1. Project title

Mining time-series data to predict positive and negative outcomes from mobile phone usage

2. Coordinators

Dr. Mariek Vanden Abeele is an Assistant Professor currently in the CIS department who will be in the new DCC department as of January 1st. Dr. Andrew Hendrickson is currently an Assistant Professor currently in the CIS department who will be in DCA as of January 1st. Drs. Vanden Abeele and Hendrickson have not previously worked on a collaboration together.

3. Project Summary

Internet and mobile communication technologies afford ubiquitous connectivity: they enable connectivity that is unhindered by time and place constraints (Rainee & Wellman, 2012). Over the past 20 years, ubiquitous connectivity has become a defining feature of everyday life in developed and developing societies, leading scholars to describe contemporary global culture as a culture of ubiquitous connectivity. This culture is visible in the marked socio-cultural changes that network technologies have brought to various spheres of life: access to personalized network technologies has enabled new ways of working (e.g., via telework applications such as Cloud computing services), new ways of managing social relationships (e.g., via social media such as Whatsapp or Facebook), new ways of consuming (e.g., via the sharing economy), new ways of spending leisure time (e.g., via personalized content services such as Netflix or Spotify), and new ways of self-enhancement (e.g., via the use of self-tracking technologies such as fitness wearables).

While people benefit from ubiquitous connectivity in multifold ways, they are also faced with new challenges and there are concerns that ubiquitous connectivity contributes to a fast-moving pace of life that people find difficult to deal with (Rosa, 2013). In the work domain, for example, network technologies enable telework and an easier adjustment of work schedules to private life, but they also blur work-life boundaries, leading to negative outcomes such as lower perceived work-life balance and higher stress (Vanden Abeele et al., 2016). In the social domain, people have to deal with the blurring of boundaries between the online and offline world, and the demands of their (quasi-simultaneous) presence in both (Vanden Abeele et al., 2017). And while self-enhancement technologies such as health-trackers can inform and motivate, people may also feel pressured and burdened by the heightened personal responsibility these technologies bring, to eat healthier, to exercise more, etcetera (Vanden Abeele et al., 2016).

The impact of technology usage is not a simple additive process and is increasingly being understood as a function of the pattern that emerges from a combination of complex social dynamics between individuals (Loos et al., 2016; Baumöl, et al., 2016) as well as non-linear within-person feedback loops (Wilmer & Chein, 2016). Traditional statistical models that simply quantify the amount of technology usage ignore these dynamics and will never identify and quantify the impact of these complex patterns. Fortunately, new statistical techniques that focus on using machine learning to identify events and patterns in time-series data are being

developed (Fu, 2011; Chaney et al., 2016). In particular, Chaney et al. (2016) identify a family of generative Bayesian models for detecting clusters of related events in data that unfolds from multiple sources over time.

This project aims to combine machine learning and experimental techniques to identify complex and interdependent patterns of technology usage that contribute, positively or negatively, to well-being and learning. This will be assessed in both a laboratory experiment as well as in a real-life classroom setting. First, we will build on previous work by Dr. Vanden Abeele and colleagues (2017) and collect real-time mobile phone usage statistics from multi-person groups as they work on a task within a lab setting. Second, we will recruit participation for detailed lifelogging data collection from students in courses that include group projects in the DCC and DCA Bachelor courses in the Fall of 2018. In both datasets, we will identify patterns of technology usage that facilitate or harm well-being (experiment 1) and educational outcomes (experiment 2) with a focus on using statistical models that identify events that cluster and interact across time (Guralnik & Srivastava, 1999; Chaney et al., 2016).

These research questions can only be addressed by bringing together expertise from two distinct fields. Dr. Vanden Abeele is an expert in the impact of mobile phone usage and has a strong record of publications focusing on quantifying the impact of mobile communication technology usage on measures of well-being, efficiency, and interaction quality. She is has extensive experience supervising and coordinating experimental and quasi-experimental data collection by students with a wide array of experience. Dr. Hendrickson is an expert in using machine learning and Bayesian models to identify patterns of human behavior in noisy, time-dependent datasets. He has authored multiple publications using statistical models to uncover individual and group level patterns in learning, decision making, and categorization. He has experience supervising data mining and statistical modeling projects by students at a wide degree of experience.

4. Project timeline

The design of Experiment 1 (a lab-based study of mobile phone usage) builds on previous work by Dr. Vanden Abeele and thus data collection can begin in early 2018. Data collection will be completed over the summer of 2018. During this time, the research trainee directly supervised by Dr. Vanden Abeele will begin recruiting participants for Experiment 2, which will collect data throughout the fall semester of 2018.

Preliminary development and testing of statistical models by the research trainee directly supervised by Dr. Hendrickson can begin in early 2018 by using existing, smaller datasets from previous studies on mobile phone use. These models can then be used as the basis to identify patterns of mobile phone usage that predict higher or lower well-being measures in the data from Experiment 1. The full set of candidate statistical models and patterns of behavior will be identified in the Experiment 1 dataset during the summer and early fall of 2018. These models will then be applied to the Experiment 2 dataset throughout the remainder of 2018.

The design and construction of Experiment 1 will be completed within the first few months of the year, with data collection complete by the midpoint of 2018. Statistical modeling of Experiment 1 will be complete by the end of Block 1 in the fall of 2018. The design and recruitment of Experiment 2 will be complete by the beginning of Block 1 in the fall of 2018 with

data collection complete by the end of 2018. Statistical modeling of Experiment 2 will be complete by the end of 2018.

5. Research Trainee Profile

The research trainee directly supervised by Dr. Vanden Abeele will be responsible for the design of Experiments 1 and 2, the recruitment of participants for both studies, and the majority of data collection for both experiments. This research trainee will be expected to have some experience with experimental methodology and research design. The research trainee directly supervised by Dr. Hendrickson will be responsible for recoding and reformatting the data from both experiments as well as implementing the statistical models to detect patterns in mobile phone usage and predict outcomes based on these patterns. They will also assist in collecting data for the lab-based experiment. This research trainee will be expected to have some experience with programming and preferably experience or a strong interest in machine learning and statistical modeling.

Students from all levels will be eligible to apply. In their application students should specify which trainee role they are applying for, any relevant experience or courses they have taken, and provide a brief description of why they are interested in participating in this traineeship. Applications should be sent to Dr. Andrew Hendrickson (a.hendrickson@tilburguniversity.edu) and applicants might be interviewed as part of the application process.