

Book of Abstracts

for the cumulative dissertation:

**“Consumer Responses to Automated Mobility Offerings
– Challenges, Antecedents, and Outcomes”**

submitted by

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1. Overview

The overall aim of this cumulative dissertation is to contribute to a better understanding of both antecedents of the usage of automated mobility offerings and outcomes that individual consumers experience from such usage. The dissertation contains three distinct papers:

Paper 1: Janotta, F. (2022), “Making emergent technologies more tangible - Effects of presentation form on user perceptions in the context of automated mobility” (accepted for publication in the *Journal of Service Management Research*).

Paper 2: Janotta, F. & Hogleve, J. (2022), “Ready for take-off? The dual role of affective and cognitive evaluations in the adoption of Urban Air Mobility services” (working paper to be submitted to the *Journal of the Academy of Marketing Science*).

Paper 3: Janotta, F.; Hogleve, J.; Gustafsson, A. & Lervik-Olsen, L. (2022), “Will automated mobility contribute to consumer well-being? The role of mindfulness interventions in the context of automated driving” (working paper to be submitted to the *Journal of Marketing*).

Each paper addresses a specific prevailing research gap in the literature related to automated mobility offerings, focusing on different use cases of automated mobility. Paper 1 investigates the effects of different presentation forms of automated driving on consumers’ perceptions, thereby addressing the challenge of effectively visualizing emergent automated technologies and making them more tangible to respondents in the context of empirical research, thus providing a methodological basis for the further investigation. Paper 2 investigates antecedents of consumers’ adoption intentions of autonomous passenger drones, specifically focusing on the dual role of affective and cognitive considerations in the formation of usage intentions. Paper 3 investigates outcomes of consumers’ usage of automated mobility offerings, focusing on the use case of automated driving and its effects on individual well-being of consumers.

2. Motivation and overall aim of the dissertation

Smart, autonomous technologies and services are on the rise and increasingly take over tasks, which were previously executed by humans (Bagozzi, Brady, and Huang 2022; Jörling et al. 2020). In recent years, technological developments have led to the increasing implementation of artificial intelligence (AI) applications and automated service technologies such as chatbots, service robots, or automated vehicles (Fernandes and Oliveira 2021; Osburg et al. 2022). Automated mobility, in particular, is set to transform the way we travel, work and live dramatically by providing consumers with safer, more efficient, and more convenient travel options (Al Haddad et al. 2020). Given the tremendous social and economic potential of automated transport, it comes as no surprise that numerous companies – both incumbent manufacturers and new market entries – are currently testing autonomous vehicle operations, with several recently announcing concrete plans to launch their automated mobility services within the next 5-10 years (e.g. Bellan and Korosec 2022; Etherington 2022; Volocopter 2022).

Correspondingly, over the past decade, there has been an increasing interest in how consumers will respond to automated mobility offerings on the ground and in the air, including automated vehicles, autonomous shuttle busses as well as unmanned passenger drones (cf. Jing et al. 2020). It has been pointed out that the transition from conventional modes of transport, characterized by human operators, to automated mobility, where consumers become passive passengers relying on an automated system, requires a special focus on consumers' perceptions of such offerings and their emotional experiences with them (Osburg et al. 2022; Sauer et al. 2019). However, to date, consumers' perceptions of automated mobility services and related outcomes are not well understood. This is reflected in several recent calls for research in leading journals in the areas of service and marketing research, highlighting the need for more research investigating how consumers perceive, feel about, and interact with automated technologies and services (Bagozzi, Brady, and Huang 2022; Hoffman et al. 2022; Ostrom et al. 2021). From

a practical point of view, it is important to understand relevant antecedents and outcomes of automated technology adoption to enable more customer-centered service offerings and experiences and thus, pave the way for the successful launch and integration of automated mobility offerings into the existing mobility landscape.

Against this backdrop, the goal of this dissertation is to address current *challenges* encountered in research on consumer responses to automated mobility offerings and contribute to a better understanding of *antecedents* of usage intentions as well as *outcomes* that individual consumers may experience from the usage of automated mobility. In doing so, this dissertation addresses several prevailing research gaps in the literature.

First, while there has been an increasing interest in automated technologies and related service offerings in the academic community (van Doorn et al. 2017; Huang and Rust 2018), one of the main *challenges* of research investigating consumers' responses to such emergent technologies and services is that respondents have not been able to experience them yet (Bjørner 2015). Thus, researchers have used various forms of visualizing these technologies and making them more tangible to study respondents to allow for more reliable evaluations in the context of empirical research. However, little is known about how different visualization forms shape respondents' imagination and perceptions of emergent technologies and thus, might influence their evaluations of the focal technology (Mara et al. 2021). Therefore, this dissertation seeks to add to this methodological discussion by comparatively assessing the efficacy of three prevalent presentation forms in visualizing a specific usage scenario of automated mobility.

Second, previous research on the *antecedents* of consumers' adoption intentions of automated technologies typically placed a strong focus on functional attributes of the technology and cognitive evaluations made by consumers (e.g. Al Haddad et al. 2020; Johnson, Miller, and Conrad 2022). However, as the use of automated technologies and services implies delegating control to a machine, researchers have emphasized the importance of trust and affective responses in human-technology interactions (Bagozzi, Brady, and Huang 2022;

Fernandes and Oliveira 2021), which have rarely been studied so far. Therefore, this dissertation places a special focus on the relative impact of consumers' affective and cognitive responses, taking a more holistic perspective on antecedents of adoption intentions of automated mobility offerings (Osburg et al. 2022).

Finally, at the current stage, potential *outcomes* of the usage of automated mobility offerings are uncertain. Despite extensive research on technological and safety aspects of automated vehicles, studies on the impact of automated mobility offerings on individuals are scarce, and previous findings are not conclusive. While early research seemed to indicate that automation may decrease mental workload and stress related to driving (e.g. Cottrell and Barton 2013; Funke et al. 2007), more recent studies suggest that it might actually have detrimental effects on users' emotional states by causing tension and stress (e.g. Morris, Erno, and Pilcher 2017). Thus, a closer focus on consumers' emotional responses and subjective experiences in interacting with the technology is needed (Osburg et al. 2022; Puntoni et al. 2021). Therefore, this dissertation aims to explore the effects of automated mobility on psychological outcomes at the individual level, particularly emotional states and well-being of consumers.

Overall, despite the increasing scholarly interest in antecedents and potential outcomes of consumers' usage of automated mobility offerings as well as the related challenges, many open questions still remain.

3. Summary of the cumulative dissertation

The overall aim of this cumulative dissertation is to contribute to a better understanding of both antecedents of the usage of automated mobility offerings and outcomes that individual consumers may experience from such usage. To this end, Paper 1 first establishes an important methodological basis for the further investigation by examining the efficacy of different visualization forms (vignette, video, and Virtual Reality) of automated mobility offerings in the context of empirical research. Building on these insights, Paper 2 and 3, respectively,

investigate antecedents and potential outcomes of consumers' usage of automated mobility offerings, as illustrated in *Figure 1*.

Overall aim	Gain a deeper understanding of antecedents and potential outcomes of consumer usage of automated mobility offerings	
Methodological basis	Paper 1	
	Addresses the <i>challenge</i> of visualizing automated mobility offerings and making them tangible to respondents in the context of research Types of visualization: vignette, video, VR simulation Use case: Automated driving, with applicability to all automated mobility modes	
Investigation of antecedents and outcomes	Paper 2	Paper 3
	Investigates affective and cognitive <i>antecedents</i> in the formation of adoption intentions of Urban Air Mobility services Types of visualization: VR simulation, videos Use case: Urban Air Mobility	Investigates improvements in emotional states and well-being as <i>outcomes</i> of consumers' usage of automated driving Types of visualization: Simulation, videos Use case: Automated driving

Figure 1: Overview of the three papers and the overall aim of the cumulative dissertation

Each paper addresses a specific prevailing research gap in the literature related to automated mobility offerings, focusing on different applications of automated mobility. Paper 1 investigates the effects of different presentation forms of automated driving on consumers' perceptions, thereby addressing the *challenge* of visualizing emergent automated technologies with the goal of making them more tangible to both respondents in the context of empirical research and future users within the scope of efforts to pave the way for future market introduction. Paper 2 examines *antecedents* of consumers' adoption intentions of autonomous passenger drones, specifically focusing on the dual role of affective and cognitive considerations in the formation of usage intentions. Paper 3 investigates *outcomes* of consumers' usage of automated mobility offerings, focusing on the use case of automated driving and its effects on individual well-being of consumers.

Table 1 provides an overview of the three papers with their corresponding research questions, chosen methodology, and key findings. Subsequently, each paper will be briefly summarized.

Table 1: Overview of the three papers, research questions, methodology, and findings

	Paper 1: Making emergent technologies more tangible - Effects of presentation form on user perceptions in the context of automated mobility	Paper 2: Ready for take-off? The dual role of affective and cognitive evaluations in the adoption of Urban Air Mobility services	Paper 3: Will automated mobility contribute to consumer well-being? The role of mindfulness interventions in the context of automated driving
Research question(s)	How do different presentation forms (vignette, real-world video, computer-generated VR simulation) of an emergent technology differ in terms of their ability to create mental images of the experience of automated driving in respondents' minds?	1) How does a switch from human supervision to autonomous operations affect trust and subsequent adoption intentions of UAM services? 2) What is the relative importance of affective and cognitive evaluations in the formation of adoption intentions of UAM services?	1) How does automated driving affect subjective well-being of passengers, compared to manual driving? 2) Which stimuli can help foster positive effects of automated driving on subjective well-being?
Studies, data, methods	Study: One-factor, three-level between subjects experimental design, lab study, n = 103 Types of visualization used: pictures, videos, Virtual Reality Data analysis: Analysis of covariance (ANCOVA)	Study 1: One-factor, two-level between subjects experimental design, lab study, n = 261 Type of visualization used: Virtual Reality Data analysis: Structural equation modeling (covariance-based) Study 2: One-factor, two-level between subjects experimental design, online study, n = 341 Type of visualization used: Videos Data analysis: Structural equation modeling (covariance-based)	Study 1: One-factor, two-level between subjects experimental design, lab study, n = 91 Type of visualization used: Driving simulator Data analysis: Analysis of covariance (ANCOVA), mediation analysis (PROCESS), facial expression analysis (FaceReader), text mining (LIWC) Study 2a: 2x2 between subjects experimental design, online study, n = 398 Type of visualization used: Videos Data analysis: Multivariate analysis of covariance (MANCOVA) Study 2b: 2x3 between subjects experimental design, online study, n = 441 Type of visualization used: Videos Data analysis: Multivariate analysis of covariance (MANCOVA) Study 3: 2x2 between subjects experimental design, online study, n = 291 Type of visualization used: Videos Data analysis: Multivariate analysis of covariance (MANCOVA)

	Paper 1: Making emergent technologies more tangible - Effects of presentation form on user perceptions in the context of automated mobility	Paper 2: Ready for take-off? The dual role of affective and cognitive evaluations in the adoption of Urban Air Mobility services	Paper 3: Will automated mobility contribute to consumer well-being? The role of mindfulness interventions in the context of automated driving
Key findings	<ul style="list-style-type: none"> • While real-world videos evoke more vivid imagery than textual descriptions, results indicate that the VR simulation does not perform significantly better at creating vivid mental images of automated driving than videos or the vignette. Analyses reveal similar results for the dependent variables ‘user experience’ and ‘visualization capability’. • Individual items of the ‘vividness of mental imagery’ scale revealed that the video consistently evoked more vivid mental images than the VR simulation. • Additionally, the real-world video was rated more favorably in terms of realism, simplicity, clarity, pleasantness and overall value than the VR simulation. 	<ul style="list-style-type: none"> • Human supervision serves as an important cue in trust formation of potential UAM users. Risk aversion as a personality trait emphasizes the positive effect of human supervision on trust. • Adoption intentions of UAM services are driven by both affective and cognitive considerations, which are firmly grounded on trust. • Findings show that affective responses exert a stronger influence on willingness to use autonomous passenger drones than cognitive evaluations. Moreover, results suggest an asymmetric impact of positive and negative affective responses, i.e. adoption intentions are more strongly guided by perceived enjoyment than by anxiety. • Willingness to pay for UAM services is strongly driven by perceived enjoyment and benefit perceptions. 	<ul style="list-style-type: none"> • Initial study provides evidence for the potential negative effects of driving automation on passengers’ individual well-being, caused by their experienced difficulty to relax, indicating that further measures are needed to support passengers in diverting their attention from the traffic scene and relax during automated driving. • The developed mindfulness intervention leads to significant improvements in subjective well-being in the context of automated driving. • Findings rule out the simple distraction of attention as an alternative explanation for the observed effects and suggest that, indeed, the mindful focus on natural elements in the environment elicits the evidenced positive effects. • The found positive effects can be transferred to urban environments using an adjusted intervention, indicating that an intervention including nature sounds leads to significant improvements in well-being, independent of the actual physical environment surrounding the consumer.

Paper 1: Making emergent technologies more tangible - Effects of presentation form on user perceptions in the context of automated mobility

One of the main challenges of investigating consumers' responses to emergent technologies is that respondents have not been able to experience them yet (Bjørner 2015). Additionally, evaluating technologies for automated mobility with potential users in real-world environments is linked to high costs and high potential risks for study participants (Gerber et al. 2019). To address these challenges, researchers have used various forms of visualizing emergent technologies and making them more tangible to study participants, ranging from textual descriptions to simulated representations in virtual reality (VR). However, while it is imperative to make experiences with these technologies more comprehensible to consumers to ensure a consistent basis for their evaluations in empirical studies, to date, little is known about how different forms of technology representation shape respondents' imagination and perceptions of emergent technologies (Mara et al. 2021). Thus, this research comparatively assesses how well text-based scenario descriptions paired with static images (vignettes), real-world videos, and computer-generated VR simulations are suited for visualizing the experience of a ride in an automated vehicle.

Adopting a between-subjects experimental design, this study examined how respondents evaluate different forms of technology presentations (text vignette, real-world video, VR simulation) in terms of their ability to create vivid mental imagery in respondents' minds, their visualization capability, and their user experience. The study employed the same driving scenario in all three presentation forms, putting study participants in the perspective of a passenger taking a ride in an automated vehicle. Analyses of covariance (ANCOVA) revealed that real-world videos may be the most suitable in mediating the experience of complex service offerings such as automated driving, compared to VR simulations and textual descriptions. Specifically, while real-world videos evoke more *vivid imagery* than textual descriptions, results indicate that the VR simulation does not perform significantly better at creating vivid

mental images of automated driving than videos or the vignette. The analyses reveal similar results for the dependent variables *user experience* and *visualization capability*.

This study offers important insights and methodological recommendations for research concerned with consumers' perceptions and subjective experiences in the context of emergent technology. First, it presents one of the first comparative studies of different presentation forms of an automated ride for the purpose of user-centered research and, thus, provides important insights into the efficacy of different presentation forms in visualizing emergent technologies. Second, from a methodological perspective, this study offers recommendations for future research on choosing suitable presentation forms for empirical studies focusing on experiential aspects of emergent technologies. While this study focused on automated mobility offerings, the recommendations provided may be transferred to research on consumers' perceptions of and experiences with other emergent technologies, such as smart products or service robots. Finally, from a practical perspective, this research provides indications as to how stakeholders can make emergent technologies more comprehensible to consumers within the scope of efforts to pave the way for successful market introduction.

Paper 2: Ready for take-off? The dual role of affective and cognitive evaluations in the adoption of Urban Air Mobility services

This paper investigates antecedents of consumers' adoption intentions of automated mobility offerings, specifically focusing on autonomous passenger drones. In recent years, various technological advancements have led to the development of autonomous aerial vehicle concepts for passenger services, often termed "Urban Air Mobility" (UAM) (Garrow, German, and Leonard 2021). Although it is expected that regulations will require onboard pilots upon initial market introduction of UAM services, a transition to remotely controlled and, ultimately, autonomous operations appears inevitable for economic reasons (cf. Thipphavong et al. 2018) and is aspired by industry leaders according to official statements (e.g. Volocopter 2021).

However, while autonomous operations are desirable from an economic standpoint (Pelli and Riedel 2020), consumer confidence and trust in the use of unmanned aircraft remain unclear. To date, scant research has focused on individual acceptance of passenger drones (e.g. Al Haddad 2020) and little is known about the specific determinants that play a role in the formation of adoption intentions of UAM services.

Building on dual-process theory (Samson and Voyer 2012), this paper posits and tests a research model to examine the dual influence of affective and cognitive considerations in the formation of adoption intentions of UAM services. Using a simulated scenario in Virtual Reality (VR), we manipulate the presence of a pilot onboard the aerial vehicle to assess the influence of human supervision on subsequent evaluations and adoption intentions using covariance-based structural equation modeling. In two experimental studies, we show that human supervision is an important factor in trust formation, and a switch to autonomous operations may lead to decreases in trust in UAM service operations. Across both studies, our results confirm that adoption intentions of UAM services are driven by both affective and cognitive considerations, which are firmly grounded on trust. Most noteworthy, we show that affective responses exert a stronger influence on willingness to use autonomous passenger drones than cognitive evaluations.

This article makes several important contributions to the literature on consumer responses to AI-enabled technologies and services. It advances scholarly understanding of the factors influencing the adoption of future UAM services and, by including affective responses in our investigation, adds to the growing literature on the importance of affect in consumer judgment and decision-making (Bagozzi, Gopinath and Nyer 1999; Lerner et al. 2015). From a practical perspective, the article provides managerial guidance on how to successfully implement automated passenger drones and related transport services. As our findings suggest that some level of human supervision may be necessary to instill confidence and trust in potential users, service providers should consider measures and design elements to ensure social support during

flight at all times and provide passengers with a sense of social presence, even when no human pilot is onboard the aircraft.

Paper 3: Will automated mobility contribute to consumer well-being? The role of mindfulness interventions in the context of automated driving

As automation will allow consumers to divert their attention from the traffic scene, it is generally assumed that automated driving will improve the overall well-being of passengers by reducing stress while driving and promoting more positive emotional states (Olsen and Sweet 2019; Funke et al. 2007). However, research on the effects of automated driving on emotional states and well-being of consumers is scant and previous findings are not conclusive. While early research seemed to indicate that automation may decrease mental workload and stress related to driving, thereby producing a more positive set of emotional responses (e.g. Cottrell and Barton 2013; Funke et al. 2007), more recent studies suggest that automated vehicles might actually have a negative impact on users' emotional states by causing tension and stress (Morris, Erno and Pilcher 2017) as well as anger and frustration in passengers (Techer et al. 2019). To shed further light on potential outcomes of automated driving, this paper examines the impact of driving automation on consumers' emotional states and well-being in four experimental studies and identifies stimuli that help foster positive effects of automated driving on the same.

Conducting a lab study using an interactive driving simulator, the article shows that consumers experience difficulty relaxing in highly automated driving, which then leads to negative downstream effects on emotional states and stress perception. Building on these findings, we develop a novel instructional intervention based on the concept of mindfulness (Langer 1989, 2005) and test its efficacy in improving emotional states and well-being of consumers while interacting with automated vehicles. Specifically, we predict and find that a simple yet effective mindfulness intervention asking passengers to focus on natural stimuli in the environment is able to significantly improve important measures of individual well-being,

including positive and negative affect, felt comfort, difficulty relaxing, and perceived stress. We find robust evidence for these effects in three experimental studies and show that the instruction to mindfully focus on natural elements in the environment is more effective at improving emotional states and well-being than a simple distraction intervention aimed at diverting attention from observing traffic and the vehicle's behavior, thus ruling out this alternative explanation. Moreover, we show that the positive effects of mindful observation can be transferred to urban settings using an adapted mindfulness intervention including an additional auditory stimulus. As such, the findings of this research provide important implications for the design of future mobility solutions and services. We show that, contrary to popular belief, highly automated driving may lead to more negative emotional states and increased stress in consumers, indicating that additional measures may be needed to enable consumers to experience the proposed beneficial effects of driving automation in terms of stress relief and well-being improvements. To this end, we propose an effective intervention and further design recommendations ready to be deployed in future concepts for automated driving.

4. Conclusion

This dissertation responds to the recent call for research aiming “to understand how consumers perceive, feel about, and interact with autonomous devices” (Hoffmann et al. 2022, p. 4) and related service offerings, and makes several important contributions to the literature on consumer responses to AI-enabled services. First, this research addresses the *challenge* of making emergent automated technologies and services tangible to consumers and adds to the methodological discussion around this issue (Hoggenmueller et al. 2021; Mara et al. 2021). Second, this dissertation advances scholarly understanding of *antecedents* influencing the adoption of automated mobility services, thereby contributing to the fields of technology acceptance, consumer behavior, and transportation research. By going beyond the prevalent focus on consumers' cognitive evaluations of automated technology, and incorporating

affective responses into our investigation, this dissertation contributes to a deeper understanding of emotions as psychological antecedents enabling or impeding automated service adoption, following previous calls for research on the emotional dimension of consumers' technology adoption decisions (Bagozzi, Brady, and Huang 2022; Valor, Antonetti, and Crisafulli 2022). Third, combining various types of data, including self-report quantitative, qualitative, and objective data in the form of facial expressions, we add to the limited base of empirical research on consumers' emotional responses to intelligent, automated transport technologies and potential *outcomes* of automated technology usage. As such, this research sheds light on the effects of automated mobility offerings on individual well-being and contributes to the nascent field of research on consumer behavior related to intelligent, AI-enabled products and services (Puntoni et al. 2021; Bertrandias et al. 2021). Finally, from a practical perspective, this work offers important insights and recommendations for developers, product designers, and marketing managers with regard to the design and communication of future mobility solutions and services.

5. Abstracts

5.1 Making emergent technologies more tangible - Effects of presentation form on user perceptions in the context of automated mobility

Abstract

One of the main challenges of investigating consumers' perceptions and acceptance of emergent technologies is that respondents have not had any experience with them. This poses the question of how such technologies can be effectively presented to consumers both in the context of research and in measures to foster acceptance. Using automated driving as a case study, this paper presents results from a comparative study of three presentation forms (vignette, real-world video, computer-generated VR) of a ride in an automated vehicle in an empirical study with 103 participants. Results from quantitative analyses show that both real-world videos and the VR simulation outperform textual descriptions in terms of visualisation capability and user experience. Unexpectedly, the VR simulation does not perform significantly better at creating mental images of automated driving than a vignette. Recommendations are offered regarding the choice of a suitable presentation form in empirical research in relation to study objectives.

Keywords: automated driving, virtual reality, videos, visualisation capability

5.2 Ready for take-off? The dual role of affective and cognitive evaluations in the adoption of Urban Air Mobility services

Abstract

Recent technological advancements have given way to aerial vehicle concepts for passenger transportation, also called “Urban Air Mobility”. Related shared mobility services are set to provide consumers with more efficient and flexible travel options. However, as flight modes will necessarily shift to autonomous operations in the near future, a deeper understanding of consumer perceptions and adoption intentions of this AI-enabled service will be crucial to its success. Building on dual-process theory, we posit and test a research model to examine the dual influence of affective and cognitive considerations in the formation of adoption intentions of autonomous passenger drones. Using a simulated scenario in Virtual Reality (VR), we manipulate the presence of a pilot onboard the aerial vehicle to assess the influence of human supervision on subsequent evaluations and adoption intentions using covariance-based structural equation modeling. In two experimental studies, we show that affective responses exert a stronger influence on adoption intentions than cognitive considerations, with positive affective responses playing the dominant role. Additionally, our results indicate that providing some level of human supervision will be crucial to trust formation, especially for risk-averse consumers.

Keywords: Urban Air Mobility, service automation, Artificial Intelligence, emotions, Virtual Reality

5.3 Will automated mobility contribute to consumer well-being? The role of mindfulness interventions in the context of automated driving

Abstract

Next to gains in safety and efficiency, the potential to improve driving comfort and reduce stress for consumers is considered one of the main drivers for forwarding the development of driving automation. However, previous empirical research does not offer conclusive evidence that automated driving will allow passengers to become “mind-free”, thereby reducing perceived stress, and improving emotional states and well-being while driving. This research examines affective reactions to driving automation and derives measures that foster more positive emotional states and decrease perceived stress in this context. Findings from a driving simulator study demonstrate that it is significantly more difficult for participants to relax during autonomous driving compared to manual driving. Subsequent experimental studies show that employing a novel instruction-based mindfulness intervention can offset this effect and lead to significant improvements in various measures of subjective well-being. From a practical perspective, this work offers important insights and recommendations for developers, product designers, and marketing managers with regard to the design and communication of future mobility solutions and services.

Keywords: automated driving, well-being, mindfulness, emotional states, stress, facial expression analysis