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To prevent road crashes it is important to understand driver related contributing factors. Important factors often include alcohol, sleepiness, distraction or fatigue.

The overall aim of the project Vehicle Driver Monitoring was to advance the understanding of two such factors; sleepiness and cognitive distraction:

• Physiological measures as indicators.
• The effect on driver behavior.
• The effects of contextual, inter- and intra-individual factors.
• Detection of the states using machine learning methods.
REALISATION

The data collection was done in several laboratory and driving simulator experiments. The driving simulator experiments were carried out in VTI’s moving base simulator, SIM III.

The cognitive distraction experiments were designed to advance the understanding of effects of cognitive distraction. Cognitive distraction experiments main focus was:

• Effect of cognitive load on driving performance in non-critical and critical situations.

• Physiological indicators of levels of cognitive load
REALISATION

Sleepiness experiments main focus was:

- Inter individual differences, professional drivers vs. "normal" drivers
- Intra individual differences, repeated visits with the same settings and preparations (3 days/3 nights).
- The confounding of light and darkness during day and night.
- The environmental (rural or urban roads) effect on driver sleepiness.
REALISATION - PHYSIOLOGY

- EEG – Brain activity
- EMG – Muscle activity
- Skin Conductance – Sweating
- EOG and Eye Tracker – Eye activity
- ECG – Heart activity
- Respiration – Breathing
KEY RESEARCH RESULTS AND CONCLUSION

- Professional drivers reported lower levels of sleepiness, even though the more objective indicators indicated that they were actually sleepier than the non-professional drivers. They also performed worse.

- Self-reported sleepiness level and driver performance differed within an individual when the same experiment was repeated three times in identical settings.

- Darkness was found to be an additive factor in several sleepiness indicators but had no effect on the number of line crossings.

- Drivers were differently influenced of sleepiness on rural and urban roads, mostly due to increased task demand rather than to a richer visual scenery.

- Support for the Cognitive Control Hypothesis was found in different traffic scenarios.

- Well established EEG frequency power measures only showed a difference between levels of cognitive load when the driving task was simple.

- A novel combined approach more suitable in mobile EEG artefact handling compared to available state of the art algorithms was developed.

- Automatic sleepiness and cognitive load classifications were improved by using contextual and behavioral measures as features in machine learning algorithms compared to physiological measures only.

The key conclusion is that context is crucial and has a great impact on driver behaviors, measures and experiences. Context can hence not be disregarded in neither design nor interpretation of studies on driver states such as cognitive load and sleepiness.
PROJECT REPORT

The project results were also summarized in the peer reviewed VTI report Vehicle Driver Monitoring – Sleepiness and Cognitive load, Nilsson et al, 2017. VTI report 937A.

Licentiate theses, master theses, peer reviewed publications and non-peer reviewed publications.
FURTHER RESEARCH

Research on contextual effects and validation of results from controlled experiments in naturalistic settings.

Further studies of effects of cognitive distraction and sleepiness, e.g., by studying the interaction between driving and distraction and the effects of local sleep.

Train machine learning methods to classify multiple driver states in large amounts of data containing multiple concurrent driver states.