

Research Statement for Mark Grimes

My research interests revolve around improving the effectiveness of information systems through non-invasive means. In pursuit of this goal I combine my expertise in information systems with a variety of other disciplines including psychology, cognitive science, and judgment and decision making (JDM). I frequently design and conduct experiments and use statistical and machine learning analysis techniques to collect and analyze large data sets. I have also conducted survey based research and I am well versed in other methodological approaches. My research has implications for improving satisfaction with online systems, assessment of credibility and intent, and helping companies to better understand their customers. My experience working with large datasets and my proficiency in data analytics is applicable to a wide range of business intelligence and data mining problems.

My primary stream of research involves non-invasive assessment of affective and cognitive states. Prior research has investigated many approaches for technology assisted assessment of affect and cognitive load including functional magnetic resonance imaging (fMRI), eye tracking, monitoring electrodermal activity (EDA) and electroencephalography (EEG). While these approaches have given great insight to cognitive processes involved in affect and cognition, the deployment of these techniques is limited as they require specialized hardware that is not widely deployed and may be prohibitively expensive, require cooperation from the individual being observed, and interfere with natural use cases.

My research takes a novel approach to addressing these problems by using changes in HCI behavior as an indicator of cognitive changes. By using techniques known as keystroke dynamics (KD) and mouse dynamics (MD) we are able to capture physiological features that may be of similar diagnostic value to the aforementioned techniques using inexpensive, ubiquitous hardware (i.e., the computer keyboard and mouse), while simultaneously facilitating real time monitoring via software in a manner that is completely transparent to the user. This has a wide range of practical applications including facilitating affective computing, improving user satisfaction, and assessing credibility in online communications.

A second area I work in involves using concepts from JDM such as heuristics and biases to influence information systems use. This work suggests that by making small changes to information systems it may be possible to encourage significant changes in user behavior. As this work continues to evolve, I have plans to integrate it with my HCI work to create adaptive systems that are able to more effectively meet the needs and desires of users.

The overarching objective of my research is to provide real value to businesses and individual consumers of technology. I have a wide range of personal, academic, and industry experience and constantly look for ways to improve information systems. It is my goal to conduct research that has a lasting and positive effect on the world.

Research Overview

Research I have been involved with has been published at Information Systems for Development, has been funded by NSF, and has been accepted at HICSS, AMCIS and ICIS. I have a rich and productive research stream and am currently involved in several projects and working papers that are targeted for publication at high quality MIS journals. The following list briefly outlines my research projects, results, and next steps.

Assessing Conceptual Fluency in Human Computer Interactions (2014)

- Working paper with Joe Valacich and Jeff Jenkins, to be submitted to ISR in 2014
- Preliminary results highly suggestive of ability to assess fluency through HCI behavior

Facilitating Natural Conversational Agent Interactions: Lessons from a Deception Experiment (2014)

- Schuetzler, Giboney, Grimes and Buckman, to be presented at ICIS 2014
- Participants were either truthful or deceptive in an online chat bot conversation
- Participants exhibited more strategic behavior when lying to a responsive chat bot agent
- Future research will extend into health care and assessment of credibility and affect

Broken Windows, Bad Passwords: Influencing Secure User Behavior via Website Design (2014)

- Grimes, Marquardson and Nunamaker, to be presented at AMCIS, 2014
- Website quality was manipulated while users created an account for the system
- High quality website led to higher intentions of secure behavior than low quality site
- Future work to explore areas beyond security (i.e., contribution quality, satisfaction, etc.)

Exploring the Effect of Arousal and Valence on Mouse Interaction (2013)

- Grimes, Jenkins & Valacich, presented at ICIS 2013 (Best Paper Award nominee)
- Captured MD features while arousal and valence were manipulated using images from the international affective picture system (IAPS)
- Negative affect led to greater distance, slower movement, and more trajectory changes
- Future research will extend findings to new scenarios and devices (i.e. touch screens)

The Effect of Arousal and Valence on Keyboard Behavior (2013)

- Written prelim, committee: Jay Nunamaker, Joe Valacich and Judee Burgoon
- Captured KD features while arousal and valence were manipulated via IAPS images
- Negative affect led to slower and more deliberate typing
- Findings being merged with MD research to create an overall measure of HCI behavior

Improving Password Cybersecurity through Inexpensive and Minimally Invasive Means: Detecting and Detering Password Reuse through Keystroke Dynamics Monitoring and Just-in-Time Fear appeals (2013)

- Jenkins, Grimes, Proudfoot and Lowry, Information Technology for Development
- Captured KD features for unique and non-unique passwords during account creation
- Identified password reuse with 81.7% accuracy, JIT fear appeals reduced reuse by 84%
- A more extensive exploration of this topic is currently underway

Detecting Impostership through Soft Biometrics and Cognitive Metrics (2013)

- Project with Burgoon, Valacich, Twyman, Proudfoot, Grimes and Schuckers - funded for \$55,000 by the Center for Identification Technology Research (a NSF Research Center)
- Mock data-theft experiment in which participants used a fake ID to gain access to a restricted computer system
- KD and MD features used to determine the identity of those that perpetrated the theft
- Continued work on this project is underway

Importance

In face to face communication, people use a wide range of physiological cues such as vocalic characteristics, proxemics, and eye gaze to determine how their communication partner feels and may adjust their communication as necessary. In recent years, we have seen rapid and widespread adoption of automated customer service systems, embodied conversational agents, online systems and new communication mediums such as forums, email, and instant messaging, which have led to many interactions that were previously face-to-face being replaced with human-computer interactions. Despite this proliferation of information systems, the ability for computers to detect and react to a user's affective state is still in its infancy.

My research aims to bridge this gap of affective intelligence by introducing a method to more effectively understand how users feel by measuring physiological changes using keyboard and mouse behavior. As this research develops, we will be able to facilitate systems that adapt to how users feel – for example, by morphing the user interface or providing just in time service interventions. This research also provides methods for improving information systems security. While current KD and MD research provides methods for dynamically identifying users based on their HCI behavior, the technology being developed in my research will make it possible to also identify arousal states that may be indicative of users engaging in risky behaviors – i.e., identifying insider threats.

Future Research

While the research to date has provided great insight, we are still in the early stages of this effort. There are many directions for future research including assessing cognitive changes of patients in healthcare related applications, identification of intent in online forums and social networks – i.e., identifying individuals who are at risk of harming themselves or others – and improving online learning through more effective estimates of cognitive effort. Future research will also work to improve the efficacy of the algorithms and techniques being used and investigate the use of additional sensors such as touch screens, accelerometers, and touchless interaction devices such as Leap Motion and the Microsoft Kinect.

This research is constantly evolving, and has significant potential for future work with a wide range of interesting and practical applications. I look forward to continuing this work and collaborating with others to explore additional areas and applications.