Safety through Collaboration: A New Challenge for Automotive Design

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Abstract

A high number of car accidents are caused as a result of excessive demands and distraction. Collaboration can support drivers, since other tasks, e.g., operating with the navigation system, can be taken over by a front-seat passenger. But how can we, as researchers and HCI designers, develop and design collaborative in-car systems that really address safety issues or reduce demands during driving? Based on findings from three ethnographic studies I draw attention on the car as a safety-critical environment, where collaboration may solve safety issues.

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ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

Context and Motivation

According to the WHO, road traffic crashes are predicted to result in the death of around 1.9 million people annually by 2020. Road traffic injuries need to be reduced. In the field of HCI, effective interventions may include improving safety features of vehicles and reducing negative effects of technology usage in the car. In the automotive domain, there is a high number of Advanced Driver Assistance Systems (ADAS) available on the market that focus on safety. However, hardly any make use of the social nature and collaborative benefits of driving [4]. So far, research concerning collaboration in safety critical environments has paid much attention on industrial settings (e.g., mines), transportation (e.g., airplanes), military, or hospitals. I see the car as another example, since participating in road traffic is a dangerous endeavor.

On the one hand, collaboration in the car has the potential to reduce drivers' workload and distraction when, for instance, a front seat passenger takes over tasks like navigation. On the other hand, this

Box1. Main Research Questions

RQ1: *What collaborative practices do exist in and beyond the car? (i.e., with passengers vs. alone)*

RQ2: *How does the car context shape this collaboration during various contexts? (e.g., ice-glance, unfamiliar areas, commutes to work or home, traffic jam etc.)*

RQ3: *What are the main UX factors that have a common impact on both, collaboration between driver-passenger pairs and lone-commuters?*

RQ4: *What are the main design challenges for developing social-sensitive and collaborative in-car systems that should be addressed? (e.g., How to achieve a common ground between the collaborators?)*

collaboration might lead to more distraction, when, for example, the front seat passenger uses an in-car system in a different way than intended by the driver. There is also the potential to collaborate with users outside the car, if e.g., two people, who do not sit in the same car, share their navigation task depending on contextual factors. Future ADAs that account for supporting collaboration hold potential to reduce distraction and workload and, thus can reduce traffic injuries.

How can we as researchers and HCI designers and in particular the CSCW community, develop collaborative and social-sensitive in-car systems that take care of safety issues or reduce workload? In order to address this challenge, we need to gain a deeper understanding of communication and collaborative practices in the car and with other users outside the car. Furthermore, related context factors (e.g., length of waiting periods) need to be taken into account. The aim of my thesis is to use collaboration to improve car safety and to introduce specific design challenges. The obtained findings from my three ethnographic studies can inform future in-car designs, which supports a more social-sensitive and collaborative usage.

Related Work

There is a notable body of research in HCI, investigating social aspects and collaborative practices in the car through ethnographic studies (e.g., [1,2,3,4,9,17]). Specifically Oskar Juhlin's group (e.g., [7] conducted various ethnographic studies that served as a basis for a range of systems related to the social dimensions of driving (e.g., the SoundPryer system [12]). Contemporary research also focuses on driver-passenger pair cooperation in navigational tasks [4,17].

Regarding observable collaborative practices, Gärtner et al. [5] highlighted that drivers and passengers often experience problems in effectively communicating with one another. Human-human mediated communication beyond the car has become more important in the automotive domain in the last years [e.g., 16, 18]. Lamas et al. [8] did some basic research and explored user requirements for a driver-to-driver communication device within a cross-cultural study. Furthermore, Cyclic et al. [3] looked at how passengers' assistance during mobile telephone calls influences driving while being engaged in co-located and remote conversations. Gauglitz et al. [6] present a system that supports an augmented shared visual space for live mobile remote collaboration on physical tasks. Nevertheless, the systems and applications are mainly designed for static settings as well as do not take specific context factors into account.

To inform the design of future collaborative in-car systems it is necessary to understand the context of use holistically, which means to include all influencing factors such as environmental conditions, traffic conditions, constraints due to car properties or internal social factors [10]. Accordingly, four research questions were defined as shown in Box 1.

Work in Progress and Results to Date

Study I: The goal of my first ethnographic study was to gain an in-depth understanding of collaboration in the car context in general and of how technology of how technology supports these interactions (e.g., collaboration). The study, which was published at CSCW 2013 [15], revealed that collaborative navigation between driver-passenger pairs is of high importance for driving, especially at night. Customized navigation

devices supported this collaboration by providing different information for the driver and passenger. I further presented a design approach for future collaborative navigation devices [13].

Study II: Taking collaborative aspects outside the car into account, I carried out a second ethnographic study with 13 single-person private car-commuters. Since traffic jams include several waiting periods that could be used for such collaboration, my idea was to research and analyze these specific waiting periods in terms of their collaborative potential. (planned publication at MobileHCI 2016). Results show that lone-commuters took advantage of short waiting periods for collaborative practices (e.g., coordinating to-do list). Moreover, the daily 'fighting' of mileage was transferred into collaborative gaming for fuel saving or to have fun. This obtained knowledge served as a base for a design workshop with eight HCI experts that resulted in 32 design ideas [11].

Study III: As my previous research has shown [15], many in-car assistance situations can be related to collaborative navigation or support in demand situations. In order to help the driver in navigation and driving related tasks, I created a tablet based navigation app, especially designed for front-seat passengers. To evaluate the collaborative potential of my prototype, I investigated navigation practices between familiar individuals (i.e., couples) in real driving situations. The prototype was presented at this year's conference on Automotive User Interface [14]. The data shows that basic information such as turn-by-turn instructions should be given to both, the driver and the front-seat passenger to generate a common basic understanding.

Expected Contribution

This research will result in two primary contributions. First, this work will expand current research on in-car collaboration as well as beyond the car. Second, this work enables deeper understanding of potentials and design challenges as well as provide suggestions for developing social-sensitive and collaborative in-car designs. For instance, how to achieve a common ground for drivers and front-seat passengers and other people outside the car. With my thesis I provide a basis for reconsidering human-human-mediated interaction in a safety-critical environment such as the car to allow for more collaboration while driving.

Objectives for the CSCW DC

The colloquium would be the ideal platform to present and discuss my ongoing research in a professional atmosphere, and to obtain valuable feedback from fellow attendees, senior researches and experts in the field. I would also welcome a discussion on the effective evaluation of combined video, interview and GPS data (used in Study II).

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