

# DEMONSTRATING BRAIN INTERACTIONS BETWEEN WORKING MEMORY LOAD AND LATERAL CONTROL DEMANDS WHILE DRIVING USING FUNCTIONAL NEAR INFRARED SPECTROSCOPY (fNIRS)

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**Introduction:** Driving is a complex task, requiring a series of cognitive demands simultaneously. Yet there is a lack of studies investigating the interactions among different sub-tasks. With the goal of ‘Adaptive Automation Systems’ to adjust the level of automation to the driver’s current demand, systems need to be able to assess cognitive demands required for each sub-task separately. This study aims at predicting changes in cognitive demands related to increased lateral control demands (LCDs) dependent on different working memory load levels (WMLLs).

**Methods:** We implemented a realistic driving scenario in the VR-lab at DLR, Braunschweig where 15 subjects performed a digit-span n-back (0-back to 4-back) speed regulation task [1]. Additionally, subjects drove half of the time through a construction site with a reduced lane width, increasing the LCDs. We recorded fNIRS data from the frontal, parietal and temporo-occipital areas.

**Results:** On average, we correctly predicted LCD-level in 72.1% of the timepoints. Mean accuracy scores varied across WMLLs with a significant effect of the WMLL on the LCD prediction accuracy (range 58.9% - 85.2%;  $F(4,70) = 10.2$ ,  $p < .001$ ). Predictions were better for intermediate WMLLs (see Fig. 1).

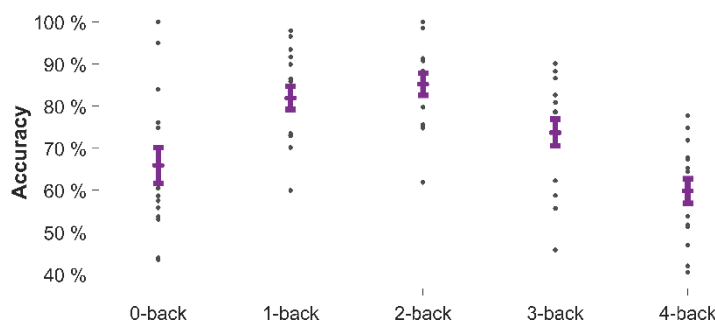


Fig. 1: Accuracy on prediction the LCDs per subject for each WMLL.

**Discussion:** Predicting different LCDs was possible, yet prediction accuracy depended on the WMLL. This indicates that the two different tasks underlie different but interacting brain processes. Based on the capacity sharing model [2], we surmise that WMLL affects the brain activation pattern underlying the LCDs, resulting in better predictions for challenging yet not overstraining WMLLs. Future studies may further investigate the interaction of different simultaneously performed driving related tasks and its effect on the assessment of related mental states.

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## References

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