Wizard of Oz design for testing automated driving on public roads

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Agenda

- “Wizard of Oz” (WoZ) experiment
- What is a “Wizard of Oz” vehicle – examples and design
- Legal requirements / wizard limitations
- Research questions
- Study design and procedure
- Preliminary results

Wizard of Oz Experiment

History

- ”Experimenter-in-the-loop” technique (Alphonse Chapanis, 1975) at John Hopkins University in Communication Research Lab
- Limited vocabulary natural language dialogue (Kelley and Chapanis, 1977)
- Wizard of Oz phrase used by John F. Kelley in his PhD thesis (1983)

Wizard of Oz Experiment

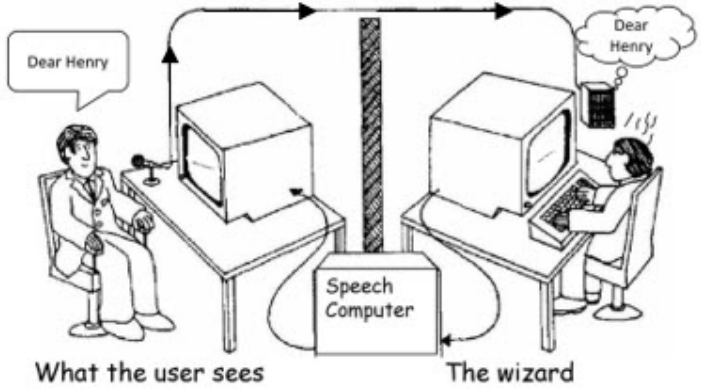
The Wizard of Oz, Warner Bros. Entertainment (1939)

Wizard of Oz Experiment

Study Human-Machine interaction

- Experimenter plays the role of the machine
- Potential to study interaction before system development
- Identify requirements for system design
- Investigate acceptance and trust
- Focus on Human Machine Interfaces (HMI)

Wizard of Oz testing – The listening type writer IBM 1984



Wizard of Oz Vehicle - Example

Study Drivers interaction with Automated Vehicles

- Hidden driver controls the car without informing the driver (introduction to study as if driving an automated vehicle)
- Potential to study driving behavior
- Testing transitions and take-overs
- Investigate acceptance and trust
- Concept for HMI

Brinkley, Posadas, Sherman, et al. 2019

Wizard of Oz Vehicle - Example

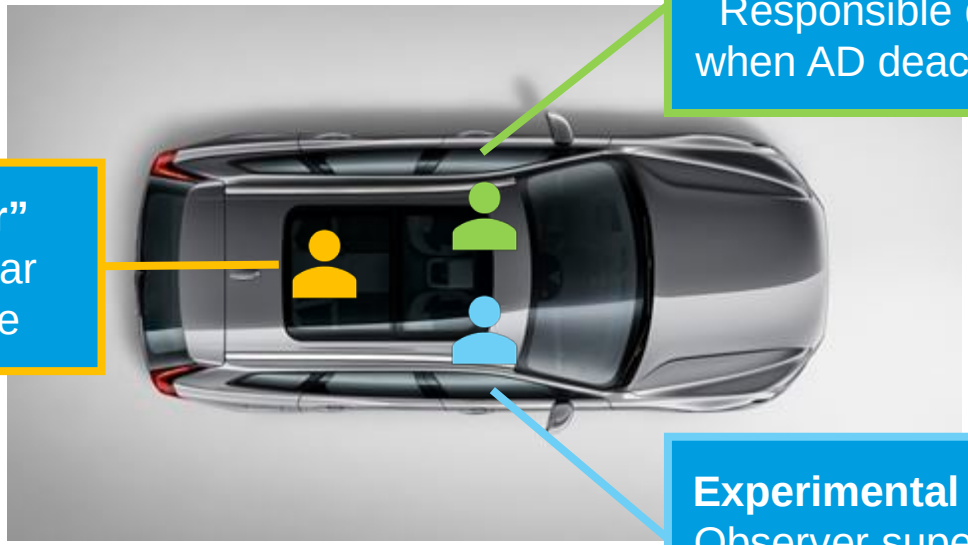
Study Pedestrians interaction with Automated Vehicles

- Tricking subjects into believing the vehicle is automated by not seeing a driver
- Aggressive vs. passive driving styles
- Is there is loss in information without a driver?
- How can automated vehicles communicate their intention?
- External HMI? Labeling automated vehicles?

Fuest, Michalowski, Schmidt, Bengler, 2019

Wizard of Oz Vehicle

Design and concept



Test subject
Responsible driver when AD deactivated

„Wizard driver"
Control of the car when AD active

Experimental leader
Observer supervising driving protocol

Wizard of Oz Vehicle

Legal requirements and safety when testing automated driving

- In EU no legislation for automated driving yet → possible with special permissions under high constraints
- In US: some states have legislation but require safety driver

- How to study safety of automated driving when not possible in normal traffic?
- Goal : Ordinary drivers experiencing automation under normal conditions
- Studying safety critical events / conflicts → need to be done on test tracks

Automation Assessment

Research Questions within L3Pilot

User Acceptance	**Impact on driver awarness**	Secondary task engagement	**Take-over process**
Willingness to use	**Impact on fatigue**	**Trust in automation**	Motion sickness

Automation Assessment

Methodology (Recommendations)

Questionnaire: use partly established and validated questionnaire (items), not too long

Logged data: test logging system, check data validity

Video annotations: time consuming, inter-rater reliability, automated approaches

WoZ – Driving study on public road

Experimental Design

- City motorway around Gothenburg
- Stretches with and without automation due to limitations for the Wizard (time)
- Two rounds; one in each direction
- 30 ordinary drivers (VCC employees) for L3 and baseline

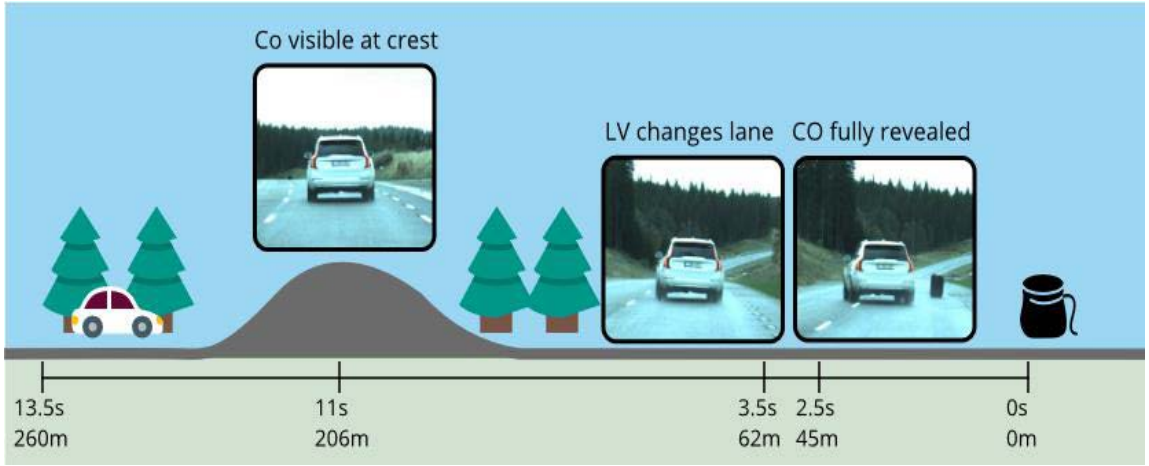
WoZ – Driving study on public road

Planned analysis

- Take over performance (after-automation effect?)
- Attention, visual behavior and secondary task engagement (annotations)
- Trust in automation after driving experience

Preliminary results

Take over + conflict (expectation mismatch)

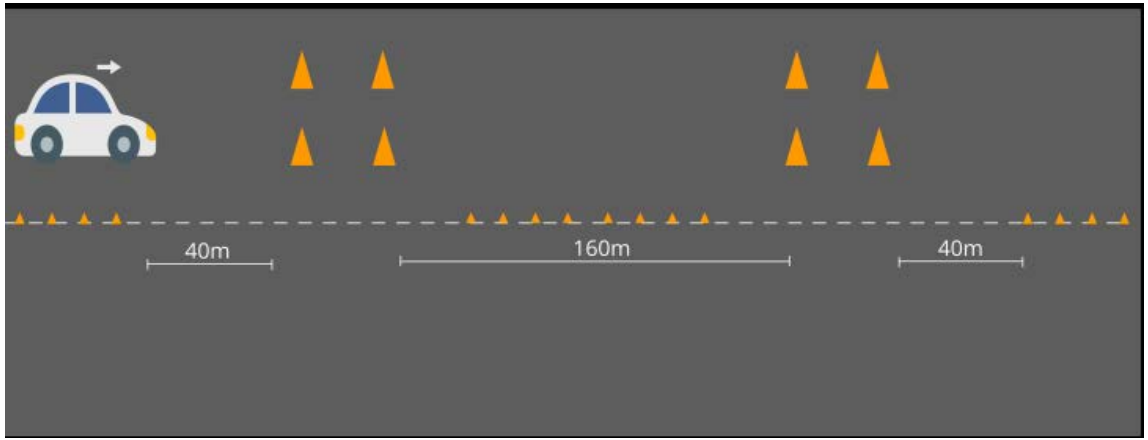


Pipkorn, L., Victor, T., Dozza, M., & Tivesten, E. (2020). ”Driver conflict response during supervised automation: do hands on wheel matter?“

Analyzed features

Preliminary results

Take over + conflict (automation aftereffect)

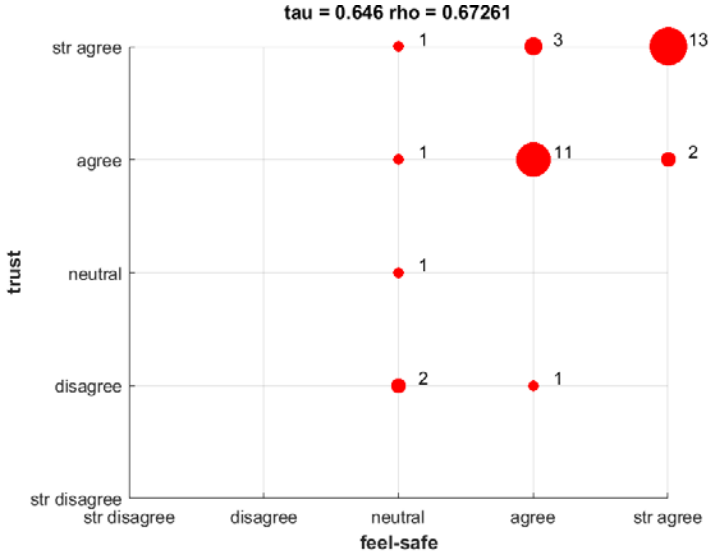


Pipkorn, L., Victor, T., Dozza, M., & Tivesten, E. (2020). The effect of automation duration on driver take-over response and driving performance: a wizard-of-oz test-track study

Analyzed features

Preliminary results

Feel-safe vs. Trust



Questions phrasing:

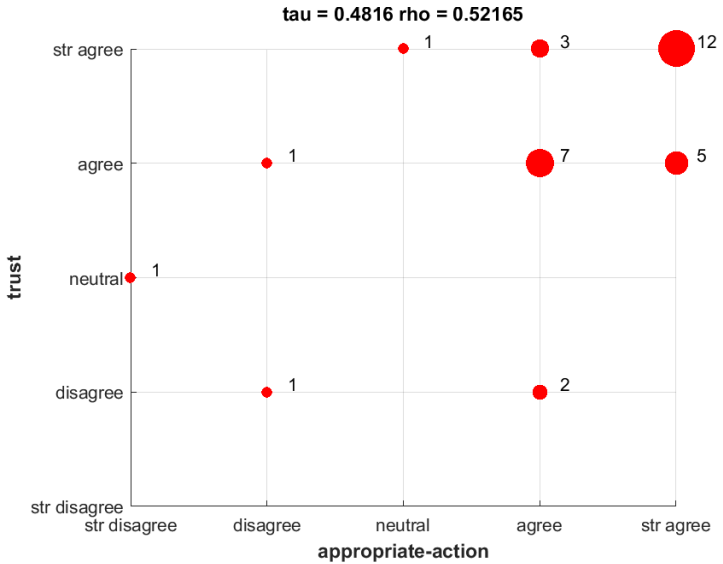
- I felt safe when driving with the system active.
- I trust the system to drive.

Discussion

- Feeling safe seems to strongly corresponds to trusting the system
- A few outliers that seem skeptical about automation but in this case not due to feeling unsafe → nothing dangerous happened

Preliminary results

Appropriate action vs. Trust



Questions phrasing:

- The system acted appropriately in all situations.
- I trust the system to drive.

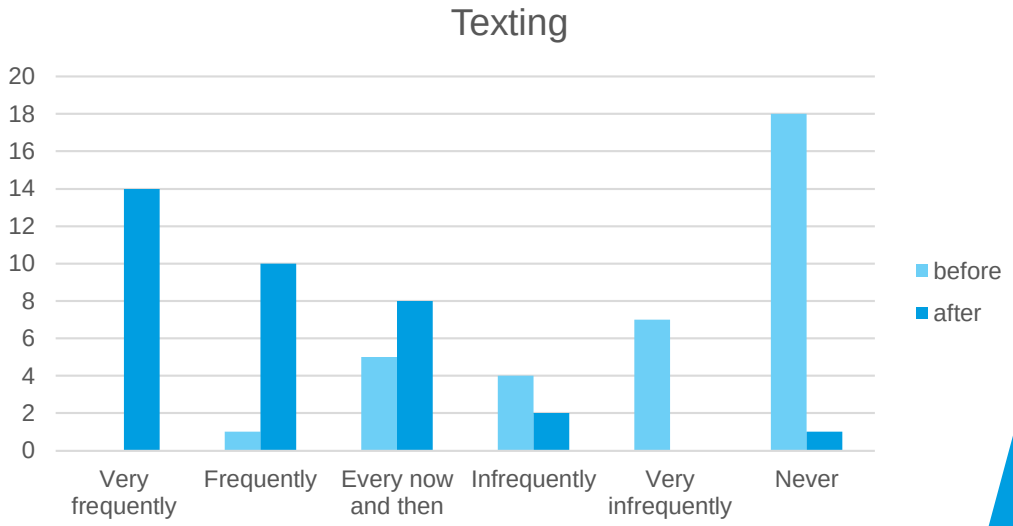
Discussion

- Some outliers that might either have reservations towards automation or have experienced misbehavior but still trust in automation
- Appropriate action seems to correspond to trust

Preliminary results

Switch of activities - Texting

- Preferred activities while driving
- Asked for manual driving (before) and experienced automated driving function (after)
- Result shows interest in other activities and some level of trust



Thank you for your kind attention.

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