Towards Cooperative Driving - Involving the Driver in an Autonomous Vehicle's Decision Making

Abdul Kawsar Tushar
tushar21@cs.Toronto.edu
Authors

- Marcel Walch
- Tobias Sieber
- Philipp Hock
- Martin Baumann
- Michael Weber

Institute of Media Informatics, Institute of Psychology and Education, Ulm University, Germany
Driving Universe and Driving Competition
Public Opinion

Slight majority of Americans would not want to ride in a driverless vehicle if given the chance; safety concerns, lack of trust lead their list of concerns

% of U.S. adults who say they would/would not want to ride in a driverless vehicle

Among those who say yes, % who give these as the main reasons

- Just for the experience/think it would be cool: 37%
- Would be safer: 31%
- Can do other things while driving: 15%
- Less stressful than driving: 13%
- Greater independence: 4%
- Convenience: 4%
- Good for long trips: 2%
- Other: 9%

Among those who say no, % who give these as the main reasons

- Don’t trust/worried about giving up control: 22%
- Safety concerns: 14%
- Enjoy driving: 13%
- Feel technology is not ready: 10%
- Potentially for hacking: 2%
- Other: 1%

Note: Respondents who did not give an answer are not shown. Variation responses have been coded into categories. Figures may add to more than 100% because multiple responses were allowed.
Source: Survey conducted May 1-5, 2017. “Automation in Everyday Life”
PEW RESEARCH CENTER

Americans have mixed opinions on whether driverless vehicles will reduce traffic deaths

% of U.S. adults who say the number of people killed or injured in traffic accidents will...if driverless vehicles become widespread

Note: Respondents who did not give an answer are not shown. Variation responses have been coded into categories. Figures may add to more than 100% because multiple responses were allowed.
Source: Survey conducted May 1-5, 2017. “Automation in Everyday Life”
PEW RESEARCH CENTER

Public strongly favors several policies restricting the use of autonomous vehicles

% of U.S. adults who say they support or oppose the following rules and regulations for driverless vehicles

- Strongly oppose
- Oppose
- Favor
- Strongly favor

- Requiring a person in the driver’s seat who could take control if needed: 86%
- Requiring driverless vehicles to travel in dedicated lanes: 47%
- Restricting them from traveling near certain areas, such as schools: 34%

Note: Respondents who did not give an answer are not shown.
Source: Survey conducted May 1-5, 2017. “Automation in Everyday Life”
PEW RESEARCH CENTER

http://www.pewinternet.org/2017/10/04/americans-attitudes-toward-driverless-vehicles/
Concerns for Acceptance

● “Trust interactions will promote confidence, control, and a sense of safety for the people operating AVs. At the heart of these interactions are four capabilities: comprehensive sensing, clear communication, response to changes, and multiple modes of interaction.”

## Assistive User Interfaces

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Direction</th>
<th>Initiation</th>
<th>Involvement</th>
<th>Completeness</th>
<th>Fallback Capability</th>
<th>Input</th>
<th>Output</th>
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<th>Haptic Output Position</th>
<th>Temporal Output Mode</th>
<th>Mode Awareness</th>
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<tbody>
<tr>
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Table 1. Academic Publications - Results (N=35)

Problems with Car Driver Handover
Experimental Setting

Figure 3: The driving simulator in which the study was conducted. The participant is watching a video while automation is activated.

Figure 4: Complex situation: in addition to the broken-down vehicle (simple situation) there is a police car behind it and another car on the side of the opposite lane.
Flow of Decision

Figure 1: System limitation / uncertainty detected: the system alerts and informs the driver before presenting propositions the driver can choose between to keep automation enabled.
Cooperative Assistant Demo

Figure 2: Cooperative assistant: it first alerts and informs the driver (2a) before asking the driver what to do (2b). The assistant gives feedback when the driver selects an autonomous driving proposition (2c) or a take-over request otherwise (2d).
Input Methods

(a) Interaction request with 2 options. The participant has to select the desired option via touch.

(b) Interaction request with 3 options. Participants select the desired option via saying the according number.

Figure 5: Screenshots of the interaction requests on the tablet in the center console. The input modality was displayed on the top of the screen.
Performance
Interaction Duration

(a) Executability

(b) Interaction modality

(c) Options
Figure 7: (Dis-)agreement of the participants on 7-point Likert scales to statements regarding the ease of interaction, the trust in automation and the perceived performance.
Discussion

- **Simplicity**: Small option count, implicit interaction
- **Supporting Driver Assessment**: e.g. Highlighting road signs when asking for support
- **Mistrusting Speech Recognition**: Robust; touch as fallback
Discussion – cont’d

- **Rear-view mirror**: Limitation in responsible decision
- **Reward System**: Participant engagement
- **Participant Group**: Mean and SD, age range
**Discussion – cont’d**

- **Trust Interactions**: Only clear communication and multiple modes of interaction was in focus.

- **Time Restrictions**: How much time will remain for the driver to communicate with the car?

- **Opportunities to Explore**: Personalization; Cooperation vs Handover; Complacency.
Next Iterations

Figure 1: Experimental setup: Participants saw the game [21] either on the flat screens in front of them (traffic scene and a speedometer) or via a VR HMD (see in-cockpit scene in Figure 2).

Figure 2: In-cockpit perspective (VR condition) of the racing game [21]. In contrast to the flat screen condition the headset displayed the cockpit including a virtual body of the driver.

Figure 4: Fixed-base driving simulator of the Department Human Factors at Ulm University.

Figure 6: SUS scores.


Thank you for your attention