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German Human Factors Summer School

September 28th to 30th 2020

Program & Abstracts

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Part I

General Information

Welcome

We are very happy to welcome you all to the Second German Human Factors Summer School 2020. The German Summer School for Human Factors is the successor of the Berlin Summer School of Human Factors which was initiated and organized from 2014-2018 by the Department of Psychology and Ergonomics, TU Berlin. The Summer School is an annual postgraduate event that is supported by the newly founded Section of Engineering Psychology of the German Psychological Society. The intention is to provide an interactive platform that promotes the transfer and communication of interdisciplinary skills, relevant to Human Factors research. Successful postgraduate applicants (PhD, M.Sc., and candidates) have the opportunity to present their research interests and/or current projects for critical discussion. Prominent researchers are invited to teach advanced methods and communicate state-of-the-art research from their laboratories.

The 2 $^{\text{nd}}$ German Summer School for Human Factors 2020 will take place virtually from September, 28th to 30th, and is organized by the Leibniz Research Center for Working Environments and Human Factors (IfADo) in Dortmund, Germany. We are looking forward to inspiring talks and discussions.

Target audience

The target audience are PhD students working in the field of human factors irrespective whether they have just started or almost finished their PhD. The objective of the Summer School for Human Factors is to offer a space for PhD students to connect and to help each other with planning, interpreting, and handling other problems during the PhD. Beside the support from other PhD students, the summer school will be attended by invited senior researchers of the field and guests to further support the discussions.

Venue

The summer school is hosted by Leibniz Research Centre for Working Environments and Human Factors located in Dortmund (Ardeystraße 67, 44139 Dortmund). Due to COVID-19, the Summer School is hold as virtual event.

Technical Details

We created a webpage that bears all information in one place (Zoom-links, program, VR-Information, posters, help):

https://ergo.blog.ifado.de/hf-summer-school-2020/

Your session:

We think the easiest way to conduct your session is that the audience will first listen to your talk and post questions to the chat window including their names. We recommend to set the Zoom option to speaker mode, so the speaking person is highlighted. You will present by sharing your screen. The whiteboard in Zoom can be used to illustrate or structure the session if you like. Once the presentation is finished either you or the chairs can call the names to pose the questions directly and to start the discussion. We kindly ask all participants to mute their microphones when not actively speaking. Still, we kindly ask you to turn on your cameras during presentations and discussions to preserve a convenient atmosphere for the speaker and a lively discussion later on. The experts' sessions on Wednesday will take place via gather.town.

Accommodation

Due to the COVID pandemic, the Summer School is a virtual event.

Information for presenters

Presentation and discussion

Presentation (including discussion) will be scheduled for 30 minutes:

- Within the 30 minutes, presenters should give a short introduction to their project (max.10–15 minutes). The remaining time can be used for intense and fruitful discussion with fellow and senior researchers. For that, the whiteboard and chat in Zoom can be used.

Discussion forum

If you want to get in touch with the organizers to discuss some ideas or upcoming questions, please get in touch via email:

- dreger@ifado.de
- reiser@ifado.de.

While the event gather.town is available as additional discussion forum.

Program

Monday, 28.09.2020

14:00 – 14.45	**Welcome IfADo & FG-Ing.-Psy.**
	Edmund Wascher and Martin Baumann
	Presentation – Discussion
	Chairs: Julian Reiser, Felix Dreger
14:45 – 15:15	Lea Dingler
15:15 – 15:45	Merle Lau
15:45 – 16:00	Coffee break
16:00 – 16:30	Janina Bindschaedel
16:30 – 17:00	Ann-Christin Hensch
17:00 – 17:30	Fabian Hub
17:30 – 17:45	Closing of day

Tuesday, 29.09.2020

14:00 – 14:10	Welcome day two
	Presentations – Discussions
	Chairs: Julian Reiser, Felix Dreger
14:10 – 14:40	Elisabeth Shi
14:40 – 15:10	Lina Kluy
15:10 – 15:40	Ann Huang
15:40 – 16:10	Alexander Dregger
16:10 – 16:20	Coffee break
16:20 – 16:50	Matthias Arend
17:00 – 18:15	**Keynote: PhD Ranjana Mehta, Texas A&M**
	The Whole is Better than Some Parts of it — Connecting neck up and neck down HF/E through Neuroergonomics
18:15 – 18.30	Closing of day (all participants)
18:30 –	**Social event/drinks VR**
	VR gathering hall, all participants

Wednesday, 30.09.2020

14:00 – 14:15	Welcome day three	
14:15 – 15:30	**Meet the experts**	
	Zoom 1	*Zoom 2*
	Experts: Martin Baumann	*Experts: Gerhard Rinkenauer*
	Experts: Lewis Chuang	*Experts: Edmund Wascher*
14:15 – 14:30	Lea Dingler	Ann Huang
14:30 – 14.45	Merle Lau	Matthias Arend
14.45 – 15:00	Janina Bindschaedel	Elisabeth Shi
15:00 – 15:15	Ann-Christin Hensch	Lina Kluy
15:15 – 15:30	Fabian Hub	Alexander Dregger
15:30 – 16:00	Coffee break	
16:00 – 16:45	**Research in industry: Research Career Reflections**	
	PhD Christopher D.D. Cabrall, The Boeing Company	
16:45 – 17:00	Farewell and closing	

Presentation topics

Matthias Arend	RWTH Aachen	Efficient sampling strategies and analysis of data for the benchmarking of automated human-computer systems.
Janina Bindschädel	Freiburg University	Interaction between pedestrians and automated vehicles: Exploring a motion-based assessment
Lea Dingler	Carmeq/ TU Berlin	How should autonomous vehicles speak with us in the future?
Alexander Dregger	FZI Karlsruhe	More than Intelligence? The role of artificial personality in the user experience of artificial intelligent agents
Ann-Christin Hensch	TU Chemnitz	Changing two into three – Designing comfortable interactions for drivers and surrounding traffic participants in automated driving
Ann Huang	LMU	Proxemics in handheld augmented reality: Implications for human–agent interaction
Fabian Hub	DLR	Designing ride access points for shared automated vehicles
Lina Kluy	TU Berlin	Working with industrial cobots: The influence of robot-related factors on subjective interaction experience
Merle Lau	DLR	Development of external human-machine interfaces (eHMIs) for automated vehicles focusing on different vehicle types
Elisabeth Shi	BASt/TUM	Effects of non-driving related tasks in Level 3 automated driving on following takeover behaviour: A meta-analysis

Part II

Abstracts

Efficient Sampling Strategies and Analysis of Data for the Benchmarking of Automated Human-Computer Systems

Matthias G. Arend, Verena Nitsch

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Automation is one of the central topics in Human Factors research, concerning the human interaction with computerized systems such as vehicles, workplace technology, or robots. With higher levels of automation (e.g., the SAE levels for automotive automation; SAE, 2018), the system controls more and more aspects of the task, which increasingly places the user in the supervisor role. Hence, human-machine systems with different levels of automation can affect performance and safety outcomes in various ways (e.g., Madigan, Louw, & Merat, 2018; Witte, Hasbach, Schwarz & Nitsch, 2020). Particularly in high-risk contexts, replacing a system with human control with demonstrated safety by an automated system with little real world performance data constitutes a major concern to policymakers (e.g., Shladover & Nowakowski, 2019). To compare the performance of established and novel human-computer systems, efficient assessment strategies are needed. Benchmarking provides a suitable approach for evaluating the performance of one or more human-computer systems (e.g., Kahn et al., 2007). To provide an empirical basis for the decision to replace one system by another, HF/E practitioners can measure the performance of the current human-computer system and use the results as benchmark for evaluating highly automated systems (e.g., the safer than the average human driver criterion; Nees, 2019). Yet, this requires considerable efforts because often, representative samples of participants, situations or devices are required. The objective of the present contribution was to introduce cross-classified modeling (CCM) as an approach towards the sampling and analysis of data collected for benchmarking (similar to assessments in, e.g., organizational psychology; Claus, Arend, Burk, Kiefer, & Wiese, 2020). In addition to classic general linear models, CCMs can model influences of random factors such as participants, situations or devices (cf. Judd, Westfall, & Kenny, 2017). Hence, not only measures of central tendencies but also measures of dispersion between participants, situations and devices can be derived reliably with CCMs. Thus, a statistical analysis with CCMs suits the data which would typically be collected for benchmarking, with samples of participants, situations and/or devices. Furthermore, CCMs allow for cross-classified sampling strategies which can be beneficial for achieving sufficient statistical power with optimal sample sizes (Judd et al., 2017). Finally, Monte Carlo simulation was used to illustrate the higher adequacy in parameter estimation with CCMs, as compared to alternative approaches.

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Interaction between pedestrians and automated vehicles: Exploring a motion-based assessment

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With increasing automation of vehicle control, new ways of communication between road users are required. A main challenge automotive manufactures face is how fully automated or even autonomous vehicles can communicate with sourrounding road users. This issue is extremly critical for vulnerable road users as pedestrians or cyclists who often suffer serve injuries in traffic accidents. One way for automated vehicles to communicate with pedestrians is through external human-machine interfaces (eHMIs), where an informative message is presented outside the vehicle. Previous studies have typically used subjectives measures to identifying eHMIs improving pedestrians' receptivity towards autonomous vehicles. However, objective behavioral measures have been missing so far. We demonstrate that objective behavioral measures based on body movements provide new possibilities to investigate the interaction between vehicles and pedestrians. In our study, we evaluated four different eHMI concepts using a virtual reality pedestrian simulator. During the simulation, participants (N = 51) were exposed to the concepts in a virtual urban traffic-environment, consisting of two different scenarios. Pedestrian body movements were obtained using a motion capture system with six sensors. The study had two major objectives: First, we wanted to extend previous research by investigating how eHMI concepts affect self-reported safety ratings and behavioral indicators. Second, by combining motion sensor based data with self-reported safety ratings we aim to gain new insights in the behavioral manifestation of receptivity towards eHMI. Using functional linear models, we evaluated how accurate self-reported safety ratings can be reliable predicted from behavioral

indicators. The results suggest that objective behavioral measures are sensitive to individual differences in self-reported safety levels. Thus, a high ecological validity of the virtual reality pedestrian simulator can be assumed. Our findings highlight the potential of big data in psychology research by transferring subjective measures to objective manifestations in behavior. Additionally, the results show how motion-sensing techniques can lead to a better understanding of the commincation between automated vehicles and vulnerable road users.

How should autonomous vehicles speak with us in the future?–Development of a test methodology for evaluating external communication

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Emerging automation technologies are paving the way for the introduction of Fully Automated Vehicles (FAVs). A sparsely researched area related to FAVs is the interactions between Vulnerable Road Users and these FAVs and particularly in regard to the evaluation of their communication. Subsequently, this paper addresses this research gap by developing a test methodology containing both subjective and objective measures for the evaluation of external communication in real driving studies. The objective measures consist of recorded decision times, crossing times and differences in crossing speed. Additionally, the study aimed at giving insights to the preferred modality or combination of modalities for external Human-Machine-Interfaces (eHMIs). The conducted study with 36 participants consisted of five trials with a different eHMI each, three distractors, one autonomous baseline and one manual baseline. Results show high inter-individual differences in objective measures indicating the test methodologies applicability for evaluation of eHMIs. Regarding the modality of eHMIs, results indicate an advantage of multimodality particularly in the face of efficiency. The test methodology, which was optimised based on the results, provides an extensive methodology for the evaluation of eHMIs in real driving studies.

More than Intelligence? The role of artificial personality in the user experience of artificial intelligent agents

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The term artificial intelligence (AI) has become synonymous with various kinds of information and communications technology (ICT) to which qualities of human intelligence can be attributed (e.g. Mileounis et al., 2015). This attribution was possible because methods such as machine learning enable ICT to interact with humans in more complex ways. Nevertheless, intelligence is not the only concept originating from psychology relevant for the user experience of AI: While interacting with machines, people do not only regard them as intelligent, but they also attribute personality characteristics to them based on their appearance and their behaviour (Christoforakos et al., 2019; Mou et al., 2020; Robert et al., 2020). For example, the amount of words used by a robot influences whether it is perceived as introverted or extroverted (Lee et al., 2006). Artificial personality, also known as personality of robot (POR) in social robotics, has a significant impact on the "affective, attitudinal, perceptional, and behavioral responses" (Mou et al., 2020, p. 601) of users engaging with AI – based agents. This thesis focusses on chatbots, analysing how the personality of a chatbot can be modelled and how this influences user experience. There is no clear consensus on the definition and operationalization of personality in psychology and hence various models such as the Big Five model (Costa & McCrae, 2008) have been used to model the personality of chatbots and robots (Christoforakos et al., 2019; Mou et al., 2020). There is no established approach either on which model suits best for this purpose (Christoforakos et al., 2019; Mou et al., 2020). Therefore, several personality models will be reviewed. Furthermore, experts in the field of chatbot development will be interviewed to evaluate how they approach this issue. Based on the review and the interviews a model will be defined. Additionally, the thesis will address how such a model can be expressed on a behavioural level by parameters such as language of the chatbot. In a second step, the thesis will test the model and its behavioural implications in a real-world setting. Currently, two use cases are considered in the field of law and in the field of customer management. Users will be given the chance to interact with prototypes of chatbots systematically varying in their expression of personality. Depending on the use case, the user experience will be measured with parameters such as trust, task fulfilment or acceptance. Based on the results, the model of artificial personality will be evaluated. The interactive part of the session shall initiate a discussion focussing on the following questions: 1) Should a "one-size fits all"-approach be used to develop one single model of artificial personality? 2) Should such a model be based on human personality models? 3) Which model of human personality should be applied for artificial personality? 4) How can the model be transferred into the language of a chatbot? 5) Should the artificial personality model match with the users' own personality or should it match with the personality that the user expects from e.g. a job profile?

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Changing two into three – Designing comfortable interactions for drivers and surrounding traffic participants in automated driving

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An increasing number of automated vehicle features and the resulting transformation of the drivers' role have shown to modify the communication between different traffic participants (i.e., vehicles, drivers and surrounding traffic participants). In manual driving, human drivers and the surrounding traffic participants (e.g., vulnerable road users; VRUs) are required to interact to ensure road safety during ambiguous traffic situations. Whereas, within higher levels of automation, the vehicles' automation itself should be considered as an additional interaction part resulting in an interaction triad (Schieben et al., 2019). To ensure road safety and support the comfort of the human driver and VRUs, a user-centered implementation of manual driving behaviour should be considered for automated vehicles (AVs). Thereby, the acceptance and thus the usage of automated driving functions could be supported. Currently, manual driving is often coordinated by informal communication. For the implementation in AVs, specific parameters regarding the informal communication and potentially influencing factors need to be further investigated from a drivers' perspective (Beggiato et al., 2017). A video simulation study explored the effects of participants' age, vehicle types and vehicles' speed on participants' gap acceptance (GA) in a shared space scenario, presenting an ambiguous traffic situation, from a drivers' perspective. Participants indicated their GA during a left-turn parking scenario including an overlap of the oncoming traffics' trajectory. During the study, the GA of two age groups (<30 years vs. >45 years) was investigated. Moreover, different vehicle types (truck, passenger car, scooter, and bicycle) approaching with different speeds (10–35km/h) were explored. The results indicated that the group of older participants preferred more conservative gaps (i.e., larger time gaps) compared to younger participants. Thus, to support human expectations and comfort during the interaction with AVs as well as the acceptance of AVs a human-centered design approach should be deployed. However, to ensure traffic safety - especially to VRUs - explicit communication (e.g., by external human-machine interfaces; eHMIs) should be applied if implicit communication is insufficient (Ackermann et al., 2019). To foster the acceptance of eHMIs and support the comfort during the interaction with AVs, the concept of eHMIs need to be investigated in further detail. Therefore, specific research questions considering e.g., particular user groups (for instance older participants; i.e., $>$ 65 years), various situational factors affecting the requirement for an eHMI as an additional communication signal or discrepancies between implicit and explicit signals provided by the AV should be investigated.

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Proxemics in Handheld Augmented Reality: Implications for Human-Agent Interaction

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Augmented reality (AR) enables the overlay of three-dimensional digital content with the users' view of the physical environment; therefore, AR provides a novel way for the users to interact with the virtual contents in the physical reality. Most recently, Google has launched an AR walking directions feature for Google Maps which provides users guidance for directions that projects onto the real environment. Applications like this have been implemented because AR is able to facilitate task completion by enabling a larger field of view, reducing gaze shifts, errors and mental workload when an individual finds him or herself in complex surroundings (Kosch, 2020; Funk et al, 2017; Biocca et al, 2006). In addition to rendering simple inanimate AR elements or spatial information, intelligent avatars, or virtual agents, can be used to communicate and convey information to the users (Guven et al., 2009; Kim et al, 2018; Kim et al, 2020; Welsch et al, 2020). While significant progress has been made in the technical designs of AR (Kim et al, 2018), less is known about effective social design features such as proxemics (Hall, 1968) in human-agent interactions in a handheld AR. The present pilot study aims to examine what features (e.g. interpersonal distance, approach speed) in proxemics are relevant when interacting with virtual agents in a handheld AR device in the case of navigation in natural environments. For this, we have recruited 14 participants to complete an experimental task which involved approaching six virtual agents augmented on a mobile device in open outdoor environments. Participants were instructed to walk towards a virtual agent from an initial

distance of 2.5m until they felt that they are at a comfortable distance for asking directions. The goal of this pilot study is to investigate whether proxemic norms for conversations hold in human-avatar interactions in AR. Our preliminary results show that subjects respected personal agent of the virtual agents (>1 meters). Drawing on proxemics research, we discuss the implications for human-agent interactions and for creating effective avatar-avatar interactions, such as that for AR telecommunication between users.

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Designing Ride Access Points for Shared Automated Vehicles

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In times of climate change, metropolization and the quest for more sustainable forms of transportation, on-demand ride-sharing services with automated vehicles (SAE level 4 & 5) show high potential (Ryley, Stanley, Enoch, Zanni & Quddus, 2014; Herminghaus, 2019). For automated mobility on-demand (AMoD) services a positive user experience (UX) is important for acceptance. Especially the users' need to feel competent with the shared automated vehicle (SAV), safety information and the perceived pragmatic quality are essential (Distler, Lallemand & Bellet, 2018). Accordingly, future oriented mobility solutions – based on digital technologies – emphasize the need for digital and flexible infrastructure to give guidance to users (Hahn, Pakusch & Stevens, 2020). We assume that for AMoD the accessibility of the vehicle might be crucial to high UX. To overcome the physical meeting problem of user and SAV, the need to enhance the users' competence and information supply with the new concept of defined virtual ride access points (RAP) presented with means of augmented reality can be derived. The objective of this study is to evaluate an early stage human-centered RAP design prototype and to conceive design guidelines for digital demand responsive transportation (DRT) infrastructure, aiming to decrease uncertainty and trigger positive experiences with a dynamic SAV service. Moderated remote user tests, using video conferencing software, with a sample of preselected early adopters of ride-sharing services ($N = 18$, $f = 11$; Age: $M = 27.67$; $SD = 4.41$), residing in urban areas were conducted. Firstly, participants were told to imagine using AMoD and the prototype was presented in form of a picture showing the RAP concept in a VR-environment (Fig.1).

Figure 1: RAP prototype evaluated by participants. Image courtesy of DLR.

After detailed explanation the participants were asked to rate comprehensibility of the prototype, using a 5-Point Likert Scale (from 1 = "not comprehensible at all" to 5 = "very comprehensible"). Secondly a standardized usability questionnaire (UEQ; Laugwitz, Held & Schrepp, 2008) with 26 randomized items was completed by the participants in order to gain under-standing about the UX of the design concept. Figure 2 shows the results of each scale of the UEQ with error bars at the 95%- probability confidence interval.

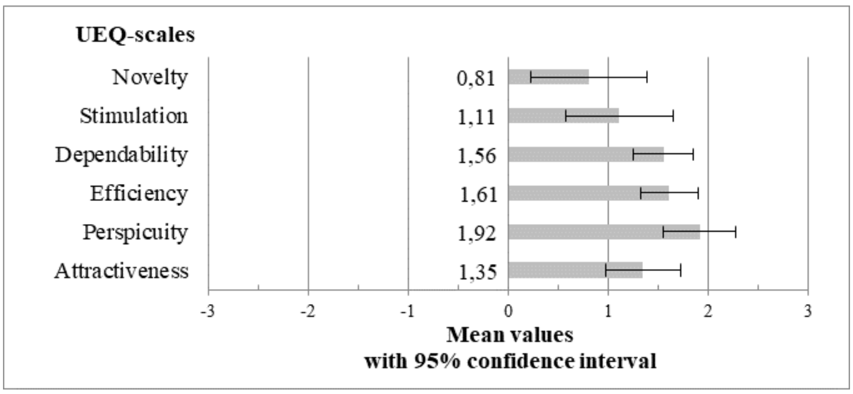

Figure 2: Participants' mean ratings regarding the user experience questionnaire (UEQ) scales.

Results show that the first RAP prototype gives a positive initial impression to the participants (Attractiveness) and already enhances the users' competence by giving useful support overcoming the meeting problem when accessing SAVs. Especially its high pragmatic quality (Dependability, Efficiency and Perspicuity) reveals the potential of RAPs to increase UX and acceptance of AMoD. The hedonic quality (Novelty and Stimulation) on the other hand shows room for improvement, which is acceptable because an appealing design was not the goal of this study. In terms of intuitiveness it can be noticed that the presented concept already received very high ratings (overall comprehensibility: M = 4.45; SD = 0.24). Concluding, the presented prototype provides a basis for further HMI design research in the field of digital AMoD infrastructure. Introducing the mere concept of RAPs for DRT services to users led to curiosity and positive feedback regarding acceptance. The study succeeds in giving first guidelines about how to design digital AMoD infrastructure. Following an iterative design process the presented prototype serves as starting point for a dissertation, investigating how to design a virtual RAP from a human-centered perspective.

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Working with industrial cobots: The influence of robot-related factors on subjective interaction experience

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Although collaborative robots (cobots) are associated with far-reaching prom ises and potentials for cellular manufacturing, they are currently hardly used collaboratively in industrial applications and hence, their advantages are not yet fully exploited. The technology is still in its infancy, so human factors research is needed to effectively support technological development and implementation in the work context. The adoption of cobots is fundamentally affected by positive perception and acceptance of as well as trust towards them. The aim of the presented work is to examine how different specifications of robot-related factors influence subjective interaction experience, including the perception of the cobot, trust and acceptance. As robot-related factors, robot transparency and reliability were manipulated systematically within the scope of an industrial use case in manual assembly. The dependent variables included affective and cognitive components of interaction experience. To investigate those factors, a video-enhanced online vignette experiment with a 2 x 2 between-subjects design was conducted in August and September 2020. The vignettes consisted of either low or high described transparency of the processes and functionality of the robot and either low (34% of work cycles with non-safety related errors) or high reliability of the robot. The subjects with an academic or professional technical background were exposed to the vignettes through texts and videos showing a computer-simulated work task with human-robot collaboration, in which a kuka iiwa assembles the seat of pedal cars together with a human. The interaction scenarios were programmed

in the simulation software IPS allowing ergonomic digital human modeling. A study protocol was registered at osf.io beforehand. On the one hand, the presentation focused on the methods, the results and their implications obtained from the study. The project used a simulation-based approach, which comes along with several advantages, but also limitations. On the other hand, the focus of the discussion was on improvements for a future follow-up project. The future project includes a real-world experiment of human-robot collaboration at work and the effects on attitudes as well as cognition (e.g. attention, flow and workload).

Development of external human-machine interfaces (eHMIs) for automated vehicles focusing on different vehicle types

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The development of highly automated vehicles (AV) and their integration into street traffic is seen by many car manufacturers as a revolution in mobility. In future urban traffic, AVs will be introduced into so called mixed traffic environment and therefore will coexist with other traffic participants, e.g., cyclists and pedestrians. While nowadays, the human driver is still executing the driving task, in future highly and fully AV (SAE level 4 & 5), the human driver will be more or less decoupled from the vehicle guidance (SAE, 2018). Along with this shift of control, the communication, which was previously performed by the human driver needs to be replaced by the AV (Habibovic et al., 2019). To face the challenge of technical progress while taking traffic communication patterns into account, an external human-machine interface (eHMI) seems to be a promising approach to transmit implicit and explicit information to the surrounding traffic environment (Schieben et al., 2019). So far, several eHMI designs have been developed, e.g., light strips on the surface of a vehicle, displays and laser projections (Bazilinskyy, Dodou, & Winter, 2019; Bengler, Rettenmaier, Fritz, & Feierle, 2020). Latest research focusing on the interaction between AV and pedestrians shows that the use of an eHMI could improve safety, acceptance and traffic flow even before it is actually necessary (Habibovic et al., 2019; Schieben et al., 2019). The present dissertation focuses on the design of eHMIs for different vehicle types regarding the interaction with other traffic participants, e.g., cyclists and pedestrians. Therefore, communication strategies of connected automated vehicles in mixed traffic environments are investigated by taking different urban scenarios with high uncertainty for the interacting traffic participants into account, e.g., shared space. Especially on a shared space, several different traffic participants interact with each other during low speed and low distance and therefore they need to communicate adequately. Following an iterative user-centered design process, firstly the conduction of an online study is intended to get a deeper insight into human needs and design preferences for the interaction with different vehicle types, furthermore, simulator studies focusing on the design of communication strategies for the interaction between AV and other traffic participants are planned. This research proposal is part of the German-Japanese research cooperation CAD-JapanGermany (Connected and Automated Driving) funded by the Federal Ministry of Education and Research (BMBF) which aims to develop novel interfaces that will enable networked and automated vehicles to communicate with other traffic participants.

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Effects of non-driving related tasks in Level 3 automated driving on following takeover behavior: A meta-analysis

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Driving automation functions of SAE Level 3 are expected to become available in the near future. After activation, the Level 3 driving automation function provides sustained driving automation until the function reaches its limits. When approaching a functional limit, the Level 3 function alerts the user to take over vehicle motion control again. These requests to intervene are sent with sufficient lead time and the fallback-ready user is expected to respond to the request by taking over vehicle motion control. During the Level 3 automated driving period, the user may engage in non-driving related tasks and does not need to monitor the automation. At the same time, the user must remain fallback-ready as s/he needs to respond to a request to intervene (SAE 2018; Gasser 2013). For traffic safety reasons, maintaining users' fallback-readiness is of major interest. The user should neither fall asleep during the automated driving period nor be too much distracted by a non-driving related task as both states may inherently impede the user from perceiving a request to intervene and exacerbate takeover behaviour. These extreme cases highlight the importance of investigating effects of non-driving related tasks on driver state and especially on takeover behaviour. Therefore, many experimental studies have investigated such effects. However, these studies vary strongly with regard to methods and experimental design, e.g. dependent variables, traffic scenarios, implemented driving automation, abstraction degree of non-driving related tasks (e.g. n-back task vs. quiz game) etc. Despite the heterogeneity, narrative reviews take the effort to summarize present findings (Naujoks et al. 2017; Jarosch et al. 2019). The current project adds to these efforts and aims at summarizing results of primary studies by means of statistical analyses. To provide deeper insights into the overall effects of non-driving related tasks that are performed during Level 3 automated driving on takeover behaviour, the method of meta-analysis is applied on the current literature landscape. A meta-analysis might offer first indications of which effects found in primary studies might be robust effects that probably have an impact on traffic safety. A major challenge for conducting a meta-analysis in this field is the vast heterogeneity of studies. Decent approaches to challenges and how to assure comparability will be discussed.

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