaths including suicide and high speed chase). The most common symptoms were mood disorder, memory loss, paranoia, poor judgement and emotional instability. The clinical features of CTE are strongly displayed in these athletes who have had a history of repetitive concussion. Although other variables such as unemployment and drug abuse could cause similar features, post-mortem examination confirmed CTE in all 51 cases of these post-concussion athletes.

### **2.3.2 Concussion and Depression**

Concussion has been associated as a risk factor for chronic depression other neurodegenerative disease such as early onset of dementing disorders, Alzheimer's disease, and Parkinson's syndrome (Guskiewicz et al., 2007). This is not only restricted to professional sports players but also has a well reported prevalence among people who have suffered concussion in the past (Alhilali, Delic, Gumus, & Fakhraan, 2015; Jorge et al., 1993). An investigation of the possible causal link between concussion and mental illness found that depressed post-concussion sufferers had decreased functionality of the white matter surrounding an area near the deep gray matter of the brain, believed to be involved in the regulation of emotions (Alhilali et al., 2015). This study used a group of post-concussed participants without mental irritability as the control group and was therefore able to rule out

possible confounding variables such as age, career and medical history. With this new finding, even though concussion does not necessarily cause depression, there is strong evidence for it as a risk factor. Depression is the most reported psychological disturbance after a concussion with prevalence of 6% (Rutherford, Merrett, & McDonali, 1977) in mild cases and 77% in more severe cases (Jorge et al., 1993; Rapoport, 2012). Devanand et al. (1996) suggested that chronic depressed mood increases cognitive impairment and dementia. Others have suggested that depression may just be the early manifestation of these disorders (Chen, Ganguli, Mulsant, & DeKosky, 1999).

### **2.3.3 Other Medical Impact of Concussion**

Research has suggested that experiencing a second concussion before recovering from the first one can result in serious cognitive problems such as thinking, attention, concentration and other brain functions (Guskiewicz et al., 2007). Although symptoms of concussion usually resolve in hours, days or weeks at most, sometimes the recovery time can extend to months. During the time of recovery, it is likely for the injured person to feel withdrawn, confused, tired and have blurry vision at times (U.S. National Library of Medicine, 2015). This is problematic because during the recovery time, the symptoms of concussion can dramatically affect the patients' everyday lives, and increase the risk of experiencing a second concussion.

## **2.4 Concussion in Rugby**

The management of sports concussion has improved since the implementation of the RTP guidelines (Davis, 2009). Prior to this, concussion was often seen as an inconvenience rather than an actual injury and media often focused on humour regarding symptoms surrounding the injury (Kolt, 2013). It is estimated that between 1.6 and 3.8 million sports-related concussions occur annually in the US (McKee et al., 2009).

Rugby sport has become a popular team collision sport played throughout the world at a variety of competition levels. This sport is highly collisional that involves numerous tackles. A tackle is a defence mechanism to bring the scoring player to the ground. Every team member is responsible for both offence and defence which means every player is faced with collisional tackles regardless whether they are scoring or defencing. Tackling is the most common cause of concussion in rugby league which is why the incidence of concussion in rugby league is high. One study found that 62% of concussed players have had a previous concussion and 30% of players sustained a concussion in the current playing season (D. King, Clark, & Gissane, 2012).

While some studies suggest that concussion is less common than other types of injury such as muscular strains and laceration (Gabbett, 2000, 2005) other studies point out that concussion is the most common injury in the rugby premiership (Bunworth, 2016). Indeed the incidents of concussion are increasing gradually in professional rugby union (Gardner, Iverson, Williams, Baker, & Stanwell, 2014). For example 12.5% of all injuries suffered in the English Rugby Premiership during the 2013 / 2014 season were concussion and this is a 59% increase from the previous season (Bunworth, 2016). Given the prevalence and health outcome, Baugh, Kroshus, Daneshvar, and Stern (2014) pointed out that concussion should be treated as a public health priority and that rugby/football clubs owe a duty of care to their players. The World Rugby Union has adopted a Pitch Side Concussion Assessment (PSCA) which has effectively prevented many players with concussion injury to return to the field. However, concussion symptoms can take hours to show up and therefore the ten minute window used by the PSCA can be entirely ineffective when diagnosing a concussion (McCrory et al., 2013) . Also currently, the PSCA recommended no establishment of a rest period when players are diagnosed with concussion (McCrory et al., 2013). Currently the sideline assessments for concussion injury in rugby sport are all trying to diagnose a complex

injury in an insufficient period of time. The World Rugby Union currently has no regulation about removing an injury cleared player from the field when they started to display symptoms after returning to play.

## **2.5 Current Measures of Concussion Injury**

There are multiple different tests to address concussion (Kerr, 2013). Some are shorter than others and they all have their own advantages and disadvantages. When an injury first occurs, it is important to assess the symptoms as quickly as possible (M McCrea et al., 2003) because delayed treatment can result in prolonged recovery and complications (Iverson et al., 2004). This is when a short test has an advantage. However, if the injury is more severe and symptoms continue to persist, other forms of tests such as computed tomography (CT) or magnetic resonance imaging (MRI) should be used to exclude dangerous complications (Pluta et al., 2011; U.S. National Library of Medicine, 2015).

The different ways to assess concussion ranges from simple posture tests to more complex yet more accurate neurocognitive screening tests. Some assessments are attainable at the edge of the field and those are called the sideline assessment. Others such as fMRI or CT scans can only be done in clinics or hospitals. Reviewing the current measures of concussion injury can identify the advantages and disadvantages of the available tools and helps with explaining what is lacking in concussion assessment.

### **2.5.1 Standardized Assessment of Concussion (SAC)**

As concussion injury can result in biological, neurological as well as psychological consequences, a multidimensional evaluation is needed to accurately assess the potential head injury of an athlete (Resch & Kutcher, 2015). One of the first sideline assessments of sports concussion was the standardized assessment of concussion (McCrea, 2001). The standardized assessment of concussion evaluates an injured athlete's immediate memory, concentration,

orientation and delated recall domains. The SAC has a high sensitivity and specificity when used to identify concussions in college athletes. The major limitation with the SAC is that its diagnostic accuracy is limited to the initial 48 hours post-injury therefore the SAC is only an effective assessment immediately after an injury rather than assessing post-concussive symptoms or evaluating injured athletes' wellbeing post injury (M. McCrea, 2001).

### **2.5.2 The King-Devick (KD) Test**

The KD test is a quick sideline assessment used to detect concussion even without any observable symptoms. The KD test uses methods such as asking athletes to read out numbers from left to right, and utilises charts of number that are arranged in an order that is difficult to read. Past studies suggested that the KD test is a good assessment for identifying potential concussion injury because it requires eye movement, language function and attention (D. King, Hume, Gissane, & Clark, 2015). An example of this test can be seen in Galetta et al. (2011), where they compared athletes' pre-season KD score to post-season scores and found athletes who experienced concussions during the season have a significantly worsened post-season score. KD tests have reported high reliability of .97, and a high sensitivity of 90% in concussed collegiate athletes (Galetta et al., 2011; Resch & Kutcher, 2015). A limitation with this assessment is that to this date there has not been a study with a sufficiently large sample size to compare if concussed athletes score differently than those with other injuries (Resch & Kutcher, 2015). Further research is required to support its clinical utility.

### **2.5.3 Postural Assessment**

Postural stability is gradually becoming an important assessment for concussion (Guskiewicz, Ross, & Marshall, 2001). There are various tests such as the Sensory Organisation Test and the Balance Error Scoring System (BESS) that provide a mature approach to evaluate stability following a potential concussive injury (Resch & Kutcher,



2015). The BESS is an easily accessible and cost-effective assessment that only requires athletes to perform 3 different stances while having their eyes shut (Guskiewicz, Riemann, Perrin, & Nashner, 1997). The scores are measured by how many errors athletes have made while taking the stances. In terms of limitations, first the errors are recorded by an observer and some studies suggest the reliability of the BESS is largely compromised by the practice effects (Guskiewicz, 2001). Also there appears to be no standard administration of this kind of test so one has to reconsider the reliability of the scores given by the BESS (Guskiewicz, 2001).

There are other more accurate ways of measuring postural stability using computerized dynamic posturography such as the Sensory Organisation Test (Broglia, Macciocchi, & Ferrara, 2007; Guskiewicz et al., 1997). This kind of measure is reliable and valid as the urography provides a sophisticated measure that takes into account the somatosensory, visual and vestibular inputs. This is a very useful assessment designed to measure neurological impairment such as Multiple Sclerosis, Parkinson's disease (Rehabilitation Measures Database, 2014), minor bodily discomfort such as stomach-ache are very unlikely affect scores to the extent it becomes a significant score (Di Fabio, 1995). The problem with this assessment is that it is not widely accessible and is expensive to use, there also appeared to be a practice effect associated with repetitive administration (Broglia et al., 2007; Wrisley et al., 2007).

## **2.5.4 Appropriate Interventions and Management**

### ***2.5.4.1 Intervention Programs in New Zealand***

In New Zealand, the Accident Compensation Corporation (ACC) allows people to make acute claims for concussion injury and this has been proven to be an effective system to encourage people's concussion reporting rate at the community level. The ACC also

developed a sideline assessment tool that is widely accessible and easy to use. The sideline assessment they developed is a pouch with five insert cards called the Sideline Concussion Check (SCC) and has recently been incorporated into the Sports Concussion Assessment Tool (Gianotti & Hume, 2007). Unlike the clinical assessments such as the KD test or the posturography assessment, the SCC is a more versatile tool that can be administered by both clinicians and community coaches, who are unlikely to be medical professionals. The SCC provides advice for the first 48 hours post-concussion including seeking medical treatments (Gianotti & Hume, 2007). The SCC provides advice to coaches/parents/players on how to manage concussion symptoms until medical assistance is available.

The ACC also covers concussion service that provides various services such as education assessment, neuropsychological screening and several medical consultations. To use this service, patients must be referred by medical practitioners or case owners and the patient must have signs and symptoms of mild to moderate concussion (2015).

#### ***2.5.4.2 Management of Concussion***

There are no universal guidelines on how to manage a concussion and typically, concussion injuries are treated on a case by case basis. The general guideline is that any athletes who manifest symptoms of concussion should not continue to play. Concussed athletes should avoid loud environments, excessive cognitive tasks (such as reading, texting) and any stimulus that hinders cognitive rest like video games (McLeod & Gioia, 2010; Verle & Logan, 2012). Traditionally, long periods of bed rest was recommended after a concussion (De Kruijk, Leffers, & Twijnstra, 2001; N. S. King, Crawford, Wenden, Moss, & Wade, 1997), however, recently some studies have demonstrated that the traditional advice of taking six days or more of complete bed rest had no beneficial effect on post concussive symptoms (De Kruijk, Leffers, Meerhoff, Rutten, & Twijnstra, 2002). Some studies have found that

excessive bed rest can be harmful (Allen, Glasziou, & Mar, 1999). It is generally suggested that injured athletes should take cognitive rest and refrain from vigorous physical activities that could potentially cause another injury or increase concussion symptoms. Any efficacy for bed rest should not be easily assumed and requires further assessment. Future research is still needed to provide more sophisticated evidence for the benefits and harm that arises with bed rest. Also future study should look at how much cognitive rest is needed before reintroducing cognitive activities to injured athletes (Moser, Glatts, & Schatz, 2012; Verle & Logan, 2012).

## **2.6 Current Problems in Concussion**

Some current problems arising in the management of concussion injuries are reviewed in this section. These problems pose a risk to the effective management of concussion injuries. The lack of understanding of concussion allowed incorrect portrayal of concussion to be made and incorrect information being disseminated. . In this section, the inconsistency in these guidelines will be discussed. This section will also examine what is lacking in the field of effective management, including correct knowledge and education about concussion that should be more widely available.

### **2.6.1 Inconsistent Guidelines**

Throughout the years, there have been many different guidelines that suggest when an athlete should return to play after concussion, e.g. the American academy neurology (AAN) guidelines, the Cantu guidelines. Some guidelines stress the importance of loss of consciousness, others suggest using post-traumatic amnesia as an indicator of severity, while others suggest that symptoms are also important (Peloso et al., 2004). The initial guidelines that were set at the 1<sup>st</sup> international symposium in Vienna detailed a systematic approach to concussion injury which consisted of neuropsychological testing, imaging procedures,

management, rehabilitation, prevention as well as legal considerations (McCrory et al., 2005). The guidelines specifically stated that brief neuropsychological testing should be implemented to assess attention and memory function after concussion injury. However, later evaluations suggested that the importance of such assessment was still underestimated and not properly implemented following concussion injury (Fazio et al., 2007; McCrory et al., 2005). To this date, at least 14 return-to-play (RTP) scales have been published since 1973 but none have been shown to be effective for all people sustaining concussive injuries (Collins, Lovell, & Mckeag, 1999).

The guidelines usually take into consideration the severity of the concussion. For example, under the Cantu (1986) system, a player with an initial Grade II concussion can only return to play within 2 weeks if they are asymptomatic at rest and on exertion in the previous 7 days. According to RTP criteria, athletes should not re-enter the game until they are completely symptom free. Schatz and Moser explained that this is because concussion may extend up to 7-10 days before the brain returns to preinjury level. A second concussive injury while the brain is still in the metabolic cascade can have catastrophic effects (Guskiewicz et al., 2007).

Under different guidelines, the length of time that players have to rest before they can return to play is different (Echemendia, Giza, & Kutcher, 2015), which means the standard protocol following concussion becomes ambiguous. For example, under the Colorado Guidelines, player who suffered a Grade I concussion may return to competition as long as they are asymptomatic after 15 minutes of the injury occurring, even though there are no data supporting the 15 minutes gap for return to play. Under the Cantu guidelines, player who suffered a Grade I injury may return to play that day if asymptomatic in select situations. There is no scientific foundation on what “select situations” should refer to, and whether the player needs to take time off from the competition at all. Often professional sports leagues

use different terminology to describe the head injury and thus do not always follow the guidelines for concussion management (McKinlay et al., 2011). The inconsistent definitions may contribute to difficulties with identifying cases of concussion. Research has also found that a large number of high school athletes are failing to comply with the RTP protocols (Yard & Comstock, 2009). To date, there also has not been a post-concussion guideline that is designed for children (Makdissi, Davis, & McCrory, 2014; Schatz & Moser, 2011).

There is no standard intervention for concussion injuries. Players may return to play with minimal treatment and as long as they did not display any physical symptoms such as disorientation or fainting, casual observers cannot really tell if the injured players have recovered or not (Bloom et al., 2004).

### **2.6.2 Lack of Knowledge and Education**

A 2004 survey by M. McCrea et al. (2004) reported 50% of high school football players in the USA failed to report their sport concussions as a result of limited awareness and not perceiving concussion as a serious injury. Another study also reported that 25% of surveyed high school athletes reported never receiving education about concussion (Cournoyer & Tripp, 2014). A 2002 study found that 25-50% of athletes failed to name any symptoms of concussion or could only name one (Delaney et al., 2002).

Kaut et al. found similar results, reporting that 56% of all athletes studied had no knowledge of potential outcomes after a head injury (Kaut, DePompei, Kerr, & Congeni, 2003). Their results also demonstrated that 25.2% of players who were actually diagnosed with a concussion failed to inform dizziness, one of the most common symptoms of concussion, to their trainers while playing (Kaut et al., 2003). Moreover, (O'Connell & Molloy, 2016) investigated the relationship between player knowledge and attitude towards concussion and found that although 90.8% of players knew that they should not continue to

play when concussed, 75% said they would still continue to play with a concussion if it was an important game, and 78.2% stated that it was easy to influence a medical decision regarding concussion. What this study demonstrates is that even when people have the correct knowledge regarding concussion management, it does not necessarily mean that they will act accordingly.

In 2012, legislation that mandates education about concussion for young athletes was passed in the USA however; a 2014 study reported that 40% of surveyed high school athletes in north-central Florida reported receiving no formal concussion education. Although compared to past studies, the 2014 study found that more players were now able to identify major symptoms such as headache and dizziness but nearly half failed to recognise behavioural symptoms such as nausea and vomiting (Cournoyer & Tripp, 2014). These studies suggest that many athletes did not have appropriate knowledge regarding the signs, symptoms and consequences of concussions. Many experts believe that having more knowledge about concussion would help both the trainers and athletes to accurately identify potential concussive events and appropriately manage them (Buzzini & Guskiewicz, 2006; Cournoyer & Tripp, 2014; Kaut et al., 2003). Actions should be taken to better educate both athletes and viewers so concussions will not be overlooked.

The general public also needs greater education about the risks and appropriate management of concussion. In a systematic review, Gardner et al. (2015) found that overall concussion knowledge was as low as 42% (meaning the participants only answered 42% of the concussion related questions correctly on average). They also identified that misconceptions about this injury were common even among people involved in contact sports. D. King, Hume, and Clark (2010b) reported that less than 34% of players who were injured would seek medical advice after the injury before returning to play. They also found in another study that 55% of club coaches who have had a player with a concussion never

sought medical clearance before returning player to play (D. King, Hume, & Clark, 2010a). People need to understand that brain injury is not always an insignificant “knock to the head”, but an injury that triggers biomechanical forces on the brain tissue. While many organizations have started to recognise the severity and the frequent occurrence of concussion, there remain many problems associated with sports-related concussions such as lack of knowledge, low injury reporting rate, and lack of standardized sideline injury management.

### **2.6.3 Conflicts of Interest**

In professional sports league such as the Rugby Union or the National Football League (NFL), it is impossible to eliminate all possible mechanism of injury because the contact part of the sport is basically the “product” that is traded in these sports leagues. A team physician is required by their professional ethics to exercise judgement in the best interest of injured players. However, given that the players’ income, popularity, and other trade of products (e.g. advocating for sports product companies) is largely dependent on the players’ performance, the physicians’ judgement will have obligations to coaches and owners who are in the business of winning games and making money. Team doctors may feel obliged to return players to the field on the same day, which means whether a guideline was implemented or not because the team doctor could not perform a diagnosis of concussion in the first place to prevent the player from being forced to remain at sideline.

## **2.7 Media Portrayal of Concussion**

How potential concussions are portrayed in the media may also have an impact on the public’s perception of concussion. McLellan and McKinlay (2011) reported that 30.8% of NRL games in the 2010/2011 season showed a player visibly experience a probable concussion: One concussion per every 2.6 games, on average. However, when examining how the return to play (RTP) criteria was executed, only 65% of players left the game due to

probable concussion. This means that more than 30% of players continued to play without receiving proper treatment. Amongst the 65% of players who left the game, 60% returned to play within the same game.

Although concussion injury has a few visible symptoms such as loss of consciousness and vomiting, two of the three major indicators (amnesia and headache) are not visibly observable to casual viewers (Hinton-Bayre et al., 2004). Thus audiences often have to rely on whether the injured player was attended by trainer or paramedics to know if there was a concussion injury. If proper concussion management was not implemented after a player had a mechanism of injury, the audience may be more likely to think that a near-certain injury event (such as head-high tackle or head contact to the ground) did not cause a concussion; moreover, it is possible that the audience will fail to identify a concussion injury in real life because they did not see any physical symptoms. Some concussions – for example those with multiple symptoms – are easier to identify than others. Having inappropriate concussion management shown on TV may affect the public's ability to identify a concussion. For example, if a player continues to play after suffering a concussion, audiences are likely to think whatever symptoms the player displayed were actually not associated with concussion.

Statements made by a television commentary team can also affect the public's perception. For example, commentators may portray the idea that playing with an injury is a heroic act, or that concussion is not a serious injury, and even in some cases make humorous references to players when they display symptoms such as disorientation or imbalance. The sometimes harsh media commentary that occurs after injury increases the stress for athletes to return to their preinjury status and force themselves to play through the injury that is invisible to most people (Bloom et al., 2004). Media commentary may affect young players' perceptions of concussion and encourage them to view continued play after suffering a concussion as a heroic act, and requesting to leave the field as a compromise to their



masculinity. It is important to consider whether media has a role in perceptions of concussion.

### **2.7.1 Agenda-Setting Theory**

Agenda-setting theory describes the ability of news media to impact public's attention for topics on the public agenda (2010). Lippmann argued that mass media is the principal catalyst in connecting real world events with how we (i.e., viewers of mass media) imagine these events. Currently, people gain information about the world via newspaper, radio, television and the internet. In this sense, the agenda setting theory is saying that media has the power to "set the agenda". According to this theory, the media has the power to decide what information is important under certain contexts. For example, if the media pays a large amount of attention on physical injuries such as a broken tibia, the information becomes more important than a concussion event.

Another example of how this theory might be related to how media's portrayal of concussion affects public's awareness of it is through over-exploiting the importance of masculinity. Sports media tends to promote the hegemonic masculine status, and that sacrificing one's body for the team is a glorious act (Anderson & Kian, 2012; Sanderson, Weathers, Grevious, Tehan, & Warren, 2014). Contact sports such as football or rugby are closely tied to a narrow version of masculinity (Sanderson et al., 2014). The mass media portrays a hegemonic system that tends to promote self-sacrifice following an injury. Masculinity establishing discourse encourage men to use their bodies as expendable weapons in the pursuit for team pride. Media glorifies the tremendous injuries endured throughout the game. These moments of exalted masculinity are glorified by fans and reproduced through sport media. Sports journals have featured less male athletes in the sport that does not meet the orthodox masculinity such as gymnastics or ice skating, and the large majority of sports

journalists, reporters, and columnists are men (Nylund, 2004). The agenda set on TV contributes to the dissemination of the incorrect perception of masculinity, thus could increase the chance of people underreport injury or hiding injury. It is possible that this action affects the younger generation emerging through their local systems of masculine stratification, encouraging them to continue playing despite possibly having suffered a concussion during a game.

### **2.7.2 Hegemonic Masculinity on Television**

Men's team sports, especially contact sports, have long played an important role in shaping the conventional forms of heterosexual masculinity in Western cultures (Hargreaves, 1994; Messner, 1992). Although relatively little has been written on rugby sport from this perspective, past researchers have often reviewed upon the violence masculine standard in American football as a prime example of hegemonic masculinity. The players for both American football and Rugby are usually young, muscular and willing to play in a competitive and violent game, and such participation is often regarded as character building. In fact, studies have suggested that many young viewers of the rugby and American football view professional players as role models (Fleming, Hardman, Jones, & Sheridan, 2005; Messner, 1992).

Media portrayals of professional contact sports players tend to emphasize similar qualities of athletes, that they are tough, bold, and powerful (Anderson & Kian, 2012). Athletes who endured tremendous physical pain on the field yet continued to play through the injuries are granted titles such as "top 10 gutsiest performances", and are publicized across various sources of mass media. Media coverage has long contributed in framing the view of heroic athletes who overcome pain and returned to play (Messner, 2002). The

masculinization of the sport depicted in media tends to reinforce incorrect perceptions and attitudes towards injuries.

The media has the power to construct, deconstruct and reconstruct a sports star (Fleming et al., 2005). The image and behaviour that public see on television or newspaper is not necessarily accurate. The invisible filter of media selects the things that are reported and portrayed and this shapes our view on what the conventional characteristics are what the acceptable way to behave on the field is.

## **2.8 Personality and Concussion Managing Behaviour**

One source of individual differences in terms of identification of concussions and behaviour following a concussive event may be personality factors. In 1952, Hans Eysenck suggested that personality can be divided into three main dimensions; extraversion, neuroticism and psychoticism (H. J. Eysenck, 1952). Extraversion is characterized by enthusiasm, assertion and optimism (Smillie, DeYoung, & Hall, 2015). Psychoticism is characterized as impulsive, non-conforming, and unempathetic (H. J. Eysenck, 1992). Neuroticism is characterised by anxiety, worry and fear (Thompson, 2008). Although these three traits are included in most personality models such as the Big Five model, Raymond Cattell's 16 personality factors (Fleeson & Gallagher, 2009; Primi, Ferreira-Rodrigues, & De Francisco Carvalho, 2014), the proposed study will use Eysenck's three-factor model. This is because these three traits are the most relevant to media selection and use according to recent research (Hall, 2005; Weaver, 1991; Weaver, Brosius, & Mundorf, 1993). In addition, the three personality dimensions in Eysenck's system can be efficiently assessed using the Eysenck Personality Questionnaire-Revised (EPQ-R) (Costa & MacCrae, 1992; S. Eysenck et al., 1985). (Weaver, 1991) Personality traits play an important role on all aspects of media selection, use, and consequences (Hall, 2005). For example, individuals that are high in neuroticism often prefer contents that helps them manage anxiety whereas those with high

psychoticism traits prefer deviant rebellious themes. Extraverts prefer viewing media with greater sensory arousal (Kraaykamp & Eijck, 2005). Extraverts also enjoy more outdoor activities therefore their interest in sports and susceptibility to how sports are portrayed in the media may be greater. Extraverts also prefer socially conventional contents and enduring injuries is seen as a social convention (Weaver, 2003) within all men's sports fields (Adams, Anderson, & McCormack, 2010). Past studies also emphasized the importance of Psychoticism in media selection, which makes the EPQ-R more relevant and practical for the current study (Weaver, 1991).

According to Sims (1985), personal problems including social relations, stressors, psychological conditions and substance abuse are associated with brain injuries, or incidents that possibly will cause them. For example, hyperactivity or developmental problems are highly associated with personality and injury. The current study aims to see how personality factors influence people's perception on injuries, thus examine how individual differences moderates the way people respond to media persuasion, for example, if extraverted people who are believed to be more risk seeking (O'Jile, Ryan, Parks-Levy, Betz, & Gouvier, 2004) pay less attention to the occurrence of concussion on field. It would be interesting to see if people with personality traits that are associated with higher injury proneness respond differently to people with low injury proneness personality traits.

### **2.8.1 Extraversion and sensation seeking**

Extraversion is usually measured based on the level of friendliness, assertiveness, provocativeness, talkativeness and sociability (Hofstee, de Raad, & Goldberg, 1992). Extraversion has been implicated in various risky health behaviour such as smoking (Arai, Hosokawa, Fukao, Izumi, & Hisamichi, 1997; Pritchard & Kay, 1993), drinking and drug use, (M. Cook, Young, Taylor, & Bedford, 1998; Kjørheim, Mykletun, & Haldorsen, 1996;

Sigurdsson & Gudjonsson, 1996), and unsafe sexual behaviour (Fontaine, 1994; McCown, 1991). Most studies are in support that higher levels of extraversion are associated with lower levels of risk perception with some studies yielding negative results (Canals, Bladé, & Domènech, 1997; Cookson, 1994; Stein, Newcomb, & Bentler, 1987). Extraversion is linked to approach-related traits (e.g., novelty-seeking, impulsivity) and greater sensitivity to rewarding stimuli. It is possible that people with higher levels of extraversion would continue to play with a concussion injury even when they know that they are concussed but prefer the immediate reward of game play over long term reward (health).

Previous studies show that sensation seeking is related with extraversion. Sensation seeking has also been associated with various risky behaviours including drug abuse and dangerous driving. Interestingly, these behaviour can also be attributed to individuals who are extraverted and impulsive (Aluja, García, & García, 2003; H. J. Eysenck, 1990). Extraverted people are also more injury prone (O'Jile et al., 2004). Research has found that people with higher extraversion level are more likely to preform risky behaviour that may subsequently lead to injury. In the current study, we predict that people with higher levels of extraversion will have a negative correlation with ability to identify concussion, and is more likely to be influenced by the educational material due to lower risk perception. They will rely more on whether or not a player was removed from playing to identify possible concussion rather than looking for actual mechanism of injury.

### **2.8.2 Psychoticism and Violence**

Of the three dimensions in Eysenck's system, psychoticism has displayed the strongest association with media selection. Psychoticism has been associated with impulsiveness, venturesomeness, callousness and weak behaviour (Hare, 1982). In a study designed to measure the links between personality traits and media selection, high psychoticism

respondents (characterized as impulsive, nonconforming, and unempathic individuals) displayed a particularly strong preference for graphically violent horror movies while appearing essentially uninterested in less deviant media content such as comedy and romance offerings (Perse, 1996; Weaver, 1991). People higher on psychoticism scores who are exposed to violent media are more prone to resolve in violence as means of resolution compared to other personality traits (Zillmann & Weaver, 1997). It would be interesting to see if people who score high on psychoticism enjoys watching sports games with more violence, and underestimates the cost of the injuries endured by players. It is unclear whether people with greater levels of psychoticism trait are more susceptible to the passive learning fed by media. However, according to cultivation theory, contents on the TV generate a biased reality (Nabi & Riddle, 2008). As the content changes overtime, so do people's attitudes. Suppose if people who are high on psychoticism are more prone to enjoy the violence in sports game, then it is logical to assume these contents misleads them on concussion knowledge more than people who scores lower on psychoticism.

### **2.8.3 Intervention and Educational Materials**

Past research has indicated that the use of educational intervention improves reporting of concussion and symptom recognition. Given that the lack of knowledge regarding concussion is one of the main reasons why people failed to report potential injuries, many researchers have examined whether educational information will help increase public's knowledge about concussion and therefore increase the awareness of injury reporting. To this date, there has not been a standardized educational program for concussion; however there some videos have been produced that have been proven to be effective as an educational tool (Hunt, 2015). Hunt et al found that the use of standardized concussion educational video helped high school athletes to more correctly identify signs and symptoms of concussion, and also encouraged their reporting of concussion. Other studies have found similar results

(Bramley, Patrick, Lehman, & Silvis, 2012; Goodman, Bradley, Paras, Williamson, & Bizzochi, 2006; Guilmette, Malia, & McQuiggan, 2007). Bramley et al. (2012) found that high school soccer players who had received education about concussion were more likely to report a concussion compared to those without such education (Bramley et al., 2012). Guilmette et al. (2007) suggested that up to 60% of coaches found that additional information regarding concussion is very helpful for them to accurately identify and report any potential concussion injuries.

## **2.9 Current Study**

The current study investigated how media's portrayal of concussion influences the attitudes towards concussion and also ability to identify a concussive event. Participants viewed a series of video clips in rugby league matches in which concussive events may have occurred. They then responded whether or not they believed a concussion had occurred. We also examined the effect of educational materials intended to increase public's awareness and knowledge towards concussion injury, by comparing responses of participants who had been provided with information regarding the return to play (RTP) guidelines with those who had not.

The aims of this study were threefold. Firstly, we planned to examine whether the RTP information will make a difference in participants' responses towards whether or not they think an athlete has experienced a potential concussion. We predict that the viewers of the videos that get prior information regarding the RTP guidelines will be less likely to think that a player has a concussion if the player returns to play.

Secondly, the research will examine the impact of televised concussion that occur in rugby games, to see if the information spread through news media may influence the public's

perception of concussion, and to have better understanding of the level of knowledge general public has towards concussion injury.

A third aim of this study was to examine the role of personality factors in observers' responses to the video clips. For example, people high on extraversion are also more risk seeking and therefore more likely to disregard possible risks of concussion or to downplay the likelihood that a concussion had occurred. Neurotic people who are more aware of risks and health threat can hold a different attitude towards concussion injury compared to extraverted people. The current study aims to examine how the different responses towards media persuasion on concussion injury can be reflected in personality traits. Overall, the current study will look at both the general correlation between personality and concussion attitude plus any moderation effect of personality.

### **2.9.1 Hypotheses:**

**Hypothesis 1** Media representations have a major influence on public's perception about whether a concussion has occurred.

A) The group who are provided information about the return to play guidelines will be less likely to think that a concussion has occurred if they are told that a player returned to play.

B) We hypothesise that all participants will be influenced by information about whether a player returned to play, did not return to play or did not leave the field following an injury to the head.

**Hypothesis 2:** Knowledge and attitude will influence the understanding of concussion and its management. Greater knowledge and more risk-averse attitude should be associated with an increased likelihood to identify a concussion.



**Hypothesis 3:** Males and females will score differently on knowledge and attitude scales. Females will be more knowledgeable and more cautious about concussions than males. Females will be more easily influenced by media persuasion and report more events of concussion.

**Hypothesis 4:** Individuals who scored highly on psychoticism and extraversion are affected more by the media persuasion than low respondents. Extraversion will be negatively correlated, and Neuroticism will be positively correlated, with likelihood to judge that a concussion has occurred.

### 3 Method

#### 3.1 Participants:

Participants were recruited from New Zealand, Australia and the United Kingdom aged 18+ ( $n = 828$ ), via the survey website Qualtrics. Relatively equal numbers of males and females from different age groups and locations were recruited. Participants were offered incentives of \$10NZD paid on completion of the survey.

#### 3.2 Measures:

*Demographics and randomised control.* Participants were asked a series of questions that assessed age, gender and experience with rugby (Questions 1-10 of Appendix 1). Participants were randomly assigned to either one of two conditions by the randomising function on Qualtrics. In condition one, participants were provided a written information regarding the return to play rules of “If a player is diagnosed with concussion they are not allowed to continue to play or return to play in the same game” whereas condition two did not receive this information.

*Attitudes and knowledge.* Questions regarding the participants’ understanding of concussive symptoms and its management were used to assess knowledge level (Question 11-25 of Appendix 1). Questions regarding attitudes towards concussive symptoms were also asked (Questions 27-34 of Appendix 1). These questions were taken from an unpublished pilot study by McLellan and McKinlay (2015). Attitudes and knowledge towards concussion were assessed again (Questions 110-126 and Questions 127-134 of Appendix 1). The concussion knowledge scale consisted true or false questions regarding symptoms of concussion, mechanisms of concussion and effects of concussion. E.g. “A concussion can only occur if there is a direct hit to the head”. There were 15 questions in each sets of the knowledge questions scored by true (1) or false (2) responses with higher score indicating

greater knowledge. The maximum possible score to achieve was 30 (all correct) and the minimum score was 15 (all incorrect). Items 2, 5, 13, and 15 were reverse scored.

The Attitude scale gave scenarios of what individuals would behave in events of concussion and participants will score on a Likert scale on whether or not they agree with how the scenario was dealt with. Many of the questions used rugby related scenarios e.g. “Athlete H is the best player on the team. I feel that Athlete H should tell the coach about the symptoms”. The scales consist of 8 questions in each set scored on a 1-5 Likert scale with 5 being the highest score. Items 1, 2, 4 and 5 were reverse scored. The maximum possible score to achieve was thus 40 and the minimum was 8. The wording for the second set of questions was slightly different from the ones before the concussion videos (e.g. players’ names were different).

*Concussion Reporting Behaviour:* 12 video clips that displayed players experiencing possible concussions during different professional rugby games were shown. The videos were between 10 and 20 seconds in length. All the videos showed a player experiencing a mechanism of concussion but not necessarily knocks to the head, e.g. in some of the videos the players tackled to the ground but did not experience a direct hit to the head. Symptoms of concussion were also present in the videos. Following each of the videos, participants were asked to indicate whether or not they player in the video experienced a concussion (Questions 36-108 of Appendix 1. Question 109 was a used as an instruction for the next sets of questions on attitude and knowledge).

After making a decision regarding whether the player in the video had experienced a concussion, participants were provided additional information. The additional information given were one of the following conditions: Remove, Stay, Return. There were 6 videos in the Remove condition, 3 videos in the Stay condition and 3 videos in the Return condition. The 12 videos were randomly assigned across the three conditions, but the assignments were

the same for each participant. We recorded the overall percentage of video clips for which each participant judged a concussion to have occurred.

In the Removed condition, the participants were informed that the player in the video was removed from the game. In the Stayed condition, participants were informed that the player remained in the game. In the Returned condition, participants were informed that player was helped off the field but later in the same game returned to play. After the extra information was provided, the participants were asked “Now do you think this player experienced a concussion” if the participant had answered No initially and “Do you still think this player experienced a concussion” if the participant had answered Yes initially. The probabilities of switching to a different response, given the initial response (i.e., from yes to no, or from no to yes) was used as the primary measure of concussion reporting behaviour. This measure is related to media because the feedback on the condition resembles the management of concussion displayed through media. By using this measure, this study can examine whether the behaviour displayed on media affects individuals’ responses to concussion.

*Concussion change Score:* The % of change score was the conditional probability that participants would switch responses, given that they had responded yes or no previously. A score is generated only when the participant has switched responses according to the conditions. The % of change takes into consideration of participants’ initial responses prior to the feedback on conditions (Remove, Stay and Return), and the conditions preceded the videos were assigned to. Therefore, one % of change score is generated for each of the video questions and the % of change is summed for each of the conditions categorized into % of change from yes, and from no. At the end, each participant should have a maximum of six different % of change score (one for yes, one for no, times three conditions, can have a blank score if they never had an initial response of a yes or a no in one condition).

*Eysenck Personality Questionnaire-Revised (EPQ-R)*: The EPQ-R (S. Eysenck et al., 1985) contains 48 yes or no items that measures the three primary personality subscales of Psychoticism, Extraversion and Neuroticism each containing 12 items. The fourth subscale is the lie scale which measures the level of social desirability. Each item was scored 1(yes) or 0 (no) and each scale has the maximum possible score of 12 and a minimum score of 0. Personality scores were summed up for each of the personality traits with higher scores indicating stronger trait. Items were scored based on the scoring key from the original EPQ-R questionnaire (S. Eysenck et al., 1985). EPQ-R has good internal consistency ( $\alpha = .80$ ) (Heath, Cloninger, & Martin, 1994) except for Psychoticism ( $\alpha = .40$ ) and good test-retest reliability. See Questions 135-183 of attached questionnaire in Appendix 1 for the items.

### **3.3 Procedure**

Participants ( $n = 828$  aged 18+ years) were randomly assigned to one of two groups (RTP, No RTP;  $n = 414$  in each group). Each participant filled in the questionnaire that collected demographic details of age and gender and their experience with rugby. Following the demographic questions, participants answered the questions on knowledge and attitude towards concussion.

Following the initial questions assessing concussion, concussion knowledge and attitude towards concussion, Group RTP was provided educational information of the return to play guidelines, then both groups were shown 12 video clips from rugby games in which mechanisms of concussion and symptoms of concussion occurred for a player and asked whether they thought a concussion had happened. After a choice had been made, participants were provided extra information regarding whether or not the player was removed from play and asked again whether or not they believed a concussion had taken place. The order of the videos was randomized across participants.

Following the video presentations, participants in both groups answered additional questions on their knowledge and attitudes towards concussion and its management as part of the concussion questionnaire. At the end of the concussion questionnaire, all participants completed the EPQ-R.

### **3.4 Data Analysis**

Mixed-model analyses were used to assess the % of change (changing answers based on extra information given) as the dependent variable. Groups, conditions, gender and location were used as fixed factors. Attitude, knowledge and age were used as covariates and the model examined the main effects of these covariates. Several models were built and the best-fitting model (including covariance structure) was selected using Schwarz's Bayesian Information Criterion (BIC) score. The model with the lowest BIC score was selected as the best-fitting model and covariance structure.

Pearson's correlations were used to examine possible relations between attitude towards concussion, knowledge about concussion, demographic factors and the probability of concussion reporting. A median split was performed on each EPQ-R dimension to make them into categorical variables. The scores were then used as a fixed factor to examine any causal effect personality has on the % of change.

### **3.5 Compliance with Ethical Standards:**

All procedures and materials were approved by the University of Canterbury Human Ethics Committee (HEC-2013/25) and were in accord with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all participants included in the study.

### **3.6 Funding**

This study was funded by a New Zealand Lottery Health Research grant (#353091) to Randolph C. Grace and Audrey McKinlay.

## 4 Results

### 4.1 Sampling Information

This study involved 828 participants of which 57.6% ( $n = 477$ ) were male and 42.4% ( $n = 351$ ) were female. Table 1 lists demographic variables for the sample according to country and age.

Table 1: Demographic information for the sample.

	Male( $N=477$ )	Female( $N=351$ )
Location		
New Zealand	6.7% ( $n=32$ )	6.5% ( $n=23$ )
UK	59% ( $n=282$ )	57% ( $n=201$ )
Australia	34% ( $n=163$ )	26.6% ( $n=127$ )
Age		
18-20	55% ( $n=5$ )	44% ( $n=4$ )
21-29	51% ( $n=17$ )	48% ( $n=16$ )
30-39	45% ( $n=45$ )	54% ( $n=54$ )
40-49	50% ( $n=81$ )	49% ( $n=80$ )
50+	62% ( $n=329$ )	37% ( $n=197$ )
Concussion History		
Yes	35% ( $n=167$ )	18% ( $n=65$ )
No	64% ( $n=310$ )	81% ( $n=286$ )
Concussion knowledge scale	25.11(SD = 1.96)	24.99(SD = 1.96)
Concussion attitude scale	32.32(SD = 3.93)	32.71(SD = 3.49)
Experience with Rugby		
Never Played	62% ( $n=292$ )	96% ( $n=338$ )
Played one season	10% ( $n=49$ )	1.4% ( $n=5$ )
Played more than one season but no longer play	25% ( $n=123$ )	0.5% ( $n=2$ )
Currently playing social games	2% ( $n=13$ )	1.4% ( $n=5$ )
Currently playing competitive games	0	0.2% ( $n=1$ )

\*Percentages were done by column percentages

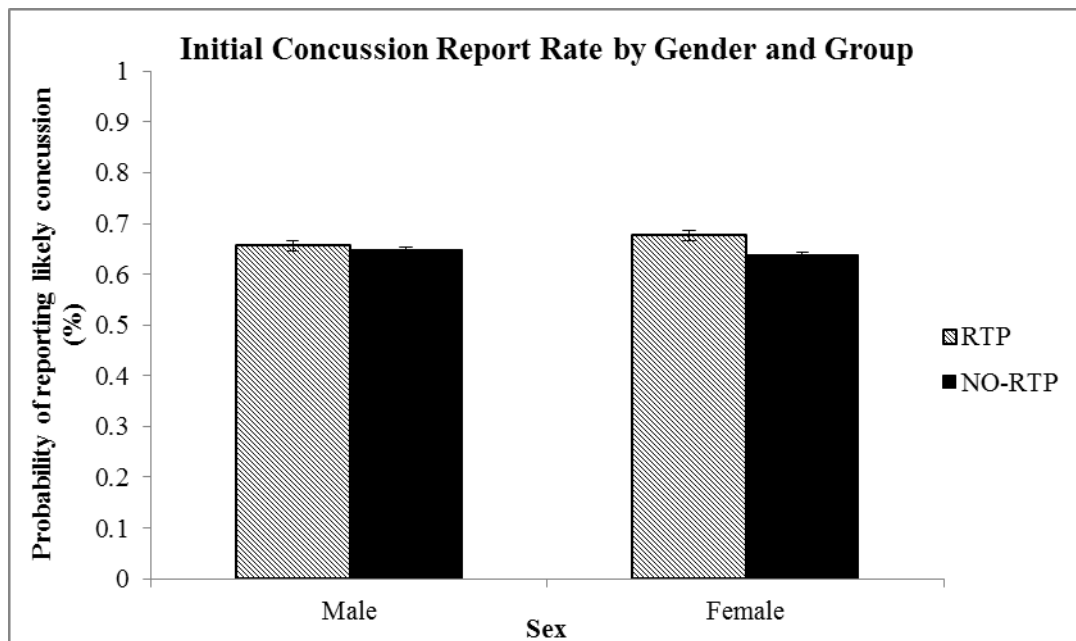


Of the sample, 28% (232 / 828) reported a history of one or more concussions and males (35%,  $n = 167$ ) were significantly more likely to report a concussion than females (18%,  $n = 65$ ) [ $\chi(1) = 27.27, p < .01$ ]. Males were also more likely to have played rugby (22%, 185/828) than females (1.5%, 13/828), [ $\chi(4) = 145.08, p < .01$ ]. Males were more likely to be older than females [ $\chi(4) = 15.27, p < .01$ . 62.5%] of the total participants who were over 50 years of age were males.

#### 4.2 Rugby Video Clips

The average probability of reporting a likely concussion, pooled over videos and participants, was 65.6% (SD = .21 ) and ranged from 0% (minimum) to 100% (maximum). The average was similar between males (65.2%, SD = .22) and females (65.81%, SD = .22). The probability of participants reporting a “yes” was assessed using a factorial ANOVA. Fixed factors included group (RTP and No-RTP), gender, concussion history, and experience with rugby. None of the factors were related to the probability of reporting a concussion. The ANOVA found no significant main effect for both groups and gender [ $F(1, 827) = 2.18, p > .1, F(1, 827) = 0.15, p > .6$ , respectively] and no interaction of groups and gender [ $F(1, 827) = 1.02, p > .3$ ]. Concussion history and experience were not significant factors that influenced the average probability of reporting a likely concussion [ $F(1, 827) = .756, p > .3, F(1, 827) = .008, p > .9$  respectively]. There were no significant main effects or interactions in this ANOVA. Figure 1 displays the result for this analysis.

Figure 1: Average probability of reporting a likely concussion.



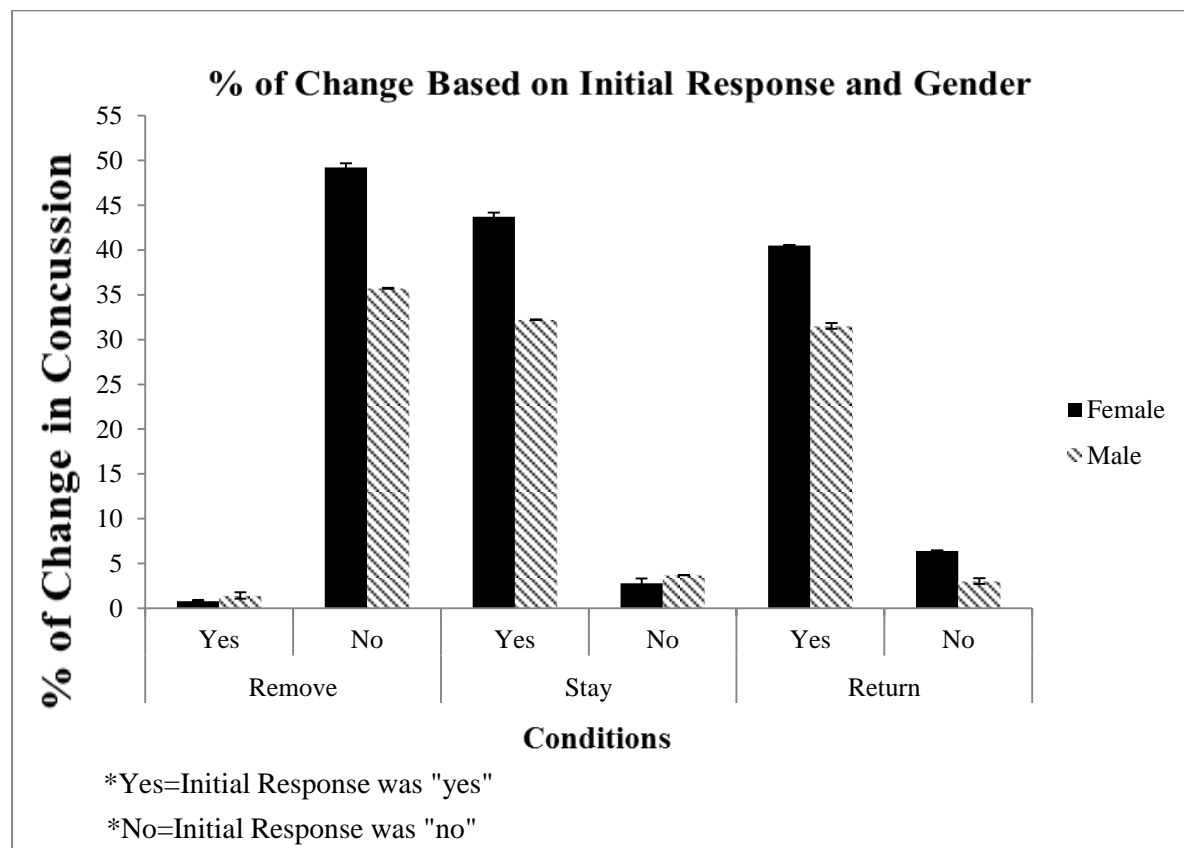
The primary goal of the present study was to assess the probability that participants would change their evaluation of a likely concussion based on the feedback provided in the conditions (remove, stay, return). Figure 1 shows the average probability that participants would change their concussion evaluation after feedback, separately by both condition and their initial evaluation. Overall, participants changed their evaluations in accord with feedback: They were more likely to change and report “no” if they had responded ‘yes’ initially in the Return and Stay conditions, and more likely to change and report “yes” if they responded ‘no’ in the Remove condition. Also, females were overall more likely to change their evaluations than males.

These observations were confirmed by a mixed-model analysis using a best-fitting covariance model (First-order Antedependence). For this analysis, group, condition (remove, stay, return) and gender were included as fixed factors. The % of change score was the dependent variable. The effect of group (RTP or No RTP) was not significant, and the interactions involving group were also not significant, so the analysis was re-run omitting the

group factor. There was a significant effect of gender [ $F(1,827) = 27.71, p < .01$ ] with females ( $M = 23.8\%$ ) reporting a higher % of change than males ( $M = 18\%$ ). The change score differed significantly across the conditions. Remove condition had an average change score of 23%, stay condition 21.9%, and return condition 21.7% [ $F(1,827) = 580.87, p < .01$ ]. There was a significant interaction between condition (remove, stay, return) and initial response (yes vs. no concussion). Participants were more likely to switch from no to yes ( $M = 42.5\%$ ) than from yes to no ( $M = 1.1\%$ ) in the Remove condition. Participants were more likely to switch from yes to no ( $M = 37.9\%$ ) than from no to yes ( $M = 3.2\%$ ) in Stay condition. Participants were more likely to switch from yes to no ( $M = 36\%$ ) than from no to yes ( $M = 4.7\%$ ) in the Return Condition.

There was a significant three-way interaction between gender, initial response (yes/no concussion) and conditions, [ $F(1,827) = 14.771, p < .01$ ]. Females were more likely to switch to “yes” ( $M = 49.2\%$ ) in the Remove condition if they had answered “No” initially than males ( $M = 35.7\%$ ). Females were more likely to switch to “No” in the Stay condition ( $M = 43.7\%$ ) and Remove condition ( $M = 40.5\%$ ) if they had answered “yes” initially than males ( $M = 32.2, 31.5$ , respectively), suggesting females are more malleable in their responses. Furthermore, males were less likely to change and report a concussion (average of 18%) in all three conditions (players removed, stayed, returned) than females (average of 23%). The remove condition generated higher % of change scores than the other two groups.

Figure 2: Change Probability by Condition and Initial Response.



### 4.3 Concussion Knowledge and Attitude Scales

Because the knowledge and attitude scales had not been used in previously published research, we conducted a preliminary reliability analysis. For the concussion knowledge scale, Cronbach's alpha was .39, and for the concussion attitude scale, Cronbach's alpha was .67. The maximum knowledge score obtained from this sample was 30 and the minimum score was 18. The maximum attitude score obtained from this sample was 38 and the minimum was 18. Thus the attitude scale demonstrated marginally-acceptable levels of internal consistency reliability. The lower alpha for the knowledge scale was expected because of the binary item scoring.

In order to examine the role knowledge and attitude played in identifying concussion, and whether there are any gender differences between knowledge and attitude,

the scores taken from the knowledge and attitude scales were analysed to examine the factors that could potentially influence knowledge and attitude levels.

Knowledge scores and attitude scores taken before and after watching the videos were compared. The average knowledge score before watching the videos was  $M = 25.06$  ( $SD = 1.96$ ), and the average attitude score was  $M = 32.49$  ( $SD = 3.75$ ).

There was a positive correlation between knowledge level and average probability of reporting a likely concussion ( $r = .112$ ,  $p < .01$ ), and a positive correlation between attitude level and average probability of reporting a likely concussion ( $r = .094$ ,  $p < .01$ ), showing that as both knowledge level and cautiousness (measured by attitude) increased, the likelihood of reporting a concussion increased. However, the magnitude of these correlations was relatively small.

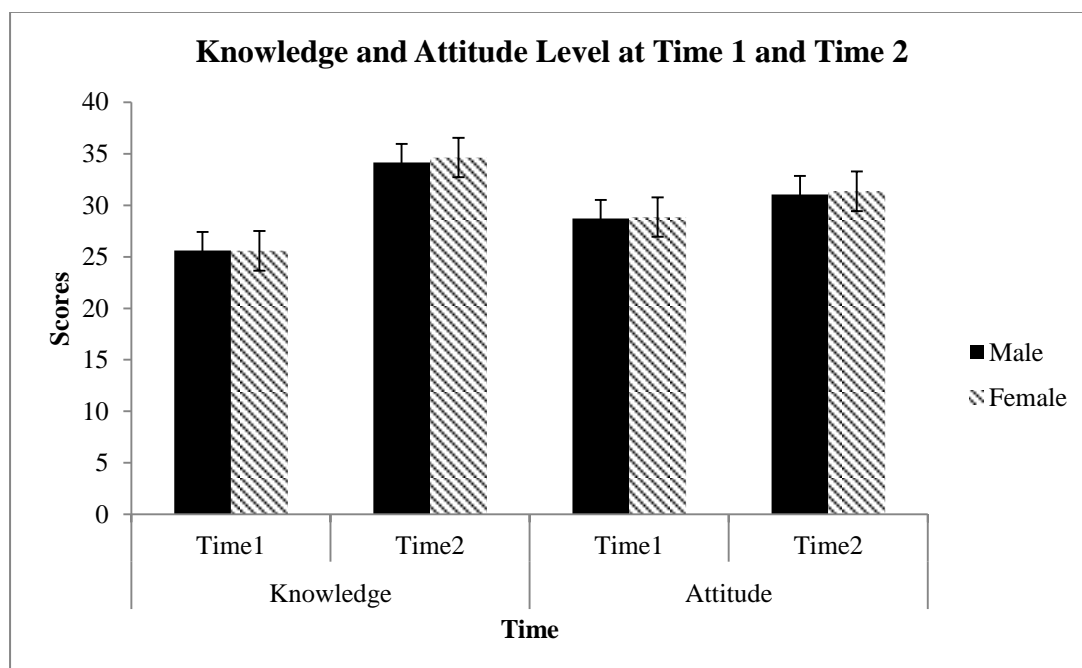
A repeated measure ANOVA was performed to examine any differences between knowledge and attitude levels before and after the watching the videos. Group factor was omitted because it had no main effect or interaction effect on knowledge.

The ANOVA included gender as the between subject factor and time 1(before videos) vs. time 2 (after videos) as the within subject factor and found a main effect between knowledge levels before (estimated  $M = 25.56$ ) and after (estimated  $M = 34.38$ ) the videos [ $F(1,826) = 5221.8$ ,  $p < .001$ ]. There was no main effect of gender. Knowledge level increased significantly after watching the videos. There was a significant interaction between gender and the knowledge levels before and after watching the videos. Females reported higher levels of knowledge ( $EM = 34.62$ ) after watching the videos than males ( $EM = 25.57$ ) [ $F(1,826) = 4.6$ ,  $p < .05$ ]. Post-hoc (Fisher LSD) confirmed these differences were significant.

For attitude, there was a main effect in attitude between time 1 ( $M = 28.78$ ) and time 2 ( $M = 31.19$ ) [ $F(1,824) = 1169.4, p < .001$ ]. Average attitude scores increased, indicating that participants reported being more careful after watching the videos. There was no main effect of gender and no interaction between gender and time was found ( $p > 0.1$ ), suggesting males and females did not respond differently across time on the attitude scales.

Correlations were used to examine the associations between age and knowledge and between age and attitude. The correlation of  $r = -.098, p < .005$  between age and knowledge showed that older participants displayed lower knowledge towards concussion than younger participants. The correlation of  $r = .15, p < .001$  between age and attitude showed that older participants were more cautious than younger participants.

Figure 3: Concussion knowledge and attitude scale by gender and time.



#### 4.4 EPQ-R

A secondary goal of our study was to examine how personality (as assessed by the EPQ-R) would be related to knowledge and attitudes about concussion. Cronbach's alpha (Cronbach, 1951) was calculated for the four traits as follows: Extraversion: .72; Psychoticism: .39; Neuroticism: .86 and Lie Scale: .74.

Psychoticism has a significant negative relationship with knowledge and attitude. Extraversion has a significant negative relationship with knowledge only. Table 5 displays the correlations between attitude, knowledge and the personality traits.

Table 5: Correlation between attitude, knowledge and the personality traits.

	Knowledge1	Attitude1	Knowledge2	Attitude2	Average concussion score
Psychoticism	-.092**	-.228**	-.188**	-.257**	-.087*
Extraversion	-.134**	-.014	-.129**	-.007	.028
Neuroticism	.005	-.012	-.005	-.014	.003
Lie Scale	-.181**	-.31	-.161**	-.028	.028
Average concussion score	.112**	.094**	.067	.068*	1

\*\*Correlation is significant at the .01 level (2-tailed).

\*Correlation is significant at the .05 level (2-tailed)

(Higher attitude indicate higher recklessness. Higher knowledge indicates increased knowledge regarding concussion).

The results showed that participants with higher psychoticism scores were less knowledgeable and less cautious about concussion. A correlation analysis also found a significant negative correlation ( $r = -.087$ ,  $p < .05$ ) between average possibility of identifying a likely concussion prior to feedback on conditions and Psychoticism. No other personality traits were correlated with the average possibility of identifying a likely concussion.

Table 5 also showed that extraversion has a significant positive relationship with concussion knowledge but extraversion was not a significant covariate for % of change in concussion response.

Neuroticism was not significantly correlated with knowledge or attitude. Lie scale (social desirability) is positively correlated with knowledge and has no significant correlation with attitude. Lie scale was also not a significant covariate for % of change in concussion response. Experience with rugby had no main effect with condition, knowledge and attitude. ( $p > .6$ ).



## **5 Discussion**

### **5.1 Purpose and Hypotheses**

Continuation of physical activity after experiencing symptoms of concussion can worsen the injury resulting in consequences from prolonged recovery to death (Cournoyer & Tripp, 2014). The goals of the present study were to determine whether how potential concussion events are portrayed in televised sporting matches may influence how people react to such injuries and whether providing educational materials will influence people's ability to identify possible concussive injuries. There is increasing evidence that media is one source for the confusion about concussion (Hux, Schram, & Goeken, 2006). Professional rugby players often do not leave the field after a concussion and this behaviour is often displayed on media and could influence how individuals react to concussion. Further, what constitutes a concussive event is often inaccurately portrayed via televised media (McLellan & McKinlay, 2011). This study sought to evaluate the potential influence of media on perceptions of concussion. The information individuals possess has a significant influence on their behaviour (Wallston, Maides, & Wallston, 1976) and therefore if the general public are given incorrect messages through media, this could influence their health seeking behaviour. This study evaluated the influence of personality traits on perceptions of concussion as personality traits of neuroticism, psychoticism, and extraversion may be correlated with correct identification and management of concussion. By understanding this, individual differences in concussion management behaviour can be further investigated.

Media representations influence viewers. This study predicted that participants would be more likely to indicate that a player had suffered a concussion if they were informed that the player had been removed from play than if they were informed that the player had stayed in the game or returned to play. The study also evaluated whether providing information regarding the return-to-play guideline would influence participants' judgments, and predicted

that if the player had returned to play, participants from this group would be less likely to report the injury as a concussion.

Another aspect of this study was to look at how knowledge and attitudes is related to concussion reporting behaviour and whether certain personality traits are associated with attitudes towards concussion, and concussion reporting behaviour. We predicted that knowledge and attitude towards concussion would be significantly related to the probability that participants would indicate a likely concussion in the video clips, specifically that individuals who were more knowledgeable and more risk-averse about concussions would be more likely to identify potential concussions in the video clips.

## **5.2 Media Influence**

The information provided to participants following viewing a video of a concussive incident had a significant effect on whether they believed a concussion had taken place, particularly when they were the player was removed from play. The results showed that the information given out after an injury had a significant effect on concussion reporting behaviour. The main effect between the three conditions indicated that people most often report concussions when they know the player has been removed from the field. Often times it is difficult for audience to clearly see an injury both on screen or live. Their judgement on how severely a player was injured depends largely on the behaviour they see after the injury. The current study used the information to replicate a similar situation and how the participants were influenced by this information. This is why the current study used the % of change as the dependent variable instead of the actual responses. In this way, we could examine how the extra information provided in the different conditions would change participants' responses to the video clips. Furthermore, the results showed that females reported higher % of change than males. What this finding suggests is that females are more easily influenced by the media information. This finding is consistent with past research that

established females are more easily influenced than males, and are more susceptible to social norms (Eagly, 1983; Morelock, 1980). In health behaviour settings, females are more likely to define problems in medical terms and seek medical intervention. Risk avoidance is more common among females (Nathanson, 1977), possibly because biologically speaking, females are the dominant carer for children and therefore play a more significant role in risk prevention (Nathanson, 1977). These differences between genders could be possible explanations on why males and females differ significantly on their response towards concussion.

### **5.3 RTP Guideline**

Providing participants with information on return to play guideline given prior to viewing the videos did not generate the predicted effect. A possible reason for this is that participants already knew about the concussion protocols – that is, that players who were removed from a game would be more likely to have been diagnosed with a concussion, whereas those who stayed or returned would have been presumably cleared. RTP guidelines did not generate any significant main effect or interactions with average probability of reporting a likely concussion nor with the % of switch. A possible explanation for this is that concussion knowledge is quite global. Most people have a general understanding of concussion therefore having the RTP guideline is only reiterating knowledge individuals already possess. This is consistent with O’Connell & Molloy’s (2016) study on knowledge towards concussion (O’Connell & Molloy, 2016). They found that 90.8% of rugby players knew about the RTP guideline. Given that both groups were given the same extra information on remove, stay return, we suspect that most people know it as common sense that when a player is removed, they have a higher chance of being concussively injured therefore the provision of the RTP information did not affect participants’ responses.

However, having the knowledge does not equal to utilising it. For example, most people know smoking is bad but smokers continue to smoke anyway. This can be problematic. Even though players know that they should not play, they do. What this suggests is that increasing educational material may not necessary lead to better concussion report rate.

#### **5.4 Knowledge and Attitude**

Past studies usually demonstrate that concussion knowledge is generally quite low. In fact, Gardner et al.'s study, the overall concussion knowledge was low at 42%. The maximum score obtained from this study was 100% (30/30) but the lowest score was 60%. This showed that there is clearly a discrepancy between peoples' knowledge level (in the current sample, between 100% and 60%) but in general quite consistent with the low knowledge level found in past studies. We found a significant difference in knowledge about concussions increased from before to after watching the videos. It is unclear what caused the increase in knowledge level. The only information provided by the questionnaire was the RTP guideline which did not have any significant effect. The discrepancy between the knowledge levels cannot be explained by the RTP group manipulation. One possible explanation is the gender difference. Females reported higher knowledge at Time 2 and also displayed higher malleability in the rugby video % of change. It is possible that the conditions of Remove, Stay and Return challenged participants to think twice before answering the second sets of knowledge questions, resulting in greater knowledge scores at Time 2 and this is especially obvious in the female participants.

The results confirmed that knowledge plays a role in concussion injury report and concussion management attitude. This study confirmed that higher concussion knowledge is associated with higher levels of cautiousness (measured by the concussion attitude scales). Participants with higher knowledge of concussion were more likely to predict that a concussion had occurred in the videos, but the relationship was overall weak. This is

consistent with our predictions and past research on the role knowledge plays in concussion management. Most of these prior studies have shown that better concussion knowledge helps with better concussion interventions such as examining injury, and injury report (P. Cook & Bellis, 2001; Cournoyer & Tripp, 2014; Hunt, 2015; Wilkes & Donnelly).

Level of cautiousness (attitude) was not significantly related to the probability of identifying a concussion, but was positively correlated with knowledge. We suspect that attitude may not have been a significant covariate in this study because the questions were more oriented to people who are actually rugby players instead of general public. The finding is not consistent with past studies such as M. McCrea et al. (2004)'s study on high school athletes which showed that players would not report concussion injuries for various reasons including not wanting to be discharged from competition. Their attitude towards concussions affected the reporting rate. The reason that the current study did not find a similar association could be because the feeling of being removed from competition would obviously be stronger for those involved in the sport than general public who do not have much experience with rugby. Fear of being exempt from play could change athletes' attitude towards concussion. Therefore given that only 2% of the sample was currently playing rugby, the attitude towards concussion was unlikely to have a real effect on concussion report rate because the majority of participants were not rugby players and the scenarios asked in the attitude scale only used situations that occur in the rugby sport. This study did not find any significant effect between experience with rugby and attitude scores. This is possibly because only 23% of the whole sample had personal experience with playing rugby, and only 2% were currently involved in rugby. We suspect that this is why the attitude questionnaire could not capture the big picture on concussion attitude and therefore attitude itself did not turn out to be a significant covariate, but was associated with knowledge.

Interestingly, there was no gender difference in terms of attitude scores. This contradicts past research suggesting males are more risk taking than females (Byrnes, Miller, & Schafer, 1999; Freeman, Rodriguez, & French, 1994; Turner & McClure, 2003). Again this finding suggest the importance of engaging a scale that measures general risk taking behaviour and see if risk taking scale serve as a better assessment than scenarios geared solely towards concussion, and concussion rugby games.

Because the present study has shown that potential lack of knowledge of the RTP guideline does not influence observers' judgments of likely concussions, the next question is how we can get public to make use of the knowledge they already possess. Health related information needs to consider something other than the RTP guidelines and focus more on altering attitude towards concussion in order for individuals' to execute existing knowledge.

### **Age**

In current study, age was a significant covariate for concussion report rate. Younger participants were more likely to report concussions in the video clips. However, in the Cournoyer and Tripp (2014) study, they reported older athletes had better knowledge about concussion. Kurowski, Pomerantz, Schaiper, and Gittelman (2014) also found that older age demonstrated better concussion knowledge. However, both of these studies used athletes as participants whereas this study used a general population. A possible explanation for this contradiction between current study and past study is that athletes who have been playing for longer have a better knowledge, which is why Kurowski et al. (2004) found older athletes have higher knowledge. A longitudinal study found that weekly physical activity decrease significantly by age 27 (Van Mechelen, Twisk, Post, Snel, & Kemper, 2000). This trend could be a possible explanation for why the current sample displayed higher knowledge for younger participants. Among the general public (current study sample), younger participants

are more likely to be active in sports (not necessarily rugby) and thus have better knowledge than the older participants. Currently there are no past studies that used age as a between subject factor for concussion knowledge and response rate. Age is usually evaluated as a covariate. Further research in this area is needed to understand the potential effect that age has on media persuasion and concussion knowledge.

## **5.5 Personality Traits**

### **5.5.1 Psychoticism**

There is a moderate correlation between Psychoticism-Knowledge and Psychoticism-Attitude. Psychoticism is negatively correlated with knowledge and attitude towards concussion. The results showed that participants with higher psychoticism scores were less knowledgeable about concussion and also were less cautious (measured by concussion attitude). The results also found that higher scorers of psychoticism reported less concussion than low scorers prior to receiving any feedbacks on conditions and this is consistent with psychoticism being associated with higher risk taking. Individuals scoring high on psychoticism are often described as more emotionally indifferent with lower empathy, guilt and remorse (Heym & Lawrence, 2010). People high on psychoticism scores have also been shown to be more prone to violent information (Zillmann & Weaver, 1997). This can explain why they might neglect the information on health and safety (information regarding concussion, for example) and thus score lower on the concussion knowledge scale.

The lower cautiousness results are consistent with the general consensus of individuals high on psychoticism being characterized as relatively more aloof and with higher risk-taking behaviour. It would be interesting to see if we still find the same results if we use a measure of general cautiousness instead of cautiousness towards concussion. According to past literature, psychotic people are more reckless. Some literatures suggested a link between

sensation seeking and psychoticism, which can be a result of trying to feel something due to their emotional coldness (Glicksohn, Naftuliev, & Golan-Smooha, 2007).

The overall findings from this study and from past literature are contradictory. It is possible that the Psychoticism scale itself is not a very reliable measure. The Cronbach's alpha (Cronbach, 1951) for this scale in this sample was only .39, suggesting low reliability and the item correlation might not be measuring the same construct. The low Cronbach's alpha seem to be problematic in several studies on personality (e.g., Ortet, Ibáñez, Moro, Silva, and Boyle (1999); Tiwari, Singh, and Singh (2009)). In general, studies presented more skewed Psychoticism score and it usually has the lowest internal reliability of the EPQ-R subscales (Boyle, 1991). Thus, results with the psychoticism scale should be interpreted cautiously.

## **5.6 Limitations and Future Research**

One limitation of the design in the current study was that the 12 videos were unable to be randomised in terms of their assignments to the conditions (Remove, Stay, Return). It is possible that some concussions are more obvious in some videos than others, and thus the conditions varied in terms of the initial probability of judging that a concussion had occurred. However, the analyses that we reported in terms of the probability of changing the response after receiving the additional information allowed us to examine the effects of that information (i.e., removed, returned, and stayed conditions) independently of the initial probability of a concussion response.

Personality correlations were quite small, although significant. Psychoticism has a small Cronbach's Alpha of .39, suggesting this subscale does not have a good internal-consistency using current sample. Practically, this means the items of the scale could be measuring something that is not psychoticism. Although psychoticism was a significant factor in



concussion managing behaviour in this study, cautions should be made when drawing any conclusion. An impulsivity scale was not included which potentially could have measured for aspects that the EPQ-R have missed.

The concussion knowledge and attitude questionnaires had not been previously validated, and were used for the first time. Further tests on validity and reliability should be performed for future use. For example, it would be interesting to know if the knowledge and attitude scales were correlated with general measures of risk taking and sensation seeking (Glicksohn et al., 2007; Pickering, 1999).

Although this study found an increase in knowledge post videos, the RTP and No-RTP groups were not significantly different, suggesting that the provision of RTP information did not affect participants' responses. If higher knowledge generates higher % of change in concussion behaviour, then the reminder of RTP guideline should have an effect. Miyashita, Timpson, Frye, and Gloeckner (2013)'s study that after educational intervention, athletes demonstrated an improvement in knowledge on concussions but the educational material from this study did not prove to have an effect. People who have had concussions should be more familiar with concussion but this study did not find any significant difference in knowledge people between participants who have had a concussion and those who had not. This contradictory finding limits the validity of the knowledge questionnaire. It is unknown whether or not the RTP guidelines were a globally known knowledge or not and whether this is why the group manipulation had not generated any effect.

There are other variable that might be interesting to consider in the future. For example, impulsivity could have a possible effect of concussion change %. We suspect there is a possible association between impulsivity and concussion reporting behaviour. Impulsivity is related to novelty seeking and extraversion. Some studies demonstrated that impulsivity

comprised three factors, corresponding to three broad personality factors: Neuroticism, extraversion, and disinhibition vs. constraint/conscientiousness (which correlates with psychoticism in Eysenck's system). Therefore it is possible that the small significant correlation between personality traits and knowledge could possibly be an ultimate effect of impulsivity. Future study can look at using an impulsivity scale such as the Barratt Impulsiveness Scale and provide a better understanding between impulsivity and various aspects regarding concussion intervention.

Another variable to consider could be the risk taking behaviour. One type of risks behaviour could possibly be generalised to other types of risks behaviour therefore, there is a possibility that individuals who take more risks would behave differently in event of concussion than those who take fewer risks. Risk behaviour is likely to be associated with personality scales and impulsivity. By adding these elements in, a better picture can be captured.

## **5.7 Practical use**

By looking at the influence of media representations of potential concussions in sporting matches, the current study provides some potentially useful information about how media portrayals influence the general public's perception of head injuries in sports. Our results confirmed that these media portrayals had a substantial effect on participants' judgements about likely concussions. Our results might inform the development of policies for how sporting matches should be portrayed in the media. Moreover, results suggested that greater knowledge about concussion increased the chance that individuals would identify likely concussions. The evidence found can be used to support the need for further education. Also, the literature review for this study identified some gaps in the research literature, and what future research should focus on (e.g. how commonly known is RTP guideline? How would sports athletes respond compared to general public? What role does impulsivity play in the

whole context?). These research topics should prompt new educational materials on proper management and detection.

This study has identified that the information of how the player is treated post-concussion has an effect on how likely people will identify their injury. Although sports matches are seen as a source of entertainment, the study suggest that the general public need to be careful when withdrawing information from them because some of the information displayed on media could be inaccurate.

Furthermore, future study could include a risk perception scale. Studies have shown that impulsivity and low risk perception are significant risk factors for risky behaviour (Ryb, Dischinger, Kufera, & Read, 2006). Extraversion is often associated with risky behaviours (Finn, Sharkansky, Brandt, & Turcotte, 2000) (Though risky behaviour are usually categorized by drug use, speeding, unprotected sex, it is unclear if neglecting injury or information regarding an injury can be considered risky on the same level). Instead of EPQR, including sensation seeking scale could better capture individual differences in concussion reporting behaviour

Actual knowledge of actual risk levels was related to risk behaviour. Attitude towards risky behaviour can extend to external sources of risk which means people who view one risky behaviour as low risk also view other types of risky behaviour as less risky (Millstein & Halpern-Felsher, 2001). Risk perception can very well be a potential factor that influences concussion management behaviour. Instead of using scales that look at attitude towards concussion, it could be more accurate to use a scale that measures general attitude towards risky behaviour and apply that to concussion management. The results will be more generalizable and possibly dig deeper into people's attitude towards risks and give more insights.

Communicating risk is a key public health strategy (P. Cook & Bellis, 2001). But what happens when people filter through the knowledge that they do not wish to be informed? Would a player who wants to continue the game keep playing even if he knew he should not? Past study have shown that there is a mismatch between knowledge and concussion reporting rate, higher knowledge does not necessary prompt treatment seeking behaviour cite study again (McAllister-Deitrick et al., 2014; Register-Mihalik et al., 2013). Certain regulations that enforce guideline is necessary if public do not react to the knowledge proactively. Communicating health knowledge does not translate into health gain unless imparting risk information results in a reduction in risk behaviour.

Another demographic to include for next time is job profession. For example, sports coaches should possess better sense and judgements as they are responsible in shaping the team's attitude.

## 6 Conclusion

The main goal of this study was to evaluate the influence of incorrect information on the ability of general public to identify a concussive event. A more accurate understanding of public misperceptions will provide an opportunity to target information campaigns and enhance appropriate treatment-seeking behaviour among those who are injured.

The current study confirmed that the information provided on through media have an influence on how people respond to concussion management. The study concluded that with the player removed from field, people are more likely to confirm that the player has experienced a concussive injury than when the player stayed or returned to play. In real life, this can be problematic as past literatures often suggested that when a player suffered a concussion, they are not always removed from play. When this scenario is portrayed through media, it is hard to pin down to what extend would this information affect peoples' actual behaviour when they themselves are put in similar situation. However, it is hard to say how often people generalize the information they see on TV to real life situation. Although past literatures have suggested that to a certain extend people are influenced by media, we don't know if the lack of concussion management is affected at all by media, or if this is something related to knowledge, attitude, personality or other individual factors. The study concluded that the information portrayed on TV serve as one risk factor that could possibly affect the way people react to concussion, but future research is still needed on how to more precisely manage such injury or how to make resources related to concussion management more accessible. It seemed like providing educational materials did not make a difference in concussion response rate. This study concluded that this is because concussion knowledge is quite commonly known yet somehow this information is prohibited when the injury occurred. Future research should focus on how to interfere with the defence mechanism that inhibits the correct behaviour in players who experience concussion, and also confirm that general public

possess concussion knowledge to a certain standard. It would be interesting to see if people's reaction to actual cases of concussion is consistent with their response to the concussion change rate in this study.

## References

- Acc. (2015). ACC Concussion Service Operational Guidelines (Vol. 2016).
- Adams, A., Anderson, E., & McCormack, M. (2010). Establishing and Challenging Masculinity: The Influence of Gendered Discourses in Organized Sport. *Journal of Language and Social Psychology*, 29(3), 278-300. doi: 10.1177/0261927X10368833
- Alhilali, L. M., Delic, J. A., Gumus, S., & Fakhran, S. (2015). Evaluation of White Matter Injury Patterns Underlying Neuropsychiatric Symptoms after Mild Traumatic Brain Injury. *RADIOLOGY*, 277(3), 793-800. doi: 10.1148/radiol.2015142974
- Allen, C., Glasziou, P., & Mar, C. D. (1999). Bed rest: a potentially harmful treatment needing more careful evaluation. *The Lancet*, 354(9186), 1229-1233. doi: [http://dx.doi.org/10.1016/S0140-6736\(98\)10063-6](http://dx.doi.org/10.1016/S0140-6736(98)10063-6)
- Aluja, A., García, Ó., & García, L. s. F. (2003). Relationships among extraversion, openness to experience, and sensation seeking. *Personality and Individual Differences*, 35(3), 671-680. doi: [http://dx.doi.org/10.1016/S0191-8869\(02\)00244-1](http://dx.doi.org/10.1016/S0191-8869(02)00244-1)
- Anderson, E., & Kian, E. M. (2012). Examining Media Contestation of Masculinity and Head Trauma in the National Football League. *Men and Masculinities*, 15(2), 152-173. doi: 10.1177/1097184X11430127
- Arai, Y., Hosokawa, T., Fukao, A., Izumi, Y., & Hisamichi, S. (1997). Smoking behaviour and personality: a population-based study in Japan. *ADDICTION*, 92(8), 1023-1033. doi: 10.1046/j.1360-0443.1997.928102312.x
- Aral, S., & Walker, D. (2012). Identifying influential and susceptible members of social networks. *Science*, 337(6092), 337-341.
- Baugh, C. M., Kroshus, E., Daneshvar, D. H., & Stern, R. A. (2014). Perceived Coach Support and Concussion Symptom-Reporting: Differences between Freshmen and Non-Freshmen College Football Players. *The Journal of Law, Medicine & Ethics*, 42(3), 314-322. doi: 10.1111/jlme.12148
- Baugh, C. M., Stamm, J. M., Riley, D. O., Gavett, B. E., Shenton, M. E., Lin, A., . . . Stern, R. A. (2012). Chronic traumatic encephalopathy: neurodegeneration following repetitive concussive and subconcussive brain trauma. *Brain Imaging and Behavior*, 6(2), 244-254. doi: 10.1007/s11682-012-9164-5
- Belanger, H. G., Spiegel, E., & Vanderploeg, R. D. (2010). Neuropsychological performance following a history of multiple self-reported concussions: A meta-analysis. *Journal of the International Neuropsychological Society*, 16(2), 262-267. doi: 10.1017/S1355617709991287
- Belanger, H. G., & Vanderploeg, R. D. (2005). The neuropsychological impact of sports-related concussion: A meta-analysis. *Journal of the International Neuropsychological Society*, 11(4), 345-357. doi: 10.1017/S1355617705050411
- Bloom, G. A., Horton, A. S., McCrory, P., & Johnston, K. M. (2004). Sport psychology and concussion: New impacts to explore. *British Journal of Sports Medicine*, 38(5), 519-521. doi: 10.1136/bjsm.2004.011999
- Boyle, G. J. (1991). Does item homogeneity indicate internal consistency or item redundancy in psychometric scales? *Personality and Individual Differences*, 12(3), 291-294. doi: 10.1016/0191-8869(91)90115-R
- Bramley, H., Patrick, K., Lehman, E., & Silvis, M. (2012). High School Soccer Players With Concussion Education Are More Likely to Notify Their Coach of a Suspected Concussion. *Clinical Pediatrics*, 51(4), 332-336. doi: 10.1177/0009922811425233
- Brewer, B. W., Van Raalte, J. L., & Linder, D. E. (1991). Role of the sport psychologist in treating injured athletes: A survey of sports medicine providers. *Journal of Applied Sport Psychology*, 3(2), 183-190. doi: 10.1080/10413209108406443

- Broglia, S. P., Macciocchi, S. N., & Ferrara, M. S. (2007). Sensitivity of the concussion assessment battery. *Neurosurgery*, 60(6), 1050-1057. doi: 10.1227/01.NEU.0000255479.90999.CO
- Broshek, D. K., De Marco, A. P., & Freeman, J. R. (2015). A review of post-concussion syndrome and psychological factors associated with concussion. *Brain Injury*, 29(2), 228-237. doi: 10.3109/02699052.2014.974674
- Bunworth, R. (2016). Egg-shell skulls or institutional negligence? The liability of World Rugby for incidents of concussion suffered by professional players in England and Ireland. *The International Sports Law Journal*, 16(1), 82-98. doi: 10.1007/s40318-016-0095-y
- Buzzini, S. R. R., & Guskiewicz, K. M. (2006). Sport-related concussion in the young athlete. *Current Opinion in Pediatrics*, 18(4), 376-382. doi: 10.1097/01.mop.0000236385.26284.ec
- Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis: American Psychological Association.
- Canals, J., Bladé, J., & Domènech, E. (1997). Smoking and personality predictors in young Spanish people. *Personality and Individual Differences*, 23(5), 905-908. doi: 10.1016/S0191-8869(97)00096-2
- Canty, G., & Nilan, L. (2015). Return to Play. *Pediatrics in review / American Academy of Pediatrics*, 36(10), 438-446. doi: 10.1542/pir.36-10-438
- Chen, P., Ganguli, M., Mulsant, B. H., & DeKosky, S. T. (1999). The Temporal Relationship Between Depressive Symptoms and Dementia: A Community-Based Prospective Study. *Archives of General Psychiatry*, 56(3), 261-266. doi: 10.1001/archpsyc.56.3.261
- Collins, M., Field, M., Lovell, M., Iverson, G., Johnston, K., Maroon, J., & Fu, F. (2003). Relationship Between Postconcussion Headache and Neuropsychological Test Performance in High School Athletes. *The American Journal of Sports Medicine*, 31(2), 168-173.
- Collins, M., Lovell, M., & Mckeag, D. (1999). Current issues in managing sports-related concussion. *Jama*, 282(24), 2283-2285.
- Cook, A., Hunt, W., McLaurin, R., Mosberg, W., Ogle, W., Walker, A., . . . Voris, H. (1996). Report of the Ad Hoc Committee to study head injury nomenclature: proceedings of the Congress of Neurological Surgeons in 1964. *Clin Neurosurg*, 12, 386-394.
- Cook, M., Young, A., Taylor, D., & Bedford, A. P. (1998). Personality correlates of alcohol consumption. *Personality and Individual Differences*, 24(5), 641-647. doi: 10.1016/S0191-8869(97)00214-6
- Cook, P., & Bellis, M. (2001). Knowing the risk: relationships between risk behaviour and health knowledge. *Public health*, 115(1), 54-61.
- Cookson, H. (1994). Personality variables associated with alcohol use in young offenders. *Personality and Individual Differences*, 16(1), 179-182. doi: 10.1016/0191-8869(94)90121-X
- Costa, P. T., & MacCrae, R. R. (1992). *Revised NEO personality inventory (NEO PI-R) and NEO five-factor inventory (NEO FFI): Professional manual*: Psychological Assessment Resources.
- Cournoyer, J., & Tripp, B. L. (2014). Concussion Knowledge in High School Football Players. *JOURNAL OF ATHLETIC TRAINING*, 49(5), 654-658. doi: 10.4085/1062-6050-49.3.34
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *psychometrika*, 16(3), 297-334.



- Davis, G. A. (2009). Concussion in sport. *Journal of Clinical Neuroscience*, 16(6), 731-732. doi: 10.1016/j.jocn.2009.02.001
- De Kruijk, J. R., Leffers, P., Meerhoff, S., Rutten, J., & Twijnstra, A. (2002). Effectiveness of bed rest after mild traumatic brain injury: A randomised trial of no versus six days of bed rest. *Journal of Neurology Neurosurgery and Psychiatry*, 73(2), 167-172. doi: 10.1136/jnnp.73.2.167
- De Kruijk, J. R., Leffers, P., & Twijnstra, A. (2001). Management of mild traumatic brain injury: lack of consensus in Europe. *Brain Injury*, 15(2), 117-123. doi: 10.1080/02699050118312
- Decq, P., Gault, N., Blandeau, M., Kerdraon, T., Berkal, M., ElHelou, A., . . . Peyrin, J.-C. (2016). Long-term consequences of recurrent sports concussion. *Acta Neurochirurgica*, 158(2), 289-300. doi: 10.1007/s00701-015-2681-4
- Delaney, J. S., Lacroix, V. J., Leclerc, S., & Johnston, K. M. (2002). Concussions among university football and soccer players. *Clinical Journal of Sport Medicine*, 12(6), 331-338. doi: 10.1097/00042752-200211000-00003
- Devanand, D. P., Sano, M., Tang, M.-X., Taylor, S., Gurland, B. J., Wilder, D., . . . Mayeux, R. (1996). Depressed Mood and the Incidence of Alzheimer's Disease in the Elderly Living in the Community. *Archives of General Psychiatry*, 53(2), 175-182. doi: 10.1001/archpsyc.1996.01830020093011
- Di Fabio, R. (1995). Sensitivity and specificity of platform posturography for identifying patients with vestibular dysfunction. *Physical therapy*, 75(4), 290-305.
- Eagly, A. H. (1983). Gender and social influence: A social psychological analysis. *American Psychologist*, 38(9), 971.
- Echemendia, R. J., Giza, C. C., & Kutcher, J. S. (2015). Developing guidelines for return to play: Consensus and evidence-based approaches. *Brain Injury*, 29(2), 185-194. doi: 10.3109/02699052.2014.965212
- Eysenck, H. J. (1952). *The scientific study of personality*. London U6 - ctx\_ver=Z39.88-2004&ctx\_enc=info%3Aofi%2Fenc%3AUTF-8&rft\_id=info:sid/summon.serialssolutions.com&rft\_val\_fmt=info:ofi/fmt:kev:mtx:book&rft.genre=book&rft.title=The+scientific+study+of+personality&rft.au=Eysenck%2C+H.+J&rft.date=1952&rft.pub=Routledge+%26+Kegan+Paul&rft.externalDBID=n%2Fa&rft.externalDocID=268178&paramdict=en-US U7 - Book: Routledge & Kegan Paul.
- Eysenck, H. J. (1990). *Handbook of personality: theory and Research* (L.A De Pervin ed.). New York: Guilford.
- Eysenck, H. J. (1992). The definition and measurement of psychoticism. *Personality and Individual Differences*, 13(7), 757-785. doi: 10.1016/0191-8869(92)90050-Y
- Eysenck, S., Eysenck, H. J., & Barrett, P. (1985). A revised version of the psychoticism scale. *Personality and Individual Differences*, 6(1), 21-29. doi: [http://dx.doi.org/10.1016/0191-8869\(85\)90026-1](http://dx.doi.org/10.1016/0191-8869(85)90026-1)
- Fazio, V. C., Lovell, M. R., Pardini, J. E., & Collins, M. W. (2007). The relation between post concussion symptoms and neurocognitive performance in concussed athletes. *NeuroRehabilitation*, 22(3), 207-216.
- Finn, P. R., Sharkansky, E. J., Brandt, K. M., & Turcotte, N. (2000). The effects of familial risk, personality, and expectancies on alcohol use and abuse. *Journal of abnormal psychology*, 109(1), 122.
- Fleeson, W., & Gallagher, P. (2009). The Implications of Big Five Standing for the Distribution of Trait Manifestation in Behavior: Fifteen Experience-Sampling Studies and a Meta-Analysis. *Journal of Personality and Social Psychology*, 97(6), 1097-1114. doi: 10.1037/a0016786

- Fleming, S., Hardman, A., Jones, C., & Sheridan, H. (2005). 'Role models' among elite young male rugby league players in Britain. *European Physical Education Review*, 11(1), 51-70. doi: 10.1177/1356336X05049824
- Fontaine, K. R. (1994). Personality correlates of sexual risk-taking among men. *Personality and Individual Differences*, 17(5), 693-694. doi: 10.1016/0191-8869(94)90144-9
- Freeman, R. C., Rodriguez, G. M., & French, J. F. (1994). A comparison of male and female intravenous drug users' risk behaviors for HIV infection. *The American journal of drug and alcohol abuse*, 20(2), 129-157.
- Gabbett, T. J. (2000). Incidence, site, and nature of injuries in amateur rugby league over three consecutive seasons. *British Journal of Sports Medicine*, 34(2), 98-103. doi: 10.1136/bjsm.34.2.98
- Gabbett, T. J. (2005). INFLUENCE OF PLAYING POSITION ON THE SITE, NATURE, AND CAUSE OF RUGBY LEAGUE INJURIES. *Journal of Strength and Conditioning Research*, 19(4), 749-755. doi: 10.1519/00124278-200511000-00005
- Galetta, K. M., Galetta, S. L., Brandes, L. E., Maki, K., Dziemianowicz, M. S., Laudano, E., . . . Balcer, L. J. (2011). The King–Devick test and sports-related concussion: Study of a rapid visual screening tool in a collegiate cohort. *Journal of the Neurological Sciences*, 309(1), 34-39. doi: 10.1016/j.jns.2011.07.039
- Gardner, A., Iverson, G., L., Williams, W. H., Baker, S., & Stanwell, P. (2014). A Systematic Review and Meta-Analysis of Concussion in Rugby Union. *Sports Medicine*, 44(12), 1717-1731. doi: 10.1007/s40279-014-0233-3
- Gardner, A., Iverson, G. L., Levi, C. R., Schofield, P. W., Kay-Lambkin, F., Kohler, R. M. N., & Stanwell, P. (2015). A systematic review of concussion in rugby league. *BRITISH JOURNAL OF SPORTS MEDICINE*, 49(8), 495-499. doi: 10.1136/bjsports-2013-093102
- Gianotti, S., & Hume, P. A. (2007). Concussion sideline management intervention for rugby union leads to reduced concussion claims. *NeuroRehabilitation*, 22(3), 181-189.
- Glicksohn, J., Naftuliev, Y., & Golan-Smooha, H. (2007). Extraversion, psychoticism, sensation seeking and field dependence–independence: Will the true relationship please reveal itself? *Personality and Individual Differences*, 42(7), 1175-1185. doi: <http://dx.doi.org/10.1016/j.paid.2006.09.025>
- Goodman, D., Bradley, N. L., Paras, B., Williamson, I. J., & Bizzochi, J. (2006). Video gaming promotes concussion knowledge acquisition in youth hockey players. *Journal of Adolescence*, 29(3), 351-360. doi: 10.1016/j.adolescence.2005.07.004
- Guilmette, T. J., Malia, L. A., & McQuiggan, M. D. (2007). Concussion understanding and management among New England high school football coaches. *Brain Injury*, 21(10), 1039-1047. doi: 10.1080/02699050701633080
- Guskiewicz, K. M. (2001). Postural stability assessment following concussion: One piece of the puzzle. *Clinical Journal of Sport Medicine*, 11(3), 182-189. doi: 10.1097/00042752-200107000-00009
- Guskiewicz, K. M., Marshall, S. W., Bailes, J., McCrea, M., Cantu, R. C., Randolph, C., & Jordan, B. D. (2005). Association between recurrent concussion and late-life cognitive impairment in retired professional football players. *Neurosurgery*, 57(4), 719-726. doi: 10.1227/01.NEU.0000175725.75780.DD
- Guskiewicz, K. M., Marshall, S. W., Bailes, J., McCrea, M., Harding Jr, H. P., Matthews, A., . . . Cantu, R. C. (2007). Recurrent concussion and risk of depression in retired professional football players. *Medicine and Science in Sports and Exercise*, 39(6), 903-909. doi: 10.1249/mss.0b013e3180383da5

- Guskiewicz, K. M., Riemann, B. L., Perrin, D. H., & Nashner, L. M. (1997). Alternative approaches to the assessment of mild head injury in athletes. *Medicine and Science in Sports and Exercise*, 29(7), S213-S221.
- Guskiewicz, K. M., Ross, S. E., & Marshall, S. W. (2001). Postural Stability and Neuropsychological Deficits after Concussion in Collegiate Athletes. *Journal of Athletic Training*, 36(3), 263-273.
- Hall, A. (2005). Audience Personality and the Selection of Media and Media Genres. *Media Psychology*, 7(4), 377-398. doi: 10.1207/S1532785XMEP0704\_4
- Hare, R. D. (1982). Psychopathy and the personality dimensions of psychoticism, extraversion and neuroticism. *Personality and Individual Differences*, 3(1), 35-42.
- Hargreaves, J. (1994). *Sporting females: critical issues in the history and sociology of women's sports*. New York;London;: Routledge.
- Heath, A. C., Cloninger, C. R., & Martin, N. G. (1994). Testing a model for the genetic structure of personality: a comparison of the personality systems of Cloninger and Eysenck. *Journal of personality and social psychology*, 66(4), 762.
- Heym, N., & Lawrence, C. (2010). The role of Gray's revised RST in the P-psychopathy continuum: The relationships of Psychoticism with a lack of fear and anxiety, and increased impulsivity. *Personality and Individual Differences*, 49(8), 874-879. doi: <http://dx.doi.org/10.1016/j.paid.2010.07.021>
- Hinton-Bayre, A. D., Geffen, G., & Friis, P. (2004). Presentation and mechanisms of concussion in professional Rugby League football. *Journal of Science and Medicine in Sport*, 7(3), 400-404. doi: 10.1016/S1440-2440(04)80035-5
- Hofstee, W. K. B., de Raad, B., & Goldberg, L. R. (1992). Integration of the Big Five and Circumplex Approaches to Trait Structure. *Journal of Personality and Social Psychology*, 63(1), 146-163. doi: 10.1037/0022-3514.63.1.146
- Hunt, T. N. (2015). Video Educational Intervention Improves Reporting of Concussion and Symptom Recognition. *Athletic Training Education Journal*, 10(1), 65.
- Hux, K., Schram, C. D., & Goeken, T. (2006). Misconceptions about brain injury: A survey replication study. *Brain Injury*, 20(5), 547-553.
- Iverson, G. L., Gaetz, M., Lovell, M. R., & Collins, M. W. (2004). Relation between subjective fogginess and neuropsychological testing following concussion. *Journal of the International Neuropsychological Society*, 10(6), 904-906. doi: 10.1017/S1355617704106139
- Jordan, B. (2015). Chronic traumatic encephalopathy. *Journal of the Neurological Sciences*, 357, Supplement 1, e502. doi: <http://dx.doi.org/10.1016/j.jns.2015.09.307>
- Jorge, R. E., Robinson, R. G., Arndt, S. V., Starkstein, S. E., Forrester, A. W., & Geisler, F. (1993). Depression following traumatic brain injury: a 1 year longitudinal study. *Journal of Affective Disorders*, 27(4), 233-243. doi: 10.1016/0165-0327(93)90047-N
- Kaut, K. P., DePompei, R., Kerr, J., & Congeni, J. (2003). Reports of head injury and symptom knowledge among college athletes: Implications for assessment and educational intervention. *Clinical Journal of Sport Medicine*, 13(4), 213-221. doi: 10.1097/00042752-200307000-00004
- Kelly, J. P., & Rosenberg, J. H. (1997). Diagnosis and management of concussion in sports. *Neurology*, 48(3), 575-580.
- Kerr, H. A. (2013). Closed head injury. *Clin Sports Med*, 32(2), 273-287. doi: 10.1016/j.csm.2012.12.008
- Kids, H., & Summit, S. S. C. (2013). Tackling the sports-related concussion crisis. *Neurology*, 80, 2250-2257.

- King, D., Clark, T., & Gissane, C. (2012). Use of a rapid visual screening tool for the assessment of concussion in amateur rugby league: a pilot study. *Journal of the neurological sciences*, 320(1), 16-21.
- King, D., Hume, P., & Clark, T. (2010a). First-aid and concussion knowledge of rugby league team management, administrators and officials in New Zealand. *NZJ Sports Med*, 37(2), 52-68.
- King, D., Hume, P., & Clark, T. (2010b). Player perspectives on return to play after a match or training injury in amateur rugby league. *NZJ Sports Med*, 37, 48-55.
- King, D., Hume, P., Gissane, C., & Clark, T. (2015). Use of the King-Devick test for sideline concussion screening in junior rugby league. *JOURNAL OF THE NEUROLOGICAL SCIENCES*, 357(1-2), 75-79. doi: 10.1016/j.jns.2015.06.069
- King, N. S., Crawford, S., Wenden, F. J., Moss, N., & Wade, D. T. (1997). Interventions and service need following mild and moderate head injury: the Oxford Head Injury Service. *Clinical Rehabilitation*, 11(1), 13-27. doi: 10.1177/026921559701100104
- Kjærheim, K., Mykletun, R., & Haldorsen, T. (1996). Selection into the restaurant business based on personality characteristics and the risk of heavy drinking. *Personality and Individual Differences*, 21(4), 625-629. doi: 10.1016/0191-8869(96)00086-4
- Kolt, G. S. (2013). Concussion in Sport. *Journal of Science and Medicine in Sport*, 16(3), 177-177. doi: 10.1016/j.jsams.2013.04.001
- Kraaykamp, G., & Eijck, K. v. (2005). Personality, media preferences, and cultural participation. *Personality and Individual Differences*, 38(7), 1675-1688. doi: <http://dx.doi.org/10.1016/j.paid.2004.11.002>
- Kurowski, B., Pomerantz, W. J., Schaiper, C., & Gittelman, M. A. (2014). Factors that influence concussion knowledge and self-reported attitudes in high school athletes. *JOURNAL OF TRAUMA AND ACUTE CARE SURGERY*, 77(3 Suppl 1), S12-S17. doi: 10.1097/TA.0000000000000316
- Langlois, J. A., Rutland-Brown, W., & Wald, M. M. (2006). The epidemiology and impact of traumatic brain injury: A brief overview. *Journal of Head Trauma Rehabilitation*, 21(5), 375-378.
- Lovell, M. R., Iverson, G. L., Collins, M. W., Podell, K., Johnston, K. M., Pardini, D., . . . Maroon, J. C. (2006). Measurement of Symptoms Following Sports-Related Concussion: Reliability and Normative Data for the Post-Concussion Scale. *Applied Neuropsychology*, 13(3), 166-174. doi: 10.1207/s15324826an1303\_4
- Mackenzie, J. A., & McMillan, T. M. (2005). Knowledge of post-concussional syndrome in naïve lay-people, general practitioners and people with minor traumatic brain injury. *British Journal of Clinical Psychology*, 44(3), 417-424. doi: 10.1348/014466505X35696
- Makdissi, M., Davis, G., & McCrory, P. (2014). Updated guidelines for the management of sports-related concussion in general practice. *Australian Family Physician*, 43(3), 94-99.
- McAllister-Deitrick, J., Covassin, T., & Gould, D. R. (2014). Sport-Related Concussion Knowledge Among Youth Football Players. *Athletic Training & Sports Health Care*, 6(6), 280-284. doi: 10.3928/01484834-20141112-03
- McCown, W. (1991). Contributions of the EPN paradigm to HIV prevention: A preliminary study. *Personality and Individual Differences*, 12(12), 1301-1303. doi: 10.1016/0191-8869(91)90204-O
- McCrea, H. J., Perrine, K., Niogi, S., & Härtl, R. (2013). Concussion in Sports. *Sports Health: A Multidisciplinary Approach*, 5(2), 160-164. doi: 10.1177/1941738112462203

- McCrea, M. (2001). Standardized Mental Status Testing on the Sideline after Sport-Related Concussion. *Journal of Athletic Training*, 36(3), 274-279.
- McCrea, M., Guskiewicz, K. M., Marshall, S. W., Barr, W., Randolph, C., Cantu, R. C., . . . Kelly, J. P. (2003). Acute Effects and Recovery Time Following Concussion in Collegiate Football Players: The NCAA Concussion Study. *JAMA*, 290(19), 2556-2563. doi: 10.1001/jama.290.19.2556
- McCrea, M., Hammeke, T., Olsen, G., Leo, P., & Guskiewicz, K. M. (2004). Unreported Concussion in High School Football Players: Implications for Prevention. *Clinical Journal of Sport Medicine*, 14(1), 13-17. doi: 10.1097/00042752-200401000-00003
- McCrory, P., Johnston, K., Meeuwisse, W., Aubry, M., Cantu, R., Dvorak, J., . . . Schamasch, P. (2005). Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. *British Journal of Sports Medicine*, 39(4), 196-204. doi: 10.1136/bjsm.2005.018614
- McCrory, P., Meeuwisse, W., Aubry, M., Cantu, B., Dvorak, J., Echemendia, R., . . . Turner, M. (2013). Consensus statement on Concussion in Sport-The 4th International Conference on Concussion in Sport held in Zurich, November 2012. *Journal of Science and Medicine in Sport*, 16(3), 178-189. doi: 10.1016/j.jsams.2013.02.009
- McKee, A. C., Cantu, R. C., Nowinski, C. J., Hedley-Whyte, E. T., Gavett, B. E., Budson, A. E., . . . Stern, R. A. (2009). Chronic Traumatic Encephalopathy in Athletes: Progressive Tauopathy After Repetitive Head Injury. *Journal of Neuropathology and Experimental Neurology*, 68(7), 709-735. doi: 10.1097/NEN.0b013e3181a9d503
- McKinlay, A., Bishop, A., & McLellan, T. (2011). Public knowledge of 'concussion' and the different terminology used to communicate about mild traumatic brain injury (MTBI). *Brain Injury*, 25(7-8), 761-766. doi: 10.3109/02699052.2011.579935
- McLellan, T., & McKinlay, A. (2011). Does the way concussion is portrayed affect public awareness of appropriate concussion management: The case of rugby league. *British Journal of Sports Medicine*, 45(12), 993-996. doi: 10.1136/bjsm.2011.083618
- McLeod, T. C. V., & Gioia, G. A. (2010). Cognitive rest: The often neglected aspect of concussion management. *Athletic Therapy Today*, 15(2), 1-3.
- Messner, M. A. (1992). *Power at play: sports and the problem of masculinity*. Boston: Beacon Press.
- Messner, M. A. (2002). *Taking the field: women, men, and sports* (Vol. 4). Minneapolis: University of Minnesota Press.
- Millstein, S. G., & Halpern-Felsher, B. L. (2001). Perceptions of risk and vulnerability. *Adolescent risk and vulnerability: Concepts and measurement*, 15.
- Miyashita, T. L., Timpson, W. M., Frye, M. A., & Gloeckner, G. W. (2013). The impact of an educational intervention on college athletes' knowledge of concussions. *Clinical Journal of Sport Medicine*, 23(5), 349-353. doi: 10.1097/JSM.0b013e318289c321
- Morelock, J. C. (1980). Sex differences in susceptibility to social influence. *Sex Roles*, 6(4), 537-548.
- Moser, R. S., Glatts, C., & Schatz, P. (2012). Efficacy of immediate and delayed cognitive and physical rest for treatment of sports-related concussion. *Journal of Pediatrics*, 161(5), 922-926. doi: 10.1016/j.jpeds.2012.04.012
- Nabi, R. L., & Riddle, K. (2008). Personality Traits, Television Viewing, and the Cultivation Effect. *Journal of Broadcasting & Electronic Media*, 52(3), 327-348. doi: 10.1080/08838150802205181
- Nathanson, C. A. (1977). Sex roles as variables in preventive health behavior. *Journal of Community Health*, 3(2), 142-155.
- Nelson, T. E., Lecheler, S., Schuck, A. R., & De Vreese, C. (2012). *Framing effects on values, emotions, and attitudes*. Paper presented at the Trabajo presentado en 2012



- Meeting of the Western Political Science Association. Portland, ee. uu.: Western Political Science Association.
- Noble, J. M., & Hesdorffer, D. C. (2013). Sport-Related Concussions: A Review of Epidemiology, Challenges in Diagnosis, and Potential Risk Factors. *Neuropsychology Review*, 23(4), 273-284. doi: 10.1136/bjsports-2013-092498.
- <http://dx.doi.org/10.1007/s11065-013-9239-0>
- Nylund, D. (2004). When in Rome: Heterosexism, Homophobia, and Sports Talk Radio. *Journal of Sport & Social Issues*, 28(2), 136-168. doi: 10.1177/0193723504264409
- O'Jile, J. R., Ryan, L. M., Parks-Levy, J., Betz, B., & Gouvier, W. D. (2004). Sensation seeking and risk behaviors in young adults with and without a history of head injury. *Applied Neuropsychology*, 11(2), 107-112. doi: 10.1207/s15324826an1102\_7
- O'Connell, E., & Molloy, M. G. (2016). Concussion in rugby: knowledge and attitudes of players. *Irish Journal of Medical Science (1971 -)*, 185(2), 521-528. doi: 10.1007/s11845-015-1313-6
- Ortet, G., Ibáñez, M. I., Moro, M., Silva, F., & Boyle, G. J. (1999). Psychometric appraisal of Eysenck's revised Psychoticism scale: a cross-cultural study. *Personality and Individual Differences*, 27(6), 1209-1219. doi: [http://dx.doi.org/10.1016/S0191-8869\(99\)00065-3](http://dx.doi.org/10.1016/S0191-8869(99)00065-3)
- Peloso, P., Carroll, L., Cassidy, J. D., Borg, J., Holst, H. v., Holm, L., . . . Neuronik. (2004). Critical evaluation of the existing guidelines on mild traumatic brain injury. *Journal of Rehabilitation Medicine*, 36(Supplement 43), 106-112. doi: 10.1080/16501960410023868
- Perse, E. M. (1996). Sensation Seeking and the Use of Television for Arousal. *Communication Reports*, 9(1), 37.
- Pickering, A. D. (1999). Personality correlates of the dopaminergic facilitation of incentive motivation: Impulsive sensation seeking rather than extraversion? *Behavioral and Brain Sciences*, 22(3), 534-535. doi: 10.1017/S0140525X99392049
- Pluta, R. M., Lynm, C., & Golub, R. M. (2011). Concussion. *JAMA*, 306(1), 114-114. doi: 10.1001/jama.306.1.114
- Powell, J. W., & Barber-Foss, K. D. (1999). Traumatic Brain Injury in High School Athletes. *JAMA*, 282(10), 958-963. doi: 10.1001/jama.282.10.958
- Primi, R., Ferreira-Rodrigues, C. F., & De Francisco Carvalho, L. (2014). Cattell's personality factor questionnaire (CPFQ): Development and preliminary study. *Paideia*, 24(57), 29-37. doi: 10.1590/1982-43272457201405
- Pritchard, W. S., & Kay, D. L. C. (1993). Personality and smoking motivation of U.S. smokers as measured by the State-Trait Personality Inventory, the Eysenck personality questionnaire, and Spielberger's smoking motivation Questionnaire. *Personality and Individual Differences*, 14(5), 629-637. doi: 10.1016/0191-8869(93)90110-O
- Rahman, B. H. (2014). Conditional Influence of Media: Media Credibility and Opinion Formation. *Journal of Political Studies*, 21(1), 299.
- Rapoport, M. J. (2012). Depression Following Traumatic Brain Injury. *CNS Drugs*, 26(2), 111. doi: 10.2165/11599560-000000000-00000
- Register-Mihalik, J. K., Guskiewicz, K. M., McLeod, T. C. V., Linnan, L. A., Mueller, F. O., & Marshall, S. W. (2013). Knowledge, Attitude, and Concussion-Reporting Behaviors Among High School Athletes: A Preliminary Study. *Journal of Athletic Training*, 48(5), 645-653. doi: 10.4085/1062-6050-48.3.20
- Rehabilitation Measures Database. (2014). *Rehab Measures: Sensory Organization Test*.

- Resch, J. E., & Kutcher, J. S. (2015). The Acute Management of Sport Concussion in Pediatric Athletes. *JOURNAL OF CHILD NEUROLOGY*, 30(12), 1686-1694. doi: 10.1177/0883073815574335
- Rutherford, W., Merrett, J., & McDonali, J. (1977). SEQUELÆ OF CONCUSSION CAUSED BY MINOR HEAD INJURIES. *The Lancet*, 309(8001), 1-4. doi: 10.1016/S0140-6736(77)91649-X
- Ryb, G. E., Dischinger, P. C., Kufera, J. A., & Read, K. M. (2006). Risk perception and impulsivity: association with risky behaviors and substance abuse disorders. *Accident Analysis & Prevention*, 38(3), 567-573.
- Sanderson, J., Weathers, M., Grevious, A., Tehan, M., & Warren, S. (2014). A Hero or Sissy? Exploring Media Framing of NFL Quarterbacks Injury Decisions. *Communication & Sport*. doi: 10.1177/2167479514536982
- Saulle, M., & Greenwald, B. D. (2012). Chronic traumatic encephalopathy: a review. *Rehabilitation research and practice*, 2012.
- Schatz, P., & Moser, R. S. (2011). Current Issues in Pediatric Sports Concussion. *The Clinical Neuropsychologist*, 25(6), 1042-1057. doi: 10.1080/13854046.2011.556669
- Sigurdsson, J. F., & Gudjonsson, G. H. (1996). Psychological characteristics of juvenile alcohol and drug users. *Journal of Adolescence*, 19(1), 41-46. doi: 10.1006/jado.1996.0004
- Sims, A. C. P. (1985). Head injury, neurosis and accident proneness (Vol. 13, pp. 49-70.).
- Smillie, L. D., DeYoung, C. G., & Hall, P. J. (2015). Clarifying the Relation Between Extraversion and Positive Affect. *Journal of Personality*, 83(5), 564-574. doi: 10.1111/jopy.12138
- Stein, J. A., Newcomb, M. D., & Bentler, P. M. (1987). Personality and drug use: Reciprocal effects across four years. *Personality and Individual Differences*, 8(3), 419-430. doi: 10.1016/0191-8869(87)90043-2
- Terrell, T. R., Cox, C. B., Bielak, K., Casmus, R., Laskowitz, D., & Nichols, G. (2014). Sports Concussion Management: Part II. *SOUTHERN MEDICAL JOURNAL*, 107(2), 126-135. doi: 10.1097/SMJ.0000000000000064
- Thompson, E. R. (2008). Development and Validation of an International English Big-Five Mini-Markers. *Personality and Individual Differences*, 45(6), 542-548. doi: 10.1016/j.paid.2008.06.013
- Tiwari, T., Singh, A. L., & Singh, I. L. (2009). The short-form revised Eysenck personality questionnaire: A Hindi edition (EPQRS-H). *Industrial psychiatry journal*, 18(1), 27-31. doi: 10.4103/0972-6748.57854
- Turner, C., & McClure, R. (2003). Age and gender differences in risk-taking behaviour as an explanation for high incidence of motor vehicle crashes as a driver in young males. *Injury control and safety promotion*, 10(3), 123-130.
- U.S. National Library of Medicine. (2015). *Concussion*.
- Van Mechelen, W., Twisk, J. W., Post, G. B., Snel, J., & Kemper, H. C. (2000). Physical activity of young people: the Amsterdam Longitudinal Growth and Health Study. *Medicine and science in sports and exercise*, 32(9), 1610-1616.
- Vasterling, J. J., & Dikmen, S. (2012). Mild traumatic brain injury and posttraumatic stress disorder: Clinical and conceptual complexities. *Journal of the International Neuropsychological Society*, 18(3), 390-393. doi: 10.1017/S1355617712000367
- Verle, V., & Logan, K. (2012). Cognitive rest in concussion management. *American Family Physician*, 85(2), 100-101.
- Wallston, K. A., Maides, S., & Wallston, B. S. (1976). Health-related information seeking as a function of health-related locus of control and health value. *Journal of Research in Personality*, 10(2), 215-222.

- Watts, D. (2010). Agenda-setting Theory.
- Weaver, J. B. (1991). Exploring the links between personality and media preferences. *Personality and Individual Differences*, 12(12), 1293-1299. doi: 10.1016/0191-8869(91)90203-N
- Weaver, J. B. (2003). Individual differences in television viewing motives. *Personality and Individual Differences*, 35(6), 1427-1437. doi: 10.1016/S0191-8869(02)00360-4
- Weaver, J. B., Brosius, H.-B., & Mundorf, N. (1993). Personality and movie preferences: A comparison of American and German audiences. *Personality and Individual Differences*, 14(2), 307-315. doi: 10.1016/0191-8869(93)90128-P
- Wiesenfeld-Hallin, Z. (2005). Sex differences in pain perception. *Gender medicine*, 2(3), 137-145.
- Wilkes, M., & Donnelly, J. Knowledge of Mild Traumatic Brain Injury: Effects of age, locality, occupation, media and sports participation. *Frontiers in Psychology*. doi: 10.3389/conf.fpsyg.2015.66.00001
- Williams, J. M., Langdon, J. L., McMillan, J., & Buckley, T. (2015). English professional football players concussion knowledge and attitude. *Journal of Sport and Health Science*.
- Wrisley, D. M., Stephens, M. J., Mosley, S., Wojnowski, A., Duffy, J., & Burkard, R. (2007). Learning Effects of Repetitive Administrations of the Sensory Organization Test in Healthy Young Adults. *Archives of Physical Medicine and Rehabilitation*, 88(8), 1049-1054. doi: 10.1016/j.apmr.2007.05.003
- Yard, E. E., & Comstock, R. D. (2009). Compliance with return to play guidelines following concussion in US high school athletes, 2005-2008. *Brain Injury*, 23(11), 888-898. doi: 10.1080/02699050903283171
- Zillmann, D., & Weaver, J. B. (1997). Psychoticism in the effect of prolonged exposure to gratuitous media violence on the acceptance of violence as a preferred means of conflict resolution. *Personality and Individual Differences*, 22(5), 613-627. doi: [http://dx.doi.org/10.1016/S0191-8869\(96\)00245-0](http://dx.doi.org/10.1016/S0191-8869(96)00245-0)



## Appendix 1

### Injuries in rugby league

Thank you for completing this survey. Please note that at times during this survey you will see athletes experiencing an injury while playing rugby league. All of the players have recovered from these injuries and we will only show you brief clips to minimize any potential discomfort. You can choose to discontinue the survey at any point if you find any images upsetting. Should you have any concerns regarding this study, please contact Dr. Audrey Mckinlay: [audrey.mckinlay@canterbury.ac.nz](mailto:audrey.mckinlay@canterbury.ac.nz) or Cindy Ku: [cindy.ku@pg.canterbury.ac.nz](mailto:cindy.ku@pg.canterbury.ac.nz). If you have agreed to participate in this study, you are asked to accept the conditions in the following consent form before proceeding.

I have read and I understand the information sheet for people volunteering as participants in this study. I have had the opportunity to discuss this study and am satisfied with the answers I have been given. I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time and for any reason. I understand that my participation in this study is confidential and no information that could identify me will be used in any reports generated on this study.

☐ Please tick if you accept the above conditions

Q1 Age?

- ☐ Under 18 (6)
- ☐ 18-20 (1)
- ☐ 20-29 years (2)
- ☐ 30-39 years (3)
- ☐ 40-49 years (4)
- ☐ 50+ years (5)

If Under 18 Is Selected, Then Skip To End of Block

Q2Sex?

- ☐ Male (1)
- ☐ Female (2)

Q3 Where do you live?

- ☐ New Zealand (1)
- ☐ United Kingdom (2)
- ☐ Australia (3)

Q4 Have you ever had a concussion?

- ☐ Yes (1)
- ☐ No (2)

If No Is Selected, Then Skip To How would you describe your experience with rugby...

Q5 How many concussions have you ever had?

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10+ (10)

Q6 How old were you at the time of your concussion (first concussion)?

- ☐ 0-1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ 10 (10)
- ☐ 11 (11)
- ☐ 12 (12)
- ☐ 13 (13)
- ☐ 14 (14)
- ☐ 15 (15)
- ☐ 16 (16)
- ☐ 17 (17)
- ☐ 18 (18)
- ☐ 19 (19)
- ☐ 20 (20)
- ☐ 21 (21)
- ☐ 22 (22)
- ☐ 23 (23)
- ☐ 24 (24)
- ☐ 25+ (25)

Q7 Did you go to the doctor or hospital after you were injured?

- ☐ Yes. On every or the only occasion. (1)
- ☐ Yes. On at least one occasion but not all. (2)
- ☐ No (3)

Q8 Which mode of injury best describes how you were concussed. Select multiple modes if required.

- ☐ Playing contact sport (1)
- ☐ Playing non-contact sport (2)
- ☐ Fall from a height (3)
- ☐ Accidentally hit with an object (excluding when playing sport) (4)
- ☐ Assault (5)
- ☐ Traffic accident involving a car, bike or pedestrian (6)
- ☐ Other (7)

Q9 How would you describe your experience of playing rugby or rugby league?

- ☐ I have never played (1)
- ☐ I have played one season in the past but no longer play (2)
- ☐ I have played more than one season in the past but no longer play (3)
- ☐ I currently play social games (4)
- ☐ I currently play competitive games (5)

Q10 How would you best describe your tendency to watch rugby or rugby league?

- ☐ I never watch (1)
- ☐ I watch 2 or 3 games a year (2)
- ☐ I watch one game a month during the season (3)
- ☐ I watch one game a week during the season (4)
- ☐ I watch more than one game a week during the season (5)

(Knowledge Scale)

Please answer the following questions by selecting TRUE or FALSE. Please answer all questions even if you are not sure - take your best guess.

Q11 A concussed person may have trouble remembering events from before the concussion, but usually does not have trouble learning new things.

- ☐ True (1)
- ☐ False (2)

Q12 A concussion can cause brain damage even if the person is not knocked out.

- ☐ True (1)
- ☐ False (2)

Q13 A concussion can have positive and negative effects on the person.

- ☐ True (1)
- ☐ False (2)

Q14 A concussion can only occur if there is a direct hit to the head.

- ☐ True (1)
- ☐ False (2)

Q15 After 10 days, symptoms of a concussion are usually completely gone.

- ☐ True (1)
- ☐ False (2)

Q16 After a concussion occurs, brain imaging (e.g., CAT Scan, MRI, X-Ray, etc.) typically shows visible physical damage (e.g., bruise, blood clot) to the brain.

- ☐ True (1)
- ☐ False (2)

Q17 Being knocked unconscious always causes permanent damage to the brain.

- ☐ True (1)
- ☐ False (2)

Q18 Emotional problems after concussion are usually not related to brain damage.

- ☐ True (1)
- ☐ False (2)

Q19 How quickly a person recovers from a concussion depends mainly on how hard they work on recovery.

- ☐ True (1)
- ☐ False (2)

Q20 If you receive one concussion and you have never had a concussion before, you will become less intelligent.

- ☐ True (1)
- ☐ False (2)

Q21 Once a recovering sports person feels “back to normal,” the recovery process is complete.

- ☐ True (1)
- ☐ False (2)

Q22 People who have had one concussion are more likely to have another concussion.

- ☐ True (1)
- ☐ False (2)

Q23 Sometimes symptoms of concussion take hours to show up.

- ☐ True (1)
- ☐ False (2)

Q24 Temporary confusion is not concussion if it clears within 5 minutes.

- ☐ True (1)
- ☐ False (2)

Q25 There is a possible risk of death if a second concussion occurs before the first one has healed.

- ☐ True (1)
- ☐ False (2)

Q26 Weightlifting helps to tone and/or build muscle. (Filter Question)

- ☐ True (1)
- ☐ False (2)

If False Is Selected, Then Skip To End of Block

(Attitude Scale)

Q27 I would continue playing a sport while also having blurry vision that resulted from a concussion.

- ☐ Very Unlikely (1)
- ☐ Unlikely (2)
- ☐ Not sure (3)
- ☐ Likely (4)
- ☐ Very Likely (5)

Q28 I feel that concussions are less important than other injuries.

- ☐ Strongly Agree (1)
- ☐ Agree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Disagree (4)
- ☐ Strongly Disagree (5)

Q29 I feel that an athlete should get back on the field as soon as they can – it's their job to ride out the symptoms of a concussion.

- ☐ Strongly Agree (1)
- ☐ Agree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Disagree (4)
- ☐ Strongly Disagree (5)

Q30 Athlete S suffered a concussion during training the week before the first game. Athlete T suffered a concussion of the same severity during training the week before the quarter-final. Both athletes had symptoms two days after the injury. I feel that Athlete S should play the first game of the season.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q31 I feel that Athlete T should play in the quarter-final.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q32 Athlete H suffered a concussion and he has a game in two hours. He is still experiencing symptoms of concussion. However, Athlete H knows that if he tells his coach about the symptoms, his coach will keep him out of the game. I feel that Athlete H should tell his coach about the symptoms.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q33 Athlete H is the best player on the team. I feel that Athlete H should tell the coach about the symptoms.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q34 If I was Athlete H, I would tell my coach about my symptoms.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q35 Please select mute on your computer now to avoid distraction. You will be asked to watch the following video clips carefully. There are 12 clips and each one is followed by two questions. Each clip shows a player experiencing some type of injury playing rugby league. Your job is to decide whether or not you think the player has experienced a concussion. Some of you will see a set of clips when only a few players had a concussion, some when about half did, and some of you will see a set of clips when every player had a concussion - so don't worry if you feel you are answering often with the same response. Please note: If a player is diagnosed with concussion they are not allowed to continue to play or return to play in the same game.

Q36 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player ... No Is Selected

Q37 Extra information The trainer helped this player off the field and he did not return to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player ... Yes Is Selected

Q38 Extra information The trainer helped this player off the field and he did not return to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q39 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)



Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q40 Extra information The trainer helped this player off the field and he did not come back on in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q41 Extra information The trainer helped this player off the field and he did not come back on in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q42 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q43 Extra information The trainer helped this player off the field but he did return later in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q44 Extra information The trainer helped this player off the field but he did return later in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q45 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q46 Extra information The trainer helped this player off the field but he returned to play later in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q47 Extra information The trainer helped this player off the field but he returned to play later in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q48 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q49 Extra information The trainer assessed this player on the field and he was removed from play Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q50 Extra information The trainer assessed this player on the field and he was removed from play Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q51 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q52 Extra information The trainer assessed this player on the field and he continued to play Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q53 Extra information The trainer assessed this player on the field and he continued to play Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q54 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q55 Extra information The trainer assessed this player and he did not continue to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q56 Extra information The trainer assessed this player and he did not continue to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q57 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q58 Extra information This player continued to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q59 Extra information This player continued to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q60 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q61 Extra information The trainer helped this player off the field and he did not return to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q62 Extra information The trainer helped this player off the field and he did not return to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q63 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q64 Extra information This player did not continue to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q65 Extra information This player did not continue to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q66 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q67 Extra information The trainer helped this player off the field but he did come back on later Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q68 Extra information The trainer helped this player off the field but he did come back on later Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q69 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q70 Extra information The trainer assessed this player and he did continue to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q71 Extra information The trainer assessed this player and he did continue to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

(Group two:No-RTP)

Q72 Please select mute on your computer now to avoid distraction. You will be asked to watch the following video clips carefully. There are 12 clips and each one is followed by two questions. Each clip shows a player experiencing some type of injury playing rugby league. Your job is to decide whether or not you think the player has experienced a concussion. Some of you will see a set of clips when only a few players had a concussion, some when about half did, and some of you will see a set of clips when every player had a concussion - so don't worry if you feel you are answering often with the same response.

Q73 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q74 Extra information The trainer helped this player off the field and he did not return to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q75 Extra information The trainer helped this player off the field and he did not return to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q76 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q77 Extra information The trainer helped this player off the field and he did not come back on in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q78 Extra information The trainer helped this player off the field and he did not come back on in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q79 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q80 Extra information The trainer helped this player off the field but he did return later in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q81 Extra information The trainer helped this player off the field but he did return later in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q82 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q83 Extra information The trainer helped this player off the field but he returned to play later in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q84 Extra information The trainer helped this player off the field but he returned to play later in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q85 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q86 Extra information The trainer assessed this player on the field and he was removed from play Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q87 Extra information The trainer assessed this player on the field and he was removed from play Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)



Q88 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q89 Extra information The trainer assessed this player on the field and he continued to play Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q90 Extra information The trainer assessed this player on the field and he continued to play Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q91 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q92 Extra information The trainer assessed this player and he did not continue to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q93 Extra information The trainer assessed this player and he did not continue to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q94 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q95 Extra information This player continued to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q96 Extra information This player continued to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q97 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q98 Extra information The trainer helped this player off the field and he did not return to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q99 Extra information The trainer helped this player off the field and he did not return to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q100 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q101 Extra information This player did not continue to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q102 Extra information This player did not continue to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q103 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q104 Extra information The trainer helped this player off the field but he did come back on later Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q105 Extra information The trainer helped this player off the field but he did come back on later Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Q106 Do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? Yes Is Selected

Q107 Extra information The trainer assessed this player and he did continue to play in this game Do you still think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

Display This Question:

If Do you think this player experienced a concussion? No Is Selected

Q108 Extra information The trainer assessed this player and he did continue to play in this game Now do you think this player experienced a concussion?

- ☐ Yes (1)
- ☐ No (2)

(Knowledge Scale)

Q109 Please answer the following questions by selecting TRUE or FALSE. Please answer all questions even if you are not sure - take your best guess.

Q110 In order to be diagnosed with a concussion, you have to be knocked out.

- ☐ True (1)
- ☐ False (2)

Q111 Symptoms of a concussion can last for several weeks.

- ☐ True (1)
- ☐ False (2)

Q112 Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.

- ☐ True (1)
- ☐ False (2)

Q113 Concussions can sometimes lead to emotional disruptions.

- ☐ True (1)
- ☐ False (2)

Q114 A person who gets knocked out after getting a concussion is experiencing a coma.

- ☐ True (1)
- ☐ False (2)

Q115 After a concussion, people can forget who they are and not recognize others but be perfect in every other way.

- ☐ True (1)
- ☐ False (2)

Q116 Rugby boots help players' feet grip the playing surface.(Filter Question)

- ☐ True (1)
- ☐ False (2)

If False Is Selected, Then Skip To End of Block

Q117 A little brain damage does not matter, as people use a small portion of their brains anyway.

- ☐ True (1)
- ☐ False (2)

Q118 The only sure way to tell if someone has suffered brain damage from a concussion is by an X-ray of the brain.

- ☐ True (1)
- ☐ False (2)

Q119 Complete recovery from a concussion is not possible, no matter how badly the person wants to recover.

- ☐ True (1)
- ☐ False (2)

Q120 There is rarely a risk to long-term health and well-being from multiple concussions.

- ☐ True (1)
- ☐ False (2)

Q121 How quickly a person recovers from a concussion depends mainly on how hard they work on recovery.

- ☐ True (1)
- ☐ False (2)

Q122 People usually have more trouble remembering things that happen after a concussion than remembering things from before.

- ☐ True (1)
- ☐ False (2)

Q123 Whiplash injuries to the neck can cause brain damage even if there is no direct blow to the head.

- ☐ True (1)
- ☐ False (2)

Q124 High-school students and University students tend to be the same age. (Filter Question)

- ☐ True (1)
- ☐ False (2)

Q125 The symptoms of concussion are always apparent at the time of injury.

- ☐ True (1)
- ☐ False (2)

Q126 It is safe to return playing sport as soon as the confusion clears.

- ☐ True (1)
- ☐ False (2)

(Attitude Scale)

Q127 I would continue playing a sport while also having a headache that resulted from a concussion.

- ☐ Very Unlikely (1)
- ☐ Unlikely (2)
- ☐ Not sure (3)
- ☐ Likely (4)
- ☐ Very Likely (5)

Q128 I feel that coaches need to be extremely cautious when determining whether an athlete should return to play.

- ☐ Strongly Agree (1)
- ☐ Agree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Disagree (4)
- ☐ Strongly Disagree (5)

Q129 I feel that an athlete has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.

- ☐ Strongly Agree (1)
- ☐ Agree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Disagree (4)
- ☐ Strongly Disagree (5)

Q130 Athlete M suffered a concussion during the first game of the season. Athlete O suffered a concussion of the same severity during the semi-final playoff game. Both athletes had persisting symptoms. I feel that Athlete M should have returned to play during the first game of the season.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q131 I feel that Athlete O should have returned to play during the semi-final playoff game.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q132 Player R suffers a concussion during a game. Coach A decides to keep Player R out of the game. Player R's team loses the game. I feel that Coach A made the right decision to keep Player R out of the game.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q133 Player R is the best player on the team. I feel that Coach A made the right decision to keep Player R out of the game.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

Q134 If I was Coach A, I would have kept Player R out of the game.

- ☐ Strongly Disagree (1)
- ☐ Disagree (2)
- ☐ Neither Agree nor Disagree (3)
- ☐ Agree (4)
- ☐ Strongly Agree (5)

(EPQ-R)

Q135 Does your mood often go up and down?

- ☐ Yes (1)
- ☐ No (2)

Q136 Do you take much notice of what people think?

- ☐ Yes (1)
- ☐ No (2)

Q137 Are you a talkative person?

- ☐ Yes (1)
- ☐ No (2)

Q138 If you say you will do something, do you always keep your promise no matter how inconvenient it might be?

- ☐ Yes (1)
- ☐ No (2)

Q139 Do you ever feel "just miserable" for no reason?

- ☐ Yes (1)
- ☐ No (2)



Q140 Would being in debt worry you?

- ☐ Yes (1)
- ☐ No (2)

Q141 Are you rather lively?

- ☐ Yes (1)
- ☐ No (2)

Q142 Were you ever greedy by helping yourself to more than your share of anything?

- ☐ Yes (1)
- ☐ No (2)

Q143 Are you an irritable person?

- ☐ Yes (1)
- ☐ No (2)

Q144 Would you take drugs which may have strange or dangerous effects?

- ☐ Yes (1)
- ☐ No (2)

Q145 Do you enjoy meeting new people?

- ☐ Yes (1)
- ☐ No (2)

Q146 Have you ever blamed someone for doing something you knew was really your fault?

- ☐ Yes (1)
- ☐ No (2)

Q147 Are your feelings easily hurt?

- ☐ Yes (1)
- ☐ No (2)

Q148 Do you prefer to go your own way rather than act by the rules?

- ☐ Yes (1)
- ☐ No (2)

Q149 Can you usually let yourself go and enjoy yourself at a lively party?

- ☐ Yes (1)
- ☐ No (2)

Q150 Are all your habits good and desirable ones?

- ☐ Yes (1)
- ☐ No (2)

Q151 Do you often feel "fed up"?

- ☐ Yes (1)
- ☐ No (2)

Q152 Do good manners and cleanliness matter much to you?

- ☐ Yes (1)
- ☐ No (2)

Q153 Do you usually take the initiative in making new friends?

- ☐ Yes (1)
- ☐ No (2)

Q154 Have you ever taken anything (even a pin or button) that belonged to someone else?

- ☐ Yes (1)
- ☐ No (2)

Q155 Would you call yourself a nervous person?

- ☐ Yes (1)
- ☐ No (2)

Q156 Do you think marriage is old fashioned and should be done away with?

- ☐ Yes (1)
- ☐ No (2)

Q157 Can you easily get some life into a rather dull party?

- ☐ Yes (1)
- ☐ No (2)

Q158 Have you ever broken or lost something belonging to someone else?

- ☐ Yes (1)
- ☐ No (2)

Q159 Are you a worrier?

- ☐ Yes (1)
- ☐ No (2)

Q160 Do you enjoy co-operating with others?

- ☐ Yes (1)
- ☐ No (2)

Q161 Do you tend to keep in the background on social occasions?

- ☐ Yes (1)
- ☐ No (2)

Q162 Does it worry you if you know there are mistakes in your work?

- ☐ Yes (1)
- ☐ No (2)

Q163 Have you ever said anything bad or nasty about anyone?

- ☐ Yes (1)
- ☐ No (2)

Q164 Would you call yourself tense or "highly-strung"?

- ☐ Yes (1)
- ☐ No (2)

Q165 Please select no for this question. (Filter Question)

- ☐ Yes (1)
- ☐ Maybe (2)
- ☐ No (3)

If No Is Not Selected, Then Skip To End of Block

Q166 Do you think people spend too much time safeguarding their future with savings and insurances?

- ☐ Yes (1)
- ☐ No (2)

Q167 Do you like mixing with people?

- ☐ Yes (1)
- ☐ No (2)

Q168 As a child were you ever cheeky to your parents?

- ☐ Yes (1)
- ☐ No (2)

Q169 Do you worry too long after an embarrassing experience?

- ☐ Yes (1)
- ☐ No (2)

Q170 Do you try not to be rude to people?

- ☐ Yes (1)
- ☐ No (2)

Q171 Do you like plenty of bustle and excitement around you?

- ☐ Yes (1)
- ☐ No (2)

Q172 Have you ever cheated at a game?

- ☐ Yes (1)
- ☐ No (2)

Q173 Do you suffer from "nerves"?

- ☐ Yes (1)
- ☐ No (2)

Q174 Would you like other people to be afraid of you?

- ☐ Yes (1)
- ☐ No (2)

Q175 Have you ever taken advantage of someone?

- ☐ Yes (1)
- ☐ No (2)

Q176 Are you mostly quiet when you are with other people?

- ☐ Yes (1)
- ☐ No (2)

Q177 Do you often feel lonely?

- ☐ Yes (1)
- ☐ No (2)

Q178 Is it better to follow society's rules than go your own way?

- ☐ Yes (1)
- ☐ No (2)

Q179 Do other people think of you as being very lively?

- ☐ Yes (1)
- ☐ No (2)

Q180 Do you always practice what you preach?

- ☐ Yes (1)
- ☐ No (2)

Q181 Are you often troubled about feelings of guilt?

- ☐ Yes (1)
- ☐ No (2)

Q182 Do you sometimes put off until tomorrow what you ought to do today?

- ☐ Yes (1)
- ☐ No (2)

Q183 Can you get a party going?

- ☐ Yes (1)
- ☐ No (2)

Thank you for completing this research. The extra information provided about each injury did not reflect true events. The immediate management of these injuries was altered to create experimental conditions.