MODELING BIOLOGICAL RHYTHMS TO PREDICT MENTAL AND PHYSICAL READINESS

ETHICAL IMPLICATIONS OF WEARABLE TECHNOLOGY IN THE WORKPLACE

An Undergraduate Thesis Portfolio
Presented to the Faculty of the
School of Engineering and Applied Science
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Systems Engineering

By

Samantha Miller

April 28, 2020

SOCIOTECHNICAL SYNTHESIS

The rise in wellness wearable technology is, by nature, accompanied by a number of unknowns such as their implications in society and the immediate effects of their reports and recommendations. The technical project sought to model individuals' biological rhythms in order to eventually provide insight on how to maximize productivity according to natural rises and falls in energy throughout the day. Meanwhile, the sociotechnical research paper investigated the privacy issues that may arise from wearable technologies in the modern workplace to gain a better understanding of the gaps in regulation to protect employees from unethical decisions made in favor of a company. These two projects are related in that the STS findings forecast what problems could occur if the technical project was introduced into society, and provides suggestions on how to prioritize wearable technology users' rights.

When people complete tasks at times that do not align with their optimal energy levels, they may not be as productive as intended. There have been attempts to associate inactivity with low productivity and work performance, yet a better approach of measuring mental and physical wellbeing is by using biometrics, such as heart rate, skin conductance, and sleep data, to model biological rhythms. For the technical project, physiological signal data was collected by wearable technologies, the Empatica E4 and the Oura Ring, and pipelined into a machine learning model built from biological rhythm features. The rhythm features from the E4 sensors were used to create models that predict the readiness score calculated by the Oura Ring. This process was designed to determine whether connections between bio-physiological indicators and overall wellbeing exist.

The results of the analysis showed that certain rhythm features derived from the physiological sensor data better predicted readiness than others. Correlation analysis suggested

that the mesor rhythmic features for acceleration and heart rate were most correlated with readiness. Additionally, most of the predictive models predicted readiness at accuracy rates above the majority class baseline. These results demonstrate the viability of using wearable devices to characterize biological rhythms and make suggestions according to the individual. Hopefully future capstone groups that take on this project will improve the current models and implement them into a device that successfully calculates an individual's rhythm from sensor data and makes scheduling recommendations accordingly.

After exploring a number of different scholarly journals and newspapers, such as Social Studies of Science and The New York Times, the oversight of the privacy and security of health data collected by wearables became prevalent. Using wearable technology in the workplace specifically raises risk of employers abusing the information they gain from their employees. In a society full of sensors and data, how does one find a balance of interest between employees' rights to privacy and employers' responsibility towards managing the workplace? Having taken everything into consideration, protecting health-related data collected by wearables will first require setting precedents to ensure the privacy of health conditions in the workplace.

Answering the research question required uncovering shortcomings of current government regulations, as well as policies regarding employees disclosing medical conditions from nicotine addition to infertility. The Social Construction of Technology framework demonstrated that employees are largely at risk of being victim to discriminatory decisions if their employers gain access to their data. Furthermore, shortcomings of the Americans with Disabilities Act (ADA) make it difficult for employees to justify disclosing their conditions when they fear it will influence how they are treated in the workplace. Once employee rights to

keeping health conditions private are set in place, the movement towards prioritizing employee autonomy will encourage protecting the privacy of health-related data as well.

A wearable technology such as that proposed by the technical project could make a positive impact on modern society by redirecting scheduling to focus on the unique biological rhythm of an individual. Productivity would likely increase due to employees performing their work when they are most cognitively alert. However, before this technology is introduced there needs to be a deep analysis of the varying motives possessed by different stakeholders in adopting the technology. Protections such as HIPAA, the ADA, and the California Consumer Privacy Act need to be expanded and clarified to accommodate all types of privacy invasions, from data to medical conditions.

TABLE OF CONTENTS