Driver visual attention before and after take-over requests in conditional automation: *a public road study*

Linda Pipkorn, Ph.D. student | Chalmers University of Technology | 2021-07-23
Co-authors: Prof. Marco Dozza (Chalmers), Ph.D. Emma Tivesten (Volvo Car Corporation)

Pipkorn, L., Dozza, M., & Tivesten, E. (2021). *Driver visual attention before and after take-over requests in conditional automation on public road.* Manuscript submitted for publication.

Background:

- Existing research on transitions of control from conditional automation to manual driving has mainly focused on take-over times typically measured in driving simulators[1, 2]. Despite its relevance for vehicle safety[3], drivers' visual attention has received little consideration. In addition, there is a need for studies in real traffic to further extend previous findings in virtual environments.

Methods:

- Thirty drivers participated in a Wizard of Oz study on public roads. Drivers' visual attention was analyzed before and after four take-over requests. Visual attention during manual driving was also recorded to serve as a baseline for comparison. Drivers needed to press two steering wheel buttons to deactivate automation.

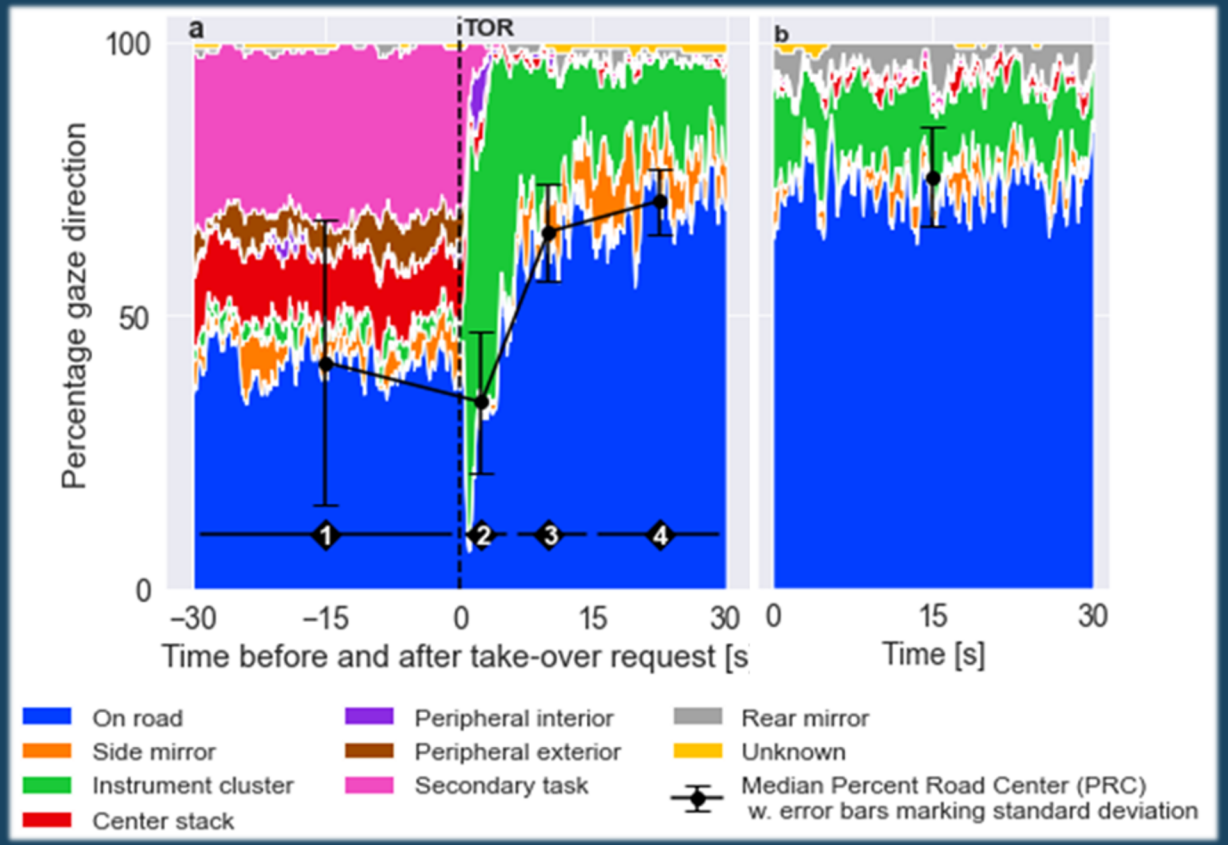
---

[1] McDonald, A. D., Alambeigi, H., Engström, J., Markkula, G., Vogelpohl, T., Dunne, J., & Yuma, N. (2019). Toward Computational Simulations of Behavior During Automated Driving Takeovers: A Review of the Empirical and Modeling Literatures. *Human Factors*, *61*(4), 642–688.

[2] Zhang, B., de Winter, J., Varotto, S., Happee, R., & Martens, M. (2019). Determinants of take-over time from automated driving: A meta-analysis of 129 studies. *Transportation Research Part F: Traffic Psychology and Behaviour*, *64*, 285–307.

[3] Victor, T., Dozza, M., Bärgman, J., Boda, C.-N., Engström, J., Flannagan, C., Lee, J. D., & Markkula, G. (2015). *Analysis of Naturalistic Driving Study Data: Safer Glances, Driver Inattention, and Crash Risk*.

a: Take-over request (TOR) in conditional automation **b:** Manual driving baseline



- Reduced visual attention to the forward road during automation, compared to manual.
- 1 s after a take-over request only 8% of glances are on road.
- Levels of visual attention towards the forward road did not return to the levels observed during manual driving until after 15 s had passed.

Pipkorn, L., Dozza, M., & Tivesten, E. (2021). *Driver visual attention before and after take-over requests in conditional automation on public road.* Manuscript submitted for publication.

CHALMERS

To conclude,

Before, and shortly after, receiving a take-over request, drivers may look less to the forward road than in manual driving. In fact, a take-over request may trigger drivers to look away from rather than to the forward road. Thus, drivers may not be aware of the driving environment when taking back control and may therefore miss safety-critical events.

Thank you for listening!

Contact me on: linda.pipkorn@chalmers.se, researchgate, twitter or linkedin

Pipkorn, L., Dozza, M., & Tivesten, E. (2021). *Driver visual attention before and after take-over requests in conditional automation on public road.* Manuscript submitted for publication.

L3Pilot Driving Automation

VOLVO