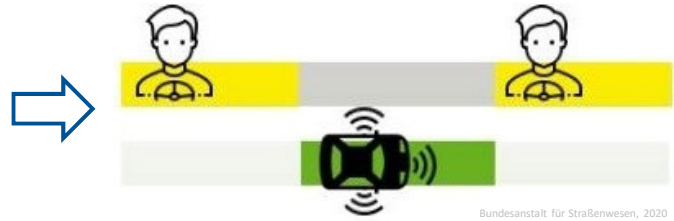# Using Task Switching to Explain Effects of Non-Driving Related Activities on Takeover and Manual Driving Behavior Following Level 3 Automated Driving

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Theoretical background

With SAE Level 3 automated driving entering the market, a new role is introduced to road traffic. While the Level 3 driving automation system is active, the former driver is released from driving and becomes a fallback-ready **user** who may engage in non-driving related activities. If the driver chooses to engage in a NDRA, the driving task and the NDRA are performed sequentially, requiring **task switching** when the request to intervene is issued.

Main finding from basic psychological research on task switching: **Switch cost** = "participants perform a discrete task on each trial. On some trials the task changes (switch trials), and on others it does not (repeat trials)" (Kiesel et al., 2010, p. 849)

Bundesanstalt für Straßenwesen, 2020

Task switching and switch cost in SAE Level 3:
(1) there is always a switch trial from NDRA to driving
(2) possibility to approximate a repeat trial by increasing similarity in cognitive demands of NDRA and driving task?

Applying task switching theory to SAE Level 3

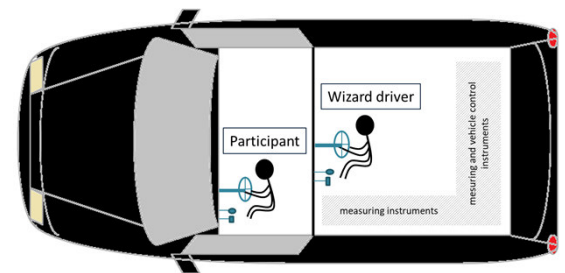| Level 3 automated driving		manual driving
NDRA	switch	driving task
task processes	executive control processes	task processes

Shi & Bengler., 2022

Hypotheses

Takeover behavior: NDRAs with higher similarity to the driving task in terms of cognitive demands are followed by lower takeover times and higher takeover quality (acc).

Manual driving behavior after takeover: NDRAs with higher similarity to the driving task in terms of cognitive demands are followed by less critical manual driving behavior (lower TTC).

Methods

	driving task	playing Tetris	reading & typing	watching a film
visual	✓	✓	✓	✓
spatial	✓	✓		
phonological			✓	✓
central executive	✓	✓	✓	

Shi & Frey, 2021

Discussion

Preliminary results are in line with the hypotheses: Takeover times after playing Tetris are lower than after the other two NDRAs. Descriptively time-to-collision data indicate lower criticality following playing Tetris compared to the other two NDRAs when participants evade a suddenly appearing balloon car in the manual driving phase after takeover. Five of 36 participants showed takeover times >10s (in total 8 takeovers). Mean takeover times (between 6s - 7s) are higher than takeover times typically found in driving simulator studies. Video analyses of participants' in-vehicle takeover behavior indicates that approx. 46% of our participants showed some kind of misbehavior in at least one takeover.

References

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