Value-based Interactions Between Autonomous Vehicles and Pedestrians

Josephine Halama
Professorship of Cognitive Psychology and Human Factors
Chemnitz University of Technology
josephine.halama@psychologie.tu-chemnitz.de

Imagine living in the year 2050. You are walking with your little granddaughter to the playground and need to cross the street. A few steps away from the road, you notice an autonomous vehicle approaching. Unsure whether to cross in front of it, you hope it will slow down and yield. However, it maintains its speed, prompting you to wait until it passes. Although there was never a safety risk, as the vehicle would have initiated an emergency stop if necessary, you feel frustrated. Expressing your frustration with a gesture toward the vehicle's passenger, you share with your granddaughter that in the pre-autonomous vehicle era, people were more considerate on the roads, showing courtesy by letting vulnerable road users cross ahead of the vehicle.

Ensuring safety is a critical aspect of the interaction between pedestrians and autonomous vehicles. However, as the example illustrates, it is equally important to consider pedestrians' expectations and moral values for fostering smooth and value-oriented interactions in the future. To achieve this value orientation, the current dissertation project adopts the value-sensitive design (VSD) approach (Friedman, 1996). This approach allows for a comprehensive examination of the interaction situation, identifying various stakeholders, their values, and value tensions to derive design solutions, such as for the AI algorithm in the vehicle. In addition to the aim of value-oriented interaction design, the research aims to elucidate pedestrian behavior, focusing on moral values in and potential interaction strategies pedestrians might employ.

To achieve these aims, various study designs have been or will be applied within the project. The starting point involved a scoping review and two expert focus groups (N = 12) to identify relevant stakeholders, values, and value tensions. One outcome of these studies was the development of a framework that allows for the mapping of a significant portion of existing Human Factors research in the field of autonomous driving through values and value tensions. Additionally, relevant pedestrian values (e.g., integrity, courtesy, resource efficiency) were collected, which, along with typical VSD values (e.g., sustainability, autonomy; Friedman et al., 2008), were examined for their relevance in the subsequent lab study.

In the lab study (N = 60), participants imagined interacting with an autonomous vs. manually driven vehicle in video-based scenarios. They indicated how likely they would cross in front of or behind the vehicle and provided reasons for their decisions. The results showed that participants were more inclined to wait when imagining interacting with an autonomous vehicle ($F(1, 59) = 5.21$, $p = .026$, $\eta^2_p = .08$). In addition, exploratory factor analyses were calculated to reduce the 21 values to relevant factors. The structure found, will be examined in an online study that is planned in spring 2024. Furthermore, the aims of the online study are to address the limitations of the lab study, such as the limited generalizability due to a small and student sample, and to explore possible strategies of pedestrians when interacting with autonomous vehicles. The results of the various studies will then be integrated into the final field test, where participants will interact with a manual vs. autonomous vehicle (Wizard of Oz). Thereby, the reduced set of relevant values will be captured, and insights into participants' strategies will be drawn through eye tracking, movement data, the thinking aloud technique and a concluding interview.

In summary, the dissertation project provides insights into relevant stakeholders, their values, and value tensions in the interaction between pedestrians and autonomous vehicles. It also proposes a values-based framework that encompasses a significant portion of Human Factors research in the field of autonomous vehicles. Furthermore, it aims to explain pedestrian behavior in interaction with autonomous vehicles by incorporating values and strategies, thus laying the groundwork for AI algorithms that aim for a predictable, smooth, and value-oriented interaction between pedestrians and autonomous vehicles.

Acknowledgement
Parts of the research were funded by the DFG (German Research Foundation – Project-ID 416228727 – CRC 1410).

References
Friedman, B. (1996). *Value-sensitive Design. Interactions, 3*(6), 6–23. https://doi.org/10.1145/242485.242493

Friedman, B., Kahn, P. H., & Borning, A. (2008). Value Sensitive Design and Information Systems. In K. E. Himma & H. T. Tavani (Hrsg.). *The Handbook of Information and Computer Ethics*. 69-102. John Wiley & Sons, Inc.

Short CV
Josephine Halama studied psychology at the Chemnitz University of Technology. Since 2016, she has been a research associate at the professorship for Cognitive Psychology and Human Factors. In her research as an engineering psychologist, she focuses on the interaction between automated vehicles and vulnerable road users, such as cyclists and pedestrians. Her work also focuses on blockchain, mobile applications, and Industry 4.0/5.0, applying the approaches of value sensitive design and user-centered design.