AoW 19

Directions:
1. Mark your confusion.
2. Show evidence of a close reading. Mark up the text with questions and/or comments.
3. Write a one-page reflection on your own sheet of paper.

The Fragile Teenage Brain

An in-depth look at concussions in high school football

Source: Jonah Lehrer/Grantland.com 1/10/12

If the sport of football ever dies, it will die from the outside in. It won't be undone by a labor lockout or a broken business model — football owners know how to make money. Instead, the death will start with those furthest from the paychecks, the unpaid high school athletes playing on Friday nights. It will begin with nervous parents reading about brain trauma, with doctors warning about the physics of soft tissue smashing into hard bone, with coaches forced to bench stars for an entire season because of a single concussion. The stadiums will still be full on Sunday, the professionals will still play, the profits will continue. But the sport will be sick.

The sickness will be rooted in football's tragic flaw, which is that it inflicts concussions on its players with devastating frequency. Although estimates vary, several studies suggest that up to 15 percent of football players suffer a mild traumatic brain injury during the season. (The odds are significantly worse for student athletes — the Centers for Disease Control and Prevention estimates that nearly 2 million brain injuries are suffered by teenage players every year.) In fact, the chances of getting a concussion while playing high school football are approximately three times higher than the second most dangerous sport, which is girls' soccer. While such head injuries have long been ignored — until recently, players were resuscitated with smelling salts so they could re-enter the game — it's now clear that these blows have lasting consequences.

The consequences appear to be particularly severe for the adolescent brain. According to a study published last year in Neurosurgery, high school football players who suffered two or more concussions reported mental problems at much higher rates, including headaches, dizziness, and sleeping issues. The scientists describe these symptoms as "neural precursors," warning signs that something in the head has gone seriously wrong.

This research builds on previous work documenting the hazards of football for the teenage brain. In 2002, a team of neurologists surveying several hundred high school football players concluded that athletes who had suffered three or more concussions were nearly ten times more likely to exhibit multiple "abnormal" responses to head injury, including loss of consciousness and persistent amnesia. A 2004 study, meanwhile, revealed that football players with multiple concussions were 7.7 times more likely to experience a "major drop in memory performance" and that three months after a concussion they continued to experience "persistent deficits in processing complex visual stimuli." What's most disturbing, perhaps, is that these cognitive deficits have a real-world impact: When compared with similar students without a history of concussions, athletes with two or more brain injuries demonstrate statistically significant lower grade-point averages.

What causes these long-term mental problems? Why are concussions so dangerous? The answer returns us to the mechanics of head trauma. Because a concussion is not a bruise. It is not a sprain. There is no bodily metaphor for what happens when the Jell-O of cortex accelerates into the skull. Although the brain is surrounded by a cushion of cerebrospinal fluid, a severe impact or abrupt change in head speed can push those three pounds of meat straight through the fluid, so that it crashes into the cranium. (The brain has no pain receptors, which means the impact can only be perceived indirectly, as a throbbing headache or loss of consciousness.)

In recent years, it's become clear that the severity of a concussion is only indirectly related to the physical force of the impact. Sometimes, players walk away from savage hits. And sometimes they are felled by incidental contact. While data compiled from the Head Impact Telemetry System, or HITS, captures the extreme physical forces at work during a football game — it's not uncommon for a player to sustain hits equivalent to the impact of a 25 mph car crash

— there is no clear threshold for injury. The mind remains a black box; nobody really understands why it breaks.

But we do know what happens once it's broken. In the milliseconds after a concussion, there is a sudden release of neurotransmitters as billions of brain cells turn themselves on at the exact same time. This frenzy of activity leads to a surge of electricity, an unleashing of the charged ions contained within neurons. It's as if the brain is pouring out its power.

The worst part of the concussion, however, is what happens next, as all those cells frantically work to regain their equilibrium. This process takes time, although how long is impossible to predict: sometimes hours, sometimes weeks, sometimes never. (The latest guidelines suggest that most concussed subjects require at least 10 days to recover, with adolescents generally needing a few days more.) While the brain is restoring itself, people suffer from a long list of side effects, which are intended to keep them from thinking too hard. Bright lights are painful; memory is fragile and full of holes; focus is impossible.

The healing also has to be uninterrupted. In the aftermath of a traumatic brain injury, the brain remains extremely fragile. Because neurons are still starved for energy, even a minor "secondary impact" can unleash a devastating molecular cascade. All of a sudden, brain cells that seemed to be regaining their balance begin committing suicide. The end result is a massive loss of neurons. Nobody knows why this loss happens. But the loss is permanent.

Teenagers are especially susceptible to these mass cellular suicides. This is largely because their brains are still developing, which means that even a slight loss of cells can alter the trajectory of brain growth. Football concussions are also most likely to affect the parts of the brain, such as the frontal lobes, that are undergoing the most intense development. (The frontal lobes are responsible for many higher cognitive functions, such as self-control and abstract reasoning. The immaturity of these areas helps explain the immaturity of teenagers.)

In recent years, neuroscientists have documented the effect of these blows over time. The worst possible outcome is a disease known as chronic traumatic encephalopathy, or CTE.1 Although CTE is often clinically indistinguishable from Alzheimer's — patients suffer from memory loss, mood disorders, and depression — this degenerative illness has a very different cause. CTE is a disease of violence. It is what happens when the brain is smashed into the skull again and again.

How common is CTE among former football players? Nobody knows. At the moment, CTE can only be diagnosed postmortem, after the cortex is dissected. However, there is disturbing evidence that CTE is occurring among players at rates many times higher than normal. For instance, a 2009 study commissioned by the NFL found that former players between the ages of 30 and 49 were being diagnosed with severe memory-related diseases at approximately nineteen times the rate of the general population.

Another disturbing clue comes from the initial results of an autopsy analysis led by Ann McKee at Boston University. Over the last five years, she has autopsied the brains of fifteen former players who suffered from various mental conditions, including memory loss and depression. Fourteen of these players had CTE.

Although McKee has only studied a single teenage brain, she found that brain damage was already detectable, with the multiple-concussed 18-year-old football player showing irreversible signs of CTE in parts of the frontal cortex. According to McKee, this is the earliest evidence of CTE ever recorded.

Needless to say, this disturbing data has not dissuaded anyone from playing in the NFL: The tremendous rewards offered to professional athletes help compensate for the potential risk. We understand why they play on Sunday.

But this same calculus doesn't apply to high school athletes, that pipeline of future talent. Although these teenagers are suffering concussions at higher rates and with worse consequences — the head trauma of football targets the most vulnerable areas of the developing brain — the overwhelming majority of these kids will never play the sport competitively again. They are getting paid nothing and yet they are paying the highest cost.

Reflection idea:

- As a parent, would you let your child play football? Why? Why not?