# CLW 2016: The Sixth 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 and increase crash risk. Interactions with in-vehicle interfaces draw upon visual, auditory, psychomotor, and cognitive resources. Researchers often investigate how using these interactions impact performance through the use of different measurement techniques, particularly doing so in applied settings such as automotive scenarios. The goal of this workshop is to share knowledge with the community regarding the theoretical underpinnings, collection, and filtering of eye tracking data within the scope of automotive research. The workshop will describe and demonstrate the theory behind these measures, approaches, limitations, and issues in collection, and successful methods of filtering data eye tracking measures. The focus of the workshop will be on ensuring participants acquire an understanding of the theoretical reasoning behind the measures shown in the workshop as well as practical knowledge of how to collect and filter data.

## 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, eye tracking measures.

## 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. Research has progressed to the point at which some processes for collecting measurements for the estimation of cognitive load (but not analyzing them) has been standardized (i.e. [1]). However, as

the popularity in measuring cognitive load increases within the in-vehicle HMI field, people are constantly exploring new options to gather this data.

One increasingly popular way to estimate cognitive load is to use eye tracking measures. Eye tracking measures are objective, and eye trackers are inexpensive and widely available. However, the successful use of these measures requires both an understanding of the theory that ties the measures to workload, as well as knowledge regarding the best methods of data collection and filtering.

Following successful workshops at AUI for the past five years [2, 3, 4, 5, 6] the purpose of this workshop is to provide the theoretical knowledge behind the use of eye tracking measures and the practical experience of collection and filtering of the data. The workshop will focus in particular on common measures such as the distribution of fixations on different visual targets, total time looking away from the road, and pupil size.

## WORKSHOP GOALS

The workshop has three goals:

1. **Explain the theoretical underpinnings behind common eye tracking measures of cognitive load.** The first goal of the workshop is to communicate the theoretical reasoning behind the use of eye tracking measures and practical considerations of how eye tracking should be conducted within the automotive setting. A strong focus will be on ensuring that participants understand how the changes seen in these measures correspond to differences in workload. The workshop will also then include discussion of practical aspects of using these measures in the automotive environment and how these can affect the outcome of the measure data.

2. **Demonstrate how eye tracking measures of workload are collected**. The attendees of the workshop will gain an understanding about how to actually collect eye tracking measures of workload. The second goal of the workshop is to ensure participants receive a demonstration of how these measures are collected and some level of hands-on experience in the collection of measures. Again the focus here will be toward the practical considerations of using these measures within an automotive environment.

3. **Present techniques of how the data from these measures are reduced and analyzed**: The last goal for the workshop in an effort to allow attendees to walk away with applicable

knowledge is to ensure they understand how to filter the data that they will collect. To some extent, this will involve summarizing existing practice codified in standards or discussed in previous studies within the space for the participants. However, the workshop will go beyond what is in those documents, discussing practical problems of filtering and cleaning the data, rules for determining and eliminating outliers, and methods of quantifying lost data. The workshop will also discuss identifying potential confounding factors and situations that arise with the use of eye tracking data that can bias interpretations of results, as well as pointing attendees to software that can help produce results.

The workshop organizers will bring together a number of experts from government, industry, and/or academia to address the above topics.

## 2. WORKSHOP ORGANIZATION

### 2.1 Before the Workshop

#### 2.1.1 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, 2012, 2013, 2014, and 2015.

#### 2.1.2 Publicity and Soliciting Papers
The workshop will be publicized using a dedicated website hosted by the University of New Hampshire [7] and the announcement of the workshop will be distributed via the following channels:

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

#### 2.1.3 Paper Submission, Review and Selection
We will invite experts in eye tracking measures of cognitive load to present at the workshop and to have position papers for the proceedings of the workshop. We will work with the authors on any necessary edits and improvements.

Position papers will be submitted and reviewed using the EasyChair conference management system [8]. This will allow for online paper submission and simple management of reviewer assignments and feedback. 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.

#### 2.1.4 Final Pre-Workshop Activities
The list of presenters and their topics will be posted on the workshop website in late August. The organizers will create a mailing list to distribute position papers to workshop participants prior to the workshop. Participants will also be encouraged to use the mailing list to initiate interactions before the workshop.

### 2.2 During the Workshop

#### 2.2.1 Sessions
The workshop will start with an introduction by a leader in the automotive user interface research community to discuss the overall impact of measuring cognitive demand and how the use of eye tracking measures can help towards this goal. This introduction will be followed by three sessions:

**Session 1: Discussion of the reasons behind the use of eye tracking measures** – Invited presenters will discuss theoretical reasoning behind the use of popular eye tracking measures and practical considerations that can come along with the collection of this data. The presentations during this session will provide the audience with the theoretical understanding of why differences in eye tracking are seen, so that in the following sessions they are able to understand the implications of the data being collected and filtered. The goal for the audience is to get basic affinity with eye tracking measures as well as a deeper understanding of practical issues in applying these measures within the automotive settings. These presentations will be aimed toward goal 1 of this workshop.

**Session 2: Demonstrations of measure collection** – Presenters will provide an opportunity during the second session to get either a hands on experience with the collection of certain eye tracking measures if the hardware is available or at the least a very in depth presentation on the process. Those attending the meeting will be invited to bring hardware and software or recordings of the use of these systems to demonstrate the eye tracking measures in question. This includes hardware and software for the measures (i.e. eye trackers and data processing software), as well as a driving simulator or driving video game to show how the data are collected in a real study. As with the whole workshop this will focus on issues that can appear during the process that are stumbling blocks for researchers within automotive research. This session is aimed at goal 2 of this workshop, in providing experience of actually using the eye tracking measures in a study.

**Session 3: Discussion of techniques of measure reduction and analysis** – The third session will focus on papers and invited speakers presenting on the topic of reduction and analysis of eye tracking measures. This process can be very long and tedious so it will not be as hands-on as other sessions but should still be informative to participants and give participants more applicable knowledge of the process of analysis in this space. This session will be particularly focused on "tricks-of-the-trade" within the automotive field and looking at different approaches and tools people use in the analysis of eye tracking data. This session aims to fulfill the 3rd goal of the workshop.

### 2.3 Feedback
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.

### 2.4 After the Workshop

#### 2.4.1 Online Report
Based on the notes taken during the workshop, the organizers will create a document summarizing some of the practical issues that seem to be common and solutions to them.

#### 2.4.2 Workshop at AutomotiveUI 2017?
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 2017.

## 3. ACKNOWLEDGMENTS

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