



HUMAN-MACHINE-  
INTERACTION



KOOPERATIVES  
HOCHAUTOMATISIERTES FAHREN

## WP 3 – Focusing on the Driver Key Findings and Results

THE PARTNERS CONDUCTED A TOTAL OF **33 EMPIRICAL STUDIES**, WITH **1723 PARTICIPANTS**, IN OVER **1750 HOURS** RESULTING IN **30 PUBLICATIONS**.

### METHODOLOGY

The developed systematics and metrics were evaluated on the basis of **prototype conditionally automated driving systems** and **generic user-interface-designs**.

In order to evaluate the influence of **relevant parameters of the driver's state (sensoric state, motoric state, cognitive state, arousal and motivation)** on take-over performance, we focused on average driver reactions. However, if the controllability of take-overs needs to be assessed, a wider range of human performance should be considered as well.

We defined a common methodology and metrics to allow for a better comparison between the experiments and the results.

The experiments in driving simulators and Wizard of Oz vehicles on unplanned, unexpected or time-critical take-over situations were conducted with **time budgets between five and ten seconds**.

### DROWSINESS AND FATIGUE

During automated driving, drowsiness and fatigue can develop or be induced quickly and might be subject to volatile changes.

Drivers show **strong inter- and intraindividual** differences in the development of drowsiness and fatigue.

An **increase of drowsiness and fatigue** under monotonous conditions could already be detected **during shorter, uninterrupted automated drives** (20 to 30 minutes). Under these conditions no significant influence on take-over time and quality could be detected. Also, **in longer, uninterrupted automated drives** (up to 90 minutes) **clear and consistent effects on take-over behavior could not be found**.

### RECOMMENDATIONS

While driving with conditional automation, **extreme levels of drowsiness and fatigue (drivers close to falling asleep)** must be avoided.

Based on the **detection of high levels of drowsiness and fatigue, countermeasures** (e.g. a specific offer of NDRTs) can be initiated to avoid or to postpone such extreme driver states. This can help to **increase the safety and acceptance** of such systems.



Technische Universität München

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