

Feeling the future car: designing for driving pleasure in the era of co-driving

Peng Lu

Politecnico di Milano, Italy
Peng.lu@polimi.it

Abstract

Due to the emergence of future transportation technologies represented by autonomous driving, people's manual driving will be transformed into a state where people and vehicles drive together, or as a term used in this PhD research: co-driving, which implies that we need to pay attention to the impact of the artificial agency of vehicles on the sense of agency of drivers. In addition, the traditional state of kinesthetic integration of driver and car in driving is considered an important source of driving pleasure (Sheller, 2004), and the prominence of car agency means that the agency involved in the activity of driving will be redistributed, which will break this driver-car assemblage (Dant, 2004, 2014) in driving practice (Shove et al., 2012). At the same time, intelligent & connected vehicles are also thought to offer increasingly multisensory, multimodal interactive experiences (Tan et al., 2020), which may in part also provide design materials for innovative new patterns of people's driving pleasure.

This PhD research focuses on the above-mentioned future driving scenarios and aims to draw on a combination of methods from Reflective Lifeworld Research (Dahlberg et al., 2008), Anticipatory Ethnography (Lindgren et al., 2021; Lindley et al., 2014) and Research through Design (Zimmerman et al., 2007) to explore:

1. How does access to driving pleasure correlate with driver's need for sense of agency in different driving contexts with/in autonomous vehicles of different levels of automation?
2. How can we design for people's driving pleasure in the future co-driving practice based on the above understanding?

Taking a practical approach to conducting this PhD study, the focus would be on the so-called smart cockpit (Sun et al., 2018) as the context of human-machine interface (HMI). As such, this PhD aims to generate a guideline/set of principles on designing for future car HMI for driving pleasure with a focus on the driver's sense of agency in different driving conditions with corresponding design tactics.

Author keywords

Driving Pleasure; Co-Driving; Sense of Agency (SoA); Social Practice Theory; Design for Human-Robot Cooperation; Human Computer Interaction (HCI)

Research Background

This is an industrial PhD program based on the cooperation with a local car design consultancy, with the original aim of exploring the design of future automotive user experience for driver emotions in future mobility context. Such a context involves disruptive technologies including autonomous vehicles (AVs) and electric vehicles (EVs).

In the era of manual cars, human agency is highlighted in the human-car relation (Dant, 2014). However, with the emergence of AVs, car driving will be transformed into a state where people and cars drive together, which is called co-driving (Walch et al., 2016) in this PhD and brings about the redistribution of agency in existing driving practice (Shove et al., 2012) and the impact of the artificial agency of cars on the sense of agency (SoA) of drivers. Here, SoA refers to "the feeling of controlling external events" (Wen et al., 2019, p. 2). As such, AVs does harm to the driving pleasure of human drivers (Casidy et al., 2021; Eckoldt et al., 2012). Specifically, AVs subvert the kinesthesia of driver's taking the car as an extension of the human body to feel the motion in the manual driving mode (Kim, 2021).

Besides, it has been shown that different driving contexts have an impact on whether drivers choose to use ADAS features (Orlovska et al., 2020), and driving pleasure means differently for human drivers in different driving contexts, whether for manual driving (Hagman, 2010) or autonomous driving (Bjørner, 2019). But in extant literature, the relationship between driving pleasure and the needs of SoA in different driving contexts is still vague.

This PhD research focuses on the future co-driving social practices and exploring implications of designing for people's driving pleasure in the future co-driving practice with different needs of SoA in different driving contexts.

Apart from the AVs technology, as the main factor that motivating this PhD research, the ethical consideration on sustainability focuses this research on EVs for their environmental friendliness. As such, it is hoped to contribute to the popularity of EVs by improving the user experience of co-driving practice. In addition, this study can be a case to explore other practices related to car-usage from a social practice perspective, such as car sharing practice.

Theoretical Roots

By recognizing the agency of future cars in the co-driving practice, this PhD research posits itself in the emerging entanglement HCI wave, which highlights the attention on



non-human agency (Frauenberger, 2019) and recognizes the potential contribution as for the more-than-human design (Giaccardi & Redström, 2020).

To be more compatible with the ontology of co-performance, this PhD study also considers co-driving as a social practice (Shove et al., 2012), which is treated as a unit for understanding and analyzing society (ibid.). Moreover, the co-driving practice can be taken as a specific example of co-performance (Kuijter & Giaccardi, 2018) by driver and future cars, which, as Kuijter and Giaccardi suggest, “considers artefacts as capable of performing and exerting agency together with people in the carrying on of social practices.” (2018, p. 4). Besides, co-driving can also be taken as a type of *human-agent/machine collaboration* (Bratman, 1992).

Research Questions

Two main research questions (RQs) are motivating this PhD research:

1. How does access to driving pleasure correlate with driver's need for sense of agency in different co-driving contexts with/in autonomous vehicles of different levels of automation?
2. How could we design for people's driving pleasure in the future co-driving practice based on the above understanding?

Research Methods & Expected Outputs

Given the constraints of people's access to high-level AVs, the RQs can be divided into two phases, *present* and *future*

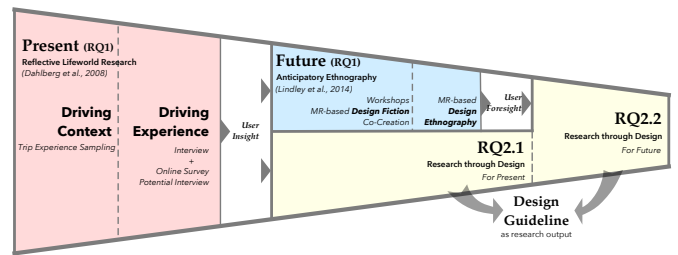


Figure 1. Research methods for elements among research questions.

with corresponding research approach, as shown in Figure 1.

For the present phase of RQ1, this PhD research would be based primarily on Dahlberg et al.'s phenomenological approach of reflective lifeworld research (2008) to understand how SoA affects people's driving pleasure in different driving contexts under the influence of currently available low-level AV technologies. For the future, anticipatory ethnography (Lindley et al., 2014) based on design fiction and design ethnography (Pink et al., 2022) would be conducted. Built on the set of design fiction prototypes, design ethnography methods including in-experience observation and post-experience interview with participants.

With the findings from RQ1, RQ2 would be explored via the research through design approach (Zimmerman et al., 2007). As a result, this PhD aims to generate a guideline/set of principles on designing for future car HMI for driving pleasure with a focus on driver's SoA in different driving contexts with corresponding design tactics.

References

- Bjørner, T. (2019). Driving pleasure and perceptions of the transition from no automation to full self-driving automation. *Applied Mobilities*, 4(3), 257–272. <https://doi.org/10.1080/23800127.2017.1421289>
- Bratman, M. E. (1992). Shared Cooperative Activity. *The Philosophical Review*, 101(2), 327. <https://doi.org/10.2307/2185537>
- Casidy, R., Claudy, M., Heidenreich, S., & Camurdan, E. (2021). The role of brand in overcoming consumer resistance to autonomous vehicles. *Psychology & Marketing*, 38(7), 1101–1121. <https://doi.org/10.1002/mar.21496>
- Dahlberg, K., Dahlberg, H., & Nyström, M. (2008). *Reflective lifeworld research* (2. ed.). Studentlitteratur.
- Dant, T. (2004). The Driver-car. *Theory, Culture & Society*, 21(4–5), 61–79. <https://doi.org/10.1177/0263276404046061>
- Dant, T. (2014). Drivers and Passengers. In P. Adey, D. Bissell, K. Hannam, P. Merriman, & M. Sheller (Eds.), *The Routledge Handbook of Mobilities* (pp. 367–375). Routledge. <https://www.taylorfrancis.com/books/9781317934134>
- Eckoldt, K., Knobel, M., Hassenzahl, M., & Schumann, J. (2012). An Experiential Perspective on Advanced Driver Assistance Systems. *Itit*, 54(4), 165–171. <https://doi.org/10.1524/itit.2012.0678>
- Frauenberger, C. (2019). Entanglement HCI The Next Wave? *ACM Transactions on Computer-Human Interaction*, 27(1), 2:1–2:27. <https://doi.org/10.1145/3364998>
- Giaccardi, E., & Redström, J. (2020). Technology and More-Than-Human Design. *Design Issues*, 36(4), 33–44. https://doi.org/10.1162/desi_a_00612
- Hagman, O. (2010). Driving Pleasure: A Key Concept in Swedish Car Culture. *Mobilities*, 5(1), 25–39. <https://doi.org/10.1080/17450100903435037>
- Kim, T. (2021). How Mobility Technologies Change Our Lived Experiences: A Phenomenological Approach to the Sense of Agency in the Autonomous Vehicle. *Kritike: An Online Journal of Philosophy*, 14(3), 23–47. <https://doi.org/10.25138/14.3.a2>
- Kuijter, L., & Giaccardi, E. (2018). Co-performance: Conceptualizing the Role of Artificial Agency in the Design of Everyday Life. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–13. <https://doi.org/10.1145/3173574.3173699>
- Lindgren, T., Pink, S., & Fors, V. (2021). Fore-sighting autonomous driving—An Ethnographic approach. *Technological Forecasting and Social Change*, 173. <https://doi.org/10.1016/j.techfore.2021.121105>
- Lindley, J., Sharma, D., & Potts, R. (2014). Anticipatory Ethnography: Design Fiction as an Input to Design Ethnography. *Ethnographic Praxis in Industry Conference Proceedings*, 2014(1), 237–253. <https://doi.org/10.1111/1559-8918.01030>
- Orlovskaja, J., Novakazi, F., Lars-Ola, B., Karlsson, M., Wickman, C., & Söderberg, R. (2020). Effects of the driving context on the usage of Automated Driver Assistance Systems (ADAS) - Naturalistic Driving Study for ADAS evaluation. *Transportation Research Interdisciplinary Perspectives*, 4, 100093. <https://doi.org/10.1016/j.trip.2020.100093>
- Pink, S., Fors, V., Lanzeni, D., Duque, M., Sumartojo, S., & Strengers, Y. (2022). *Design Ethnography: Research, Responsibilities, and Futures* (1st ed.). Routledge. <https://www.taylorfrancis.com/books/9781003083665>
- Sheller, M. (2004). Automotive Emotions: Feeling the Car. *Theory, Culture & Society*, 21(4–5), 221–242. <https://doi.org/10.1177/0263276404046068>
- Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: Everyday life and how it changes*. SAGE.
- Sun, X., Chen, H., Shi, J., Guo, W., & Li, J. (2018). From HMI to HRI: Human-Vehicle Interaction Design for Smart Cockpit. In M. Kurosu (Ed.), *Lecture Notes in Computer Science* (pp. 440–454). Springer International Publishing. https://doi.org/10.1007/978-3-319-91244-8_35
- Tan, Z., Dai, N., Zhang, R., & Dai, K. (2020). Overview and perspectives on human-computer interaction in intelligent and connected vehicles. *Jisuanji Jicheng Zhizao Xitong/Computer Integrated Manufacturing Systems, CIMS*, 26(10), 2615–2632. <https://doi.org/10.13196/j.cims.2020.10.002>
- Walch, M., Sieber, T., Hock, P., Baumann, M., & Weber, M. (2016). Towards Cooperative Driving: Involving the Driver in an Autonomous Vehicle's Decision Making. *Proceedings of the 8th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*, 261–268. <https://doi.org/10.1145/3003715.3005458>
- Wen, W., Kuroki, Y., & Asama, H. (2019). The Sense of Agency in Driving Automation. *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.02691>
- Zimmerman, J., Forlizzi, J., & Evenson, S. (2007). Research through design as a method for interaction design research in HCI. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 493–502. <https://doi.org/10.1145/1240624.1240704>