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Motorcycle riders vs. automated vehicles in a congested-traffic situation: a simulator study

Pauline Michel¹, Hemza Nedjari Benhadj Ali², Flavien Delgehier¹, Samir Bouaziz¹, Stéphane Espié²

Introduction

Powered Two-Wheelers (PTW) riders are now facing the increasing distraction of motorists stemming from the use of infotainment devices. A recent study reported that interacting with such a device while driving leads to reaction times up to 50% slower (Ramnath, et al., 2020).

Vehicle automation addresses, amongst other issues, driver distraction. However, the introduction of Automated Vehicles (AVs) in mixed traffic still raises questions, especially regarding interactions with VRUs. There is some bibliography on pedestrians/AVs interactions (e.g., Dey, et al., 2019; Nuñez Velasco, et al., 2019), but none to the best of our knowledge on PTW riders/AVs interactions.

Research question

In urban or peri-urban areas, where traffic is dense, a typical riding practice is **lane splitting**, i.e., riding between two lanes of slow-moving or stopped traffic in the same direction. This practice is common (even if illegal) in many countries.

Motorists' behaviors are sometimes **erratic**, as a result of distraction, and sometimes **uncooperative**, if the motorists consider that the practice is unacceptable; they are also often **cooperative**: motorists tighten themselves to the left/right of their lane to let PTW pass like they would for emergency vehicles.

The behavior of AVs is more consistent, with each of them following its lane with limited deviations. However, AVs do not reproduce the empathic behavior observed in motorists. Therefore, many researchers consider it relevant to visually signal AVs to help their interactions with Vulnerable Road Users (VRUs).

The objective of our study was to examine and compare the riding behavior of PTW riders when interacting with human-driven vehicles or signaled AVs in a congested-traffic situation.

Methods

The study was conducted using a **motorcycle riding simulator**.



We chose to **signal the AVs** and make them easily identifiable using their unique **yellow color**.

23 participants (20 men, 3 women) rode twice on a heavily congested virtual 2 x 2 urban ring. The traffic jam consisted either of human-driven ("standard") vehicles or fully automated (SAE level 5) vehicles, moving at an average speed of 7.2 km/h. The participants were instructed to ride as they usually would. The order of exposure to both variants was counter-balanced between the participants.



Simulated traffic jam of standard vehicles



Simulated traffic jam of automated vehicles

The traffic simulation reproduced the behaviors observed in human drivers: variable lateral positioning, with some of them behaving empathically (i.e., "opening the way" for PTW riders practicing lane-splitting).

Questionnaire results

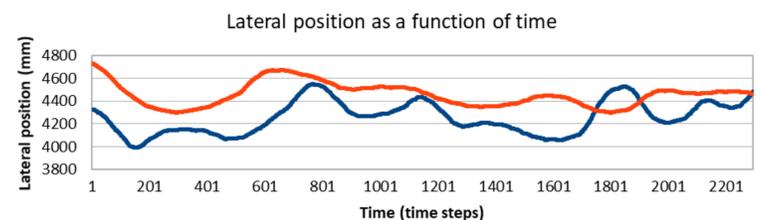
User Experience Questionnaire highlights that most participants considered AVs safer than "standard" human-driven vehicles (PTW riders regularly face unsafe situations due to motorists' unawareness?). Overall, the AVs being easily identifiable via their visual signature was judged "understandable" and "enjoyable" by the participants.

Technology acceptance questionnaire shows that they regarded AVs as "good" and "desirable". Moreover, **SHAPE Automation Trust Index** scores indicate that automation was considered "useful", "reliable", and "robust", and participants felt confident interacting with AVs.

Bias? The participants had a clear appetite for technology. Volunteers to participate in an experiment using a highly technical system (i.e., a MC-riding simulator) may not be representative of the whole population.

Quantitative data

The **lateral positioning** of the riders was **less variable** when passing the AV traffic jam. In the case of human-driven vehicles, the rider had to adjust their position due to drivers not opening the way.



On average, the **speed practiced** during lane-splitting was **equal** for both traffic jams (participants facing a variable but wide inter-lanes corridor? a stable but narrow one?).

The **average differential speed** of 18.4 km/h in the standard traffic jam and 17.7 km/h in the AV one was **in-line with safe lane-splitting practice recommendations** (20 km/h).

Conclusion

PTW riders are facing increasing motorist inattention. Our participants **trusted automation technology**, notably **in dangerous situations like lane-splitting**. They found **visual differentiation** of fully automated vehicles **beneficial** in order to **adjust their expectations** of the behavior of these vehicles.

References

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