Why did my car just do that?

Explaining semi-autonomous driving actions to improve driver understanding, trust, and performance

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Agenda

1. Background and Introduction
2. Methodology
3. Results
4. Discussion
5. Future Work

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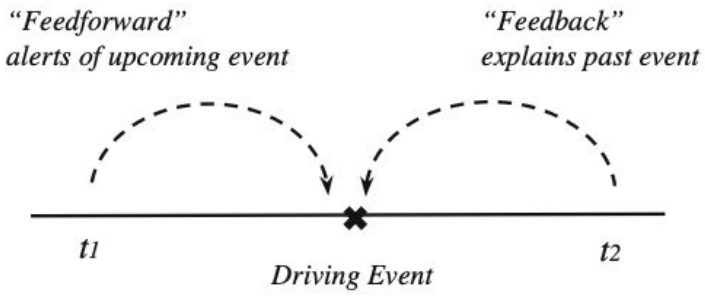
Background

“Designers are challenged to model appropriate ways of conveying necessary and timely information to the driver”

“We must design our technologies for the way people actually behave, not the way we would like them to behave” - Don Norman

Feedforward vs Feedback

- The central problems in conveying information are inadequate action and inappropriate feedback.
- Feedback alone is not sufficient, you need context!
- Authors argue that in ADS scenarios, feedback is not sufficient. **Feedforward** information is required to provide information ahead of an event.



Research Question

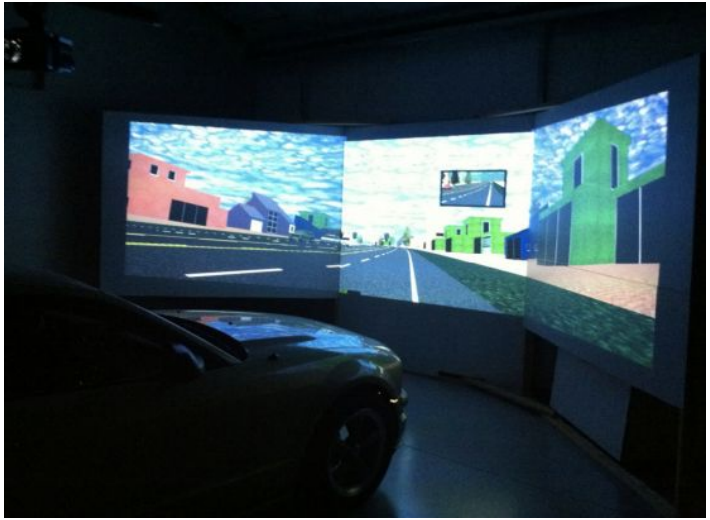
“When it comes to informing drivers about impending autonomous behaviour, how should we generate appropriate messages explaining the machine’s intelligence and intention?”

Messages

How	***Why***	***How + Why***
Information about how the car is acting. “Car is braking.”	Situational information explaining the reasoning for engaging automation. “Obstacle Ahead”	Combination of both how and why messages “Car is braking due to obstacle ahead”

Methodology

1. Participants
   a. 64 university aged participants (32 male and 32 female).
   b. All had between two and ten years of driving experience.
2. Apparatus
   a. STISIM driving simulator equipped with auto-braking functionality in the case of an impending collision.
   b. 12-km driving course incorporating urban, suburban and highway sections with changing driving conditions.
3. Procedure
   a. 5 min practice course
   b. 30 min test course
   c. Online Questionnaire to assess driving experience and their reactions to the warning system



Dependent Variables

Attitudinal Measures

1. Emotional Valence
   a. How well do the following words describe how well you felt while driving?
2. Machine Acceptance
   a. How well do the following adjectives describe the car?

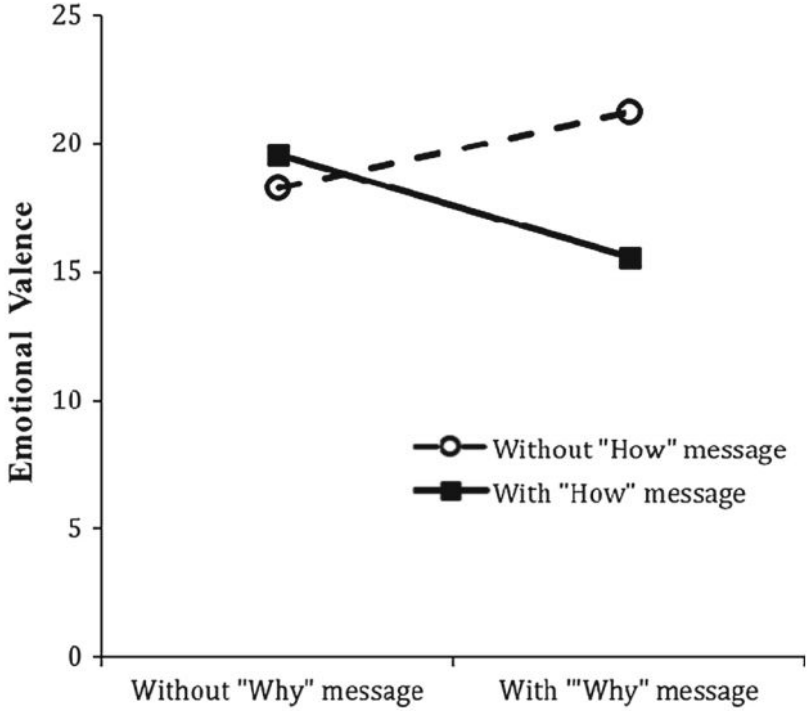
Behavioural Measures

Safe driving analyzed by data collected from the simulator with regards to: collisions, speeding, traffic light violations, stop signs missed, road edge excursions, and driving time.

Emotional Valence

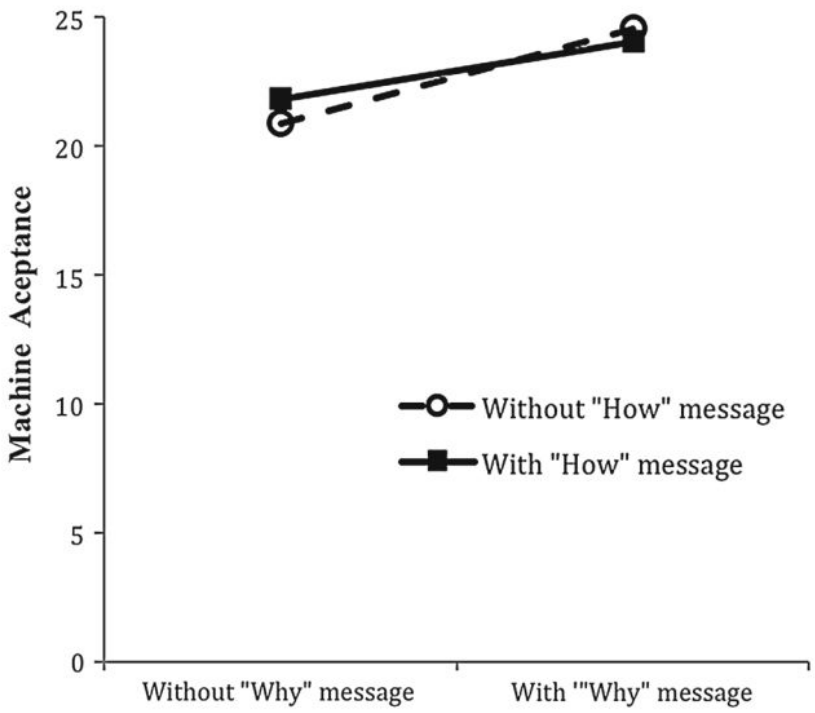
1. Least positive emotional valence when a combination of both how and why was given to the user.

2. Most positive when only the why message was included.



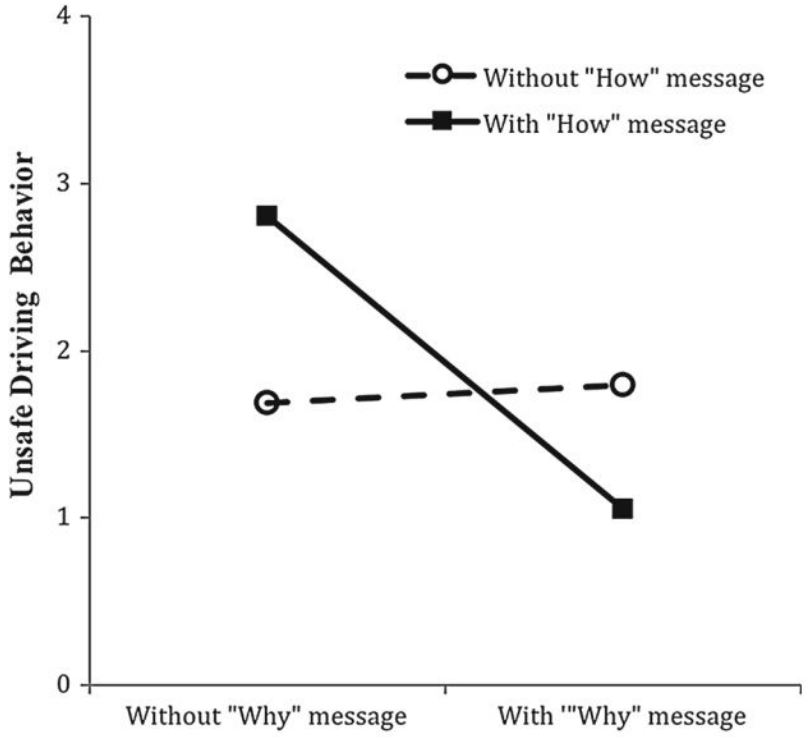
Machine Acceptance

1. Why message had significant effect on driver acceptance of the automated system.



Safe Driving Behaviour

1. When users did not receive the how message, why message made no difference.
2. If user was told the how without the why, they “drove” significantly worse.
3. Safest driving performance when both how and why were delivered.



Discussion

- Why did users respond negatively to the **how**+**why** message?
  - Cognitive Load?
  - “...the consumer appeal of the product does not always correlate with high performance and satisfaction in actual use.”

- Why did the **how** message on its own not do well?
  - Locus of control (Driver/Internal vs System/External)
  - Endsley’s model of Situational Awareness
  - Was the car being impolite?

- Why did users like the **why** message?
  - Gave enough information without being redundant.

Future work

- Towards Cooperative Driving: Involving the Driver in an Autonomous Vehicle's Decision Making
  - Marcel Walch, Tobias Seiber, Philip Hock (Institute of Media Informatics, Ulm University, Germany)

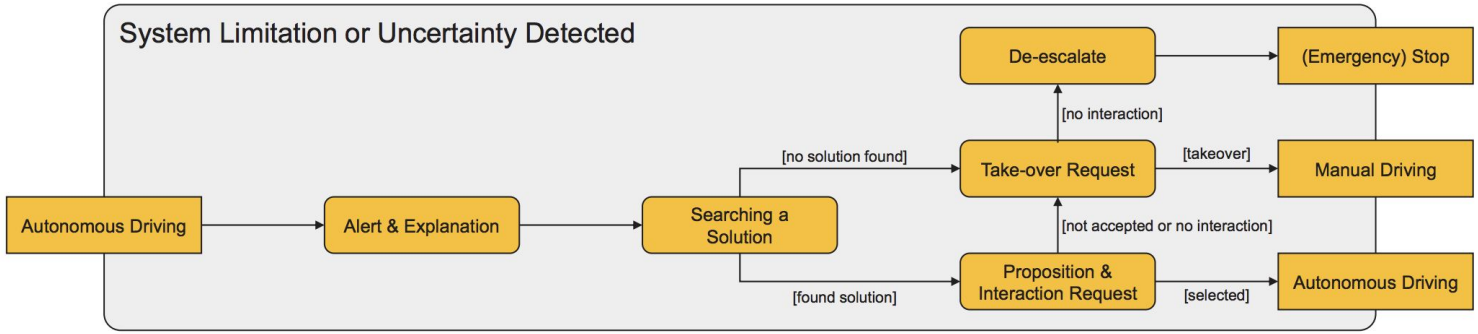
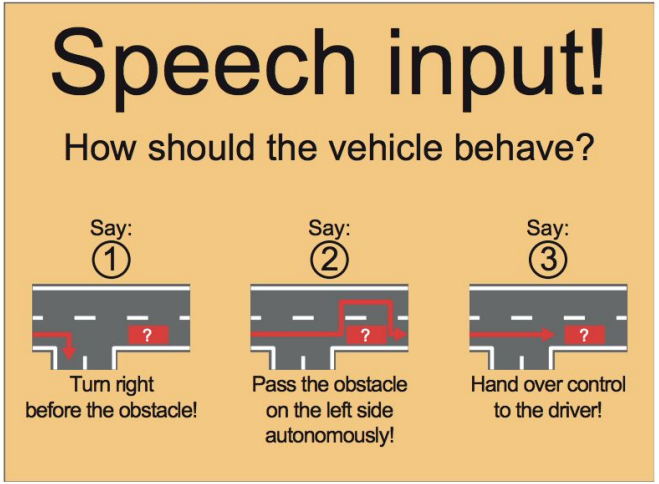
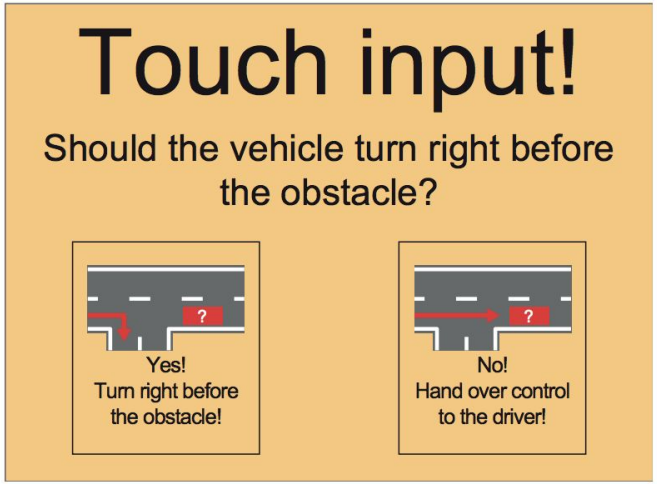


Figure 1: System limitation / uncertainty detected: the system alerts and informs the driver before presenting propositions the driver can choose between to keep automation enabled.



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



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

My concerns with the paper

1. Are driving simulators sufficient in mimicking real driving conditions?
2. Is the participant group diverse enough to capture user behaviour?
3. The authors' notion of safe driving behaviour was too basic.
4. How can we guarantee enough time for feedforward information to be delivered before automated action is taken?
5. Is a voice alert the best way to convey information to the user?

Thank you for listening. Questions?