Assessing complacency in critical driving situations for automated vehicle guidance
Gloria Pöhler, Tobias Heine & Barbara Deml

Introduction
In highly automated driving applications, the driver needs to be able to regain manual control in critical driving situations (NHTSA, 2013). However, this transition to manual driving predominantly results in prolonged reaction times (De Waard et al., 1999) or collisions with preceding obstacles (Saxby et al., 2013). In highly automated driving conditions, complacency plays an important role as the system is highly reliable and the driver will be dealing with competing secondary tasks (Manzey & Bahner, 2005).

Method

Participants
- N = 48 drivers (n = 32 men, n = 16 women)
- M_age = 24.48 years (SD_age = 4.36 years)

Experimental Design
- 2x3 Mixed-design
- Between factor: critical scenario (braking truck, broke-down car)
- Within factor: automation level (manual, automated-highly reliable, automated-low reliable)

Dependent Variables
- Subjective Measures: Trust, Distrust, Mental Workload, Immersion, Fatigue
- Secondary Task Measures (SuRT): number of completed tasks, mean time per task, number of errors
- Driving parameters: collisions, TTC_br, TTC_min, reaction time to the critical scenario
- Eye-Tracking measures: number of fixations on both AOI’s “windscreen” and “secondary task”, cumulative fixation time on both AOI’s

Results

Driving Parameters
- 51.1 % of all subjects expected the system not to work in the low reliable automated mode

Subjective Measures
- Trust decreases significantly in low-reliable automation after experiencing highly-reliable automation (t(46) = 5.31, p < .001, d = 1.08)

Eye-Tracking Measures
- The differences in cumulative fixation times between manual and both automated levels were significant at all time intervals (p < .001)

Conclusions
Drivers fail to regain manual control in automated mode after the appearance of a critical driving scenario as a consequence of inadequate monitoring behavior. Secondary task performance as well as eye movement data implies that participants show high levels of complacency in automated driving in comparison to the manual driving condition. Continuously presented feedback which is peripherally detectable might support drivers to relocate attention to the windscreen.

References