Understanding driver-vehicle interaction using **neuroergonomics**

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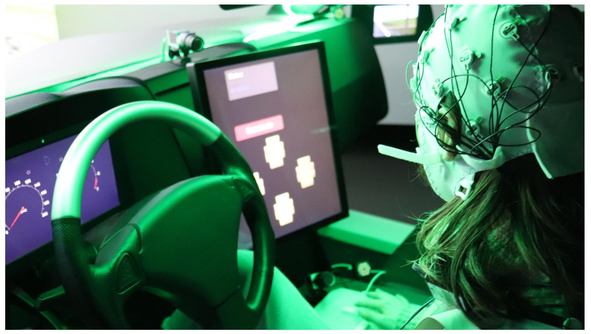
Understanding what is happening in drivers' brain while **interacting** with an **automated vehicle** (AV) can help us design **safer** and more **efficient** systems.

NEUROERGONOMICS

- Neuroscience + ergonomics
- **Focus**: Perception, cognition, and performance in relation to real-world technologies
- **Methods**: electroencephalography (EEG), event-related potentials (ERPs), eye-tracking



MAIN FOCUS OF MY PROJECT

- Drivers' **attentional allocation** in various levels of automation
- **Control transition** in L3 AVs
- Mental workload
- **Psychophysiological** measures

EXPERIMENT 1 - EEG

Can we use **ambient light** conveying the current level of **reliability** of a L3 AV to support driver's **take over performance**?

Method

- Driving simulator experiment
- 42 participants (two groups)
- Four-stage ambient LED light mounted around the windshield
- Mental workload (EEG & NASA-TLX)
- Driving performance (vehicle jerk)

Results

- Mental workload was not increased by the ambient light
- Drivers with the ambient light had lower vehicle jerk after a TOR

Fig. 1: The theta activity of drivers without (left) and with (right) the ambient light

Conclusion

Ambient light conveying the current reliability level of a L3 AV **improves** driver's **take over performance** without increasing mental workload.

EXPERIMENT 2 - ERPs

Do drivers allocate their **attentional resources** differently when operating a **manual**, **L2**, and **L3** AV?

Method

- Bosch test track & AV prototype
- 30 participants in August 2022
- L2, L3, and manual drive
- Distracting task-irrelevant sounds
- EEG and ERPs, eye-tracking

Expected results

- **Brain response** to the distracting sounds is **different on L2 and L3** automation, suggesting different allocation of attention
- Different **gaze** behaviour

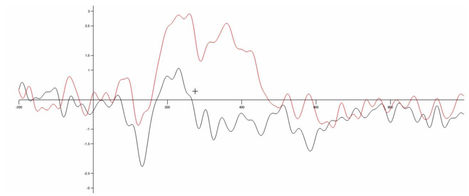


Fig. 2: The brain response to the sound when there is enough (red) or not enough (black) free attentional resources (pre-study)

FUTURE WORK

- Developing a **framework** for using EEG/ERPs to assess drivers' states
- Implementing findings to **improve** the transition of control in L3 AVs
- Evaluating **validity of EEG/ERP** methods in different environments

LATEST PUBLICATION

Figalová, N., Chuang, L. L., Pichen, J., Baumann, M., & Pollatos, O. (2022). Ambient light conveying reliability improves drivers' takeover performance without increasing mental workload. *Multimodal Technologies and Interaction*, *6*(9), 73. https://doi.org/10.3390/mti6090073

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SHAPE-IT