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New Allies in the Concussion Battle

By Emily Kaplan

ABERDEEN PROVING GROUND, Md. — The future of warfare innovation lies 35 miles north of Baltimore, where a team of Army researchers develop products like the Arm Gauntlet, a bionic-looking brace that improves handgun accuracy, and Liquid Armor, a fluid that instantly hardens when struck by a bullet. “I recently spoke at a career day at my wife’s school,” says Eric Wetzel, now in his 11th year with the Materials Division of the Army Research Lab. “To explain to the kids what I did, I said, ‘I pretty much work in the Iron Man lab.’”

Wetzel’s team is now flexing its mental muscle on a different combat clientele: NFL players. Since November, ARL researchers have been fixated on an 87-pound crash test dummy wearing shoulder pads and a Riddell helmet. Over and over they make the dummy tumble backward, falling onto a two-inch layer of stiff black foam. *Thump*. It’s difficult not to cringe as the helmet smacks the ground; if it were strapped onto a real head, its owner would likely be subjected to concussion protocol.

A high-speed camera captures the simulation while a dozen sensors on the helmet log data. In April, Wetzel’s team will present its findings to the NFL. They believe their experiment could help the league mitigate its concussion crisis. The NFL hopes the experiment yields results that can be put in place soon—maybe as soon as next season.

When 24-year-old 49ers linebacker Chris Borland announced his retirement from football last week, citing concerns about the long-term effects of repetitive head trauma he might suffer over the course of a career, many wondered if it was a watershed moment for the NFL. Borland’s exit amplified concerns over what the the league is doing to protect players.

In an [interview with The MMQB this week, commissioner Roger Goodell said the game is “safer and better than ever.”](#) But behind closed doors, the league has been pouring resources into an ambitious and far-reaching project to find solutions. In partnership with two of its largest corporate sponsors, Under Armour and GE, the NFL is basically holding an open tryout, enticing candidates in science,



academia and, yes, the military, in the form of \$500,000 grants to find ingenious ways to make the game less dangerous.

In many ways, the concept feels like a reality competition. The Head Health Challenge is part of the four-year, \$60 million Head Health Initiative. More than 450 research teams from 19 countries proposed ideas to the NFL. A panel of judges awarded seven teams each a \$500,000 grant for research, testing and development of the technology in the first year, with the potential for another \$1 million in the second year.

The plan sounds unconventional, but not as unconventional as some of the ideas researchers have come up with. There's [the University of New Hampshire's helmetless practices](#). An hour south in Lexington Mass., a company called Quanterix is developing a simple blood test to detect traumatic brain injury—possibly instantaneously. This would allow concussion detection to be quantifiable data in the same way we can measure cholesterol for heart disease and sugar for diabetes. In Los Angeles, UCLA researchers and Architected Materials Inc. are fine-tuning a new, energy-absorbing microlattice material to line helmets, which would also have 3D printing platforms for real-time responsiveness. And in Miami researchers are working on goggles that can identify mild traumatic brain injuries in real time by measuring precise eye movements.

Wetzel's team? They believe the key to mitigating concussions involves a magical sticky substance.

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In his laboratory, Wetzel often consults a printout featuring screen grabs of NFL players falling backward, eventually lying with their backs flat against the turf. There is Aaron Rodgers, rendered motionless in a game against the Lions in 2010, and Nick Foles, in the aftermath of a hit during a fateful 2013 game against the Cowboys. Wetzel, a lifelong Eagles fan, makes special note of that Foles picture. It was the final play of the third quarter in an eventual 17-3 loss. Foles faces pressure from Dallas defensive ends George Selvie and Jarius Wynn, and as the duo teams up for a sack Foles is thrown to the ground. His back hits the surface first, then his head slams against the turf.

The play is common among head-to-ground induced concussions, the type of trauma Wetzel's team has honed in on. In January, the NFL claimed the rate of concussions during the 2014 season was down 25 percent from the previous year. They cited rules changes—primarily protecting defenseless receivers and barring hits with the crown of the helmet—as large reasons why. According to the league, a total of 59 concussions were caused by helmet-to-helmet or shoulder-to-helmet hits in 2014, less than half the '13 number. However, the number of head-to-ground induced concussions remains stagnant. This is where the ARL comes in.

“Many people might wonder why the Army is spending time trying to fix football's problem,” Wetzel says. “Well, we can explain.”

Nearly 10 years ago, when working on a Defense Advance Research Project Agency (DARPA) grant to prevent joint injuries in the military, the ARL developed something called shear thickening fluid. The consistency of the liquid changes depending on the level of stress put on it. If you put the liquid in a tube and pull gently, it stretches like silly putty. If you try jerking it quickly, the tube resists. Researchers couldn't figure out a way to make the shear thickening fluid work on something like a knee or ankle



brace, but when they heard of the NFL's Head Health Challenge, they realized they could have an application.

What if the fluid was placed in strap attaching the chin of a helmet to a player's chest? Would that prevent a player's head from snapping back and slamming on the ground when he's tackled, as in the Foles sack?

"If we can control that type of head motion, and reduce the whipping motion when the head hits the ground, we can reduce the acceleration on the head and the brain, and maybe reduce the likelihood of the concussion," Wetzel says.

And so they test the theory on the dummy, hoping they can find the answer in time to present to the NFL. All the while, they know their research could benefit the military, too. Specifically, they believe the strap could help paratroopers, whose concussion rate is twice as high as all other soldiers.

"There's a very specific and common scenario where a paratrooper has to execute a landing in non-ideal conditions, and with the wind blowing, they may fall backward in the same way a football player falls backward," says computational modeling expert Thomas Plaisted, a member of Wetzel's team.

The ARL has made some headway with their research, but Wetzel is still unsure if they will have concrete findings by the competition's deadlines. Usually, when conducting experiments, they are looking at what soldiers may need 10 to 15 years down the road.

"They want us to have a product that they can then produce," Wetzel says. "Maybe that happens. But there's also a scenario where we've gotten the problem 80 percent solved. We say, 'Look at all of these cool things we've discovered. We've solved this problem and that problem, but there are a few things we still haven't figured out.' We publish the information and then people all over the world look at it. Someone says, 'I have an idea, they can make it something more final.' If that happens, we've still done our job."

Even if the NFL ceases to fund the experiments, the ARL will see it through. They'll just swap the dummy's Riddell helmet for a green army helmet.