ubHFES University at Buffalo Student Chapter of Human Factors & Ergonomics Society

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INTER-UNIVERSITY WORKSHOP

University at Buffalo
The State University of New York

THE 15TH ANNUAL HUMAN FACTORS ENGINEERING

Inter-University Workshop

ubHFES University at Buffalo Student Chapter of Human Factors & Ergonomics Society

November 15, 2014
Buffalo, NY
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Notes

Tear out Ballot

- ❑ **Liberty Hoekstra-Atwood**: *"Attentional differences and driving under distraction"*
- ❑ **Fiona F. Tran**: *"Improving operations and maintenance effectiveness using mobile devices in process industries"*
- ❑ **Natalie C Benda**: *"Employing User-Centered Design Techniques in Developing Industries: Anecdotes from a Study of Electronic Health Record Vendors"*
- ❑ **Paul Bruno Wiele**: *"Incident Reporting Systems: Usability of Input Interfaces and Resulting Data"*
- ❑ **Nicolette McGeorge**: *"Supporting the Work of ED Clinicians: Assessment of a Novel Emergency Department Information System in a Clinical Simulation Center"*
- ❑ **Umair Abdul Rehman**: *"Evaluating Augmented Reality for Indoor Navigation & Attention Guidance Applications using Cognitive Architectures"*
- ❑ **Nasif Addnan**: *"Sociotechnical Analysis in Mobile Interface Design for Maintenance Departments?"*
- ❑ **Sean William Kortschot & Cole Wheeler**: *"Applying Cognitive Work Analysis to Large Screen Display Design"*

Welcome to the 2014 IUW

THE INTER-UNIVERSITY WORKSHOP is a human factors engineering student-organized event. For 15 years now, the State University of New York at Buffalo, the University of Waterloo, and the University of Toronto rotate hosting this single-day mini-conference. The purpose of the event is to give students an opportunity to present their work in a friendly, low-pressure forum. It is a place where they can gain experience in speaking and presenting as well as garner feedback and constructive criticism from their peers, keynote speakers, and attending faculty members. Students are able to gain professional experience presenting their research and enjoy networking opportunities with fellow peers, researchers, professors, and professionals. This year, we're fortunate to have students and faculty from Cornell University, Ryerson University, the Rochester Institute of Technology, as well as employees of Baxter, Lake Regional Medical, M&T Bank, and the Roswell Park Cancer Institute among our attendees.

This workshop showcases current and proposed research related to human factors engineering and other related disciplines, such as biomechanics, ergonomics, psychology, cognitive engineering, user experience, and design research in academia and industry. While the day's events are centered around student presentations, the IUW also features keynote speakers, a poster competition, and a social/networking dinner.

We hope that this IUW will be as successful and memorable as years past. We wish all of our attendees an enjoyable and informative day!

Sincerely,
The 2014 IUW Organizing Committee,
SUNY Buffalo HFES Student Chapter

Time	Description	Presenter
9:00am—9:45am	Registration and breakfast	
9:45am—10:00am	Opening Remarks	Adam Houser & David LaVergne IUW 2014 Co-Chairs
	Welcome Address	Dr. Ann Bisantz, ISE Chair
10:00am—11:00am	Keynote Address I: *What Matters: Escaping the Dichotomy to Explore the Duality of Mind and Matter*	Dr. John Flach Wright State University
11:00am—12:00pm	Student Presentations *Session 1*	Xinhui Zhu Mojdeh Pajoutan Wayne Chi Wei Giang Adam Reiner & Maya Whitehead
12:00pm—12:50pm	Lunch and Student Posters	

Tear out Ballot

Please mark one (continued on back):

❑ **Xinhui Zhu**: *"Postural stress experienced by surgeons: A case study of vaginal surgeons"*

❑ **Mojdeh Pajoutan**: *"Obesity effect on central and peripheral fatigue contributions to functional performance of ankle dorsiflexor muscle"*

❑ **Wayne Chi Wei Giang**: *"Interpreting visualizations of historical variability"*

❑ **Adam Reiner & Maya Whitehead**: *"Automatic Target Cueing Aids in Combat Identification"*

❑ **Dr. Winnie Chen**: *"Designing feedback to help mitigate risks associated with driver distractions"*

❑ **Jingyan Wan**: *"The Effect of Lead Time of Collision Warning Messages on Driver Performance"*

❑ **Susana Marulanda Villa**: *"Test-Retest Reliability of the Susceptibility to Driver Distraction Questionnaire (SDDQ)"*

1:00pm—2:00pm	Keynote Address II: *Biomechanics and Ergonomics of the Modern Office*	Dr. Jack Dennerlein Northeaster University
2:00pm—3:30pm	Student Presentations *Session 2*	Dr. Winnie Chen Jingyan Wan Susana Marulanda Villa Liberty Hoekstra-Atwood Adam M. Houser Fiona F. Tran
3:30pm—4:00pm	Coffee Break	
4:15pm—5:30pm	Student Presentations *Session 3*	Natalie C Benda Paul Bruno Wiele Nicolette McGeorge Umair Abdul Rehman Nasif Addnan Sean Kortschot & Cole Wheeler
5:30pm—6:00pm	Closing ceremony and awards	Judith Tiferes Student Chapter President
6:30pm—8:30pm	Dinner	

What Matters: Escaping the Dichotomy* to Explore the Duality** of Mind and Matter (10:00)

Dr. John Flach, *Wright State University*

Abstract: This talk will explore the intersection of cognitive science and design to speculate on the nature of human experience. The over riding hypothesis is that experience is a joint or dual function of mind and matter. Thus, it requires constructs that span the gap created by the conventional mind/matter dichotomy to address the joint relations that shape the dynamics of experience. Building on intuitions from semiotics and system dynamics the talk will suggest three constructs: satisfying, specifying, and affording as the fundamental dimensions of ecological rationality (i.e., abduction). The argument will be made that the ultimate test of cognitive science will be its practical value for guiding the design of technologies that enhance human experience.

Biography: John Flach is a Professor of Psychology at Wright State University in Dayton, OH, where he teaches graduate and undergraduate courses in the areas of cognitive psychology and cognitive systems engineering. John's research explores the application of cognitive science in the design and evaluation of sociotechnical systems. His publications include two edited books on Ecological Approaches to Human-Machine Systems and two co-authored books – one with Richard Jagacinski explores control theoretic approaches to human performance; another with Kevin Bennett explores the design of interface representations to support productive thinking. John is currently on a three month appointment as a visiting research professor at Liberty Mutual Research Institute for Safety in Hopkinton, MA.

**dichotomy*: a division or contrast between two things that are or are represented as being opposed or entirely different.

***duality*: the quality or condition of being dual. dual–consisting of two parts, elements, or aspects.

Xinhui Zhu—University at Buffalo

Postural stress experienced by surgeons: A case study of vaginal surgeons

Increasing attention has been drawn to the prevalence of work-related musculoskeletal disorders (MSDs) among surgeons in various medical specialties; however, the risk of work-realted MSDs among gynecologic surgeons has not received much attention. This study aimed to investigate the postural load among gynecologic surgeons for various surgical tasks during vaginal surgery. The frequency and percentage of duration of awkward upper body postures experienced by vaginal surgeons during eleven different vaginal surgical tasks observed during thirteen surgeries were collected using a new observational ergonomic job analysis tool, Ergonomic Posture Assessment in Real Time (ErgoPART). Results indicate that the postural loading is high for many surgical tasks but that the frequency and duration of awkward neck, shoulder, and trunk postures is variable across tasks. Surgeons' postural load was significantly higher for the transvaginal hysterectomy compared to others. This task, in particular, is a candidate for ergonomics interventions designed to reduce postural stress.

Mojdeh Pajoutan—University at Buffalo

Obesity effect on central and peripheral fatigue contributions to functional performance of ankle dorsi-flexor muscle

About two-thirds of the U. S. population are either obese or overweight. The increasing prevalence of obesity (defined as BMI $\geq$ 30) among adults and its association with increased risk of falls raise some concerns. Physiological changes with obesity may lead to a faster onset of muscle fatigue, which can moderate the risk of injuries. It is essential to determine obesity-related differences in motivation, effort, and fatigue development to understand the impact of obesity on the performance of occupational activities and the subsequent risk of injury. Understanding the influence of obesity on muscle fatigue is an area that has begun to receive attention from the ergonomics and occupational safety research communities due to the increased prevalence of obesity and the adverse health outcomes observed in the workplace. The majority of the work done in this area so far has not considered the underlying mechanisms that could be resulting in observed perfor-

mance and productivity measures. Identification of risk factors and understanding the mechanisms of fatigue can help to design some preventive strategies. Functional capacity of the ankle muscle influence balance recovery after a perturbation using an ankle strategy. This study aims to identify obesity-related differences in ankle muscle fatigue mechanisms, quantifying the role of central and peripheral fatigue on task performance and endurance. It is hypothesized that obesity will lead to greater fatigue development, and that the group-level differences will be the result of different contributions of central and peripheral factors. It is expected that the contribution of central fatigue, and motivation, will be greater in individuals who are obese.

To test these hypotheses, an experimental study will be conducted with 21 adults between 18-40 years old in three groups: obese, overweight and non-obese. Participants will complete one experimental session, involving ankle dorsiflexion superimposed isometric strength and endurance with the workload of 60% relative to maximum strength. The workload selected for the isometric endurance task simulate realistic workload levels and recruit different levels of muscle fibers. Superimposed electrical stimulation will be used to activate the muscle using an interpolated twitch method. Outcome measures will include strength, muscle activation ratio, strength loss, muscle activity (measured using electromyography), and endurance time. Data from the experimental study can be used toward the development of a model of fatigue development and work scheduling intervention.

Wayne Chi Wei Giang—University of Toronto

Interpreting visualizations of historical variability

Dynamic decision making scenarios are characterized by high time pressure, limited information, and often deal with short-term, tactical decisions. In these situations, decision makers often need to make judgments and predictions about key decision variables in order to facilitate their decision process. The presentation of historical data about such variables is one method to support the decision makers, however there has been limited research in how decision makers interpret visualizations of this information. In this presentation, I describe the planning of a study that examines how different display characteristics including representation (numeric vs. analogical) and

amount of information provided about the historical variability influences decision maker estimates of variables and their confidence in these estimates.

Adam Reiner & Maya Whitehead—University of Toronto

Automatic Target Cueing Aids in Combat Identification

In combat, soldiers are required to detect individuals on the battlefield and make a judgement about their identity based on a variety of cues, which can be obvious or subtle based on the situation. The consequences of incorrect identification in combat could result in fratricide (killing a friendly soldier), neutricide (killing civilians or other non-hostile forces) or failing to notice a hostile target, which may result in friendly casualties. Automated systems of various kinds have been developed to aid soldiers in both target detection and identification tasks. Automatic target cueing (ATC) has been developed as a detection aid and works by highlighting individuals in the environment to alert the user to their location. ATC is expected to result in the greatest benefits to target detection and possibly identification when conditions are relatively difficult, such as when targets are at far distances or in low lighting conditions. ATC, in reality, is not a perfectly reliability system and possible biases in cueing errors can occur due to the settings of the algorithm of the automation. The algorithm may miss some targets or highlight something in the environment that is not a human target. In this study, the Virtual Immersive Soldier Simulator (VISS) is used to investigate the effects of target cueing bias on target identification under conditions of varying illumination and automation reliability. Of particular interest is determining whether soldiers are able to use knowledge of automation reliability and bias to their advantage in deciding whether or not a target is a threat. Based on the results of this experiment, subsequent research will involve investigating various modes through which to relay automation reliability information to soldiers. In the current study, soldiers are informed of such conditions verbally, however graphical representations of such conditions may be more effective and time-sensitive. Therefore, subsequent studies will involve the development and testing of novel graphical displays of automation reliability. The results from these studies will be assessed using signal detection theory from a multidimensional perspective.

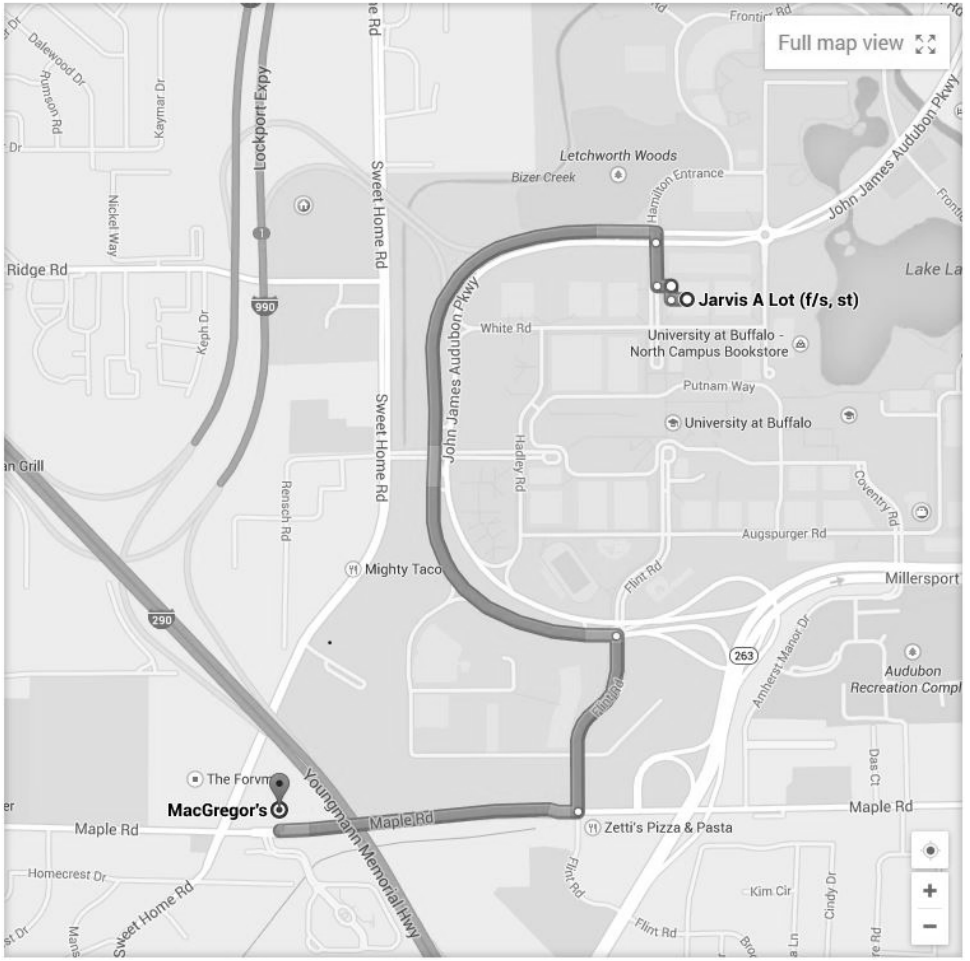
Lunch and Poster Session

Poster Presentation:

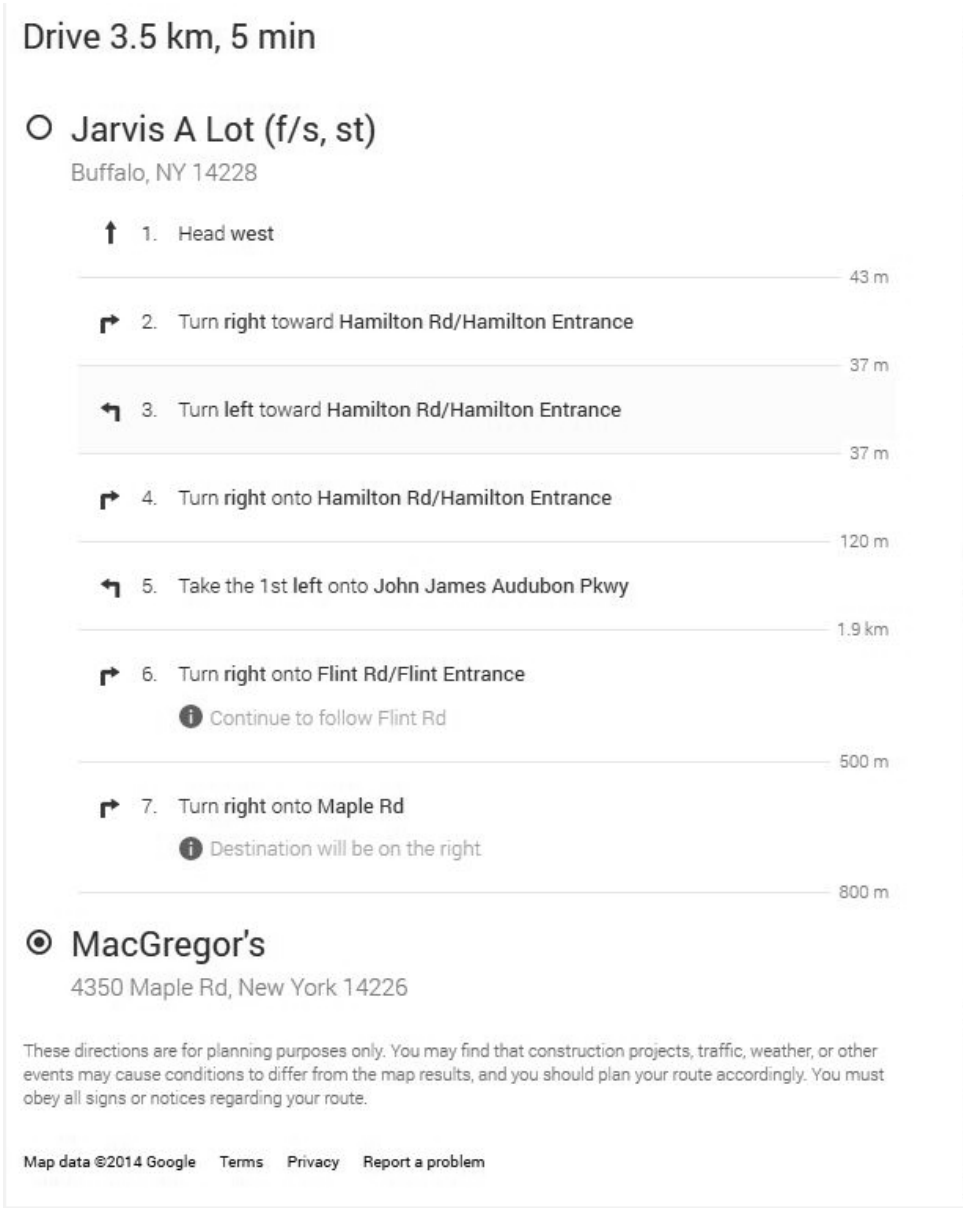
Meng Li—University at Buffalo

An Approach to Generating Human-Computer Interfaces from Task Models

To properly follow human-centered design principles, designers should create interfaces that facilitate the task goals humans need to accomplish. However, the concurrent nature of human-computer interaction can result in unanticipated interactions that may violate this principle. To address this problem, we are investigating a novel technique that will enable human-computer interfaces to be automatically generated from task analytic models, models specifically designed to describe how humans accomplish task goals with a system. Specifically, we are designing a method that will use task models to automatically generate interface designs guaranteed to usably support human task goals. In this method, we use the Enhanced Operator Function Model (EOFM), a task analytic modeling formalism, to represent human task behavior. This is used as input to a machine learning program capable of generating a formal interface design from the task model. This program learns an interface design through the use of L* learning and model checking. The L* algorithm learns a finite state automata model (design) of the interface by iteratively issuing and getting answers to queries asking about the output behavior of the interface for sequences of human actions. A model checker (an automated tool for performing formal verification) uses a formal representation of the task model to process the L* algorithm's query and determine the appropriate outputs for a given action sequence. This poster will describe our method and present preliminary results for the generation of a vending machine. Future research efforts will also be covered.



We invite you to join us for an informal celebration following dinner. Please see directions below to McGregor's Grill and Tap Room.



Afternoon Keynote

Biomechanics and Ergonomics in the Modern Office (1:00)

Dr. Jack Dennerlein, *Northeastern University*

Abstract: The field of ergonomics in regards to the modern office has progressed considerably over the past 20 years with the adoption of mobile computing technology and the increasing concern for sedentary behavior. During this period there are many strong examples of physical ergonomics that demonstrate how design of input devices affect and can improve postural and biomechanical load of the upper extremity. For example, the design of pointing devices dictates their location within the workspace, which affects shoulder loads. Their design also dictates how hand and fingers grip and operate the devices, which affects the stresses in the tissues and muscles that articulate the hand. Examples of added adjustability (i.e. sit -stand stations to reduce sedentary behavior) impact on both physical and productivity issues. As we progress with more and more mobile technology, we add more and more variability into the physical interactions. Simple solutions that help us be hand free can also assist in providing opportunities for improving system performance and human wellbeing.

Biography: Jack Dennerlein is a Professor in the Department of Physical Therapy at Northeastern University. His research aims to prevent work-related injuries and musculoskeletal disorders (MSDs) through multiple research approaches that in general examine how the design of the environment, both built and organizational, affects worker health outcomes. This research is based on a systems approach articulated through the goal of modern ergonomics, which is to optimize system performance and human wellbeing. His research study designs are both observational/descriptive and experimental, based in both the laboratory and in the real work environment.

Student Presentations

Dr. Winnie Chen—University of Toronto

Designing feedback to help mitigate risks associated with driver distractions

Driver distractions have been heavily associated with increased crash risks. Our earlier work focused on understanding individual susceptibility to driver distractions, differentiating between voluntary and involuntary driver distractions. In this talk, we propose two sets of driving simulator experiments to evaluate feedback alternatives for mitigating driver engagement in voluntary distractions. In one experiment we will examine two characteristics that are hypothesized to have an impact on the effectiveness of feedback: intervention point (post-drive versus real-time feedback) and motivation (e.g. gamification and monetary incentives). In a concurrent experiment, we will examine the influence of social norms information (e.g. what parents do versus what peers do) as feedback for adolescent drivers.

Jingyan Wan—University at Buffalo

The Effect of Lead Time of Collision Warning Messages on Driver Performance

Collision warning systems (CWSs) are in development in the intelligent transportation system domain to reduce collision accidents. The lead time of warning messages is a crucial factor in determining system effectiveness in the prevention of accidents. The present experiment studied the effects of controlled lead time at 16 levels (predetermined time headway from the subject vehicle to the collision location when the warning message was issued) and lead vehicle conditions (without vs. with lead vehicle) on driving behaviors in various collision scenarios. The results indicated the controlled lead time and lead vehicle conditions significantly affected driver performance. Maximum effectiveness of warning messages was achieved when the controlled lead time was within the range of 4.5s to 6s. When the warning messages were relatively late, the existence of a lead vehicle brought greater safety benefits and more abrupt deceleration. Potential applications of the results in designing of CWSs are further discussed.

Special Thanks

To our caterers:

- The Big Blue Food Truck
- 3 Pillars Catering

To our keynote speakers:

- Dr. Jack Dennerlein, Professor, Northeastern University
- Dr. John Flach, Professor, Wright State University

To all participating universities:

- University of Toronto
- University of Waterloo
- Rochester Institute of Technology
- Cornell University
- Ryerson University

To our partners in organizing this workshop:

- Department of Industrial and Systems Engineering, SUNY Buffalo
- Industrial and Systems Engineering Graduate Student Association, SUNY Buffalo

and finalizing research direction.

Sean William Kortschot & Cole Wheeler—University of Toronto

Applying Cognitive Work Analysis to Large Screen Display Design

Large-screen displays (LSDs) have become signature features in the recent evolution of nuclear power plant control rooms. LSDs are often introduced with the claims that they will enhance situation awareness and collaboration between operators. However, an operating experience review by Myers and Jamieson revealed that these claims have yet to be thoroughly evaluated and validated in the nuclear domain. This paper presents the results of a three phase cognitive work analysis (CWA). This analysis will establish the information requirements for a novel LSD design, which will be implemented and evaluated in subsequent phases of the project. Providing a clear example of the formative stages in LSD design will benefit human factors practitioners engaged in - and regulators evaluating - similar projects.

In this paper we present detailed graphical and tabular extracts from a CWA analysis of Candu 6 reactor subsystems. The first phase of the CWA (similar to Functional and Task Analysis) examined the physical components involved in each test scenario and how they contribute to the plant functions at intermediate and high levels, thereby revealing the underlying structure of the plant across multiple levels of abstraction. The second phase examined the cognitive and physical constraints on the processes required to execute the experimental scenarios. The final phase examined the skills and knowledge required by the operators to accomplish the goals of these experimental scenarios. The social organization and collaboration requirements for each experimental task were considered within each phase of analysis. These phases represent the formative steps towards the development of a novel LSD design. A detailed account of them can provide the framework for developing the foundations of novel LSD designs across the process industries.

Susana Marulanda Villa—University of Toronto

Test-Retest Reliability of the Susceptibility to Driver Distraction Questionnaire (SDDQ)

The Susceptibility to Driver Distraction Questionnaire (SDDQ) investigates voluntary and involuntary factors associated with driver distraction. It consists of 39 items in six subscales: (1) self-reported distraction engagement, (2) attitudes towards distractions, (3) perceived control of driving while engaged in distractions, (4, 5) injunctive and descriptive social norms associated with distraction engagement, and (6) susceptibility to involuntary distractions. The test-retest reliability of SDDQ was assessed using a sample of 43 adults, ages 25-39. The mean time between test and retest conditions was approximately 20 days. For subscale averages, test-retest reliability was assessed using intra-class correlation (ICC) statistics; for individual items, it was assessed through weighted kappa statistics. ICC results suggest good to excellent test-retest reliability for subscales of self-reported distraction engagement, attitudes towards distractions, and descriptive social norms. Perceived control of driving while engaged in distractions had fair test-retest reliability, and injunctive norms and susceptibility to involuntary distraction subscales had poor test-retest reliabilities. These last two subscales may have to be redesigned; we provide relevant suggestions in the discussion section. As an additional preliminary analysis, data from a sample of 10 additional participants were used to investigate consistency of responses across longer periods of time. The mean time between test-retest conditions in this sample was approximately 8 months. The findings were in general similar to the main sample. Overall, SDDQ appears to have good test-retest reliability. A larger sample is recommended to further validate these results, in particular across long test-retest periods.

Liberty Hoekstra-Atwood—University of Toronto

Attentional differences and driving under distraction

Distracted driving is a cause in traffic crashes. In 2011, 10% of all fatal crashes (3,020), and 17% of people injured in crashes (387,000) in the United States were in motor vehicle crashes with driver distraction as a causal factor (National Highway Traffic Safety, 2013). Feedback delivered to driv-

ers that is tailored to their individual characteristics is more likely to change risky driving behaviors. Thus to inform feedback design to help mitigate driving while distracted, we ran a driving simulator experiment using participants with different attentional abilities and willingness to engage with distractions. We recruited drivers with high and low self-reported willingness to engage in distractions while driving, as defined by the Susceptibility to Driver Distraction Questionnaire (SDDQ), and assessed differences in distraction engagement and driving performance under distraction conditions. Three different distraction type conditions were used in the experiment: involuntary distraction, voluntary distraction, and the baseline condition. Voluntary distractions are distractions where drivers intentionally engage in a secondary task unrelated to the driving activity and involuntary distractions are information or stimuli unrelated to the driving activity that drivers are unable to suppress. We found significant differences for how high self-reported distraction engagement individuals responded to unexpected events in the driving simulator under the different distractions. Drivers' interaction with the distractors also varied based individual differences in self-reported distraction engagement and attentional ability. We hope to use these results to inform improvements for the SDDQ and inform distraction mitigation ideas for our next experiment.

Adam M. Houser — University at Buffalo

Safety not guaranteed: Using formal methods in human factors engineering

Humans play a critical role in the performance of safety-critical systems and must be accounted for in engineering and analysis efforts. Simulation is one of the tools engineers can use to evaluate how humans impact safety-critical system performance, particularly because it scales well and allows analysts to explore scenarios that could be empirically infeasible. However, simulations can miss critical issues that may not be readily apparent to analysts or engineers. Formal methods are different collections of tools that can be used synergistically with simulation, where proof-based system analyses and exhaustive search techniques can provide guarantees about system performance or find unanticipated problems. Unfortunately, formal analyses are limited by their poor scalability. This talk will provide a brief introduction to formal methods, then describe how we are using them with agent-based

tions could include:

1.) AR guiding customers to promoted products and displaying multimedia product information.

2.) AR displaying patient medical record and disease knowledge supporting physicians' diagnostic decision making.

3.) AR providing indoor navigation.

4.) AR displaying virtual targets as part of immersive games.

Since no HPM simulation model has been developed for the evaluation of such AR navigation devices, there is a grave need for more empirical studies to accumulate human data with new AR navigation devices in comparison to traditional navigation (maps) and other existing AR navigation methods so that a qualified performance evaluation could be conducted.

Nasif Addnan—University of Toronto

Sociotechnical Analysis in Mobile Interface Design for Maintenance Departments

Implementing mobile solutions in complex workplaces has the potential to increase equipment reliability and support workplace safety. The Greater Toronto Airport Authority (GTAA) conducted a project to optimize the inspection interval for runway lights, and developed a mobile application to assist in maintenance task; and allow for easy data management for future research evaluation. Follow up on the project demonstrated that the application was not used as intended, and paper forms were still in circulation. This significantly hampered the evaluation process and prospects for future application development. Possible explanations for this information system failure include sociotechnical factors that were overlooked as part of the design, such as workplace dynamics, technology adoption rates and worker competencies. My research hypothesis is that Socio-Technical analysis is an essential part of information system design for maintenance departments in complex workplaces. Integrating such analysis during interface design iteration phases has the potential to result in increased adoption, better maintenance practices, reliability and overall safety. The research is still in its preliminary proposal phase, and further discussions with GTAA are scheduled for the beginning of December 2014. Current focus is on literature review

area (MedStar Health, Washington, D.C.), and was compared to a control interface which mimicked the primary view of an existing EDIS within the emergency departments at Medstar Health where subjects were recruited. At two points, the simulation was paused and participants answered a set of situation awareness questions (Situation Awareness Global Assessment Technique - SAGAT). At the end of the simulation, participants answered questionnaires regarding workload (NASA Task Load Index) and cognitive performance support (research team developed questions regarding usability and performance support in regard to the information display used). The results of these subjective questionnaires will be presented. In summary, cognitive systems engineering methods were successfully used to design displays for an ED information system and comparison of these novel displays with currently in-use designs demonstrated that these novel displays better support the work of providers without increasing workload.

Umair Abdul Rehman—University of Waterloo

Evaluating Augmented Reality for Indoor Navigation & Attention Guidance Applications using Cognitive Architectures

The research proposal focuses on designing, building and evaluating high impact augmented reality applications on specialized platforms like Google Glass. The project explores the possibility of indoor localization and navigation using augmented reality capability on Google Glass to develop engaging attention guidance systems tailored for industry specific uses. The latter stage of the project involves human experiments and human performance modeling using cognitive architectures to achieve system simulation and comparative evaluation of goals. Our outdoor navigation needs are satisfied by Global Positioning Systems which does not work perfectly in indoor environments due to signal attenuation and inaccuracy of positioning. To solve this problem, technologies like Wi-Fi, Bluetooth and infrared are employed which are more reliable for basic indoor navigation. Indoor navigation alone cannot make a viable attention guidance system as we would require augmented reality capability to complement the high positioning accuracy and object tracking capacity needed. Such technologies when implemented on devices like Google Glass can find its application in a variety of industrial domains where such user assistance is entailed. Possible Applica-

simulation to evaluate human-automation interaction in air traffic control scenarios.

Fiona F. Tran — University of Toronto

Improving operations and maintenance effectiveness using mobile devices in process industries

Distributed control systems (DCS) are the human-machine interface between operations and maintenance (O&M) workers, and the machines they control. Mobile devices are on the verge of replacing traditional stationary control room displays in DCS, because they extend opportunities for communication, team collaboration, and worker efficiency. This can reduce equipment and process downtime, O&M expenditures, and mitigate safety risks. However, mobile devices currently deployed in industrial settings are simply terminals for the control systems in place; the full potential of mobile computing has not yet been realized. For example, operators could monitor processes anywhere on the field instead of the control room, and common sensors among consumer mobile devices could be used for field measurements. I will explore how to implement mobile devices in DCS to improve field worker effectiveness in process industries, particularly oil and gas. I will develop use cases and design requirements through interviews with field workers using the mobile interfaces, design a mobile application interface, and conduct usability testing to iteratively improve the design. My new design will reduce downtime and O&M expenditures by increasing field worker productivity, and improve safety. Further applications for this work may extend to other natural resources, manufacturing, and energy utility operations.

Natalie C. Benda—University at Buffalo

Employing User-Centered Design Techniques in Developing Industries: Anecdotes from a Study of Electronic Health Record Vendors

As a part of the Health Information Technology for Economic and Clinical Health (HITECH) Act, eligible hospitals and providers receive government incentives to use Electronic Health Record (EHR) technology. In order to receive these incentives, hospitals and providers must demonstrate that they "meaningfully use" a certified EHR. In order to certify their EHRs, vendors must meet requirements surrounding "Safety Enhanced Design" (SED), which is a phrase legislators use to describe what human factors professionals would call User-Centered Design (UCD). This study entailed visiting various EHR vendors to learn about their UCD practices and complete a feasibility assessment of the current SED requirements. Subsequently, a high-level qualitative analysis of the SED reports that vendors submitted to the government for certification was also performed. The results ranged from impressive to concerning. Some vendors had a robust UCD processes while others did not even have a proper understanding of the term UCD. Many lessons learned from this study may be generalized to inform other developing industries attempting to incorporate UCD processes. Two of the most prominent points include - the importance of the ability to share general information and lessons to help progress the industry and the need for consumable materials that highlight the principles and importance of UCD.

Paul Bruno Wiele—Rochester Institute of Technology

Incident Reporting Systems: Usability of Input Interfaces and Resulting Data

Research into improving the safety of healthcare systems has recently focused on learning how instances of unintentional harm to patients ("incidents" or "near misses") happen and how to prevent them. One way this problem is adressed by the healthcare industry is through organizational and record-keeping practices referred to collectively as "incident-reporting systems", which aim to catalog, analyze, and prevent the causes of incidents. Such systems rely on healthcare workers to provide descriptions of incidents, but low participation rates contribute to the problem of poor error prevention, and little research has focused on why this is the case or how participation may be improved. The present study proposes that both participation in and use of incident-reporting systems can be improved by examining usability of the input and output of reporting systems, and organizational influences on their use. Preliminary testing of a local hospital's incident-reporting software suggests several possible sources of discouragement related to the user interface. Violations of several of Nielsen's (1994) usability heuristics and Bargas-Avila and colleagues' (2010) guidelines for web forms were identified. The preliminary results described here are the basis for my thesis research, which will use several qualitative and quantitative methods to explore the hospital's incident-reporting system as a case study on the general problems of poor reporting and poor use of reports. We expect to be able to produce a clear and exhaustive classification of usability-and organization-related problems based on their frequency and severity. Such results can be used to improve the design and use of incident reporting systems and to develop a procedure to provide feedback to "close the loop" between operational staff reporting incidents and hospital administrators analyzing the reports and implementing interventions to improve patient and employee safety in the hospital.

Nicolette McGeorge—University at Buffalo

Supporting the Work of ED Clinicians: Assessment of a Novel Emergency Department Information System in a Clinical Simulation Center

The objective of this study was to use cognitive systems engineering (CSE) methods to create interfaces for an emergency department (ED) information system and then to assess the created interfaces in a clinical simulation center. CSE methods were used to develop a model of the ED, depicting the major goals and functions of an ED, as well as the underlying processes completed and constraints affecting accomplishment of those goals and functions. This model was used to develop information requirements for an ED information system. An iterative design approach was then used to create novel displays using these information requirements and final revisions to the displays were made in preparation for further assessment.

The final set of displays was assessed within MedStar SiTEL clinical simulation center, part of a 10-hospital system in the Baltimore-Washington DC