Thesis Project Portfolio

Enabling Overground Walking During Motion Capture Pulling Force Trials
(Technical Report)

The "Average Human": Danger of Homogeneity in Data Used to Construct Biomechanical Research Models
(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

Introduction

I chose both my capstone project and my STS research paper topic on the basis of my interests in biomechanics and equity in research. Through my capstone project, I gained a deeper appreciation for and understanding of motion capture research. I learned how a motion capture study is conducted and developed a system to enable a new type of motion capture data collection. These efforts were towards a more equitable future, one in which people with cerebral palsy have access to the most effective tools that will maximize their opportunities for mobility. It is crucial that these tools be designed to benefit the most users possible and provide the assistance that their users desire, not the assistance that researchers assume their users want. It is no coincidence that my STS research topic led me to better understand how to make tools and conduct studies that do just that. My STS research stemmed from an observation I have made in my time conducting biomechanics research. I found myself asking questions about the equity of the choices researchers make in the subject pools they choose for their biomechanics research. Through both my capstone project and my STS research paper, I sought to answer and address these questions.

Technical Summary

Cerebral palsy is the most common cause of physical disability in children affecting 2 to 3/1000 children worldwide. 31% of children with CP in the US use special equipment of some kind. When it comes to mobility, many individuals with CP rely on walkers or wheelchairs. As part of his PhD project, Evan Dooley is designing a power walker to allow children with CP to spend a longer amount of time per day on their feet, by decreasing the amount of effort it takes for people with CP to get around. In order to do this, there is a need to know how much pulling

force the walker will need to apply based on the person's body weight. Typically these types of measurements are done via treadmill walking, however treadmill walking elicits different gait patterns than normal, or overground walking. Such as differences in stride length and phase durations. The goal of myself and my capstone partner, Anne, was to create an overground walking system that will allow for continuous data collection. In order to do this we constructed a bidirectional system that has a pulling force on each end applied by a weighted pulley system, a belt that allows for turning 180 degrees, and then compatible with a VO2 measurement system.

STS Research Summary

Imagine the average human being. Picture the way they move, the way they look. What is their physique? What sex, race, and ethnicity are they? There is no way for you to accurately answer these questions because there is no "average human being." Even so, we live in a world whose safety and function has been analyzed, most often, for the "average human being." Biomechanical modeling requires large sums of data to accurately depict human limbs and movements. To simplify such models, researchers have historically limited their data sets on the basis of sex, mass, height, and athleticism. This simplification has resulted in groups such as women and people outside of the 50th percentile for height and weight being overlooked in biomechanical modeling, which affects everything from the design of tools to the testing of cars for crash safety. This research answers the question: How does the demographically homogeneous data used to construct biomechanical models impact their efficacy? The Political Technologies Theory is used to better understand the ways in which biomechanical modeling inadvertently generated an entirely new political issue. This will reveal what cultural mindsets of the scientific community led to the formation of such inequities in modeling representation and bring to light the means through which modern day researchers can combat these inequities.

Concluding Reflection

The synthesis of my capstone project and my STS research paper has been crucial to bettering my understanding of both. Working in the Motion Analysis and Motor Performance lab gave me a perspective on just how motion capture studies are conducted and the difficulties faced during subject recruitment as well as data collection. Having this knowledge made it easier for me to understand just how the inequities in motion capture subject pool selection occurred and continue to occur. Conducting research for my STS paper on the nature of these inequities gave me clarity on the negative effects they have on the communities that they underrepresent and misrepresent. My STS research also showed me the ways in which steps can be taken to reduce these inequities, while accounting for the struggles that I observed in my capstone work.