CLW 2013: The Third Workshop on Cognitive Load and In-Vehicle Human-Machine Interaction

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ABSTRACT

Interactions with in-vehicle electronic devices can interfere with the primary task of driving. The concept of cognitive load can help us understand the extent to which these interactions interfere with the driving task and how this interference can be mitigated. The workshop will address cognitive load estimation and management for both driving and interactions with in-vehicle systems, as well as the need for standardizing cognitive load-related concepts and experimental practices.

Categories and Subject Descriptors

H.5.2 Information interfaces and presentation: User Interfaces. H.5.1 Multimedia information systems.

General Terms

Design, Experimentation, Human Factors, Measurement.

Keywords

Cognitive load, estimation, management, driving.

1. INTRODUCTION

In-vehicle human-machine interaction (HMI) can interfere with the primary task of driving. The concept of cognitive load can help us understand the extent to which these interactions interfere with the driving task and how this interference can be mitigated [1]. While multiple definitions of cognitive load (also called cognitive or mental workload) appear in the literature (see [2] for a brief review), it is commonly defined as the relationship between the cognitive demands of a task and the cognitive resources of the user [3]. While research results on in-vehicle cognitive load are frequently presented at automotive research conferences and in related journals, CLW 2013, the third in the series [4], will provide a unique forum for focused discussions on this topic.

2. WORKSHOP GOALS

The workshop has four goals:

1. **Explore the concept of cognitive load:** While the concept of cognitive load has been used by a number of researchers working on in-vehicle HMI (as well as those working in other fields), the definition of cognitive load is still debated. What are the definitions of cognitive load used in industry and academia? How is cognitive load related to different aspects of driving and various in-vehicle secondary tasks? Workshop participants will discuss these questions and will propose their own definitions of cognitive load.

2. **Explore issues in cognitive load estimation:** In estimating cognitive load (on-road [5, 6] and laboratory-based [7, 8]), researchers and practitioners use three types of measures: performance, physiological and subjective. The workshop will explore the practical use of these measures. Specifically, participants will discuss estimation methods, including details such as measurement equipment, reference tasks, and experimental design.

3. **Explore issues in cognitive load management:** How can we design in-vehicle HMI such that the driver has the cognitive resources to safely operate the vehicle, even while interacting with in-vehicle devices? Researchers and practitioners have explored a number of approaches for workload management [9], from simply turning off HMI in certain situations, to introducing novel interaction methods which hopefully do not introduce undue cognitive interference with the driving task (voice interfaces [10, 11], augmented reality [12, 13], mediation [14], tactile interfaces [15], subliminal notifications [16], etc.). The workshop will explore various aspects of managing the driver's cognitive load.

4. **Explore the need for standardization:** In light of current approaches to cognitive load estimation and management, what are the areas of standardization that would be of the greatest benefit to researchers and practitioners? Workshop participants will discuss approaches of interest, including the introduction of standard definitions, toolsets, and corpora, which could

be used to make new results replicable and easily compared to the results of others.

The workshop organizers will bring together a number of experts from government, industry, and/or academia to address topics on exploring the concept of cognitive load (goal 1). Furthermore, we will solicit research papers exploring issues in cognitive load estimation and management for interactions with in-vehicle devices (goals 2 and 3). Authors will be encouraged to also include at least one paragraph addressing standardization (goal 4). Additionally, position papers on goal 4 will also be solicited. Topics of interest will include:

- Cognitive load estimation in the laboratory,
- Cognitive load estimation on the road,
- Sensing technologies for cognitive load estimation,
- Algorithms for cognitive load estimation,
- Performance measures of cognitive load,
- Physiological measures of cognitive load,
- Visual measures of cognitive load,
- Subjective measures of cognitive load,
- Methods for benchmarking cognitive load,
- Cognitive load of driving,
- Cognitive overload and cognitive underload,
- Approaches to cognitive load management inspired by human-human interactions.

3. WORKSHOP ORGANIZATION

3.1 Before the Workshop

3.1.1 Program Committee Recruitment
The program committee will be recruited from the extensive list of academic and industry contacts of the organizers, in the HCI, speech, ubiquitous computing, and human factors and ergonomics communities. We will primarily target our colleagues who were part of the PC in 2011 and 2012.

3.1.2 Publicity and Soliciting Papers
The workshop will be publicized using a dedicated website hosted by the University of New Hampshire. The Call for Papers will be distributed via the following channels:

- ACM CHI mailing list,
- Ubicomp mailing list,
- SIGdial mailing list,
- WikiCFP,
- HFES Surface Transportation Technical Group Newsletter,
- Driving Assessment conference email list;
- Contacts of program committee members in their respective fields.

3.1.3 Paper Submission, Review and Selection
Papers will be submitted and reviewed using the EasyChair conference management system [17]. This will allow for online paper submission and simple management of reviewer assignments and feedback. The organizers will make the final paper selection based on reviewer recommendations. Note that EasyChair is a free service hosted by the University of Manchester CS Department; therefore no funding will have to be secured for its operation.

3.1.4 Final Pre-Workshop Activities
The list of accepted papers will be posted on the workshop website in early October. The organizers will create a mailing list to distribute accepted papers to workshop participants prior to the workshop. Participants will also be encouraged to use the mailing list to initiate interactions before the workshop.

3.2 During the Workshop

3.2.1 Sessions
This all day workshop will start with a keynote address and continue with three sessions.

Keynote by Klaus Bengler. Dr. Bengler is professor at the Technische Universitat Munchen. One of his primary focus areas is in-vehicle human-computer interaction. In his keynote Dr. Bengler will discuss issues of driver availability (underload vs. overload situations).

Session 1: Expert presentations on cognitive load and in-vehicle HMI. The first session will feature 2-4 experts who will discuss their views on the concept of cognitive load: what it is, how to estimate it, and what its role is in exploring in-vehicle HMI. The session will include a presentation by Toyota's James Foley, who will discuss NHTSA guidelines for the design of in-vehicle HMI and their relationship to cognitive load.

Session 2: Contributed presentations on cognitive load and in-vehicle HMI. Session 2 will feature oral presentations by workshop participants introducing papers accepted for publication by CLW 2013. The presentations will focus on cognitive load estimation and management, specifically the topics listed at the end of section 2.

Session 3: Sharpening our arguments. In the final session we will invite all participants to discuss the contributed presentations (Session 2), especially in light of the keynote and the expert presentations (Session 1). We will offer the following seed questions for this discussion:

1) Are the problems, goals and hypotheses of the contributed presentations well-defined and grounded in existing knowledge? How could they be improved based on the keynote and expert presentations?

2) Did the authors of the contributed presentations consider all interesting questions that are raised by their work? Are there aspects of their discussion and conclusions that could be improved?

3) Are the presented results repeatable? What are the aspects of cognitive load-related research that should be standardized?

3.2.2 Collecting Feedback
As in 2011 and 2012, at the end of the workshop organizers will solicit feedback from participants in anonymous written form. Participants will be asked to evaluate the relevance and ultimate value of the workshop using responses on a Likert scale. Suggestions for improvements will also be solicited.

3.3 After the Workshop

3.3.1 Online Report

Based on the notes taken during the workshop, the organizers will create a report about the workshop's outcomes and post it on the workshop website. The organizers will also report on participant evaluations.

3.3.2 White Paper(s) on Future Work

The organizers will initiate an effort to prepare a white paper to provide guidance on future work in the field of cognitive load as it relates to in-vehicle HMI. The intended consumers of this guidance are fellow researchers and developers, industry, and funding agencies.

3.3.3 Workshop at AutomotiveUI 2014?

Assuming that participant feedback indicates that the workshop was successful, the organizers will contact participants for suggestions for a workshop to be held at AutomotiveUI 2014.

4. ACKNOWLEDGMENTS

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