

FRONTAL LOBE DAMAGE IN FOOTBALL PLAYERS AND DEVIANT BEHAVIOR

BY

APRIL CETINA

A thesis submitted
in partial fulfillment of the requirements for the degree of
Master of Arts in Forensic Psychology
California Baptist University
School of Behavioral Sciences

2017

SCHOOL OF BEHAVIORAL SCIENCES

The thesis of April Cetina, "Frontal Lobe Damage in Football Players and Deviant Behavior," approved by her Committee, has been accepted and approved by the Faculty of the School of Behavioral Sciences, in partial fulfillment of the requirements for the degree of Master of Arts in Forensic Psychology.

Thesis Committee:

Ana Gamez, PhD

Anne-Marie Larsen, PhD
Committee Chairperson

May 1, 2017

DEDICATION

I dedicate this thesis to my mother Marlene Cetina-Mendez from heaven you are watching me succeed in my life. My Fiancé Carlos Gomez-Mustafa, thank you for always supporting my dreams and to my loving twin sister Lillian Cetina, thank you for always believing in me. You two have been my best support during these last three years I couldn't have done it without you.

ACKNOWLEDGMENTS

I would like to thank my committee members who were more than generous with their expertise and valuable time. A special thanks to my committee chair Dr. Anne-Marie Larsen for always believing in my work and always being there to lend a hand when I needed her help. Thank you Dr. Ana Gamez for always supporting me on this thesis.

ABSTRACT OF THE THESIS**Frontal Lobe Damage in Football Players and Deviant Behavior**

By

April Cetina

School of Behavioral Sciences

Anne Marie Larsen PhD

Thesis Committee Chairperson

Anne-Marie Larsen PhD

2017

Given the recent high profile suicides among NFL football players, an interest in the role of closed head injuries in these deaths has ensued. Utilizing archival data, a historical analysis was conducted to test the hypothesis that executive function may have been damaged due to traumatic brain injury incurred while playing football. The findings support that damage to the frontal lobe appears to influence a major change in NFL players.

TABLE OF CONTENTS

	Page
DEDICATION.....	iii
ACKNOWLEDGMENT.....	iv
ABSTRACT OF THE THESIS.....	v
Chapter	
1. The Problem Statement.....	1
a. Introduction.....	2
b. Problem Statement.....	2
c. Purpose of Study.....	2
d. Research Questions/Objectives.....	2
e. Delimitations.....	2
f. Assumptions.....	2
g. Definition of Key Terms.....	3
2. Review of the Literature.....	5
a. Introduction.....	5
b. Head Injuries.....	5
1. Traumatic Brain Injury.....	6
c. Concussions.....	8
d. Chronic Traumatic Encephalopathy.....	10
e. Executive Functioning.....	12

3. Methods.....	22
Participants.....	22
Design.....	22
Procedure.....	23
4. Results.....	24
Results.....	25
Summary.....	30
5. Discussion.....	31
Introduction.....	31
Conclusions.....	31
Limitations.....	32
Significant.....	32
Future Research.....	33
References.....	34
Appendices.....	38
A. Checklist.....	38

Chapter 1

THE PROBLEM STATEMENT

The deaths of hall of fame football players such as Mike Webster, Justin Strzelczyk, and Junior Seau have all been caused by traumatic brain injury due to concussion while playing in the NFL. Indeed, a high number of football players have suffered from the symptoms of concussion over the last 15 years. An example of a concussion is the result of someone hitting his or her head on the steering wheel in an accident. Moreover, frontal lobe damage can be sustained from major head injury in a car accident, leading to brain trauma. A significant effect of frontal lobe damage due to chronic concussion is that an individual's executive functions are compromised as a result of the injuries sustained on the football field. When an individual loses control of executive functions, he or she may become more violent.

Problem Statement

In the NFL, frontal lobe damage is a major problem that is caused by concussions leading to traumatic brain injuries. This major problem is due to the repetitiveness of these types of injuries. This is a problem because these injuries are undiagnosed. This becomes a problem when players don't report their injuries and when trainers do not recognize these injuries.

Purpose of the Study

The purpose of this study is to test the hypothesis that frontal lobe damage caused by traumatic brain injury results in violent or deviant behavior. This study is important because there are a significant number of NFL players who suffer from traumatic brain injuries due to concussion, and go on to exhibit violent behavior.

Research Question/Objectives

Does frontal lobe damage affect executive functioning and lead to violent or deviant behavior.

H1: Frontal lobe damage incurred by NFL football players' concussions leads to violent or deviant behavior.

Delimitations

The study focused on male NFL players who have suffered from some type of head injury in their football career. There is no discussion, in this context, of memory, females, other sports or other injuries.

Assumptions

In this study, the researcher assumed that all the sources are credible. A further assumption is that there exist biased opinions about to the behavior of NFL players. People may be biased due to the popularity of the game and not care about such a study because, it is believed, no matter what happens players will get injured. It is expected that people who feel very passionate about football will not understand the importance of this study.

Definition of Key Terms

ABC Assessment. An assessment that stands for airway, regular breathing, and a normal circulation/pulse which is a brief mental status exam (Barth et al., 2004).

Chronic Traumatic Encephalopathy (CTE). A progressive degenerative aging disease of the brain found in individuals with a history of repetitive brain trauma (Omalu, 2013).

Closed head injury. A harsh blow to the head from a striking object (Maas, Maas, Stocchetti, & Bullock, 2008)

Executive Functioning. The general ability to engage in independent, purposeful, self-directive, and self-serving behavior. This includes the ability to set goals, to initiate actions, and to regulate behavior. There are in total five functions: attention, sexual, planning, aggression, and impulsivity (Lezak, 1982).

Graded. A continuum from 1-3 measuring the severity and seriousness of a head injury (Drysdale, 2013).

Mild traumatic brain injury (mTBI). A form of acquired brain injury which is a mild or minor form of TBI (Traumatic brain injury.com, 2016).

Open head injury. A penetrating injury. This which occurs when an object breaks the skull and injures the brain, due to the speed and impact of the object (Maas, Maas, Stocchetti, & Bullock, 2008).

Traumatic brain injury (TBI). A form of acquired brain injury, which occurs when sudden trauma causes damage to the brain (Barth, Bender, & Irby, 2004).

Tinnitus. The perception of noise or ringing in the ears (American Tinnitus Association.org, 2015).

Chapter 2

REVIEW OF THE LITERATURE

Introduction

American football has been popular for the last 30 years, and it is now the most watched sport on television. All types of football injuries occur on the field: broken fingers, head injuries, shattered knee caps, and punctured kidneys. There is increasing research on head injuries in football, which has become an unavoidable topic of concern. The long-term effects of these recurring concussions are forcing football players, as well as coaches and fans, to take a closer look at their sport and the sacrifices that they must make (Burke, 2012). Frontal lobe damage incurred by NFL football players' concussions leads to violent or deviant behavior. This study is going to cover the types of head injuries that cause frontal lobe damage. This study will also cover the executive functions that are damaged due to these injuries.

Head Injuries

A head injury is trauma to the brain, skull, or scalp. It may also be minimal like a bump or bruise on the head, or invasive like a serious brain injury. There are two types of head injury: closed or open. Closed head injury is a harsh blow

to the head from a striking object. The second type, open head injury, is also called penetrating injury. This occurs when an object breaks the skull and injures the brain, due to the speed and impact of the object. Football players often suffer from of traumatic head injury including concussion and skull fracture (Maas, Maas, Stocchetti, & Bullock, 2008).

Traumatic Brain Injury

Barth, Bender, and Irby (2004) stated that traumatic brain injury (TBI) is a form of acquired brain injury, which occurs when sudden trauma causes damage to the brain. Barth et al. (2004), furthermore, noted that healthcare professionals are interested in mild traumatic brain injuries (mTBIs), and, for the last 15 years, have relied increasingly on neuropsychological tests for evidence that relates mTBI to concussion. Prior to the 1980s, brain injuries were not taken seriously as healthcare professionals believed that patients would recover quickly. Wills and Leathem (2001) conducted a study on individuals who suffered concussion, in order to determine the lasting effects of TBIs. The results indicated that TBI in individuals impaired concentration, attention, and the way they processed information. Moreover, Rimel, Giordani, Barth, Boll, and Jane (1983) found that 55% of all closed head injuries were determined as mTBIs.

Despite healthcare professionals not taking mTBIs seriously, the frequent injuries continued to affect football players and other athletes in different sporting stadiums. Researchers realized that there were many athletes who were not properly examined after a concussion, and the vast majority of TBIs were underreported. The reason for this was because the terms concussion, mTBIs, and closed head injury were used inconsistently. Medical professionals were unaware how to use these terms properly because they were more descriptive of the exact type of head injury and differed from common terms such as head contusion and skull injury (Barth et al., 2004).

According to The Centers for Disease Control and Prevention (CDC), one to two million new incidents of mTBI are reported each year in the US and many more are not reported. Researchers established that 30-37% of those playing football in high school and university sustained a mild brain injury at some time in their football career (CDC, 2016). Segalowitz and Lawson (1995) stated that common concussion symptoms include sleep disturbance, depression, reading and speech disorders, and a variety of psychological deficits. The NFL ignored mTBIs when they occurred on the playing field because football players did not seek medical assistance after suffering a possible brain injury. They suggested that injured football players were not

sent to the hospital because the league did not want them to be out of the game. Often, only the team doctors examine these football players quickly so that they can continue playing.

The biggest challenges faced by team doctors when providing a mental status evaluation of athletes during a game and shortly after a concussion are the numerous distractions, interruptions, and the limited time they have to make an accurate assessment. The quick evaluation of injured players by the team physician is called an ABC assessment, which is a brief mental status exam. ABC assessment stands for airway, regular breathing, and a normal circulation/pulse. This assessment was proposed by Maddocks, Dicker, and Saling (1995) to discriminate between concussed and non-concussed players. When the game has come to an end, the player undergoes a more in-depth evaluation that includes a neurological exam. The evaluation includes brief tests of orientation, attention, and memory, and is used in conjunction with a brief neurological exam (Barth et al., 2004).

Concussions

According to Giza and Hovda (2004), traumatic brain injury is the leading cause of death and disability in young people who participate in sports. One study of CDC data collected in 2005-2006 estimated that 55,007 concussions occur each year in

organized high school football alone. Concussion, which is the most common type of TBI, is defined as a traumatically induced brain dysfunction with or without loss of consciousness. A characteristic of concussion is the massive structural change in the brain with persistent motor, cognitive or behavioral impairment. Brain concussion generates physiological changes that have important effects on cerebral vulnerability, plasticity, and persistent neurocognitive deficits. Neurocognitive deficits include a decreasing ability to think rationally, to make decisions, and to control one's behavior (Giza & Hovda, 2004).

As reported by the American Academy of Neurology (2012), symptoms of concussion are blurry vision, confusion, lack of sleep, and sensitivity to light and sound. Giza et al. (2013) stated that individuals who suffered from concussion also exhibited drastic behaviors and personality changes. These symptoms include unclear speech, delayed responses, confusion, and change in coordination. The Director of Mount Sinai Center for Cognitive Health and NFL Neurological Center, Dr. Sam Gandy, highlighted that "damage to the frontal lobe can compromise the inhibiting effect and cause mood swings and even violence" (Abreu, et al., 2016). This is relevant to concussion because studies have shown that NFL players such as Mike Webster and

Justin Strzelczyk displayed such erratic behaviors as a result of concussion and traumatic brain injury. Stamm et al. (2015) examined the brain images of 40 former NFL players ranging in ages (40-65 years), who had experienced more than 12 years of playing football. They determined that those who started their football careers at an early age often suffered from exposure to repetitive head trauma during their neurodevelopmental period, which may have resulted in mood and behavior deficits in adulthood (Baugh et al., 2015).

Powell and Barber-Foss (1999) found that 63% of sport-related injuries in football were due to tackling. It was often the case that factors such as the mass, weight, velocity, and hardness of the force could not predict the extent of the brain damage (Barth, Bender, & Irby, 2004). This relates to the hypothesis because it explains the extent of the concussion.

Drysdale (2013) graded concussions on a continuum of one to three: grade one being the least severe form of head injury, and grade three being the most severe. When a player sustains a grade one concussion, he remains conscious and only suffers from temporary confusion, thus medical attention is not needed. Grade two concussions often results in tinnitus, combined with temporary amnesia and nausea. A grade three concussion leaves

the individual unconscious and in need of medical attention (Drysdale, 2013).

Chronic Traumatic Encephalopathy

Chronic Traumatic Encephalopathy (CTE) is a progressive degenerative disease of the brain found in athletes with a history of repetitive brain trauma. According to McKee et al. (2009), CTE is a neurodegenerative disorder. When a brain starts to deteriorate, it produces immense amounts of the tau protein, which constitute what is known as a neurofibrillary tangle, because they resemble yarn. CTE is a rare brain disorder because the tau protein (neurofibrillary tangle) produces a unique pattern compared with any other brain disease or disorder (McKee et al., 2009). CTE was first identified by Dr. Harrison Martland in a group of boxers. Shortly after this discovery, other researchers noted similar symptoms in victims of brain trauma. The symptoms of CTE include memory loss, difficulty controlling impulses, erratic behavior, impaired behavior, and disturbing behavior such as aggression and depression (Brain Injury Research Institute, 2017).

In 2005, Dr. Bennet Omalu, a pathologist in Pittsburgh, published the first study of CTE in football players. In their examination of former NFL player Mike Webster, Dr. Omalu and his

colleagues linked evidence of long-term neurodegenerative concerns associated with CTE to repetitive exposure to mTBIs caused by football. Breslow (2014) noted that in 2005, there was an increase in the number of former NFL players who donated their brains to science. In total, the brains of 76 out of 79 former players were examined. In the NFL, offensive and defensive linemen are most often diagnosed with CTE. The reason why players in these positions are commonly diagnosed is because they are tackled the most during games (Breslow, 2014).

According to Fainaru and Fainaru-Wada (2013), before 2013, CTE could only be diagnosed once the player was deceased. Doctors would take a large sample of the brain during autopsy and examine it for signs of CTE. Not only was CTE difficult to determine after death, but it was also practically impossible to detect potential signs and symptoms in NFL players. In 2009, the Professor of Neurology and Pathology at Boston University, Dr. Ann McKee, identified that athletes diagnosed with CTE had symptoms of irritability, impulsivity, aggression, depression, and high rates of suicide, 8 to 10 years after experiencing repetitive mTBIs. NFL retirees suffered from anger and older retired players experienced memory-related illness (McKee et al., 2009).

A medical breakthrough in 2013 at UCLA led to detection of the symptoms of CTE in living brains. UCLA scientists discovered that by using positron emission tomography (PET) scans, this could benefit medical treatment, helping doctors pre-diagnose and manage the disease in NFL players. Though there is no cure for CTE, researchers are still looking for ways to prevent and treat this prominent disease (Fainar & Fainaru-Wada, 2013).

Executive Functioning

According to Lezak (1982), executive functioning is the general ability to engage in independent, purposeful, self-directive, and self-interested behaviors. Executive functioning also includes the capacities to set goals, to form plans, to initiate actions, and to regulate and evaluate behaviors, according to a plan and situational constraints. Executive functions are only required in new, non-routine, and complex situations (Lezak, 1982). These executive functions are considered to be advanced-level functions, which control the basic cognitive functions of an individual. Such skills are key to how an individual makes use of his or her knowledge, skills, and intellectual abilities. By implication, the intactness of executive functions determines whether an individual has brain damage with lower levels of cognitive deficits (Lezak, 1982).

The development of executive abilities correlates with the gray matter growth and white matter volume resulting in synaptogenesis (Constantinidou et al., 2012). Synaptogenesis is the formation of synapses between neurons in the nervous system. This phase occurs twice in an individual's neurological development: during the first two years of life, and during pre-adolescence through to mid-20s. During the development of the second phase, other vital cognitive domains such as decision-making and psychosocial skills are acquired (Constantinidou, Wertheimer, Evans, & Paul, 2012).

Research by Shallice and Burgess (2000) supported evidence that executive functioning is linked to the prefrontal cortex. Individuals who suffer from head trauma and prefrontal damage are perceived to frequently encounter problems identifiable as dysexecutive, namely, an inability to plan and regulate personal behavior adequately (Shallice & Burgess, 2000). There are a total of six functions: attention, hyper sexuality, aggression, impulsivity, decision-making and planning.

Attention

Research by Crépeau and Scherzer (1993) further demonstrated that individuals who suffered from traumatic brain injury tended to have difficulty performing more than one task at a time. This difficulty has been found to be significantly

correlated with the inability of dependency in the complex activities of daily living. Certain inconsistencies could result from the different attentional demands within individual daily responsibilities. Park, Moscovitch, and Robertson (1999) examined the interaction between divided attention and working memory capacity, and established that the dual-task and attention performances of severe TBI patients were extremely impaired (Crépeau & Scherzer, 1993).

Sexual

Phineas Gage is a perfect example of frontal lobe damage caused by TBIs, leading to change in behavior. He was one of the first cases of TBI, and whose psychiatric symptoms were reported in detail. Gage was a construction worker who, in 1848, survived an accident in which an iron bar went through his skull, seriously damaging the frontal lobe (Tobia, 2015). As a result, he developed numerous personality and behavior changes. Hypersexuality, one of the behavior changes Gage developed, has been defined as the subjective experience of sexual loss of control, recognizable as increased need for sexual satisfaction. Eghwurdjakpor and Essien (2008) described five patients who suffered from frontal lobe damage caused by TBI and exhibited hypersexuality. The various levels of behavior ranged from

inappropriate verbal profanity, aggressive grabbing, compulsive masturbation, and attempted rape (Eghwrudjakpor & Essien, 2008).

Aggression

According to Amante et al. (2008), individuals suffering from traumatic brain injury can exhibit aggression. Agitation describes restlessness, with specific cognitive and behavioral characteristics, while aggression describes negative or threatening behaviors (Amante et al., 2008).

Research by Davidson, Putnam, and Larson (2000) showed how impulsive behavior can affect the brain. They also explained how aggressive environmental stimulus affects the basal ganglia function, which integrates information to the orbitofrontal cortex. The orbitofrontal cortex is a prefrontal cortex region in the frontal lobes in the brain, which is involved in the cognitive processing of decision-making. The basal ganglia are responsible for voluntary motor control, procedural learning, and eye movement, as well as cognitive and emotional functions. Physical or functional abnormalities in these areas can increase impulsive aggression. Common aggressive or impulsive actions include violent outburst, random fights, and erratic aggressive moods. Overall, aggression may be categorized as impulsive behavior, either spontaneous or planned (Davidson, Larson, & Putnam, 2000).

Decision-making/Planning

Patients with frontal lobe brain damage exhibit impairment in attempting to undertake tasks that require planning to accomplish (Alexander et al., 2000). When an individual has to plan something, a number of cognitive procedures are required, including a look-ahead mechanism intended to cause multiple sequences of assumed events and their consequences. The development of stored planned-event structure can guide an individual to certain goals in life, and to an appreciation of goal achievement. All of these developments depend on the use of the prefrontal cortex. The performance of frontal lobe lesion patients suggests impairment in execution-related processes, while frontal lobe dementia patients appear to be impaired in both plan development and execution (Alexander et al., 2000).

Impulsivity

Impulsivity is a common concern following TBI, which has many effects on a patient's quality of life, social and professional results, and well-being. For this reason, it is important to identify correctly impulsivity in patients who suffer from TBI. According to Annon et al. (2010), there is no valid instrument to identify specifically impulsivity in TBI

patients. Some examples of impulsive behavior include behavioral and emotional change, lack of impulse control, and change in spending habits (Annon, et al., 2010).

Gagnon and Kocka (2014) discussed three types of impulsivity: motor impulsivity (acting without thinking); cognitive impulsivity (quick decision-making); and non-planning impulsivity (involving day-by-day tasks). Of the three models of impulsivity, the most dangerous is motor impulsivity, which is often spontaneous. Patients do not think about the negative consequences of their actions on themselves and others. Impulsivity includes risky acts, disrupting behaviors, unreasonable acts, promiscuous actions, and self-injurious behaviors (Gagnon & Kocka, 2014).

Football Players

Mike Webster

On September 28, 2002, Mike Webster, one of the most iconic athletes, passed away due to injuries he sustained while playing football for 17 years (Fainaru-Wada & Fainaru, 2013). He was the legendary center of the Pittsburgh Steelers. Webster was 50 years old when he died, and there were plenty of rumors about his illness, that he was living in his car, and was jobless. According to his family, during Webster's playing years, he was

a kind-hearted man, who loved football and being around his family. However, everything changed abruptly soon after he stopped playing. Webster purchased a Sig Sauer P226 semiautomatic pistol and two other guns. He said that he would kill NFL officials including executive members of the Steelers because of the financial troubles he was in. When Webster's body was examined by Dr. Bennet Omalu, his brain looked normal and there was no visible bruising or aneurysm. Dr. Omalu discovered that Webster had CTE, which was due to all of the TBIs he sustained (Fainaru-Wada & Fainaru, 2013).

Throughout Webster's career, his wife Pam Webster noticed that her husband was coming home from playing football with severe headaches. He must have sustained multiple head injuries. However, only two reports were made by his doctors stating that he had suffered from a head injury. The first was on December 19, 1982, which marked Webster's eighth year playing in the NFL. It noted that he passed out after a game experiencing dizziness. The second report of a head injury was made on November 3, 1988. It stated that he had hit his head during a practice game and complained about being a little dizzy. The lack of medical attention by NFL physicians caused major changes in Webster. He was growing tired of playing, so he decided to retire. Shortly after, his family started to notice that he was becoming short

tempered, easily distracted, and forgetful. He was suffering financial problems and, overall, his personality had changed. Pam Webster was at a loss to explain what was happening to her husband. His behavior was more erratic, and she was beginning to think that someone else was occupying his body (Fainaru-Wada & Fainaru, 2013).

Due the TBI Webster sustained while playing in the NFL for 17 years, he started to develop impulsivities. The first was random shopping sprees to buy speedboats, motorcycles, and other unnecessary items. He even opened dozens of bank accounts, stopped paying his taxes, and even started to spend his children's college funds. He also began to wander off throughout the day and Pam Webster never knew where her husband was.

Justin Strzelczyk

Justin Strzelczyk was another football player who was found to have suffered from TBI and CTE during his career between 1990 and 1998. People described him as a loving and friendly person, who loved to play the banjo and to be with his family. This all changed shortly after he retired. Strzelczyk claimed that he was hearing voices. His personality started to change, and he became angry more easily. He was losing his mind. On the morning of his death, Strzelczyk was suffering from one

of his erratic meltdowns and decided to get behind the wheel. He became more upset and was involved in a high-speed chase with law enforcement. He collided with another vehicle and his car exploded killing him instantly. Mary Strzelczyk, his mother, gave permission to Dr. Omalu to examine her son's brain for signs of CTE. Omalu remained confident that Strzelczyk's erratic behavior was caused by concussion and TBI suffered during his NFL career (Schwarz, 2007).

Junior Seau

Junior Seau, throughout his 20-year NFL career suffered from multiple concussions. According to *Frontline*, he suffered from impulsivity such as gambling, violent off the field incidents, and unpredictable mood behaviors. Seau committed suicide and many wondered whether CTE was the cause. *Frontline* also reported that he was involved in a domestic violence dispute with his 25-year-old girlfriend. Seau was also accused of reckless driving when he crashed his car. His ex-wife Gina even stated that she was unaware why he would come home upset and detached, and his children noted that he became distant and disconnected. Seau's brain had signs of CTE resulting from continuous concussion and brain injuries (Frontline PBS, 2014).

Chapter 3

METHOD

Participants

This study included archival data on three male NFL players ranging in age ($M = 34-50$), who were deceased at the time the study was conducted. All participants were selected based on their history of head injuries and violent behavioral tendencies. No other sports-related injuries were examined in this study.

Design

A historical analysis was performed to test the hypothesis that deviant behavior results from frontal lobe damage caused by a head injury.

Instruments

A checklist was developed to describe the executive functions that were possibly damaged due to head injuries. The checklist encompassed a total of five constructs : (a) lack of planning/decision-making, (b) impulsivity, (c) sexual Gratification, (d) aggression, and (e) attention. Each of these

constructs contained a checklist of items that described selected executive functions (see Appendix A).

Procedure

Articles were used from the *Academic Search Premier* database, using the following key words: frontal lobe damage, executive functioning, chronic head injuries, traumatic brain injuries, concussions, and deviant behavior. The timeframe of the archival data (1982-2016) was selected because during the early 1980s head injuries were not considered to be serious. Furthermore, only archival data on NFL players, TBI, and deviant behavior were used to determine the injuries all the participants had in common. The checklist determined whether they fall into the executive functions described in the study. Data collected were first coded broadly and then axially for themes. Once themes were established, they were compared to the checklist to see if anecdotally these players met the criteria.

Chapter 4

RESULTS

The overall hypothesis was supported that frontal lobe damage cause by traumatic brain injury results in violent or deviant behavior. It was supported by the abundant amount of evidence that each of the three NFL players applied into each categories of behaviors.

Mike Webster met the criteria of deviant behavior due to frontal lobe damage. He exhibited significant changes in behavior, which included aggression, impulsivity, attention, and lack of planning. Justin Strzelczyk also demonstrated significant personality changes and impulsivities that caused harm to himself and his love ones. Junior Seau, finally, experienced significant changes in lifestyle and behavior that led, ultimately, to his death.

Lack of Planning/Decision-Making

Mike Webster. Due to the frontal lobe damage caused by traumatic brain injury, Mike Webster started to lose his memory. His son recalled the following about his father.

"He forgets how to get to the grocery store and forgets how to get home" (Colin Webster, Frontline PBS League of Denial, 13:56).

"He couldn't get his thoughts together, he was always so confused" (Colin Webster, Frontline PBS, League of Denial, 14:01).

Junior Seau. Due to the frontal lobe damage sustained while playing football, Junior Seau became reclusive. He withdrew from his family and close friends, going months without seeing his children (Fainaru-Wada and Fainaru, 2013, p. 327). "The past two years have been the roughest for a couple of months, at one point I wouldn't hear from him at all" (Sydney Seau, Frontline PBS, League of Denial 2:41).

Impulsivity

Mike Webster. Webster began spending money due to the inability to control his impulsive behaviors, which affected his entire family.

"Money is gone, his providing is gone, our bills are overdue, our house is getting foreclosure, all the security is gone so everything is crumbling right in front of us" (Pam Webster, Frontline PBS, 14:31).

Justin Strzelczyk. Melissa was driving over the Pittsburgh Bridge on the way home one day when he began to throw money out of the car. He believed that Pittsburgh was possessed by the devil.

"Justin started throwing money (coins) out the sunroof of her car one day while saying 'if this is what the devil wants then he can have it'" (Melissa Strzelczyk, ESPN, 4:47).

Justin Strzelczyk's best friend Chris Turgeon stated, "Justin was upset and depressed and said that the people of Pittsburg are evil and the devil is everywhere" (Chris Turgeon, ESPN, 2:12).

Junior Seau. Due to the frontal lobe damage that *Junior Seau* sustained from playing football, he began to lose control and became impulsive.

"He lost millions of dollars in gambling including compulsive gambling, alcohol abuse and violence off the field incidents" (Narrator, Frontline PBS 0:05).

"Seau's gold Cadillac SUV plunged over a cliff five hours after posting a bond after being arrested for domestic violence" (John Carroll, CNN, 2010).

Hoffman had become alarmed by Seau's growing gambling addiction, which cost him hundreds of thousands, if not millions of dollars. "It became more and more serious", said Hoffman, who

had control of Seau's finances. He would often call her from Las Vegas, sometimes frantic, asking her to wire huge amounts of money to keep him going (Fainaru-Wada and Fainaru, 2013, p. 327).

Sexual Gratification

None of the NFL players in this study had any behaviors linked to sexual gratification.

Aggression

Mike Webster. Mike's began to develop aggression towards to his family members and the NFL. "Mike was angrier than before, Mike wasn't Mike he had no patience and no physical stamina" (Pam Webster, Frontline PBS 2013, 13:25). "Mike was so angry that he took a knife and slashed all of his football pictures and shattered all of his trophies and memorabilia" (Pam Webster, Frontline PBS 2013, 14:07).

Justin Strzelczyk. Justin found God and started to attend church. He became erratic and did not know how to control his impulses. "He started preaching about God and if you wouldn't listen to him then he would get so angry. He would yell and then all of a sudden be fine. He would be peaceful and then in another moment he would display erratic behavior like he was someone else" (Melissa Strzelczyk, ESPN, 4:00).

Junior Seau. Junior aggression became uncontrollable; he would get upset very easily and take it out on his family. "We didn't know why he was detached or forgetting or why he would bark at us at nothing" (Gina Seau's ex-wife, Frontline PBS). ABC News reported that Junior Seau was arrested for domestic violence.

On October 17, 2010, he was arrested on charges of assaulting his live-in girlfriend, Mary Nolan. She told officers that Seau had "grabbed her by the arm and shoved her into the wall dresser in their bedroom" (Fainaru-Wada and Fainaru, 2013, p. 328).

Attention

Mike Webster. Mike began to lose his memory due to the repetitive concussions he sustained in his NFL career. "He forgets how to get to the grocery store and forgets how to get home" (Colin Webster, Frontline PBS League of Denial, 13:56). "He couldn't get his thoughts together" (Colin Webster, Frontline PBS League of Denial, 14:01). "For Iron Mike, TV interviews became impossible due to him losing his thoughts and not being able to talk in complete sentences" (Narrator, Frontline PBS League of Denial, 16:19).

Webster's attorney said, "Mike was so intelligent but he couldn't keep his thought process for 30 seconds to a minute and would go off in tangents" (Bob Fitzsimmon, Frontline PBS League of Denial, 17:50).

Justin Strzelczyk. Dan Horan an old friend of, Justin Strzelczyk, of note is the strange phone call that he made to his old friend Dan Horan. Strzelczyk told him, "I spoke to my father, he was at home and collected cans". However, Dan told him that his father was dead, to which Strzelczyk replied, "No, Dan, my dad is alive" (Dan Horan, ESPN 2006, 1:45).

Junior Seau. Junior would spend his days gambling away all of his money and not see his family or friends. "We didn't know why he was detached or forgetting or why he would bark at us at nothing" (Gina Seau, ex-wife, Frontline PBS). Sydney Seau "wouldn't hear from her dad at all for days" (Sydney Seau, Frontline PBS League of Denial, 2:45). His memory was fading. One day, his son Jake, a star lacrosse player, had a game in Torrey Pines. Seau's daughter, Sydney, called repeatedly to remind him to be there on the morning of the game. "I text him 20 minutes beforehand and I'm like, 'Where are you? They're warming up'", she recalled. "And he's like, 'What are you talking about? I thought that's tomorrow'. And I'm like 'No, I called you this morning. We talked about this. You need to be

here. Get here now'” (Fainaru-Wada and Fainaru, 2013 p. 327).

“We get real close and I feel like his life is turning around and he wants to be a part of my life and then all of a sudden I wouldn't hear from him” (Tyler Seau, Frontline PBS League of Denial, 2:52).

The main finding of this archival study is that TBIs in NFL players with frontal lobe damage affect their executive functions causing deviant behaviors: lack of planning/decision-making, impulsivity, aggression, and attention. It is hypothesized that frontal lobe damage caused by TBI results in violent or deviant behavior. The evidence presented in this section proves that these NFL players committed deviant or violent behavior due to TBI or concussion resulting from playing professional football.

Chapter 5

Discussion

The primary aim of this study was to identify whether frontal lobe damage caused by TBI results in deviant or violent behavior. The evidence supports that NFL players who sustain numerous concussions or TBIs damage their executive functions. This finding supports other studies such as Giza et al. (2013), who showed that individuals who suffer from concussion also exhibit drastic behaviors and personality changes. Mike Webster, Justin Strzelczyk, and Junior Seau all appeared to have damaged executive functions, which appear to have resulted in deviant and violent behavior. They had an erratic personality, and could be violent and act defiantly. The hypothesis also supports previous findings from Dr. Sam Gandy, who identified that "damage to the frontal lobe can compromise the inhibiting effect and cause mood swings and even violence" (Abreu, et al., 2016). The checklist analyzed the executive functions affected by each participant's damage to the frontal lobe. Four of the five executive functions appeared dysfunctional according to the checklist: lack of planning/decision making, attention,

impulsivity, and aggression. The only executive function not supported was sexual gratification. Evidence for each of the executive functions is supported by reports of the experiences of family and friends.

The results of this study were expected, but it was important to find evidence to corroborate past research. The findings were further supported by using the checklist created by the researcher, and by explaining each of the executive functions in detail.

Limitations

There were several limitations. The first limitation is related to the type of research; historical analyses do not allow for control or experimentation and therefore lack in generalizability. Given this, it is impossible to speak of cause and effect, as no control for confounding variables. Another limitation includes the lack of live participants and bias inherent in qualitative research. Finally, there is a limitation that these effects come solely from playing football; players can get concussions from other means and this study did not control for outside factors such as substance use, fighting, or other ways to incur significant frontal lobe damage.

Implications

This study is important because it can help parents to make the right decision if they are thinking of encouraging their children to play football. They are provided with information on the consequences and dangers. Moreover, explanation of the significance of concussions, and why these injuries should be taken seriously, can help prevent professional football players from developing CTE and suffering other head injuries in future.

This study is also important for psychologists to understand that TBI can affect important executive functions, which are necessary for everyday living. It can also explain the impulsivities that characterize football players with traumatic brain injuries.

Future Research

There are still investigations that can be made in this field of research. Every day millions of football players are being affected by concussion and other brain injuries. Notable research on CTE has only emerged in the last decade. However, I believe it is a topic that will continue to attract increasing attention owing to its significance.

REFERENCES

- Abreu, M. A., Cromartie, F. J., & Spradley, B. D. (2016).
Chronic Traumatic Encephalopathy (CTE) and Former National
Football League Player Suicides. *Sport Journal*.
- Alexander, G., Bonerbaa, J., Carlin, D., Grafman, J., Phipps,
M., & Shapiro, M. (2000). Planning impairments in frontal
lobe dementia and frontal lobe lesion patients.
Neuropsychologia, 655-665.
- Amante, L., Diaz, A., Hohl , A., Linhares, M., Quevedo, J.,
Rufino, A., . . . Walz, R. (2008). Psychiatric disorders
and traumatic brain injury. *Neuropsychiatric Disease and
Treatment*, 797-816.
- American Academy of Neurology. (2012). Consensus Statement on
Concussion in Sport—Th4th International Conference on
Concussion in Sport Held in Zurich, November 2012 .
American Academy of Neurology. Retrieved from Concussions.
- Ann C. McKee, M. R.-W.-S. (2009). Chronic Traumatic
Encephalopathy in Athletes: ProgressiveTauopathy After
Repetitive Head Injury. 709-735.
- Annon, J.-M., Azouvi, P., Beni, C., Billieux, J., Rochat, L., &
Van der Linden, M. (2010). Assessment of impulsivity after

moderate to severe traumatic brain injury.

Neuropsychological Rehabilitation, 778-797.

Barth , J. T., Bender, S. D., & Irby, J. (2004). Historical Perspectives. In *Traumatic Brain Injury in Sport* (pp. 3-6). Swets & Zeitlinger.

Baugh, C. M., Chaisson, C., Coleman, M. J., Fritts, N. G., Giwerc, M. Y., Koerte, I. K., . . . Zhu, A. (2015). Age at First Exposure to Football Is Associated with Altered Corpus Callosum White Matter Microstructure in Former Football Players. *Journal of Neurotrauma*.

BIRI. (2017). *What is CTE?* Retrieved from Brain Injury Research Institute: <http://www.protectthebrain.org/Brain-Injury-Research/What-is-CTE-.aspx>

Breslow, J. M. (2014). 76 of 79 Deceased NFL Players Found to Have Brain Disease.

CDC. (2016, 01 22). *Traumatic Brain Injury/Concussion* . Retrieved from Centers for Disease Control and Prevention: <https://www.cdc.gov/traumaticbraininjury/index.html>

Constantinidou, F., Wertheimer, J. C., Evans, C., & Paul, D. R. (2012). Assessment of executive functioning in brain injury: Collaboration between speech-language pathology and neuropsychology for an integrative neuropsychological perspective. *Brain Injury*, 1549-1563.

- Crépeau, F., & Scherzer, P. (1993). Predictors and indicators of work status after traumatic brain injury: A meta-analysis. *Brain Injury*, 5-35.
- Davidson, R. J., Larson, C. L., & Putnam, K. M. (2000). Dysfunction in the neural circuitry of emotion regulation-- a possible prelude to violence. *American Society for the Advancement of Science*.
- Drysdale, T. A. (2013). Helmet to Helmet Contact: Avoiding a Lifetime Penalty by Creating a Duty to Scan Active NFL Players for Chronic Traumatic Encephalopathy. *Journal of Legal Medicine* , 425-452.
- Eghwudjakpor, & Essien. (2008). Hypersexual behavior following craniocerebral trauma an experience with five cases. *Libyan Journal of Medicine*, 192-194.
- Fainar, S., & Fainaru-Wada, M. (2013). CTE found in living ex-NFL players.
- Fainaru-Wada, M., & Fainaru, S. (2013). Bird Brains. In *League of Denial: The NFL, Concussions, and the Battle for the Truth* (pp. 3-5). New York: Crown Archetype.
- Gagnon, J., & Kocka, A. (2014). Definition of Impulsivity and Related Terms Following Traumatic Brain Injury: a review of the different concepts used to assess impulsivity,

- disinhibition and other related concepts. *behavioral sciences*, 352-370.
- Giza, C. C., & Hovda, D. A. (2004). The Pathophysiology of Traumatic Brain Injury. In *Traumatic Brain Injury in Sports* (pp. 45-46). Swets & Zetlinger.
- Knight, R. G., & Marsh, N. V. (1991). Relationship Between Cognitive Deficits and Social Skill After Head Injury. *Neuropsychology*, 108.
- Lezak, M. D. (1982). The problem of assessing executive functions. *International Journal of Psychology*, 281-297.
- Maas, A. I. R., Maas, A. I., Stocchetti, N., & Bullock, R. (2008). Moderate and severe traumatic brain injury in adults. *The Lancet Neurology*, 7(8), 728-741.
- Omalu, D. (2013, March 25). The League of Denial: The NFL's Concussion Crisis. (M. Kirk, Interviewer)
- Schwarz, A. (2007). Lineman, Dead at 36, Exposes Brain Injuries. *The New York Times*.
- Shallice, T., & Burgess, P. W. (2000). Deficits in strategy application following frontal lobe damage in man. *Journal of Clinical and Experimental Neuropsychology*, 325-338.
- Tobia, K. (2015). Personal identity and the Phineas Gage effect. *Analysis*, 75(3), 396-405. doi:10.1093/analys/anv041

APPENDIX A

- Lack of planning/decision-making

The behaviors to look for in this category include not being able to plan simple daily tasks, wandering, being easily distracted, and lack of self-care.

- Impulsivity

The behaviors to look for in this category include mania impulsivity, promiscuous actions, self-injurious behaviors, random shopping sprees, gambling addiction, opening several bank accounts, spending children's college funds, debt, petty crimes and alcohol abuse, public intoxication, abusing prescription drugs, and drug use.

- Sexual gratification

The behaviors to look for in this category include inappropriate verbal profanity, aggressive grabbing, compulsive masturbation, multiple sex partners, promiscuity, and voyeurism.

- Aggression

Behaviors to look for in this category include violent outbursts, random fights, erratic aggressive moods, Antisocial Personality Disorder, domestic violence, and assault.

- Attention

Behaviors to look for in this category include short attention span, not following simple instructions, difficulty organizing daily tasks and activities, forgetfulness, and Attention-Deficit Disorder.