MODELING BIOLOGICAL RHYTHMS TO PREDICT MENTAL AND PHYSICAL READINESS

WEARABLE MOTIVATION: THE EFFECTS OF MOBILE HEALTH SENSING ON USERS

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SOCIOTECHNICAL SYNTHESIS

Wearable devices for fitness are a relatively new segment of consumer technology that, as of yet, have not reached their optimal form. The technical project was an attempt to use computational modeling to predict physical and mental alertness using the ways autonomic functions change over time, or biological rhythms, for the purpose of providing individualized insights for participants. The Science Technology, and Society (STS) project was an investigation of the usefulness of fitness wearables in an effort to provide increased information to consumers. The two projects are tightly coupled by the devices involved, as the technical project aimed to improve fitness wearables, and the STS project evaluated ones that already exist.

The technical project attempted to determine whether the features from biological rhythms can be used to predict a user's alertness, or readiness for daily tasks. It attempted to discover what specific aspects of biological rhythms are useful for predicting alertness. It relates to the higher rationale of these two projects by seeking to understand ways that fitness wearables work and can be improved in the future. Data was recorded using two wearable sensors from four participants for four months and created computer models of these participants' heart rate, skin temperature, electrodermal activity, and blood volume pulse. The mathematical features of these models such as mean and amplitude were used to predict the participants' individual alertness using a quantitative "readiness score" provided by a fitness wearable. This method was designed to provide clear, quantitative conclusions about the possibilities of biological rhythms as a predictor of alertness and readiness.

This investigation led to several interesting results and conclusions about biological rhythms. The research team discovered that a low mean heart rate is strongly correlated with high

readiness and that the peaks of several biological rhythms are effective predictors of readiness score. The peaks of rhythms being so effective is an interesting result because that model was composed of the peaks of each rhythm evaluated, meaning that a model using a holistic approach to biological rhythms performed best. These results demonstrate that biological rhythms, or at least aspects of them, have predictive power in determining alertness for individuals.

Similar to the technical project, the science, technology, and society project also seeks to better understand fitness wearables. This investigation hopes to discern whether users of wearable fitness trackers see significant improvement in their own health. It seeks to assert that fitness wearables do have a positive impact and that methods exist to improve them further. An actor network theory analysis of model development was employed to investigate what influences model research and development. A synthesis of several sources on activity tracking and sleep analysis was also used to investigate their efficacy. These methods produced several interesting findings.

Following the research into model development, activity tracking, and sleep analysis several points about fitness wearables became clear. A variety of negative pressures are applied to model designers and researchers by other actors. Activity tracking, on the technical side of the device, is shown to perform well on basic measurements like step count for a wide range of popular fitness, however certain users may be distracted from their health by focusing on improving certain metrics obsessively like step count. Sleep analysis from these devices can be useful in monitoring general trends in users' sleep, despite this they could be improved, especially on more detailed calculations like the timings of phases of sleep. Due to the pressures that may negatively influence the usefulness of computational models, more transparency in their development would be of a great benefit to potential users who are curious about the workings of

their devices. In their current form, fitness wearables can be very beneficial for certain users, any potential user needs an understanding of themselves to know whether or not these devices could be a useful tool for them.

Following these two investigations, certain aspects of fitness wearables in the real world become apparent. In terms of their technical components, they do appear to do what they are designed to do well enough to relay that information to users. However, there are ways they can be improved by using biological rhythms and increased standards of transparency and validity that could increase their usefulness to consumers. Further research into these possibilities will certainly be necessary, but hopefully this investigation will aid others as a starting point for future research.

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