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OFFENSIVE PLAY

How different are dogfighting and football?

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An offensive lineman can't do his job without "using his head," one veteran says, but neuropathologists examining the brains of ex-N.F.L. players have found trauma-related degeneration.

One evening in August, Kyle Turley was at a bar in Nashville with his wife and some friends. It was one of the countless little places in the city that play live music. He'd ordered a beer, but was just sipping it, because he was driving home. He had eaten an hour and a half earlier. Suddenly, he felt a sensation of heat. He was light-headed, and began to sweat. He had been having episodes like that with increasing frequency during the past year—headaches, nausea. One month, he had vertigo every day, bouts in which he felt as if he were stuck to a wall. But this was worse. He asked his wife if he could sit on her stool for a moment. The warmup band was still playing, and he remembers saying, "I'm just going to take a nap right here until the next band comes on." Then he was lying on the floor, and someone was standing over him. "The guy was freaking out," Turley recalled. "He was saying, 'Damn, man, I couldn't find a pulse,' and my wife said, 'No, no. You were breathing.' I'm, like, 'What? What?'"

They picked him up. "We went out in the parking lot, and I just lost it," Turley went on. "I started puking everywhere. I couldn't stop. I got in the car, still puking. My wife, she was really scared, because I had never passed out like that before, and I started becoming really paranoid. I went into a panic. We get to the emergency room. I started to lose control. My limbs were shaking, and I couldn't speak. I was conscious, but I couldn't speak the words I wanted to say."

Turley is six feet five. He is thirty-four years old, with a square jaw and blue eyes. For nine years, before he retired, in 2007, he was an offensive lineman in the National Football League. He knew all the stories about former football players. Mike Webster, the longtime Pittsburgh Steeler and one of the greatest players in N.F.L. history, ended his life a recluse, sleeping on the floor of the Pittsburgh Amtrak station. Another former Pittsburgh Steeler, Terry Long, drifted into chaos and killed himself four years ago by drinking antifreeze. Andre Waters, a former defensive back for the Philadelphia Eagles, sank into depression and pleaded with his girlfriend—"I need help, somebody help me"—before shooting himself in the head. There were men with aching knees and backs and hands, from all those years of playing football. But their real problem was with their heads, the one part of their body that got hit over and over again.

"Lately, I've tried to break it down," Turley said. "I remember, every season, multiple occasions where I'd hit someone so hard that my eyes went cross-eyed, and they wouldn't come uncrossed for a full series of plays. You are just out there, trying to hit the guy in the middle, because there are three of them. You don't remember much. There are the cases where you hit a guy and you'd get into a collision where everything goes *off*. You're dazed. And there are the others where you are involved in a big, long drive. You start on your own five-yard line, and drive all the way down the field—fifteen, eighteen plays in a row sometimes. Every play:

collision, collision, collision. By the time you get to the other end of the field, you're seeing spots. You feel like you are going to black out. Literally, these white explosions—*boom, boom, boom*—lights getting dimmer and brighter, dimmer and brighter.

“Then, there was the time when I got knocked unconscious. That was in St. Louis, in 2003. My wife said that I was out a minute or two on the field. But I was *gone* for about four hours after that. It was the last play of the third quarter. We were playing the Packers. I got hit in the back of the head. I saw it on film a little while afterward. I was running downfield, made a block on a guy. We fell to the ground. A guy was chasing the play, a little guy, a defensive back, and he jumped over me as I was coming up, and he kned me right in the back of the head. *Boom!*”

“They sat me down on the bench. I remember Marshall Faulk coming up and joking with me, because he knew that I was messed up. That's what happens in the N.F.L.: ‘Oooh. You got effed up. Oooh.’ The trainer came up to me and said, ‘Kyle, let's take you to the locker room.’ I remember looking up at a clock, and there was only a minute and a half left in the game—and I had no idea that much time had elapsed. I showered and took all my gear off. I was sitting at my locker. I don't remember anything. When I came back, after being hospitalized, the guys were joking with me because Georgia Frontiere”—then the team's owner—“came in the locker room, and they said I was butt-ass naked and I gave her a big hug. They were dying laughing, and I was, like, ‘Are you serious? I did that?’”

“They cleared me for practice that Thursday. I probably shouldn't have. I don't know what damage I did from that, because my head was really hurting. But when you're coming off an injury you're frustrated. I wanted to play the next game. I was just so mad that this happened to me that I'm overdoing it. I was just going after guys in practice. I was really trying to use my head more, because I was so frustrated, and the coaches on the sidelines are, like, ‘Yeah. We're going to win this game. He's going to lead the team.’ That's football. You're told either that you're hurt or that you're injured. There is no middle ground. If you are hurt, you can play. If you are injured, you can't, and the line is whether you can walk and if you can put on a helmet and pads.”

Turley said that he loved playing football so much that he would do it all again. Then he began talking about what he had gone through in the past year. The thing that scared him most about that night at the bar was that it felt exactly like the time he was knocked unconscious. “It was identical,” he said. “It was my worst episode ever.”

In August of 2007, one of the highest-paid players in professional football, the quarterback Michael Vick, pleaded guilty to involvement in a dogfighting ring. The police raided one of his properties, a farm outside Richmond, Virginia, and found the bodies of dead dogs buried on the premises, along with evidence that some of the animals there had been tortured and electrocuted. Vick was suspended from football. He was sentenced to twenty-three months in

prison. The dogs on his farm were seized by the court, and the most damaged were sent to an animal sanctuary in Utah for rehabilitation. When Vick applied for reinstatement to the National Football League, this summer, he was asked to undergo psychiatric testing. He then met with the commissioner of the league, Roger Goodell, for four and a half hours, so that Goodell could be sure that he was genuinely remorseful.

“I probably considered every alternative that I could think of,” Goodell told reporters, when he finally allowed Vick back into the league. “I reached out to an awful lot of people to get their views—not only on what was right for the young man but also what was right for our society and the N.F.L.”

Goodell’s job entails dealing with players who have used drugs, driven drunk and killed people, fired handguns in night clubs, and consorted with thugs and accused murderers. But he clearly felt what many Americans felt as well—that dogfighting was a moral offense of a different order.

Here is a description of a dogfight given by the sociologists Rhonda Evans and Craig Forsyth in “The Social Milieu of Dogmen and Dogfights,” an article they published some years ago in the journal *Deviant Behavior*. The fight took place in Louisiana between a local dog, Black, owned by a man named L.G., and Snow, whose owner, Rick, had come from Arizona:

The handlers release their dogs and Snow and Black lunge at one another. Snow rears up and overpowers Black, but Black manages to come back with a quick locking of the jaws on Snow’s neck. The crowd is cheering wildly and yelling out bets. Once a dog gets a lock on the other, they will hold on with all their might. The dogs flail back and forth and all the while Black maintains her hold.

In a dogfight, whenever one of the dogs “turns”—makes a submissive gesture with its head—the two animals are separated and taken back to their corners. Each dog, in alternation, then “scratches”—is released to charge at its opponent. After that first break, it is Snow’s turn to scratch. She races toward Black:

Snow goes straight for the throat and grabs hold with her razor-sharp teeth. Almost immediately, blood flows from Black’s throat. Despite a serious injury to the throat, Black manages to continue fighting back. They are relentless, each battling the other and neither willing to accept defeat. This fighting continues for an hour. [Finally, the referee] gives the third and final pit call. It is Black’s turn to scratch and she is severely wounded. Black manages to crawl across the pit to meet her opponent. Snow attacks Black and she is too weak to fight back. L.G. realizes that this is it for Black and calls the fight. Snow is declared the winner.

Afterward, Snow’s owner collects his winnings; L.G. carries Black from the ring. “Her back legs are broken and blood is gushing from her throat,” Evans and Forsyth write. “A shot rings out barely heard over the noise in the barn. Black’s body is wrapped up and carried by her owner to his vehicle.”

It’s the shot ringing out that seals the case against dogfighting. L.G. willingly submitted his dog to a contest that culminated in her suffering and destruction. And why? For the entertainment of an audience and the chance of a payday. In the nineteenth century, dogfighting was widely accepted by the American public. But we no longer find that kind of transaction morally acceptable in a sport. “I was not aware of dogfighting and the terrible

things that happen around dogfighting,” Goodell said, explaining why he responded so sternly in the Vick case. One wonders whether, had he spent as much time talking to Kyle Turley as he did to Michael Vick, he’d start to have similar doubts about his own sport.

In 2003, a seventy-two-year-old patient at the Veterans Hospital in Bedford, Massachusetts, died, fifteen years after receiving a diagnosis of dementia. Patients in the hospital’s dementia ward are routinely autopsied, as part of the V.A.’s research efforts, so the man’s brain was removed and “fixed” in a formaldehyde solution. A laboratory technician placed a large slab of the man’s cerebral tissue on a microtome—essentially, a sophisticated meat slicer—and, working along the coronal plane, cut off dozens of fifty-micron shavings, less than a hairbreadth thick. The shavings were then immunostained—bathed in a special reagent that would mark the presence of abnormal proteins with a bright, telltale red or brown stain on the surface of the tissue. Afterward, each slice was smoothed out and placed on a slide.

The stained tissue of Alzheimer’s patients typically shows the two trademarks of the disease—distinctive patterns of the proteins beta-amyloid and tau. Beta-amyloid is thought to lay the groundwork for dementia. Tau marks the critical second stage of the disease: it’s the protein that steadily builds up in brain cells, shutting them down and ultimately killing them. An immunostain of an Alzheimer’s patient looks, under the microscope, as if the tissue had been hit with a shotgun blast: the red and brown marks, corresponding to amyloid and tau, dot the entire surface. But this patient’s brain was different. There was damage only to specific surface regions of his brain, and the stains for amyloid came back negative. “This was all tau,” Ann McKee, who runs the hospital’s neuropathology laboratory, said. “There was not even a whiff of amyloid. And it was the most extraordinary damage. It was one of those cases that really took you aback.” The patient may have been in an Alzheimer’s facility, and may have looked and acted as if he had Alzheimer’s. But McKee realized that he had a different condition, called chronic traumatic encephalopathy (C.T.E.), which is a progressive neurological disorder found in people who have suffered some kind of brain trauma. C.T.E. has many of the same manifestations as Alzheimer’s: it begins with behavioral and personality changes, followed by disinhibition and irritability, before moving on to dementia. And C.T.E. appears later in life as well, because it takes a long time for the initial trauma to give rise to nerve-cell breakdown and death. But C.T.E. isn’t the result of an endogenous disease. It’s the result of injury. The patient, it turned out, had been a boxer in his youth. He had suffered from dementia for fifteen years because, decades earlier, he’d been hit too many times in the head.

McKee’s laboratory does the neuropathology work for both the giant Framingham heart study, which has been running since 1948, and Boston University’s New England Centenarian Study, which analyzes the brains of people who are unusually long-lived. “I’m looking at brains constantly,” McKee said. “Then I ran across another one. I saw it and said, ‘Wow, it looks just

like the last case.’ This time, there was no known history of boxing. But then I called the family, and heard that the guy had been a boxer in his twenties.” You can’t see tau except in an autopsy, and you can’t see it in an autopsy unless you do a very particular kind of screen. So now that McKee had seen two cases, in short order, she began to wonder: how many people who we assume have Alzheimer’s—a condition of mysterious origin—are actually victims of preventable brain trauma?

McKee linked up with an activist named Chris Nowinski, a former college football player and professional wrestler who runs a group called the Sports Legacy Institute, in Boston. In his football and wrestling careers, Nowinski suffered six concussions (that he can remember), the last of which had such severe side effects that he has become a full-time crusader against brain injuries in sports. Nowinski told McKee that he would help her track down more brains of ex-athletes. Whenever he read an obituary of someone who had played in a contact sport, he’d call up the family and try to persuade them to send the player’s brain to Bedford. Usually, they said no. Sometimes they said yes. The first brain McKee received was from a man in his mid-forties who had played as a linebacker in the N.F.L. for ten years. He accidentally shot himself while cleaning a gun. He had at least three concussions in college, and eight in the pros. In the years before his death, he’d had memory lapses, and had become more volatile. McKee immunostained samples of his brain tissue, and saw big splotches of tau all over the frontal and temporal lobes. If he hadn’t had the accident, he would almost certainly have ended up in a dementia ward.

Nowinski found her another ex-football player. McKee saw the same thing. She has now examined the brains of sixteen ex-athletes, most of them ex-football players. Some had long careers and some played only in college. Some died of dementia. Some died of unrelated causes. Some were old. Some were young. Most were linemen or linebackers, although there was one wide receiver. In one case, a man who had been a linebacker for sixteen years, you could see, without the aid of magnification, that there was trouble: there was a shiny tan layer of scar tissue, right on the surface of the frontal lobe, where the brain had repeatedly slammed into the skull. It was the kind of scar you’d get only if you used your head as a battering ram. You could also see that some of the openings in the brain were larger than you’d expect, as if the surrounding tissue had died and shrunk away. In other cases, everything seemed entirely normal until you looked under the microscope and saw the brown ribbons of tau. But all sixteen of the ex-athlete brains that McKee had examined—those of the two boxers, plus the ones that Nowinski had found for her—had something in common: every one had abnormal tau.

The other major researcher looking at athletes and C.T.E. is the neuropathologist Bennet Omalu. He diagnosed the first known case of C.T.E. in an ex-N.F.L. player back in September of 2002, when he autopsied the former Pittsburgh Steelers center Mike Webster. He also found

C.T.E. in the former Philadelphia Eagles defensive back Andre Waters, and in the former Steelers linemen Terry Long and Justin Strzelczyk, the latter of whom was killed when he drove the wrong way down a freeway and crashed his car, at ninety miles per hour, into a tank truck. Omalu has only once failed to find C.T.E. in a professional football player, and that was a twenty-four-year-old running back who had played in the N.F.L. for only two years.

“There is something wrong with this group as a cohort,” Omalu says. “They forget things. They have slurred speech. I have had an N.F.L. player come up to me at a funeral and tell me he can’t find his way home. I have wives who call me and say, ‘My husband was a very good man. Now he drinks all the time. I don’t know why his behavior changed.’ I have wives call me and say, ‘My husband was a nice guy. Now he’s getting abusive.’ I had someone call me and say, ‘My husband went back to law school after football and became a lawyer. Now he can’t do his job. People are suing him.’ ”

McKee and Omalu are trying to make sense of the cases they’ve seen so far. At least some of the players are thought to have used steroids, which has led to the suggestion that brain injury might in some way be enhanced by drug use. Many of the players also share a genetic risk factor for neurodegenerative diseases, so perhaps deposits of tau are the result of brain trauma coupled with the weakened ability of the brain to repair itself. McKee says that she will need to see at least fifty cases before she can draw any firm conclusions. In the meantime, late last month the University of Michigan’s Institute for Social Research released the findings of an N.F.L.-funded phone survey of just over a thousand randomly selected retired N.F.L. players—all of whom had played in the league for at least three seasons. Self-reported studies are notoriously unreliable instruments, but, even so, the results were alarming. Of those players who were older than fifty, 6.1 per cent reported that they had received a diagnosis of “dementia, Alzheimer’s disease, or other memory-related disease.” That’s five times higher than the national average for that age group. For players between the ages of thirty and forty-nine, the reported rate was nineteen times the national average. (The N.F.L. has distributed five million dollars to former players with dementia.)

“A long time ago, someone suggested that the [C.T.E. rate] in boxers was twenty per cent,” McKee told me. “I think it’s probably higher than that among boxers, and I also suspect that it’s going to end up being higher than that among football players as well. Why? Because every brain I’ve seen has this. To get this number in a sample this small is really unusual, and the findings are so far out of the norm. I only can say that because I have looked at thousands of brains for a long time. This isn’t something that you just see. I did the same exact thing for all the individuals from the Framingham heart study. We study them until they die. I run these exact same proteins, make these same slides—and we never see this.”

McKee’s laboratory occupies a warren of rooms, in what looks like an old officers’ quarters

on the V.A. campus. In one of the rooms, there is an enormous refrigerator, filled with brains packed away in hundreds of plastic containers. Nearby is a tray with small piles of brain slices. They look just like the ginger shavings that come with an order of sushi. Now McKee went to the room next to her office, sat down behind a microscope, and inserted one of the immunostained slides under the lens.

“This is Tom McHale,” she said. “He started out playing for Cornell. Then he went to Tampa Bay. He was the man who died of substance abuse at the age of forty-five. I only got fragments of the brain. But it’s just showing huge accumulations of tau for a forty-five-year-old—ridiculously abnormal.”

She placed another slide under the microscope. “This individual was forty-nine years old. A football player. Cognitively intact. He never had any rage behavior. He had the distinctive abnormalities. Look at the hypothalamus.” It was dark with tau. She put another slide in. “This guy was in his mid-sixties,” she said. “He died of an unrelated medical condition. His name is Walter Hilgenberg. Look at the hippocampus. It’s wall-to-wall tangles. Even in a bad case of Alzheimer’s, you don’t see that.” The brown pigment of the tau stain ran around the edge of the tissue sample in a thick, dark band. “It’s like a big river.”

McKee got up and walked across the corridor, back to her office. “There’s one last thing,” she said. She pulled out a large photographic blowup of a brain-tissue sample. “This is a kid. I’m not allowed to talk about how he died. He was a good student. This is his brain. He’s eighteen years old. He played football. He’d been playing football for a couple of years.” She pointed to a series of dark spots on the image, where the stain had marked the presence of something abnormal. “He’s got all this tau. This is frontal and this is insular. Very close to insular. Those same vulnerable regions.” This was a teen-ager, and already his brain showed the kind of decay that is usually associated with old age. “This is completely inappropriate,” she said. “You don’t see tau like this in an eighteen-year-old. You don’t see tau like this in a *fifty*-year-old.”

McKee is a longtime football fan. She is from Wisconsin. She had two statuettes of Brett Favre, the former Green Bay Packers quarterback, on her bookshelf. On the wall was a picture of a robust young man. It was McKee’s son—nineteen years old, six feet three. If he had a chance to join the N.F.L., I asked her, what would she advise him? “I’d say, ‘Don’t. Not if you want to have a life after football.’ ”

At the core of the C.T.E. research is a critical question: is the kind of injury being uncovered by McKee and Omalu incidental to the game of football or inherent in it? Part of what makes dogfighting so repulsive is the understanding that violence and injury cannot be removed from the sport. It’s a feature of the sport that dogs almost always get hurt. Something like stock-car racing, by contrast, is dangerous, but not unavoidably so.

In 2000 and 2001, four drivers in Nascar's elite Sprint Cup Series were killed in crashes, including the legendary Dale Earnhardt. In response, Nascar mandated stronger seats, better seat belts and harnesses, and ignition kill switches, and completed the installation of expensive new barriers on the walls of its racetracks, which can absorb the force of a crash much better than concrete. The result is that, in the past eight years, no one has died in Nascar's three national racing series. Stock-car fans are sometimes caricatured as bloodthirsty, eagerly awaiting the next spectacular crash. But there is little blood these days in Nascar crashes. Last year, at Texas Motor Speedway, Michael McDowell hit an oil slick, slammed head first into the wall at a hundred and eighty miles per hour, flipped over and over, leaving much of his car in pieces on the track, and, when the vehicle finally came to a stop, crawled out of the wreckage and walked away. He raced again the next day. So what is football? Is it dogfighting or is it stock-car racing?

Football faced a version of this question a hundred years ago, after a series of ugly incidents. In 1905, President Theodore Roosevelt called an emergency summit at the White House, alarmed, as the historian John Sayle Watterson writes, "that the brutality of the prize ring had invaded college football and might end up destroying it." Columbia University dropped the sport entirely. A professor at the University of Chicago called it a "boy-killing, man-mutilating, money-making, education-prostituting, gladiatorial sport." In December of 1905, the presidents of twelve prominent colleges met in New York and came within one vote of abolishing the game. But the main objection at the time was to a style of play—densely and dangerously packed offensive strategies—that, it turns out, could be largely corrected with rule changes, like the legalization of the forward pass and the doubling of the first-down distance from five yards to ten. Today, when we consider subtler and more insidious forms of injury, it's far from clear whether the problem is the style of play or the play itself.

Take the experience of a young defensive lineman for the University of North Carolina football team, who suffered two concussions during the 2004 season. His case is one of a number studied by Kevin Guskiewicz, who runs the university's Sports Concussion Research Program. For the past five seasons, Guskiewicz and his team have tracked every one of the football team's practices and games using a system called HITS, in which six sensors are placed inside the helmet of every player on the field, measuring the force and location of every blow he receives to the head. Using the HITS data, Guskiewicz was able to reconstruct precisely what happened each time the player was injured.

"The first concussion was during preseason. The team was doing two-a-days," he said, referring to the habit of practicing in both the morning and the evening in the preseason. "It was August 9th, 9:55 A.M. He has an 80-g hit to the front of his head. About ten minutes later, he has a 98-g acceleration to the front of his head." To put those numbers in perspective, Guskiewicz

explained, if you drove your car into a wall at twenty-five miles per hour and you weren't wearing your seat belt, the force of your head hitting the windshield would be around 100 gs: in effect, the player had two car accidents that morning. He survived both without incident. "In the evening session, he experiences this 64-g hit to the same spot, the front of the head. Still not reporting anything. And then this happens." On his laptop, Guskiewicz ran the video from the practice session. It was a simple drill: the lineman squaring off against an offensive player who wore the number 76. The other player ran toward the lineman and brushed past him, while delivering a glancing blow to the defender's helmet. "Seventy-six does a little quick elbow. It's 63 gs, the lowest of the four, but he sustains a concussion."

"The second injury was nine weeks later," Guskiewicz continued. "He's now recovered from the initial injury. It's a game out in Utah. In warmups, he takes a 76-g blow to the front of his head. Then, on the very first play of the game, on kickoff, he gets popped in the earhole. It's a 102-g impact. He's part of the wedge." He pointed to the screen, where the player was blocking on a kickoff: "Right here." The player stumbled toward the sideline. "His symptoms were significantly worse than the first injury." Two days later, during an evaluation in Guskiewicz's clinic, he had to have a towel put over his head because he couldn't stand the light. He also had difficulty staying awake. He was sidelined for sixteen days.

When we think about football, we worry about the dangers posed by the heat and the fury of competition. Yet the HITS data suggest that practice—the routine part of the sport—can be as dangerous as the games themselves. We also tend to focus on the dramatic helmet-to-helmet hits that signal an aggressive and reckless style of play. Those kinds of hits can be policed. But what sidelined the U.N.C. player, the first time around, was an accidental and seemingly innocuous elbow, and none of the blows he suffered that day would have been flagged by a referee as illegal. Most important, though, is what Guskiewicz found when he reviewed all the data for the lineman on that first day in training camp. He didn't just suffer those four big blows. He was hit in the head *thirty-one times* that day. What seems to have caused his concussion, in other words, was his cumulative exposure. And why was the second concussion—in the game at Utah—so much more serious than the first? It's not because that hit to the side of the head was especially dramatic; it was that it came after the 76-g blow in warmup, which, in turn, followed the concussion in August, which was itself the consequence of the thirty prior hits that day, and the hits the day before that, and the day before that, and on and on, perhaps back to his high-school playing days.

This is a crucial point. Much of the attention in the football world, in the past few years, has been on concussions—on diagnosing, managing, and preventing them—and on figuring out how many concussions a player can have before he should call it quits. But a football player's real issue isn't simply with repetitive concussive trauma. It is, as the concussion specialist

Robert Cantu argues, with repetitive *subconcussive* trauma. It's not just the handful of big hits that matter. It's lots of little hits, too.

That's why, Cantu says, so many of the ex-players who have been given a diagnosis of C.T.E. were linemen: line play lends itself to lots of little hits. The HITS data suggest that, in an average football season, a lineman could get struck in the head a thousand times, which means that a ten-year N.F.L. veteran, when you bring in his college and high-school playing days, could well have been hit in the head eighteen thousand times: that's thousands of jarring blows that shake the brain from front to back and side to side, stretching and weakening and tearing the connections among nerve cells, and making the brain increasingly vulnerable to long-term damage. People with C.T.E., Cantu says, "aren't necessarily people with a high, recognized concussion history. But they are individuals who collided heads on every play—repetitively doing this, year after year, under levels that were tolerable for them to continue to play."

But if C.T.E. is really about lots of little hits, what can be done about it? Turley says that it's impossible for an offensive lineman to do his job without "using his head." The position calls for the player to begin in a crouch and then collide with the opposing lineman when the ball is snapped. Helmet-to-helmet contact is inevitable. Nowinski, who played football for Harvard, says that "proper" tackling technique is supposed to involve a player driving into his opponent with his shoulder. "The problem," he says, "is that, if you're a defender and you're trying to tackle someone and you decide to pick a side, you're giving the other guy a way to go—and people will start running around you." Would better helmets help? Perhaps. And there have been better models introduced that absorb more of the shock from a hit. But, Nowinski says, the better helmets have become—and the more invulnerable they have made the player seem—the more athletes have been inclined to play recklessly.

"People love technological solutions," Nowinski went on. "When I give speeches, the first question is always: 'What about these new helmets I hear about?' What most people don't realize is that we are decades, if not forever, from having a helmet that would fix the problem. I mean, you have two men running into each other at full speed and you think a little bit of plastic and padding could absorb that 150 gs of force?"

At one point, while he was discussing his research, Guskiewicz showed a videotape from a 1997 college football game between Arizona and Oregon. In one sequence, a player from Oregon viciously tackles an Arizona player, bringing his head up onto the opposing player's chin and sending his helmet flying with the force of the blow. To look at it, you'd think that the Arizona player would be knocked unconscious. Instead, he bounces back up. "This guy does not sustain a concussion," Guskiewicz said. "He has a lip laceration. Lower lip, that's it. Now, same game, twenty minutes later." He showed a clip of an Arizona defensive back making a dramatic tackle. He jumps up, and, as he does so, a teammate of his chest-bumps him in

celebration. The defensive back falls and hits his head on the ground. “That’s a Grade 2 concussion,” Guskiewicz said. “It’s the fall to the ground, combined with the bounce off the turf.”

The force of the first hit was infinitely greater than the second. But the difference is that the first player saw that he was about to be hit and tensed his neck, which limited the sharp back-and-forth jolt of the head that sends the brain crashing against the sides of the skull. In essence, he was being hit not in the head but in the head, neck, and torso—an area with an effective mass three times greater. In the second case, the player didn’t see the hit coming. His head took the full force of the blow all by itself. That’s why he suffered a concussion. But how do you insure, in a game like football, that a player is never taken by surprise?

Guskiewicz and his colleagues have come up with what they believe is a much better method of understanding concussion. They have done a full cognitive workup of the players on the U.N.C. team, so that they can track whatever effect might arise from the hits each player accumulates during his four years. U.N.C.’s new coach, Butch Davis, has sharply cut back on full-contact practices, reducing the toll on the players’ heads. Guskiewicz says his data show that a disproportionate number of serious head impacts happen on kickoffs, so he wonders whether it might make sense, in theory, anyway, to dispense with them altogether. But, like everyone else who’s worried about football, he still has no idea what the inherent risks of the game are. What if you did everything you could, and banned kickoffs and full-contact practices and used the most state-of-the-art techniques for diagnosing and treating concussion, and behaved as responsibly as Nascar has in the past several years—and players were still getting too many dangerous little hits to the head?

After the tape session, Guskiewicz and one of his colleagues, Jason Mihalik, went outside to watch the U.N.C. football team practice, a short walk down the hill from their office. Only when you see football at close range is it possible to understand the dimensions of the brain-injury problem. The players were huge—much larger than you imagine them being. They moved at astonishing speeds for people of that size, and, long before you saw them, you heard them: the sound of one two-hundred-and-fifty-pound man colliding with another echoed around the practice facility. Mihalik and Guskiewicz walked over to a small building, just off to the side of the field. On the floor was a laptop inside a black storage crate. Next to the computer was an antenna that received the signals from the sensors inside the players’ helmets. Mihalik crouched down and began paging through the data. In one column, the HITS software listed the top hits of the practice up to that point, and every few moments the screen would refresh, reflecting the plays that had just been run on the field. Forty-five minutes into practice, the top eight head blows on the field measured 82 gs, 79 gs, 75 gs, 79 gs, 67 gs, 60 gs, 57 gs, and 53 gs. One player, a running back, had received both the 79 gs and the 60 gs, as well as another hit,

measuring 27.9 gs. This wasn't a full-contact practice. It was "shells." The players wore only helmets and shoulder pads, and still there were mini car crashes happening all over the field.

The most damaged, scarred, and belligerent of Michael Vick's dogs—the hardest cases—were sent to the Best Friends Animal Sanctuary, on a thirty-seven-hundred-acre spread in the canyons of southern Utah. They were housed in a specially modified octagon, a one-story, climate-controlled cottage, ringed by individual dog runs. The dogs were given a final walk at 11 P.M. and woken up at 7 A.M., to introduce them to a routine. They were hand-fed. In the early months, the staff took turns sleeping in the octagon—sometimes in the middle, sometimes in a cot in one of the runs—so that someone would be with the dogs twenty-four hours a day. Twenty-two of Vick's pit bulls came to Best Friends in January of 2008, and all but five of them are still there.

Ray lunged at his handlers when he first came to Best Friends. He can't be with other dogs. Ellen lies on the ground and wants her stomach scratched, and when the caregivers slept in the octagon she licked them all night long. Her face is lopsided, as if it had been damaged from fighting. She can't be with other dogs, either. Georgia has a broken tail, and her legs and snout are covered with scars. She has no teeth. At some point, in her early life, they had been surgically removed. The court-ordered evaluation of the Vick dogs labelled Meryl, a medium-sized brown-and-white pit-bull mix, "human aggressive," meaning that she is never allowed to be taken out of the Best Friends facility. "She had a hard time meeting people—she would preempt anyone coming by charging and snapping at them," Ann Allums, one of the Best Friends dog trainers, said, as she walked around Meryl's octagon, on a recent fall day.

She opened the gate to Meryl's dog run and crouched down on the ground next to her. She hugged the dog, and began playfully wrestling with her, as Meryl's tail thumped happily. "She really doesn't mind new people," Allums said. "She's very happy and loving. I feel totally comfortable with her. I can grab and kiss her." She gave Meryl another hug. "I am building a relationship," she said. "She needed to see that when people were around bad things would not happen."

What happens at Best Friends represents, by any measure, an extravagant gesture. These are dogs that will never live a normal life. But the kind of crime embodied by dogfighting is so morally repellent that it demands an extravagant gesture in response. In a fighting dog, the quality that is prized above all others is the willingness to persevere, even in the face of injury and pain. A dog that will not do that is labelled a "cur," and abandoned. A dog that keeps charging at its opponent is said to possess "gameness," and game dogs are revered.

In one way or another, plenty of organizations select for gameness. The Marine Corps does so, and so does medicine, when it puts young doctors through the exhausting rigors of residency. But those who select for gameness have a responsibility not to abuse that trust: if

you have men in your charge who would jump off a cliff for you, you cannot march them to the edge of the cliff—and dogfighting fails this test. Gameness, Carl Semencic argues, in “The World of Fighting Dogs” (1984), is no more than a dog’s “desire to please an owner at any expense to itself.” The owners, Semencic goes on,

understand this desire to please on the part of the dog and capitalize on it. At any organized pit fight in which two dogs are really going at each other wholeheartedly, one can observe the owner of each dog changing his position at pit-side in order to be in sight of his dog at all times. The owner knows that seeing his master rooting him on will make a dog work all the harder to please its master.

This is why Michael Vick’s dogs weren’t euthanized. The betrayal of loyalty requires an act of social reparation.

Professional football players, too, are selected for gameness. When Kyle Turley was knocked unconscious, in that game against the Packers, he returned to practice four days later because, he said, “I didn’t want to miss a game.” Once, in the years when he was still playing, he woke up and fell into a wall as he got out of bed. “I start puking all over,” he recalled. “So I said to my wife, ‘Take me to practice.’ I didn’t want to miss practice.” The same season that he was knocked unconscious, he began to have pain in his hips. He received three cortisone shots, and kept playing. At the end of the season, he discovered that he had a herniated disk. He underwent surgery, and four months later was back at training camp. “They put me in full-contact practice from day one,” he said. “After the first day, I knew I wasn’t right. They told me, ‘You’ve had the surgery. You’re fine. You should just fight through it.’ It’s like you’re programmed. You’ve got to go without question—I’m a warrior. I can block that out of my mind. I go out, two days later. Full contact. Two-a-days. My back locks up again. I had re-herniated the same disk that got operated on four months ago, and bulged the disk above it.” As one of Turley’s old coaches once said, “He plays the game as it should be played, all out,” which is to say that he put the game above his own well-being.

Turley says he was once in the training room after a game with a young linebacker who had suffered a vicious hit on a kickoff return. “We were in the cold tub, which is, like, forty-five degrees, and he starts passing out. In the cold tub. I don’t know anyone who has ever passed out in the cold tub. That’s supposed to wake you up. And I’m, like, slapping his face. ‘Richie! Wake up!’ He said, ‘What, what? I’m cool.’ I said, ‘You’ve got a concussion. You have to go to the hospital.’ He said, ‘You know, man, I’m fine.’ ” He wasn’t fine, though. That moment in the cold tub represented a betrayal of trust. He had taken the hit on behalf of his team. He was then left to pass out in the cold tub, and to deal—ten and twenty years down the road—with the consequences. No amount of money or assurances about risk freely assumed can change the fact that, in this moment, an essential bond had been broken. What football must confront, in the end, is not just the problem of injuries or scientific findings. It is the fact that there is something profoundly awry in the relationship between the players and the game.

“Let’s assume that Dr. Omalu and the others are right,” Ira Casson, who co-chairs an N.F.L.

committee on brain injury, said. “What should we be doing differently? We asked Dr. McKee this when she came down. And she was honest, and said, ‘I don’t know how to answer that.’ No one has any suggestions—assuming that you aren’t saying no more football, because, let’s be honest, that’s not going to happen.” Casson began to talk about the research on the connection between C.T.E. and boxing. It had been known for eighty years. Boxers ran a twenty-per-cent risk of dementia. Yet boxers continue to box. Why? Because people still go to boxing matches.

“We certainly know from boxers that the incidence of C.T.E. is related to the length of your career,” he went on. “So if you want to apply that to football—and I’m not saying it does apply—then you’d have to let people play six years and then stop. If it comes to that, maybe we’ll have to think about that. On the other hand, nobody’s willing to do this in boxing. Why would a boxer at the height of his career, six or seven years in, stop fighting, just when he’s making million-dollar paydays?” He shrugged. “It’s a violent game. I suppose if you want to you could play touch football or flag football. For me, as a Jewish kid from Long Island, I’d be just as happy if we did that. But I don’t know if the fans would be happy with that. So what else do you do?”

Casson is right. There is nothing else to be done, not so long as fans stand and cheer. We are in love with football players, with their courage and grit, and nothing else—neither considerations of science nor those of morality—can compete with the destructive power of that love.

In “Dogmen and Dogfights,” Evans and Forsyth write:

When one views a staged dog fight between pit bulls for the first time, the most macabre aspect of the event is that the only sounds you hear from these dogs are those of crunching bones and cartilage. The dogs rip and tear at each other; their blood, urine and saliva splatter the sides of the pit and clothes of the handlers. . . . The emotions of the dogs are conspicuous, but not so striking, even to themselves, are the passions of the owners of the dogs. Whether they hug a winner or in the rare case, destroy a dying loser, whether they walk away from the carcass or lay crying over it, their fondness for these fighters is manifest. ♦

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