RUMBA

Realisierung einer positiven User Experience mittels benutzerfreundlicher Ausgestaltung des Innenraums für automatisierte Fahrfunktionen

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# How drivers allocate their attentional resources when operating an automated and manual vehicle: An EEG experiment

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## 1 | Motivation

- Partially automated vehicles (AVs) are becoming more present on the streets, but not all automated system have the same abilities
  - **SAE[1] level 2** vehicle requires the driver to constantly monitor the system and be prepared to take over anytime
  - **SAE level 3** vehicle allows the driver to be involved in non-driving tasks (e.g. smartphone) and be prepared to take-over upon request
- Overreliance in the system abilities can potentially lead to safety-critical situations
- Understanding how drivers behave in vehicles on different level of automation helps to design warning systems and drivers training

**Research question**

Do drivers allocate their attentional resources differently when they drive manually and operate a level 2 and level 3 AV?

## 2 | Theoretical background

- **Manual driving** requires a lot of mental resources for monitoring of the environment, updating the perceptual motor loop, attuning gaze, and steering accordingly[2]
- **Automated driving** requires less mental resources as the vehicle takes-over (part of) the driving task

**Assessing mental workload using event-related potentials (ERPs)**

- Humans have only a finite amount of mental resources available[3]
- Mental workload is ratio between the task demands and the mental resources of the human operator[4]
- Only the free attentional resources are re-directed to the processing of the distracting stimuli (bottom-up)[5]
- Steering demands diminish the P3a, P3b, and RON components of the event-related potential of task-irrelevant sounds[4]
- **Three stage distraction model:**
  1. Automatic detection of unexpected task-irrelevant events;
  2. orienting attention towards the event;
  3. reorienting attention after temporary distraction.

## 3 | Hypotheses

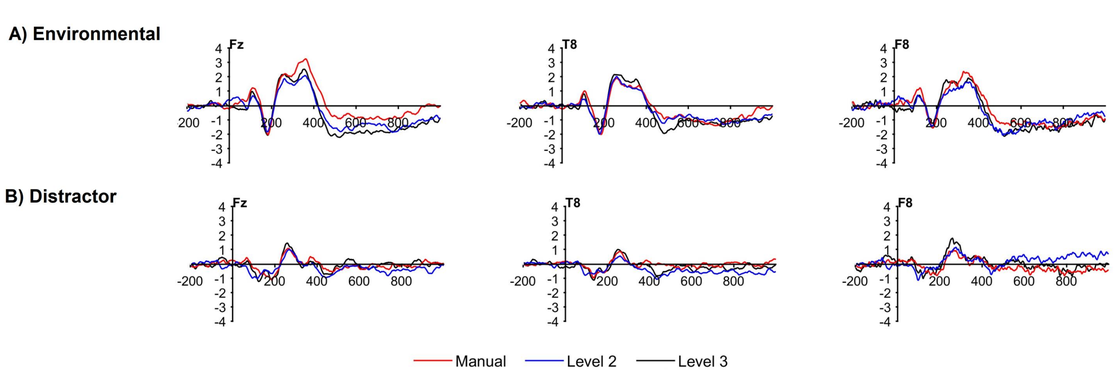
- **H1**: Frontal N1, fronto-central P3a, P3b, and RON components have the smallest amplitude when drivers conduct manually.
- **H2**: Frontal N1, fronto-central P3a, P3b, and RON components have larger amplitude when drivers operate an SAE level 3 compared to SAE level 2 vehicle.

## 4 | Methods

- Test-track experiment with 30 participants (age M = 42.6, SD = 14.0)
- Within-subject design (manual driving **vs**. level 2 **vs**. level 3 driving)
- System abilities explained using pre-recorded videos
- Brain activity measured using 32 channel EEG
- Auditory probes presented via headphones
  - Frequent standard (probability 70 %, 450 trials per condition);
  - infrequent distractor (probability 15 %, 90 trials per condition);
  - infrequent environmental sound (probability 15 %, 90 trials per condition).
- ERPs extracted from the EEG and averaged over the trials

## 5 | Preliminary results (for N = 10)

- Mean amplitude for the distractor sounds is lower compared to the environmental sound
- No difference in mean amplitude between L2, L3, and manual drive
- Hypotheses can not be accepted, likely due to the small sample size
- Analysis will be repeated with the complete dataset




## 6 | Links & Acknowledgements

Literature

ResearchGate (Nikol Figalová)

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