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Submission Summary

Track: **3rd International Conference on Human Factors in Transportation**

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Title: Effects of Automated Driving on Traffic Flow Efficiency: Challenges and Recent Developments.

Abstract: The main challenges in road transport are to reduce congestion levels, accident rates, and levels of emissions. Automated vehicles and systems supporting the drivers in their control task can contribute to solving these challenges. Automated vehicles, in particular those that include cooperative systems, are expected to improve traffic flow efficiency because they will help to anticipate traffic conditions downstream and speed up the outflow from a queue. However, these effects on traffic flow might be significantly influenced by human factors such as behavioural adaptions of drivers and user acceptance.
Under certain traffic situations, drivers may prefer to switch the automated system off (or transfer to a lower level of automation) or they may be forced to do so, for example in case of a sensor failure. These so-called authority transitions can have a substantial effect on the longitudinal and lateral motion of vehicles and are consequently expected to have a significant impact on traffic flow efficiency. To evaluate this impact, mathematical models of driving behavior of manually driven and automated vehicles can be implemented in microscopic simulation software packages. However, most mathematical models describing car-following and lane changing behavior do not account for these authority transitions. Thus, the effects predicted by these models might not be accurate and new models are needed.
To develop a new model of driving behaviour predicting and describing these authority transitions, we need an empirically underpinned theoretical framework in which human factors are accounted for. Our research aims at developing this theoretical framework, which represents the basis for the prediction of the effects of automated driving on traffic flow efficiency. For this purpose, empirical data from Field Operational Tests and driving simulation experiments need to be collected and analysed.
The first step in this direction is to investigate the automated systems that are currently available on the market. Adaptive Cruise Control (ACC) is a driver assistance system taking over longitudinal control through maintaining a desired speed and time headway. Field Operational Tests (FOTs) have suggested that drivers may prefer to disengage ACC and resume manual control in dense traffic conditions and before manoeuvres such as lane changing. In a driving simulator experiment, we found that the speed dropped significantly and the time headways increased after a sensor failure of ACC because drivers needed a certain time to react and press the gas pedal again. These results indicate that authority transitions might significantly influence the longitudinal motion of vehicles and mitigate the expected benefits of ACC on traffic flow. Our current research efforts focus on the development of a driver behaviour model that describes the

drivers' responses during and after authority transitions and is suitable to understand the implications of these transitions on traffic flow efficiency.

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