Thesis Project Portfolio

Football Helmet: Head to Ground Test Device

(Technical Report)

Long Term Health Risks of Concussions in the NFL

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

This portfolio integrates technical and sociotechnical research focused on replicating and understanding head-to-ground impacts in American football. The technical project, completed as a senior capstone in mechanical engineering, involved designing and testing a device capable of simulating head-to-ground collisions using instrumented dummies and real-world NFL concussion incident data. The objective was to replicate concussion instances in a controlled environment to support future advancements in helmet technology and ultimately reduce concussion risk. This system introduced improvements in repeatability and control over existing methods, offering a novel way to simulate and analyze head-to-ground impacts.

In parallel, the STS research paper examined how sociocultural factors, particularly masculinity norms and economic pressures, influence NFL players' and the league's decisions surrounding Chronic Traumatic Encephalopathy (CTE). Drawing on the Ethnography of Infrastructure framework, the research investigated how underlying systems such as equipment standards, medical protocols, team hierarchies, and media narratives obscure the long-term risks of repeated head trauma. These often invisible infrastructures contribute to a culture that minimizes the seriousness of CTE, discouraging open acknowledgment and proactive prevention. The analysis revealed that these deeply embedded systems shape player behavior and institutional priorities, making it challenging to address the cumulative and latent dangers of brain injury in the sport.

The prospectus served as a planning document, mapping the connections between the technical and sociotechnical aspects of the project. Together, these works demonstrate that addressing safety in sports requires not only innovative engineering solutions but also critical

engagement with the social and institutional infrastructures that influence behavior and decision-making.