Thesis Project Portfolio

Football Helmet: Helmet to Ground Test Device

(Technical Report)

The history of football helmets and their improvements over time

(STS Research Paper)

An Undergraduate Thesis

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Introduction:

The connection between my technical work and my STS project lies in football helmets. My technical project was creating a device that simulated football helmet to ground impacts and my STS project dove into the changes that have been made to football helmets over time, and what has driven those changes. The technical project revolved around developing a device that could be used to analyze helmet's ability to prevent concussions in certain impact scenarios. While my STS research paper never touched on different testing devices or even testing in general, the relation lies in concussions in football and what are the ways to make the sport safer to play.

Capstone Project Summary:

Our Capstone Project aims to develop an improved system for simulating linearrotational head-to-ground (H2G) impacts, a type of "whipping" motion increasingly recognized as a significant cause of concussions in American football. While current helmet testing and design focus heavily on direct, head-to-head impacts, H2G impacts responsible for an estimated 20% of NFL concussions, remain under researched due to their complexity and variability. These impacts involve rotational forces and a wide range of initial conditions, such as head angle and angular velocity, making them difficult to replicate consistently. Our project addresses this gap by designing a simulation system that enables more accurate testing of helmet performance under diverse H2G scenarios. This system has the potential to inform future helmet design standards and enhance player safety across all levels of the sport. The device produced is a curved tracked in which a dummy rolls down and eventually makes contact with the ground, simulating a H2G impact.

STS Research Paper Summary:

Football helmets have undergone significant transformations, evolving from rudimentary leather caps to sophisticated protective gear incorporating advanced materials and engineering. This study explores the historical development of football helmets and examines the factors driving these advancements, particularly in response to increasing concerns about player safety. The central research question is: How have technological advancements in football helmets influenced player safety and perceptions of risk in the sport, as well as why is it important to continue research and advancement in helmet technology? How do the technological improvements of helmets influence the continued advancements of the sport?

This research employs Actor-Network Theory (ANT) to analyze the complex interactions between key stakeholders, including players, helmet manufacturers, medical professionals, and regulatory bodies like the NFL and the NFL Players Association. By mapping these relationships, the study seeks to understand how technological innovations, rule changes, and cultural attitudes towards safety have shaped the modern football helmet.

Preliminary findings suggest that while technological advancements have led to safer helmets, they have also contributed to a phenomenon known as risk compensation, wherein players may engage in riskier behavior due to a perceived increase in protection. Additionally, continued research into Chronic Traumatic Encephalopathy (CTE) underscores the long-term neurological risks associated with repeated head trauma.

This research is significant because it highlights the interplay between technology, safety, and human behavior in a high-impact sport. Understanding these dynamics can inform better helmet design, policy decisions, and educational initiatives aimed at reducing concussions and improving player safety at all levels of football.

Concluding Reflection:

It has been really interesting to be able to work on both of these projects simultaneously. The STS project is really all about the driving forces for improving helmets and changing the sport of football to make it safer while the capstone project is something that could someday be used to make the sport safer. While there is a direct relation to both of my projects it is interesting to see the problems that both sides face. The engineering side faces problems from getting funding to research and build devices that are able to meet all the needs of the NFL and helmet companies. Making a device that is affordable and can create consistent and reliable results that could be used to improve helmets. On the other side, for the STS project, there needs to be a constant driving force that is analyzing what plays cause concussions, what helmets are more susceptible for players getting concussions, and what rule changes and helmet improvements are needed to make the sport safer. Through working on both these projects, I was able to understand how important scientists and engineers are in making sports safer. I never realized how much data went into creating new rules and designing new helmets and that was incredibly fascinating to me.