

V O L V O

How do we know the driver is in the loop?

Mikael Ljung Aust, PhD

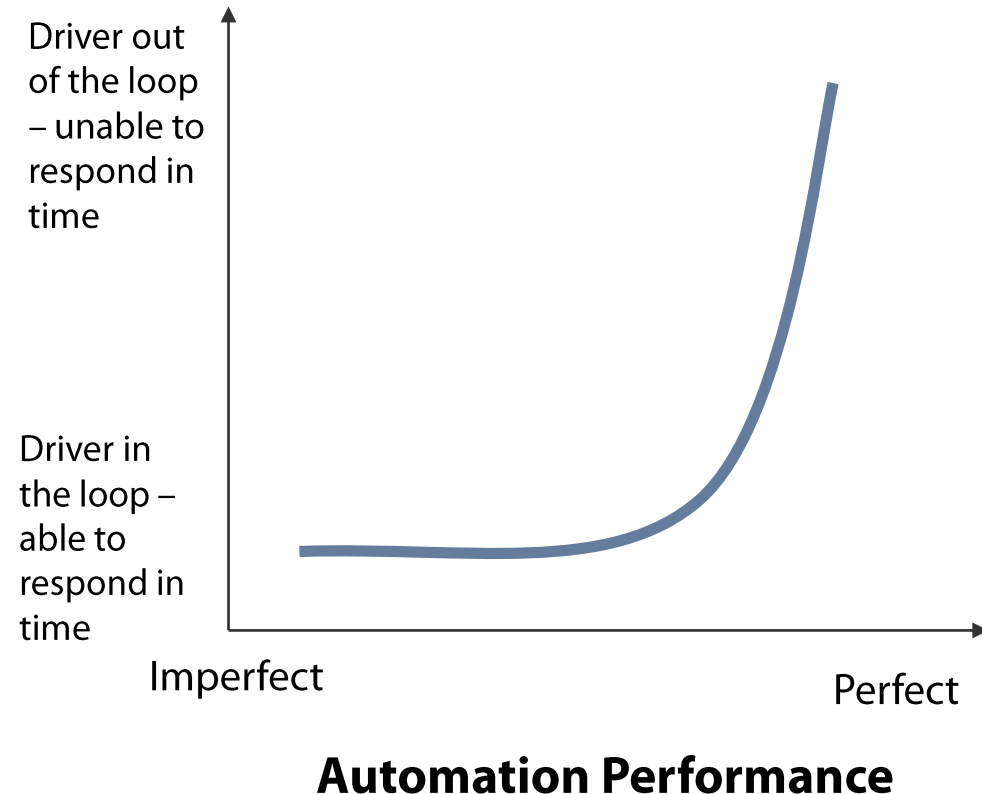
Senior Technical Leader Crash Avoidance, Volvo Cars
Mikael Ljung Aust Volvo Cars

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The classic irony of automation



- The more reliable the system, the less human operators have to do, so the less attention they pay to the system while it's operating
- Reliable systems tend to make it hard for operators to notice when something's wrong



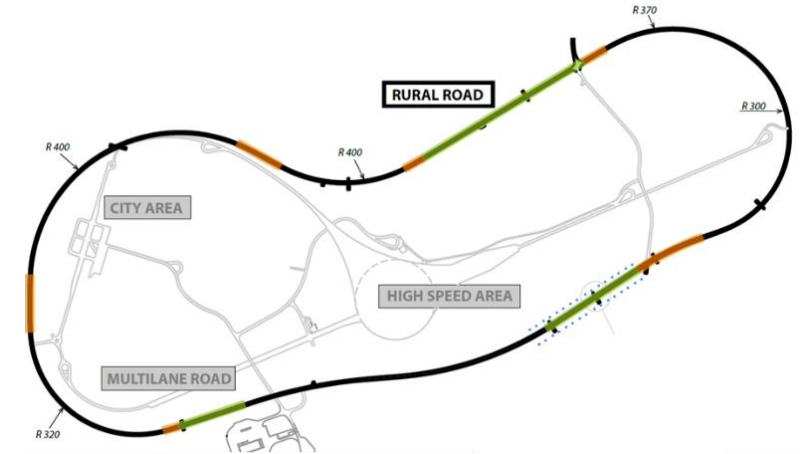
ADEST project: Wizard-of-Oz experiments



Test participants drive with Supervised AD engaged for 30 minutes

- Perfect performance for half an hour
- No need for test participants to intervene

After 30 minutes, they are exposed to a conflict object which the system does **not** respond to



ADEST project: Wizard-of-Oz experiments

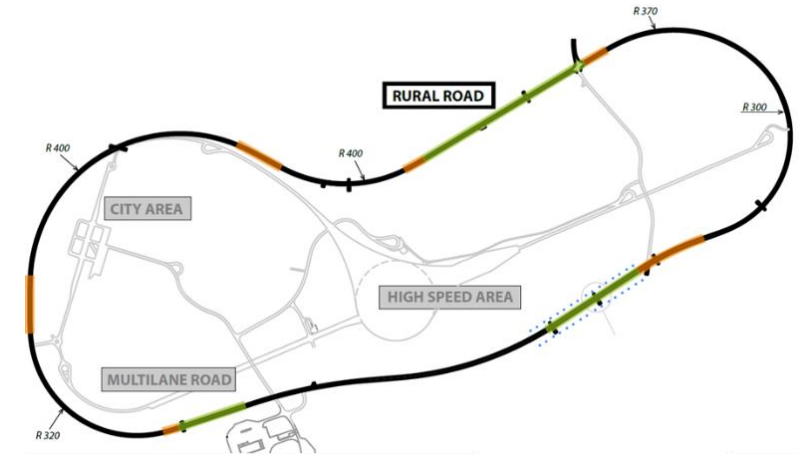


Three levels of detail when instructed on system limitations

- Low, Medium or High

Three Supervision reminder conditions

- No reminder
- Visual Attention Reminder
- Attention + Hands-on-Wheel Reminder

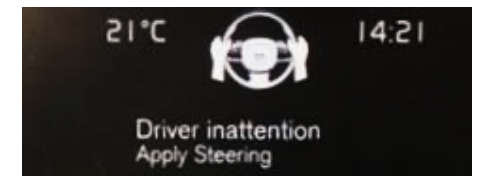
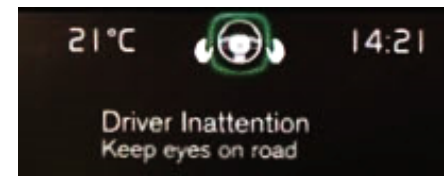
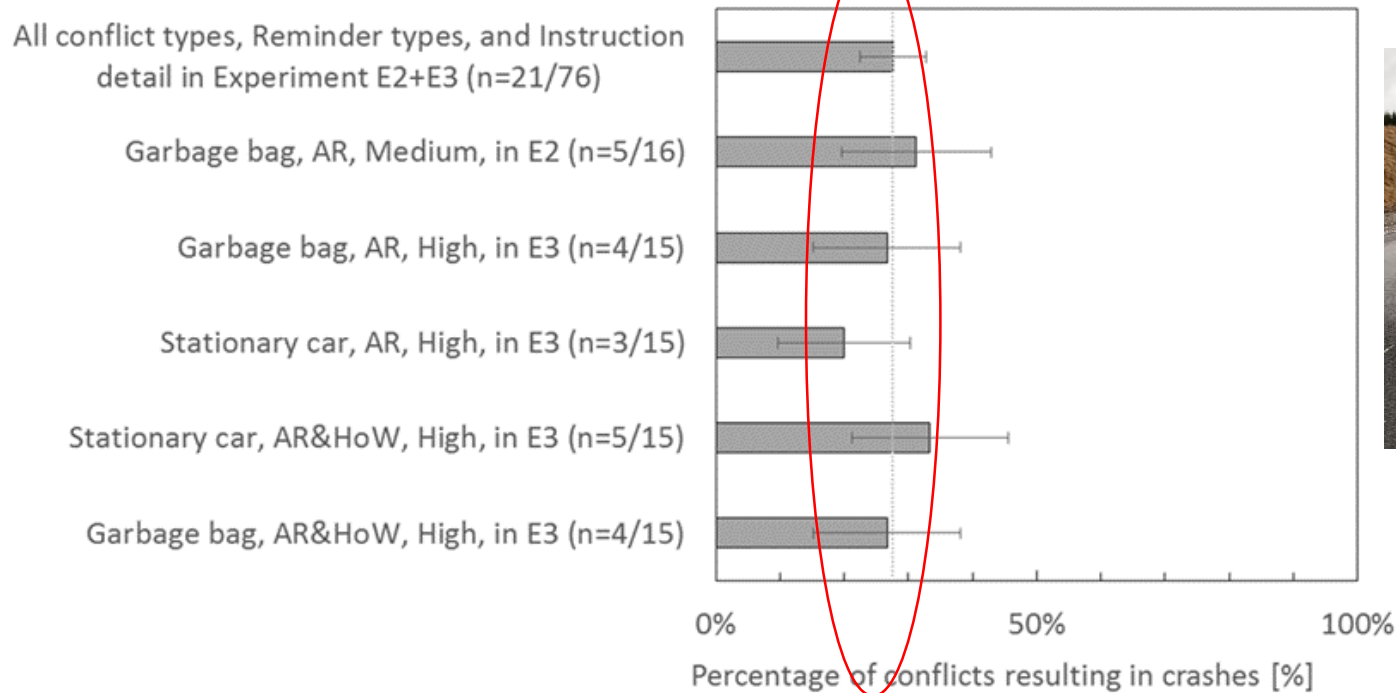


ADEST project: Wizard-of-Oz experiments



RESULT: Similar crash rates in all conditions

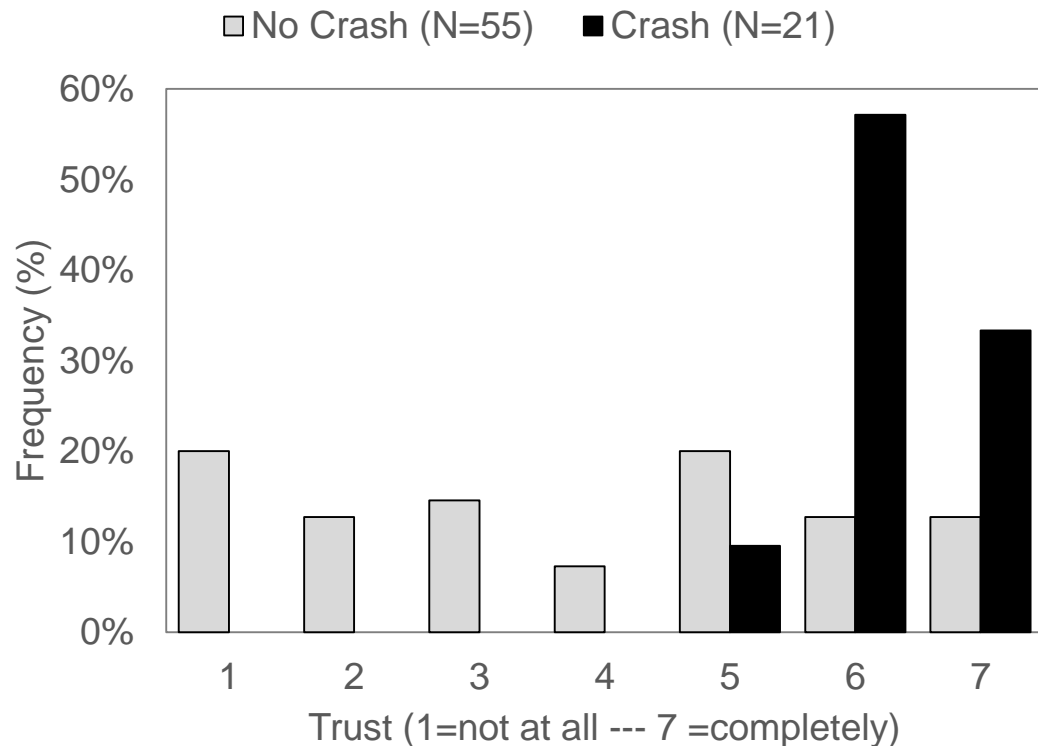
- ~30% crashed regardless of **Instruction detail level** and **Supervision reminders**





What were the crashers thinking?

Crashers reported **high trust** in the automation to handle conflict



Common **comments** related to high trust:

- Expected vehicle to detect and handle conflict
- Good driving performance by vehicle
- Felt safe during drive



What have we learned?

- Supervision reminders can be effective for keeping drivers' eyes on the road and hands on the wheel, **but...**
- ...Automation Expectation Mismatch still develops if driving performance is perfect!
- Automation Expectation Mismatch develops independently of how you are trained, what type of conflict object it is and whether you have your hands on the wheel or not

Implications for development of self driving cars



- When self driving performance is experienced as highly reliable:
 - Either make it truly highly reliable (unsupervised AD), **OR...**
 - ... make sure you can detect AEM
 - and if detected, offer less precise vehicle control or deactivate function (push the driver back in the loop)

Automation Expectation Mismatch: Incorrect Prediction Despite Eyes on Threat and Hands on Wheel
Fulltext at: <https://journals.sagepub.com/doi/pdf/10.1177/0018720818788164>

What were they thinking? Subjective experiences associated with automation expectation mismatch
Fulltext at: https://www.researchgate.net/publication/328388914_What_were_they_thinking_Subjective_experiences_associated_with_automation_expectation_mismatch

Out-of-the-loop crash prediction: the automation expectation mismatch (AEM) algorithm
Fulltext at: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8777364>