Human Factors and Ergonomics Society
EUROPE CHAPTER

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LÜBECK – GERMANY

ABSTRACTS

Human Factors and Ergonomics Society
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Organization Committee 2024

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WEDNESDAY APRIL 17th

SESSION 1:
SUSTAINABILITY AND HUMAN FACTORS

Perceived sustainability and acceptance of carbon-reinforced concrete – Results of scenario-based vignette experiments

Christian BÖFFEL, Jan BIELAK, Lukas KALUZA, Julia ERNST, Martin CLAßEN, Sabine J. SCHLITTMEIER
RWTH Aachen University, Germany

The successful implementation of new, sustainable construction materials depends on their subjective evaluation by decision-makers and users. This subjective evaluation may be influenced by cognitive biases and heuristics and therefore different from its objective properties. We investigated how different material properties of carbon-reinforced concrete, a sustainable alternative to steel-reinforced concrete, influence users' subjective evaluation of the material. In two scenario-based vignette experiments (n1 = 69; n2 = 61), we asked participants to read descriptions of a fictitious construction project featuring a bridge built with carbon-reinforced concrete. In these descriptions, we systematically varied CO2 emissions, costs, service life, and visible surface cracking of the concrete. The latter is a purely cosmetic factor but has previously been observed to affect users' perceptions of the material negatively. Participants then rated the project regarding its subjective ecological sustainability and acceptance. The results showed that all examined properties significantly affected the perceived sustainability of the material. Furthermore, CO2 emissions, service life, and costs influenced the acceptance of the project. We use insights from cognitive psychology to explain how cognitive biases and heuristics influenced the participants' judgments and discuss the importance of considering the human factor in the early design stages of construction projects.

Immersive urban planning: Infusing virtual reality into citizen participation for amplified engagement and sustainable planning

Marc SCHWARZKOPF, André DETTMANN, Jonas TREZL, Holger HOFMANN & Angelika C. BULLINGER
Chemnitz University of Technology, Germany

Citizen participation challenges urban planning, a complex discipline that shapes the spatial development of urban and rural areas. Current participation methodologies lack structured processes, user-centred approaches and user-friendly (digital) tools, leading to diminished citizen comprehension, reduced engagement, and non-sustainable implementation of proposed measures. In response to these challenges, we designed a Virtual Reality (VR) tool to engage citizens and increase their interest in participation in the initial phases of the participation process. Our tool was designed with a focus on simplicity for novice users, location-independent accessibility for participation events in the field, and the incorporation of existing planning data with minimal effort for urban planners. To assess the tool's effectiveness, we conducted prototype testing during public information events related to the redesign of a park, involving a total of N = 52 participants. The participants provided feedback on the suitability of

the tool for the planning process via a questionnaire. The results indicate that the tool was perceived as easy to use, and the VR environment was deemed appropriate for participatory contexts. This study demonstrates the potential of integrating VR into participatory processes, highlighting its efficacy in enhancing citizens' understanding of planning content and fostering sustainable development of urban areas.

Weathering the Storm: Human Factors Interventions in Railway System Resilience

Richard BYE
Network Rail, United Kingdom

As storms batter the coastline, floods wash away ballast and bridges, and heatwaves buckle tracks, the frequency and intensity of extreme weather events is testing the resilience of the railway like never before. This applied case study will explore activities at the nexus of human-centred design, weather forecasting, predictive maintenance and incident response that aim to build adaptive capacity for future rail systems. Applying naturalistic decision making and UX design methods to novel disruption management processes and technology innovations (including tilt sensors that detect landslides, algorithm-enriched radar data and computational models of asset condition), ergonomics and human factors specialists from Network Rail are working with meteorologists, data scientists, frontline operations teams and geotechnical engineers to help design strategies, concepts and technologies that will fortify railway systems against weather-related adversities. Although the work is in its infancy, initial results indicate that the emerging socio-technical systems will be able to cope with turbulent, uncertain and complex environmental conditions and demonstrate that, through continued efforts and investments in human factors engineering, it's possible to ensure the continuity and safety of rail operations, whatever the weather.

Using Optimal Speed Signals in HMIs to Improve Ecodriving in Electric Vehicles - A Driving Simulator Experiment

Markus GÖDKER, Lukas BERNHARDT, Vivien MOLL, Thomas FRANKE
University of Lübeck, Germany

Energy-efficient driving (ecodriving) in electric vehicles (EVs) plays a crucial role in enhancing overall mobility sustainability and in improving drivers' competencies while interacting with limited range resources, thus, their user experience. Ecodriving can be difficult due to volatile and bidirectional energy flows, hence, requires ecodriving knowledge and energy-related situation awareness (we refer to as Energy Dynamics Awareness, EDA). Ecodriving displays may facilitate more efficient driving by either providing energy-relevant information (e.g., instantaneous consumption displays) or action-oriented recommendations (e.g., instantaneous optimal speed signals). The objective of the present research was to observe and compare the effect of prototypes of these two ecodriving display types in comparison to a control group without display. Using the EcoSimLab EV driving simulator, participants drove different driving scenarios with the instruction to achieve low average energy consumption. We measured ecodriving performance (e.g., average consumption) and variables related to user experience in action regulation (e.g., EDA) to estimate the supporting effect of both displays. The driving scenarios were ordered according to their situation complexity to estimate interaction effects of driving task demands. The results of the study are discussed regarding implications for interface design and theoretic conceptualizations of energy-related driver control models.

SESSION 2: HUMAN-AI INTERACTION - 1

Proven and accepted: Do mathematical proofs for AI algorithms increase acceptance in non-expert users?

Alina TAUSCH, Daniel NEIDER, Magdalena WISCHNEWSKI, Annette KLUGE
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Mathematical verification is an established mean to ensure reliable functioning of AI algorithms. Nevertheless, does this actually help elicit non-expert users' acceptance and trust in an AI? Achieving calibrated trust (Lee & See, 2004) requires information on the AI's reliability that the users can then adapt their evaluation and behaviour to. On the other hand, the process and results of formal verifications are just as incomprehensible as the AI themself to most people operating such systems. Hence, we examine if and how mathematical proofs help achieve calibrated trust and thus appropriate AI use. We conduct online experiments with 180 people working with an AI-driven software under different conditions. The AI is verified either by systematic testing, runtime monitoring or a full mathematical proof. Those are compared to a condition without a proof and one with a self-generated proof. With an in-depth evaluation of one of the conditions by each participant and a conjoint analysis, we aim to find a way to balance computational effort for the proofs and gain in acceptance and trust. We also investigate psychological mechanisms via trust dimensions, vicarious control, i.e., gaining control through the proof as a representative control agent (Rothbaum et al., 1979), and self-efficacy.

Comparison of team emergent states between all-human teams and human-AI teams

RIETH, Greta ONTRUP, Annette KLUGE, Vera HAGEMANN
University of Bremen, Germany

The integration of artificial intelligence (AI) into organizational teams is transforming the landscape of teamwork. This research investigates how team emergent states (team cohesion, team identification, team psychological safety) differ between human-AI teams (HATs) and purely human teams (HTs). In a laboratory experiment, participants (final N = 67 teams; 134 individuals) performed two successive work-related tasks (max. 20 min each). The first round comprised two human teammates, while the second round introduced a third teammate, either human (represented by a confederate, resulting in HTs) or AI (with a Wizard-of-Oz approach, resulting in HATs). Results revealed decreased team cohesion and identification in HATs, with perceived team performance and trust mediating these effects. Team psychological safety did not show a significant difference. Participants in HATs indicated a weaker identification with the AI compared to their human teammate. Based on our findings, AI seems to be able to trigger social dynamics and affective reactions, but in a different way than in all-human teams. Moreover, our results underscore the crucial roles of trust and performance in human-technology interaction, justifying the ongoing scientific discourse on these constructs. The study provides valuable insights for the successful integration of AI in teams while maintaining optimal teamwork effectiveness.

The Role of Explainability in Dynamic Human-AI Interaction

Eileen ROESLER & Tobias RIEGER, Linda ONNASCH
George Mason University USA/Technische Universität Berlin, Germany

Explainability is often presumed to increase trust and performance in human interaction with artificial intelligence (AI). Yet, particularly in dynamic interactions, the interplay between explainability, trust, and performance may be more complex. Initially, explainability highlights fallibility, possibly undermining trust but still prompting effective behavioural adjustments. As interaction progresses, the experience might shape the understanding of the system, making it the primary driver of behaviour, even without prior explainability information. As previous research addressed explainability using mainly discrete choice experiments, our current lab study (N = 54) aimed to expand this to dynamic interactions. Participants worked for three blocks with an AI in a car control scenario. The AI gave perfect recommendations for all but one error-prone colour of cars. We manipulated participants' awareness of the error-prone colour between subjects. The analyses revealed on a subjective level only higher transparency in the explainable compared to nonexplainable condition. On an objective level, participants performed significantly better with the explainable AI and increased after the first learning experience. More detailed exploratory analysis revealed that the advantage of explainability was mainly present in the first interaction block for erroneous error-prone cars. Therefore, explainability could offer particular advantages for inexperienced users of AI systems.

Exploring affective states and trust in a faulty chatbot

Tabea BERBERENA, Maria WIRZBERGER
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Assistive dialogue-oriented systems, commonly known as chatbots, have become ubiquitous in contemporary society, evoking varying levels of trust among users. While some individuals readily entrust sensitive information to such technology, others are more reluctant, refraining from reliance on potential support. Existing human-technology trust approaches often overlook the role of momentary emotional states however. In this study, we aimed to investigate the influence of emotional states, specifically valence and arousal, on trust in a faulty chatbot within a real-world setting. Therefore, we conducted a three-part experimental study involving interactions with a faulty chatbot. Participants engaged with the chatbot in the first part of the study to schedule an appointment for the subsequent phase. However, a deliberate mistake was introduced by the chatbot, providing an incorrect appointment date for the second part of the study. In the experimental group we manipulated fault attribution, blaming the chatbot for the mistake, whereas there was no attribution to fault in the control group. Our findings indicate that valence significantly relates to self-reported trust even after the chatbot made a mistake. Notably, self-reported trust itself did not predict subsequent trusting behaviour. The observed dynamics shed light on the relationship between emotional states, trust reports, and actual trusting behaviour in the context of faulty chatbot interactions. This study contributes theoretical advancements to the existing trust research landscape, offering insights that are particularly relevant for everyday life scenarios involving human-technology interactions.

SESSION 3: TRANSPORTATION

A Field Study of Augmented Reality for Collaborative Ship Navigation

Floris VAN DEN OEVER, Abel VAN BEEK, Morten FJELD, Kjetil NORDBY, Bjørn SÆTREVIK
University of Bergen, Norway

High-quality collaboration between team members is crucial in safety-critical operations like ship navigation. Key collaboration components are team decision-making (TDM), shared situation awareness (SSA), and communication. Augmented Reality (AR) has the potential to improve collaboration during ship navigation. An AR prototype for collaborative ship navigation was developed and tested in Norwegian coastal waters. Testing of the prototype by the ship crews was observed and the crews were interviewed. TDM, SSA, usability, technology acceptance, advantages, disadvantages, and suggestions for development will be examined with thematic analysis. Usability and technology acceptance will also be measured with questionnaires. Preliminary results indicate that AR may improve collaboration through supporting SSA. It can make information more accessible, facilitate building mental models of surroundings, and increase head-up time. AR may support communication by virtual pointing and highlighting. Other advantages include improving operator mobility and facilitating handovers. Disadvantages include overreliance, night vision loss, information overload, and fatigue. For further development, it is crucial to achieve high accuracy and unobtrusiveness. AR promises to be useful for individual and collaborative ship navigation. To become implementable, it must be highly accurate and unobtrusive. Findings may inform the development and research of AR for collaboration in safety-critical operations like ship navigation.

The effect of multiple camera feeds on task performance, usability and attention allocation in Remote Train Operation

Nicole GOOSSENS, Jasper van Zanten, Ellemieke van Doorn
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With Remote Train Operation (RTO) a train cabin will be exchanged for a remote workplace, changing the way visual, auditory and haptic cues are received. This study evaluated 6 different display configurations to gain insight on the effect of information presentation on task performance, usability and attention allocation in the RTO context. Videos depicting a train driver's point of view simulated the multiple camera feeds. Eye tracking glasses, questionnaires and observations using the think out loud method were used. The original and big screen configurations resulted in the best task performance. The latter being the drivers preferred configuration, finding it more realistic and immersive. The different camera views gave drivers sufficient information to perform their task. However, the camera views are task dependent and were distracting when not needed. Moreover, drivers indicated that they found the concept of RTO interesting, but disliked the idea of having a 'desk job'. Additionally, one train driver experienced motion sickness, indicates that motion sickness might be an issue in RTO. This study offers guidelines for

designing a Remote Operation Center for RTO and makes recommendations for further research on the impact of remote driving on motion sickness and workplace design.

Development and Evaluation of a Checklist for a Specific Non-Normal Situation in Electronic Interlockings

Justin ADAM, Dietlind Helene CYMEK
Technische Universität Berlin, Germany

As railway signallers are increasingly supported by automation, passive monitoring with occasional manual intervention during disturbances is becoming the new normal. Unfortunately, passive monitoring can reduce situation awareness, which can slow down manual action taking after a take-over request, or even lead to incorrect actions. The transition from monitoring to full operator responsibility is a critical phase for which the current signalling rulebook provides inadequate guidance. The use of checklists has been recommended to better support signallers. In order to test this assumption, we designed an exemplary non-normal checklist for train-detection or route-setting failure, which we developed using an iterative user-centred design approach. In an A/B test with 31 signallers using an electronic interlocking systems (ESTW) simulator, we tested whether the checklist reduced workload, train delay, troubleshooting time and incorrect actions taken, while increasing situation awareness, anticipatory actions and user experience, compared to a rulebook-only condition. The measures of interest were collected through simulation data, observations, questionnaires, and interviews. Our results indicate that while troubleshooting time, workload and situation awareness did not differ significantly, the checklist significantly reduced safety-critical errors, promoted anticipatory actions that minimised train delays, and improved user experience.

Avoiding automation bias through critique? Experimental evaluation of a decision-support critiquing system for UAV task delegation.

Marius DUDEK, Axel SCHULTE
Universität der Bundeswehr München, Germany

In our contribution, we investigate the effects of a decision-support critiquing system for UAV task delegation. We compare the critiquing system with an equivalent decision-support system that proposes solutions (proposal system) by leveraging a human-in-the-loop simulator study with eight fighter-jet pilots. In the study, participants had to destroy multiple ground targets by delegating attack tasks to their UAVs. These tasks required careful configuration, a process by which they were supported with either the critiquing system or the proposal system. We expected superior performance with the proposal system when the generated solutions are correct, but reduced error detection and resolving capabilities when the solutions are incorrect. Results show that participants were faster and thus managed to engage more targets with the proposal system. When the system solutions were incorrect, participants misconfigured more tasks when using the critiquing system. Participants who received accurate critique from the system beforehand may have developed a high level of trust, causing them to only briefly review system solutions. This may also be associated to certain participants intentionally submitting incorrect configurations in order to trigger a solution by the critiquing system. We conclude that critiquing systems need to be protected against this kind of abusive use.

SESSION 4: AVIATION

Applying the Human System Exploration Model to develop the AI-Based Flight Deck Decision Support System IPAS.

Jakob WÜRFEL, Frank FLEMISCH
DLR, Germany

The integration of human users into AI-based systems is crucial for developing AI assistance systems in safety-critical working environments. Explainability, tailored to the user's needs, has been identified as a key factor in human-AI teaming. The German Aerospace Centre (DLR) is developing the Intelligent Pilot Advisory System (IPAS) to demonstrate the application of AI in aircraft flight decks. The IPAS generates recommendations for actions in emergency situations and makes them available to pilots according to the explainability requirements. A fundamental challenge at the beginning of the IPAS development was that there were limited requirements for AI-based systems in the flight deck, nor were there any requirements for explainability tailored to airline pilots. In order to identify the requirements for the system from the pilots' point of view, the IPAS is being developed in an exploratory manner using the Human System Exploration Model. This allows an iterative search for requirements from the pilots' perspective on the system and the required explanations provided by the system. The paper explains the selection of the Human System Exploration Model, the modifications required and its practical application as a development process for the IPAS. It guides the reader through the development process, introduces the methods used, presents the results achieved, and discusses the value of this approach for the development of AI-based systems in the aircraft cockpit.

Analysis of human and organizational factors of serious events involving aircraft from the French state aircraft fleet: preliminary results from a retrospective study from 2010 to 2020

Anthony VACHER, Mandy LAMBERT, Sami MECHERI, Damien MORISSON, Léonore BOURGEON
Armed Forces Biomedical Research Institute, France

Objective. This study aims to describe the Human and Organizational Factors (HOFs) contributing to serious events involving the French state fleet (i.e., aircraft from the Armed Forces, Civil security, National gendarmerie and Customs) using a standardized framework. Methods. Data on serious events occurring within the French state fleet from 2010 to 2020 were obtained from safety reports from the French State Aircraft Accident Investigation Bureau. Reports were reviewed, and HOFs were coded independently by two investigators using the Human Factors Analysis and Classification System (HFACS). Descriptive statistics were used to describe the events (aircraft, mission, phase of flight, occurrence category) and the levels and categories of HFACS identified as causal factors. Relationships between the HFACS levels and categories were explored using multivariate methods. Results. A total of 144 serious events (62 accidents, 82 incidents) were identified, of which 93.7% comprised at least one cause in one of the four levels of HFACS. Unsafe acts, preconditions for unsafe acts, supervision and organizational factors accounted for 25.3%, 42.5%, 16.9% and 15.3%, respectively. Conclusion. Our study highlights recurrent HOFs involved in

serious events implicating the French state aircraft fleet and what could be used to help better identify target areas for safety initiatives.

KEYNOTE

Robotics Quo Vadis?

Prof. Dr. Sabine Theresia KÖSZEGI
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Recent scientific advances in robotics and AI systems fuel the hope that autonomous, intelligent machines will free humans from tedious and exhausting routine tasks, leaving plenty of room for creative - and for humans - meaningful tasks. What's more, with the help of intelligent machines, we make better decisions and solve significant challenges such as climate and care crises. According to this narrative, AI augments people's capabilities without replacing them altogether. But there is another narrative. One in which the use of intelligent machines in the context of work leads to a change in the role and identity of humans. Not only does the use of robotics and AI lead to diminished self-efficacy and autonomy, but over time, people lose essential skills and confidence in their competencies and thus become dependent on these technologies. In this narrative, robots and AI replace unreliable, error-prone humans in the work process. Which of these narratives becomes reality will ultimately determine the design of these technologies. Current empirical evidence suggests that the full potential of robotics and AI in the work context can only be realised if humans and machines are understood as a socio-technical ensemble and the design of machines adapts to the needs of humans and not vice versa.

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SESSION 5: MARITIME HUMAN FACTORS

The role of human factors in safety of inland vessels

Magnus LIEBHERR, Björn WIERCZOCH, Jörn LINDE, Jens NEUGEBAUER, Jan OBERHAGEMANN, Igor BAČKALOV
University of Duisburg-Essen, Germany

Decades of research in the automotive domain have yielded valuable insights into the impact of human factors on accidents, contributing to the development of increasingly automated technologies and a subsequent reduction in severe incidents. In contrast, the shipping domain, particularly inland vessels, lags in understanding human factors' influence on safety, necessitating increased attention amid growing discussions about automation. The present study analyses three years of official accident reports (2018-2020) from Germany's inland waterways, identifying safety "hot spots" and critical issues. The findings emphasize the pivotal role of human factors, including risky behaviour, rule violations, inexperience, fatigue, and inattention, echoing concerns seen in road traffic. Notably, monotony, inherent in many inland navigation activities, amplifies the significance of fatigue and inattention. The study also identifies the cases in which accidents were attributed to human errors, whereas in fact the roots were to be found in environmental conditions or operational causes. A holistic examination of accident locations, considering both human and environmental factors, provides a foundation for identifying situations where increased automation could mitigate human error, for example on long straight stretches with monotonous environments. Consequently, this study delineates conditions under which automation and assistance systems can be most beneficial to increase safety.

To sea, or not to sea, that is the question: Evaluating eye-tracking as didactical support and facilitator of tacit knowledge transfer in simulator-based maritime pilot training

Rikard EKLUND, Anna-Lisa OSVALDER
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Maritime pilots provide navigational expertise on specific waterways. Such knowledge can be referred to as tacit since it can be difficult to articulate. Maritime pilot training (MPT) is partially performed in simulators where training can be performed in an efficient way. Eye-tracking, where eye-movements are observed, can be means of assessing different environments. The objective of this study was to evaluate eye-tracking as didactical support and facilitator of tacit knowledge transfer during simulator-based MPT. An explorative mixed-method design including four sub-studies with 57 participants evaluated eye-tracking during MPT. The result showed that eye-tracking enhanced the didactical quality of simulator briefings and the objectivity and shared perception of events. Eye-tracking also visualized differences in eye-movement strategies between experienced and novice maritime pilots. Controlled navigation, ship handling, and hydrodynamics covered most of the simulator-based MPT. However, such topics are linked to general naval skills and not specific pilot skills. Specific pilot skills were trained to a higher extent during Maritime Resource Management (MRM) training. It remains unclear if specific pilot skills are based on tacit

knowledge transfer or the development of know-how combined with pattern recognition. Furthermore, links between eye-movements, cognitive processes, and learning are not clear and require more attention.

The transformation of a safety culture: Implementation of Safety-II

Thomas KOESTER
FORCE Technology, Denmark

The offshore oil and gas drilling industry has, since approximately 2015, reached a safety plateau on the health and safety statistics (TRIR around 2-3) from using traditional approaches and tools and is therefore now in a transformation from the classical Safety-I paradigm (learning from failure) to the new Safety-II paradigm (learning from normal work and building capacity in the system) to improve further. The transformation includes, and is based on, integration of human factors in the daily work on board the rigs, e.g., in how the on-board leadership is practiced and in the training of personnel. This presentation is a case study describing a pilot project focused on implementing Safety-II in a drilling contractor's fleet. I will explain how we developed learning materials based on ethnographic observations of positive practice, i.e., how the crews on board, during their normal daily work, added capacity to the work processes, and thereby improved safety, through communication, interaction, leadership style, use of technology etc. I will also show how we developed an on-board leadership program based on the learning material and the interactive Learning Teams format to support and facilitate safety learning based on the crew's reflection-over-action and co-creation of good and safe practices.

Watchstanding on naval vessels: Are rotating or fixed schedules better?

Panagiotis MATSANGAS, Christopher K. MCCLERNON, Nita Lewis SHATTUCK
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For decades, U.S. Navy ships used rotating watchstanding schedules resulting in day lengths of 15-20 hours rather than the 24-hour day required for human circadian alignment. Although such schedules distribute the burden of night shifts to all watchstanders, they contribute to circadian misalignment, fatigue, and degraded alertness and mood. To provide actionable recommendations to U.S. Navy leadership, we conducted studies on USN ships to determine the prevalence and impacts of various watchstanding schedules. Approximately 1300 Sailors from underway USN vessels participated in these naturalistic and longitudinal studies. Sleep attributes, fatigue, insomnia symptoms, mood states, and work schedules were assessed by actigraphy and questionnaires. Performance throughout each study was assessed using the Psychomotor Vigilance Task (PVT). After adjusting for the number of available duty sections, participants assigned to fixed watchbills had better outcomes in terms of alertness, severity of insomnia symptoms, sleep quality, and mood compared to those sailors assigned to rotating watchbills (all $p<0.05$). Also, crewmembers working on fixed schedules had faster response times and made fewer errors on the PVT than their peers working on rotating schedules (all $p<0.05$). Findings from these studies informed the US Navy's 2017 fleet-wide directive to implement circadian-based, fixed watchbills for all surface ships.

Evaluation of a four-section maritime watch schedule design and the question of rotation

Stefan RÖTTGER, Johanna ABENDROTH, Thomas JACOBSEN, Panagiotis MATSANGAS, Nita SHATTUCK
Naval Institute of Maritime Medicine, Germany

Data from a seven-day sea trial of a four-section watch schedule with watch turnovers every three hours starting at midnight will be reported. Subjective sleepiness as indicated by the Karolinska Sleepiness Scale (KSS) was significantly higher for section 1 compared to the other sections, with duty times in section 1 from 00:00 - 03:00 and 12:00 - 15:00. Over the course of the trial, a decrease in KSS was observed in all sections but section one. Reaction times in a three-minute Psychomotor Vigilance Task (PVT) did not differ between watch sections, but the number of errors in PVT was highest in section 1. This reflects a typical phenomenon of watch schedules with constant duty times: Sections working at night are usually worse off than sections that can sleep at night. Guidelines for shift design ashore advise against permanent night watches and recommend fast-forward rotating schedules with a maximum of three consecutive night watches. In the literature on maritime watch schedule design, there seems to be a consensus that duty times should remain unchanged for several weeks or until port. The theoretical and empirical foundations of these opposing views will be addressed and a study comparing fixed and rotating watch schedules will be proposed.

SESSION 6: HUMAN-AI INTERACTION - 2

Meta-Defined Virtual Humans and Moderated Multiparty Dialogues: A Novel GPTs Agent Architecture.

Frank JOUBLIN, Antonello CERAVOLA, Johane TAKEUCHI
Honda Research Institute Europe GmbH, Germany

This research delves into the burgeoning field of human-machine interface for multiparty open dialogues, focusing on the development of human simulators using ChatGPT-4. Our work introduces a novel framework where virtual humans are meta-defined, with their personalities, preferences, skills, and personal vitae generated by Large Language Models (LLMs) based on concise specifications. The dialogues' topics are similarly meta-defined, transformed into dialog synopsis by an LLM. Each virtual human's dialogue contributions are synthesized by LLMs, ensuring consistency with their personality traits. A virtual moderator, also powered by an LLM, oversees the dialogue, guiding it in accordance with the defined synopsis. Our analysis employs a blend of quantitative Key Performance Indicators (KPIs) and qualitative assessments conducted by another LLM instance. The results demonstrate that our approach can successfully generate realistic human dialogues in a multiparty context. This capability has significant implications for testing artificial systems, creating dialogue benchmarks, and evaluating human-machine interactions in dialogue settings. Our findings suggest that the use of meta-defined virtual humans and moderated dialogues can enhance the realism and applicability of simulated human-machine interactions.

From Human-Automation and Human-Autonomy Teaming to Human-AI Teaming: Should, Want, Can, Do and be Accountable in Human Systems Integration

Frank FLEMISCH, Marcel USAI, Nils MANDISCHER
RWTH Aachen University, Germany

With increasing abilities of machines in form as automation or AI the scientific question of cooperation between humans and machines becomes even more important. Starting with aviation, cars, nuclear plants and defence, and based on paradigms of human-machine cooperation (e.g. Hoc & Lemoine 1998, Flemisch, Pacaux-Lemoine, Abbink et al. 2019) and human-robot collaboration (e.g. Tabrez et al. 2020, Mandischer et al. 2023), a paradigm of human-autonomy teaming (e.g. Lyons, Sycara et al. 2021, Draper & Flemisch 2019) has been scientifically developed and is now gradually applied to real systems. Starting with ChatGPT, generative AI and large language models become adapted in the industry and private life, and the question of cooperation and teaming, especially the interplay of goals, intents, abilities, actions and responsibility, i.e. the should, want, can, do and be accountable of human and AI will become crucial. The presentation will introduce the topic, will sketch the design and value space, and will especially discuss the transfer from automation and HAT to Human-AI Teaming: What concepts can be re-used? What should be additionally investigated? The contribution will balance theory and practice by sketching the most important theories behind and describe practical examples from the aviation, car and production domain.

Train your robot in AR: investigating user experience with a continuously learning robot

Anna BELARDINELLI, Chao WANG, Daniel TANNEBERG, Stephan HASLER, Michael GIENGER
Honda Research Institute Europe, Germany

Assistive robots that can be deployed in our homes will need to be understandable, operable, and teachable by non-expert users, calling for an intuitive and explainable Human-Robot Interaction approach. While most studies in the field are conducted with short, prescribed interactions and often with Wizard-of-Oz settings, we set out to test how users' experience and mental model evolve when teaching a personal robot in Augmented Reality, across repeated interactions and in an unsupervised setting, outside of the lab. Participants were invited to freely access the AR glasses in a common office space and to demonstrate physical tasks in a virtual kitchen scene, while the holographic robot gives feedback about its understanding and can ask questions to generalize the learned skill. The robot learns semantically the effects of the demonstrated actions and upon request can reproduce them on observed or newly generalized food items. Preliminary results show that users find the system interesting and engaging (User Engagement Scale), while perceiving the robot as reliable (Trust in HRI scale) and comprehensible (SIPA scale). Further analyses will assess how subjective measures can be correlated to user behaviour, to evaluate the relation between system understanding and teaching effectiveness.

Learning, Troubleshooting, Teaching: When and why do healthcare professionals read instructions for use

Stephanie SCHWENKE, Thore REITZ, Anna OSSEGE
Use-Lab GmbH, Germany

Healthcare professionals do read instructions for use. An ongoing study at Use-Lab with over 70 data sets shows that (as of now), fewer than 10% of users don't remember the last time they looked at instructions for use (IFU). Their reasons for looking at the instructions vary. 60% of users report reading the IFU before first use; 60% also report reading when they are unsure; and 50% report reading for troubleshooting. When we asked users why they last read an IFU, 60% wanted to find specific information or fix a problem while 33% wanted to learn (or re-learn) how to use the device. Looking at what formats users prefer, the trend is clear, 62% of users most prefer a quick reference guide. What do these results mean in practice? Instructions for use have to serve a dual purpose: Teaching and troubleshooting. How best to present information for these purposes diverges, and manufacturers, both in healthcare and other fields, must make decisions about how to present information in such a manner that users with both goals can work with their IFUs. We look at the data from our ongoing study and what it means for designing useful instructions for use.

SESSION 7: HUMAN FACTORS METHODS

Hazard perception and attention of track safety supervisor as a function of working time

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Ben-Gurion University of the Negev/Department of Industrial Engineering & Management/Student, Israel

Railway systems are prominent transportation of people and goods across large distances. Track work often occurs during trains' operating hours. To ensure track worker safety, the role of the track safety supervisor (TSS) is to continuously scan the environment and notify the workers of approaching trains and other hazards. TSS task demands to remain attuned for prolonged durations and identify hazards as soon as possible. Although all TSSs must complete a certification procedure, in practice, there are TSS-certified workers who are designated to do TSS tasks only, and others who can do other track work tasks as well. This study examined hazard perception and attention differences between designated TSS and non-designated TSS workers. Fifteen certified full-time TSSs, 12 certified partial-time TSSs, and 8 non-certified TSSs, were connected to a remote eye tracker and observed 18 short videos from a TSS perspective and had to press a response button each time they identified a hazard. All participants showed a significant decrease in their scanning efficiency and attention over time. Full-time TSS were more efficient in their scanning and were more likely to respond to static hazards compared to the other groups. Non-designated TSS demonstrated the lowest performance. The implications are discussed.

Spare visual capacity and driver inattention: Comparing simulator and naturalistic driving data

Abhishek SARKAR, Tuomo KUJALA
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Drivers often shift their attention away from the forward roadway for various reasons, whether justifiable or not. This creates a challenge for driver inattention monitoring systems, as false alarms should be prevented while maintaining safety. We propose that quantifying situational spare visual capacity based on the possible but unlikely worst-case scenario can provide a valid baseline for classifying a driver attentive or inattentive. In a previous study, we have developed and validated a model for defining, if, when, and for how long drivers can safely divert their attention from the lead car without risking rear-end collisions in a car-following task. The objective of the current study was to analyse if the model provides similar estimates of driver inattention in car-following scenarios in real-world traffic (N=22) when compared to the driving simulator study (N=20). Statistical analyses revealed no significant differences in the percentage of driver inattention in car-following between simulated and naturalistic driving at speeds of and above 80 km/h. Notably, most of the time, drivers face a potential risk of unlikely yet possible collision when they divert their attention away from the forward roadway. The findings underscore the potential utility of our novel approach for valid identification of driver inattention.

Investigating the effect of salience and effort on the prediction of attentional distribution: A SEEV model analysis in the context of anaesthesiology

Robin ABENDSCHEIN, Oliver HAPPEL, Tobias GRUNDGEIGER
Julius-Maximilians Universität Würzburg, Germany

Anaesthesiologists monitor changes in their patients' conditions for appropriate care during the induction of general anaesthesia. The Salience Effort Expectancy Value (SEEV) model can be used to predict the allocation of visual attention during such tasks. However, most studies have investigated the predictive power of the model (model fit) by employing only the factors expectancy and value (EV model). Initial findings regarding the usefulness of the salience factor are mixed. In the present study, we investigated the predictive power of the SEEV model in the context of anaesthesiology with different combinations of the four model parameters (EV, S-EV, E-EV, S-E-EV). We obtained the highest model fits for the EV ($r = 0.88$) and the S-EV ($r = 0.87$) model. Our findings indicate that complementing the EV model by the parameter salience does not improve model predictions and that adding the effort parameter even deteriorates predictions in the context of anaesthesiology. Future research needs to improve the validity of salience and effort measures and should expand these findings on different scenarios and domains.

Comprehensibility and effectiveness of adapted beach safety flag designs

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Beach safety flags are used in over a hundred countries worldwide, forming an internationally adopted warning system to prevent adverse incidents. The flags convey safety information through a single colour or a pattern of two colours. In the first of two studies, we interviewed 174 Dutch residents about the meaning of eight beach safety flags. The results show an overall poor understanding of the meaning of all flags except for the red flag, which indicates high hazard. Respondents also reported low confidence in their answers for most flags, except the red one. We conclude that familiarity with the flag system in the Netherlands is wanting. Our second study investigated whether comprehensibility and behavioural compliance could be improved by adopting an alternative graphic design based on scientifically substantiated design guidelines. We created two alternative flag sets, based on the existing flag set but including clarifying pictograms. These were tested using an online questionnaire completed by 465 Dutch residents. Compared to the existing set, the adapted flag sets almost doubled the level of comprehension and led to a significantly higher intention to comply. We conclude that adding pictograms increases the effectiveness of beach safety flags and can thus aid in promoting safety.

SESSION 8: ROAD TRANSPORT

The Wave Driving Course

Antonio LUCAS-ALBA, Ana FERRUZ, Santos OREJUDO, Oscar MELCHOR
University of Zaragoza, Spain

This communication addresses the problem of traffic congestion, highlighting the capabilities of Information and Communication Technologies to transform society. Recent physical and mathematical analysis of congestion reveals that training drivers to keep a safe distance systematically contributes to the emergence and maintenance of interference congestion (so-called phantom traffic jam). The WaveDriving Course (WDC), is a simulated learning environment designed to help drivers progress from the traditional Drive-to-keep-Distance (DD) technique to a new car-following (CF) principle better suited for wave-like traffic, Drive-to-keep-Inertia (DI). The WDC consists of a series of five tutorial videos connected to five practice modules in a driving simulator. Overall, the WDC helped drivers to verify that it is possible to achieve the same objective (dealing with congested traffic flows) with different consequences. An evaluative CF test was administered before and after visioning the tutorials (only experimental group) and practicing on the simulator (both experimental and control groups). The results in two countries (Israel, 68 participants; Spain, 80 participants) confirmed the adoption of the expected DI strategies (decreased speed variability, increased distance and variability of the distance to the leader, lower fuel consumption, lower platoon elongation) by of the experimental group compared to the control group.

The use of smart glasses in the driving context under different distraction conditions

Nikita Rajendra SHARMA, Gerhard RINKENAUER, Jai Prakash KUSHVAH
Leibniz Research Centre for Working Environment and Human Factors at Dortmund University, Germany

Smart glasses could be part of future in-vehicle information systems. They could be used either to present warning information to anticipate future events or to present action information relevant to performing steering manoeuvres. In our study, we used an extended action preparation paradigm within a lane change task to investigate which of the two presentation categories is best supported by smart glasses. For this purpose, either the pre-cue information or the response information was presented on the smart glasses. Congruent or incongruent irrelevant information was presented before either the preparation cue or the response signal to test which category of information presentation was more susceptible to interference. The results show that reaction times are shortest when the response signal is presented on the smart glasses. However, this type of presentation is also the most susceptible to interference from incongruent, irrelevant information. On the other hand, presenting the warning information on the smart glasses shortens the lane change duration and shows only low distraction costs. Overall, the results suggest that the way in which information is presented on smart glasses also depends on the distraction or interference effects that can be expected in the context of information systems.

Nudge based interventions to improve equity of road safety

Jesse RUMBALL SMITH
Student - Wellington College New Zealand

Speeding is the leading cause of road accidents, contributing to loss of vehicle control and reduced reaction time, increasing the likelihood and severity of crashes. One effective way to enhance speed limit compliance is through real-time auditory and visual cues alerting drivers when they exceed set limits - prevention rather than treatment. New cars increasingly come equipped with Intelligent Speed Adaptation (ISA) systems for this purpose, these features are predominantly found in a minority of the fleet, leaving economically disadvantaged drivers at risk. To address this inequity, the study developed a mobile app that employed the methods of nudge-based intervention, and intervention fatigue mitigation. The app democratises access to such vital safety cues, making them available to all drivers regardless of their socioeconomic status. Results indicate a significant 35% reduction in speeding events and a, more impressive, fundamental change in driver behaviour over time. Apart from enhancing individual compliance with speed limits and thus safety, gathered data can serve as a resource for policy formulation, pinpointing high-density locations where speeding infractions are most prevalent, and helping authorities take targeted preventative measures. My presentation will summarise the effectiveness and its broader potential in contributing to a more equitable and safer road environment.

Eyes on the screen, feet on the street: How pedestrians adapt their crossing and gaze behaviour when using a smartphone

Mirjam LANZER, Miriam GIESELMANN, Martin BAUMANN
Ulm University, Germany

Smartphones have become an integral part of everyday life and accompany people in various settings, including traffic. They can be a source of distraction that affects not only drivers but also pedestrians. For instance, more unsafe crossing behaviours are displayed by pedestrians who use their smartphones. So far, most observational studies have examined the effects of smartphone distraction on the crossing process as a whole. In this study, the traffic observation behaviour, smartphone use and walking behaviour of pedestrians during different phases of a street crossing are investigated. A total of 569 pedestrians were observed at an unsignalised crossing. Around a quarter of pedestrians were holding a smartphone, with roughly half of them looking at their device at least once throughout the crossing process. The results show that active engagement with the smartphone influences the pedestrians' gaze and stopping behaviour. When the pedestrians are further away from the curb, they look less towards traffic and more towards their smartphone. In addition, distracted pedestrians stop more often at the curb when there is no traffic. This indicates that pedestrians using their smartphone adapt their behaviour in order to safely cross the street.

FRIDAY APRIL 19th

SESSION 9: HIGHLY AUTOMATED VEHICLES

How do occupants perceive automated driving depending on seating position and non-driving related tasks?

Pia WALD, Martin ALBERT, Katharina FUCHS
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In future urban traffic, there will be a variety of different vehicles, ranging from manually driven cars to robotaxis. Depending on the type of transportation, both the seating position and the tasks of the occupants will vary. Therefore, this investigation examines the influence of seating position and non-driving related tasks (NDRT) on the perception of the automated vehicle's driving behaviour and on the information requirements of a display. For this purpose, 43 participants either sat in the front passenger seat or in the back seat. They drove two automated driving rounds through Ingolstadt, one with and one without answering a quiz. The results show that, compared to those in the back seat, participants in the front passenger seat rate the appropriateness of driving behaviour lower, report a higher level of mistrust, look at the display more often and have a greater demand for information. Additionally, engaging in NDRTs has a positive impact on the feeling of comfort and the perception of the appropriateness of driving behaviour. The results suggest that improved visibility of the traffic situation and the execution of NDRT have an influence on the perception of driving behaviour and on the information requirements of a display.

User Perspective on Highly Automated Shuttle Buses in Rural Areas

Nadine RAUH, Silvio HESS, Sabine SPRINGER-TEUMER, Lana MOHR, Josef F. KREMS
Chemnitz University of Technology, Germany

Population trends in German rural areas such as the Ore Mountains are expected to change significantly in the near future. Overall, population - especially the proportion of working people - will continue to decline, while the total number of older people (≥ 65 years) will increase [1]. To meet current and future challenges of public transport in rural areas, the use of highly automated shuttle buses (HASBs) is a promising approach. The introduction of HASBs has the potential to ensure widespread access to mobility, particularly for older people while reducing personnel costs. However, in addition to supply, various aspects such as trust, perceived safety, and user satisfaction are crucial for people's willingness to use HASBs [2, 3]. In order to identify persistent challenges and barriers in this regard and to derive possible countermeasures, a one-week pilot operation of a HASB with an accompanying user survey was carried out in Gelenau, a rural community in the Ore Mountains. A mixed methods approach was applied. N = 179 participants experienced a test drive with an SAE Level 4 [4] HASB and completed questionnaires before and after the drive. Subsequently, semi-structured interviews were conducted with n = 54 participants. Results are discussed.

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Enhancing Usability for Older Users in an Autonomous Car: Insights from the autoELF Study

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TU Braunschweig, Germany

As demographics shift towards an ageing society in many countries, it becomes imperative to address the mobility challenges of older individuals. Autonomous vehicles tailored to the needs of older individuals might be a way to counteract the consequences of reduced mobility in older age, such as decreased social participation or loneliness. The autonomous high-fidelity prototype autoELF, built as part of the UNICARagil project was developed for older people unable, not allowed, or unwilling to drive themselves. In a usability study, we investigated the first interaction of 14 older individuals (> 65 years) with the vehicle during a fictitious trip. The participants engaged in 14 tasks that included all vehicle function necessary to travel from home to the theatre, such as entering the route or locking a rollator. Effectiveness, efficiency, and satisfaction were measured for each task. Results show that older individuals were generally open for technology, especially when it improves the ease of use, such as pressing a touch button to close a door instead of closing it manually. However, individuals had difficulties such as entering the route since the process deviates from a common navigation system. Our results promote the human-centred design of automated vehicles tailored to older individuals.

What could possibly go wrong? Using Human Factors and Ergonomics methods to assess the risks associated with advanced artificial intelligence.

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University of the Sunshine Coast, Australia

There are concerns that Artificial General Intelligence (AGI) could pose an existential threat to humanity; however, as AGI does not yet exist it is difficult to identify risks and develop effective controls. We used the Event Analysis of Systemic Teamwork Broken Links (EAST-BL; Stanton & Harvey, 2017) and Cognitive Work Analysis Broken Nodes (CWA-BN; King et al., 2023) methods to identify potential risks associated with two future 'envisioned world' AGI-based systems: an Uncrewed Combat Aerial Vehicle (UCAV) system and a fully autonomous road transport management system. The risks identified were grouped into eight categories and included sub-optimal performance, goal alignment, super-intelligence, enfeeblement, over-control, malicious use, organisational, and sociotechnical system risks. Two of these categories, goal alignment risks and super-intelligence risks, have not previously been encountered or dealt with in conventional safety management systems, and include instances where the AGI intentionally violates system values or hides its own advanced capabilities, and where human colleagues cannot

maintain compatible levels of situation awareness. Potential controls are discussed, including controls on AGI developers, internal controls within AGI, and broader sociotechnical system controls. The work demonstrates the utility of applying systems Human Factors and Ergonomics methods to assess the risks associated with future advanced technologies.

Automatic cars as role models for human drivers? A driving simulator study

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At some point in the future, it might be common to see automated vehicles driving next to human drivers on public roads – in so-called mixed traffic. One arising question regarding mixed traffic considers the influence automated vehicles will have on the traffic system. The expected effects of AVs range from a better traffic flow to overall more safety due to AVs rule-compliance. Another possible impact of AVs on traffic is almost not discussed yet: The influence that AVs might have on human drivers (HDs) through imitation learning. Therefore this project investigates possible role model effects from AVs to human drivers. A simulator experiment is being conducted, where the participants are driving in a city environment. The participants stop at a stop sign at a junction, where ten role model cars cross. Following the Social Learning Theory, the participants (observers) are being exposed to the presented behaviour of those role models with the intent to make the observers copy the observation. To check the hypothesis the models' behaviour is being varied in 15 scenarios. The variation occurs in the distances the model cars are keeping (small, optimal, large) and their driving modes (AC or HD). The measured variable is the distances the participants keep after the observation phase. The results suggest that observed driving behaviour influences human drivers' driving style. However, the influence doesn't occur through direct imitation of the observed behaviour. Both, very large presented distances and very short distances lead to larger distance keeping behaviour in human drivers.

SESSION 10: HMI & UX

Can a Virtual Break Room help to improve Relaxation and Performance for Air Traffic Service Officers?

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DLR, Germany

This exploratory research investigates the effects of stress and fatigue on Air Traffic Controllers (ATCOs) and evaluates the potential of virtual reality (VR) interventions to enhance their performance. Faced with high demands, ATCOs often experience fatigue and occasionally stress, which can significantly impact their decision-making and reaction times. The study examines how VR simulations of natural environments can aid relaxation and reduce stress during break periods, incorporating Attention Restoration Theory (ART) and Stress Recovery Theory (SRT). The intervention features a photorealistic forest environment designed to promote relaxation, with hand tracking for interactive experiences. The experiment employs a within-subject design to compare VR and non-VR conditions, focusing on the impact of these interventions on ATCOs' cognitive performance. Findings showed a promising trend in stress and fatigue reduction during VR sessions, indicating the intervention's potential in enhancing workplace well-being and cognitive efficiency. The study offers valuable insights into the application of VR in high-demand professions, highlighting its role in managing occupational stress and fatigue.

Countering sedentary behaviour – how adaptive feedback can increase standing desk usage

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The modern workplace is conducive to sedentary behaviour, i.e., behaviour with low metabolic activity. Standing desks have been introduced to counteract negative sedentary behaviour outcomes such as back pain and cardiovascular diseases. However, the frequency of use of these height-adjustable desks and factors contributing to standing times have not been scientifically explored until now. In this study, 25 standing desks were equipped with sensors to detect workers' table positions and at-desk presence. After a baseline assessment, two feedback solutions were deployed in a between-subject design, with one group receiving individual visual feedback on their standing time while the other group received team-based feedback based on the team's average standing time. Both feedback solutions visualized an hourly standing time goal. As dependent variables, sensor-assessed individual standing time (as percentage of time at desk) and survey-reported subjective variables were collected. Results show low general standing desk use in the baseline, with an average of 8.2% of presence in standing. This value increased significantly to 23.2% standing time during the feedback conditions. The results underscore the effectiveness of feedback interventions in promoting higher standing percentages and point to the potential of standing desks to mitigate sedentary behaviour in office settings.

User experience of Virtual Reality as a tool for knowledge work

Cecilia BERLIN, Maral BABAPOUR CHAFI
Chalmers University of Technology, Sweden

Virtual Reality (VR) holds promise as a professional work tool – one such potential is knowledge work, characterized by tasks like researching, generating, and editing documentation, alongside interpersonal information exchanges. We present an experimental study in which user experience of VR for knowledge work was explored. 24 participants individually carried out four fictive knowledge work tasks in a VR environment. Observational data was collected with video recordings of the participants' movements in the physical and virtual environment. After each task, participants were surveyed about their performance, perceived mental workload, degree of control, and physical (dis-)comfort. After completing the tasks, the participants were interviewed and surveyed about overall impressions, preferences, technology acceptance, visual and physical comfort, usability, and motion sickness. Preliminary findings show a relatively short learning curve, mismatches of user expectations to offered functionality, appreciated aspects, and various sources of confusion, discomfort or frustration for the users. Developers of VR solutions may benefit from our observations regarding ergonomic risks with respect to headset size and weight, screen resolution, and compatibility with other tools. More importantly, attention should be paid to the haptics of interacting with physical and virtual data entry devices, and the required transitions between these modalities.

Evaluation of pilot spare capacity through control activity

Lauren DUGGAN, Mark WHITE
University of Liverpool, United Kingdom

Many metrics are used to assess pilot workload both subjectively and objectively. Advances have been made in developing objective metrics by, amongst others, Memon et al. who developed a time-frequency domain method for analysing pilot control activity that in his case, correlated with the subjective pilot comments and ratings related to workload. When applied to Cooper-Harper handling qualities ratings, insight into where in a flying task the pilot was 'working hardest' was gained. This paper will present flight simulation trial results that examine the new application of this metric to workload assessment from a spare capacity perspective. Secondary tasks (e.g., authentication) were introduced to discretely change the pilot's workload, and investigate this metric's sensitivity to these changes. This was assessed using the Bedford Workload Rating (BWR) scale and objective flight data, e.g., longitudinal control inputs. Preliminary findings show a positive correlation between greater BWR and increasing task difficulty. However, there was a negative correlation between BWR and peak longitudinal axis control activity rates. It is hypothesised that this metric can be used to discretely measure secondary task impact on primary task performance and indicate spare capacity availability. This paper will present subsequent flight simulation trial results to confirm this hypothesis.

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POSTERS

Better Training - Better Takeover? About the Impact of Knowledge on Takeover Reactions in Automated Driving

Tanja STOLL, Christian CORDIN, Markus HACKENFORT
Human Factors Psychology, ZHAW, Zurich, Switzerland

Automated driving is changing the role of the driver: Novice drivers need to learn automated driving in a safe way. So far, automated driving is not part of the curriculum of driving schools in many countries. Driving instructors report that there is not enough time to teach students about the potential hazards of automated driving. Therefore, in a driving simulator study, we investigated whether a short video about automated driving has a positive effect on novice drivers regarding an interaction with an automated vehicle. 26 newly licensed drivers (M = 21.55; SD = 2.37 years), all holding a Swiss driving licence (M = 20.27; SD = 12.38 months) watched the video explaining the different levels of automation and the correct way of interacting with them. Afterwards they experienced a level three automation and a take-over request (TOR). A control group watched a video about saving fuel before experiencing the same scenarios. The results show that informing novice drivers about the risks of automated driving improves the quality of their reaction to a TOR. However, a longer training might improve the reaction even more. These findings indicate that automated driving should be part of the curriculum in driving schools.

"AVATAR" - Anonymizing Personal Health Data by Creating Digital Avatars in Medicine and Care

Sven BOCK
German Aerospace Center - Institute of Data Science, Germany

The primary objective of the AVATAR competence cluster is to pioneer a ground-breaking methodology in anonymizing personal health data. Our approach involves aggregating diverse data sources—encompassing studies, medical records, fitness data, and health applications—into a decentralized data pool. Upon request, data possessing requisite characteristics is selectively extracted from this pool to craft digital avatars through a meticulous anonymization process. These avatars, akin to artificial personas, are constructed upon real data, rendering it impossible to deduce the identity of the original data donor. This approach not only opens avenues for practical utilization of the abundant available data but also introduces an unprecedented level of transparency for data donors regarding the usage of their information. To facilitate this, donors are invited to release their data when specific usage requests arise, allowing for the creation of tailored digital avatars. Importantly, donors retain the autonomy to decide on a case-by-case basis whether to authorize their data for such specific purposes. This innovative concept successfully harmonizes the imperative of data economy with the demand for extensive data utilization. Our presentation will feature four demonstrators showcasing data donation, request processes, avatar creation, and data connection, highlighting the technical features and transparency integral to our approach.

The use of vitamin C in seasickness and visually induced motion sickness - a randomised placebo-controlled trial in sailors

Andreas KOCH, Lina RIXGENS, Deiko HECHT, Reinhart JARISCH, Wataru KÄHLER, Sebastian KLAPA, Stefan RÖTTGER
Christian-Albrechts-Universität zu Kiel, Germany

Seasickness and visually induced motion sickness can exhibit severe symptoms. Classical pharmacological therapies show adverse side effects and have a long onset time. In controlled conditions, vitamin C has shown significant capacity to improve seasickness symptoms. In our trial, it was tested if vitamin C can improve motion sickness symptoms at sea and in virtual reality environments in sailors. In the first study part, 50 participants prone to seasickness took a vitamin C containing chewing gum at sea. In typical seasickness-provoking situations when sailing, after prophylactic intake of vitamin C chewing gums, 66% of the participants reported reduced or even no symptoms. Adverse side effects were minor. The second study part was a simple blinded, randomized, placebo-controlled trial with 100 sailors, 50 of them being susceptible to seasickness. Half of the participants chewed gums laced with 1250 mg vitamin C, the other half without vitamin C. All participants were watching a 30-minute video of waves via virtual reality goggles on dry land. The results showed a tendency without significance for improvement of simulator sickness symptoms from vitamin C. Susceptibility to seasickness and visually induced motion sickness were significantly linked.

Minimal risk manoeuvre communication in highly automated shuttles via internal human-machine interfaces using media richness for user-centred interface design

Thorben BRANDT, Marc WILBRINK, Michael OEHL
German Aerospace Center (DLR), Germany

Highly automated shuttles (HAV; SAE 4) replace the human driver through sophisticated automation systems. This means that users will have no one to communicate directly with in case of problematic situations. One possible countermeasure could be increasing system transparency, by a multi-layered internal Human-Machine Interface (iHMI), providing information to shuttle users. However, it is still unclear how information should be communicated to users to ensure good user experience during minimal risk manoeuvres (MRM). We conducted an experimental study in virtual reality, facilitating the media richness theory to address this issue providing a multi-layered iHMI consisting of a visual representation of upcoming steps during MRMs accompanied by an avatar surrogating the media richness of face-to-face communication with a shuttle driver. Using a block-design, the participants experienced three versions of the iHMI in three situations each, either a solely visual interface with the problem-solving steps, the visual interface including loudspeaker announcements, or the visual interface in addition to the avatar giving the announcements. After each situation, participants were asked to answer several short questionnaires regarding their experience. Results provide insights into how media-richness of iHMIs can foster passenger experience in HAVs and, therefore, facilitate user adoption of these future mobility services.

Railway remote driving: Reactions times and decision making of train operators

Beatrice SCHMIEDER
TU Chemnitz, Germany

Teleoperated automated trains (GoA3) could work as a fall-back solution or as a technical support system and mean a major step for future transportation. Though supervising an autonomous system can lead to fatigue and delayed decisions in Remote Operators (Brandenburger et al., 2021). Different HMI solutions in Remote Control were discussed for driving on sight (Pacaux-Lemoine et al., 2020) and switching to the Remote Operator only in predefined conditions (Grippenkoven et al., 2020). The aim was to compare these approaches for developing a remote workspace and to reduce delayed or false decisions of Remote Operators. The N=30 participants saw videos of simulated train rides and solved perception-reaction-tasks. If an object appears on the track, a button should press as fast as possible. Decision accuracy and speed will be analysed as performance indicators (study will take place in late December). Reaction times should be shorter in the driving after alert condition, but the accuracy will be higher while driving on sight. A combination of both approaches should be tested in future studies. The results can help to solve current problems of Rail Human Factors research like reducing fatigue and holding an optimal mental workload of remote operators as well as public questions regarding the lack of train drivers.

Boosting Perception of Relevant Road Users Under Adverse Weather Conditions: Evaluation of a Human-Machine Interface for Remote Assistants of Highly Automated Vehicles

Andreas SCHRANK, Marc WILBRINK, Michael OEHL
German Aerospace Center (DLR), Germany

Remotely operating vehicles enables the effective use of vehicle automation even when fully automated driving is not feasible. A human operator assists the vehicle automation remotely when its capabilities are exceeded. The vehicle's remote assistant, legally defined as Technical Supervisor ("Technische Aufsicht"), is a prerequisite to operate highly automated vehicles (HAVs, SAE 4) on public roads in Germany. Assessing traffic situations and providing assistance heavily depends on the video stream from the surroundings of the supervised vehicle. However, adverse weather conditions may deteriorate the visibility of relevant road users, decreasing the remote assistant's performance in assessing and acting on traffic situations that the vehicle's automation cannot handle independently. This poster presents a human-machine interface (HMI) concept for augmenting the remotely assisted HAV's video stream displayed at the remote assistant's workplace. The video stream is overlaid with boundary boxes around relevant road users, boosting salience and improving the remote assistant's perception. The required data can be generated by conventional HAV sensors. The HMI concept was evaluated in an experimental user study with modulated workload via a secondary task regarding performance, workload, situation awareness, and usability. The study's results inform the iterative development of a workplace for remotely assisting HAVs.

The effects of side lesion: Drivers with a left hemisphere stroke show the lowest Hazard Prediction accuracy.

Cándida CASTRO, Daniel A. SALAZAR-FRÍAS, Ana SZOT, Lucia LAFFARGA, María RODRIGUEZ-BAILÓN
CIMCYC (Mind, Brain and Behaviour Research Centre), Spain

A Hazard Prediction tests was administered to 2 groups of experienced drivers: a.) 37 drivers that had suffered a stroke (with an age of M=55.1 years, SD=13.7) and b.) 37 healthy drivers (with an age of M=54.5 years, SD=6.59). In both tests, participants were shown video clips of naturalistic driving footage from the driver's point of view. These were recorded in the participants' native country (Spain) and in another country (U.K.). In the Hazard Prediction task. all the clips ended as the hazard was starting to develop, and participants had to choose the right choice of 4 multiple options, which described the hazard (What is the hazard? Where was it? developing and What would happen next? (Situational Awareness). Drivers with a left hemisphere stroke had a lower Hazard Prediction accuracy percentage (M=59.1, SD=16.7) than drivers with a right hemisphere stroke (M=64.6, SD=11.8) and healthy drivers, who had the highest accuracy percentage (M=68.6, SD=13.1). Additionally, a significant effect was found with respect to the location where the videoclip was recorded [F(1,72)=6,78, p=,011, η2p=,086]. The accuracy of drivers in the Hazard Prediction test was greater in the clips shot in Spain compared to those shot in the U.K. Training to improve the Hazard Prediction performance would be especially convenient in the case of drivers who suffered a Stroke in the left hemisphere, as these drivers must make a greater effort to process details, especially when driving in different or unfamiliar environments.

Towards Performance Prediction: Exploring Physiological Indicators of Process Control Operators' Motivational State.

Sebastian PÜTZ, Alexander MERTENS, Lewis CHUANG, Verena NITSCH
RWTH Aachen University, Germany

With increasing automation, operators of supervisory process control tasks face numerous human factors challenges that could be mitigated by dynamic operator assistance. However, the implementation of any viable solution will require an assistance system to continuously assess the operator's mental state and task performance abilities. This challenge might be addressed by current research that explores the possibility of using physiological measures of the operator's mental state as predictors of human task performance. In line with this vision, we investigated how physiological measures, as correlates of operators' mental effort, could provide meaningful contributions to the prediction of operator performance. Our analysis of experimental data reveals that the predictive value of pupil size and heart rate variability measures is limited by the influence of variations in task demands and the presence of learning effects over time on task, as both alter the amount of mental effort the operator must invest to achieve a certain level of performance. In spite of these limitations, pupil size measures can reliably detect changes in the operator's motivational state and provide predictive power for operator performance beyond conventional model predictors of task demands and time on task.

Job requirements for future train drivers: A job analysis.

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Technological changes enable higher automation in the transport sector. Thus, job environments for train drivers will change. Job holders will potentially operate trains from a control centre, responsibly supervising multiple trains at once during routine operations. Additionally, they might remotely intervene in particular train rides if necessary. This study aims at identifying the requirements of remote train operators for automated trains and at comparing these to job requirements of high-speed train drivers. An expert sample of N=36 train drivers was instructed to immerge into future job activities by a written job description and two videos describing future tasks. Following, they were asked to assess future job requirements by rating 75 abilities of the Fleishman Job Analysis Survey regarding their importance for the successful accomplishment of future work tasks. The highest rated competencies were in the domains of sensory/perceptual, cognitive and interactive/social abilities followed by psychomotor abilities. However, physical abilities were evaluated as being unimportant for remote train operators. Most important competencies were dependability, emotional control and perseverance (social/interactive domain) as well as operational monitoring, vigilance and time sharing (cognitive domain). Similarities and differences to the requirements for drivers of high-speed trains are discussed.

Guardians of the SAV – Security Measures for the Interior of Shared Automated Vehicles.

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The advent of SAE Level 4 automated driving functions creates new opportunities to reduce traffic through innovative mobility concepts such as shared, automated vehicles (SAVs). The general willingness to use SAVs in the future is high. However, assaults on passengers like verbal, non-verbal or physical harassment are already a major problem in public transport today and it can be assumed that it will also occur in SAVs. This could massively impair acceptance and even lead to avoidance by groups of people who are particularly affected. It is therefore essential to consider security measures early on in SAV interior design. In a first step, as part of a mixed reality study, n = 42 participants were asked about their general attitude towards in-vehicle security as well as measures to increase security after experiencing the 3D model of an automated shuttle bus. Based on participants' ratings, a set of security features was designed and implemented into the virtual bus model. This represents a first solution towards visualizing and making security measures in SAVs tangible for future users. The results can be used in follow-up studies in which user acceptance of the implemented security features can be determined.

AI-assisted control in network operations.

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The HORIZON-project «AI for REAL-world NETwork operation» (AI4REALNET) aims at developing methods for AI-supported human-in-the-loop decision-making in network operations (electricity, railway, and air traffic management), with the resilience, safety, and security of these critical infrastructures as core objectives. Core requirements for method development are trustworthiness in AI-assisted control with augmented human cognition, and hybrid human-AI co-learning. A content framework model is currently under development that aims to address three main topics from the perspective of work and organizational psychology: How to augment human decision-making agency with AI on the basis of mutual complementarity, how to support human learning (i.e., building subject matter expertise) by AI in a targeted manner, and how to integrate human and AI in a way increasing human motivation and task orientation. Concepts integrated into the framework model originate from the traditions of natural decision-making, complementary function allocation, sociotechnical system design, experiential learning, and task design for intrinsic motivation. The framework model will be presented as a poster.

Evaluation of train remote control via tablet in a model railway layout.

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In the project ARTE (Automated Regional Trains in Lower Saxony), we investigate driverless operation in grade of automation (GoA) 3/4 on regional lines. An important component is the development and investigation of remote train operation (RTO) as a fall back solution in the event of automatic train operation (ATO) failure or other incidents. One aim is to implement a simplified remote control system that can be operated by either train personnel or a remote train operator. A user test with 13 participants was carried out in a model railway layout in order to check whether remote control using a tablet and the Z21 model railway app is practicable. After an introduction to the tablet and the app, participants remotely drove a model train in timetable mode. After that, participants completed the SUS and a questionnaire regarding tablet control with the app. Overall, the user test showed that remote control is feasible using a tablet and the Z21 app. The key findings were that route knowledge is also required for remote control and that the video image must be of sufficient size and quality. Further optimisation requirements for using this tablet solution for the remote control of a real train were identified.

Poetry is not a random set of words: a study of fidgeting as a response to vigilance decrement.

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This study aims to explore fidgeting as an adaptive strategy for addressing boredom. We compared fidgeting behaviours in a signal detection task with two levels of boredom. Participants listened to an artificial voice reading a flow of 7137 words and had to identify each occurrence of the word "love" by verbally responding "target." Participants were randomly assigned to two conditions: in the "meaningful" condition, words belonged to a poem specifically created by ChatGPT, whereas in the "meaningless" condition, words were delivered pseudorandomly. The Xsens 3D motion tracking was used for recording participants' body movements. Additionally, participants completed the Habitual Boredom Scale to assess their subjective experience of boredom and the NASA-TLX to evaluate mental workload. Results indicated more fidgeting associated with meaningless tasks than with the meaningful task. These findings shed light on the relationship between body movements, variability, and boredom, highlighting the functional aspects of fidgeting as an indicator of engagement in monotonous tasks. Knowledge gathered from this study can contribute to developing intervention strategies to mitigate the negative impacts of boredom on the operator functional state in various domains. Information about fidgeting may be used to provide timely assistance when needed, for example, in adaptive automation systems.

Capturing the workplace cognition of adults with dyslexia via virtual reality testing and self-reports.

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The effects of developmental dyslexia persist into adulthood, extending beyond reading and spelling to affect broader aspects of cognition. Given the different demands of, and responsibilities placed on, cognition in adulthood, it is important to investigate the cognition of adults with dyslexia in its own right. Cognitive performance in the workplace is one obvious area of such concern. While optimal cognitive performance under laboratory conditions and typical cognitive performance in everyday life have been studied in adults with dyslexia, little direct evidence regarding the effects of dyslexia on workplace cognition exists. The current paper reports recent work using i) a non-immersive office-based virtual reality task and ii) an online self-report survey investigating the relationship between dyslexia symptoms and the frequency of cognitive failures in the workplace. The results indicate the pattern of strengths and weaknesses in the workplace cognition of adults with dyslexia, highlighting specific areas of cognition in which support would be beneficial and indicating areas of strength which could be harnessed. Targeted, research-informed support for areas of cognition such as prospective memory, executive function, and planning would allow workers with dyslexia to gain greater job satisfaction and facilitate their advancement opportunities, as well as benefiting their employers.

Perceived traffic safety and the use of different types of carriers to transport children by bicycle.

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While an increasing amount of research focuses on the safety of cyclists, little is known about the safety of children transported on an adult's bicycle. To close this gap, this research examines the use of bicycle seats, trailers and cargo bikes as well as specific changes in cycling behaviour when adults transport children. For this purpose, an online-survey (n=274 German participants) and a combination of interviews and field observations (n=101) have been conducted. The results show that almost one in two people have already experienced at least one critical situation or even an accident when transporting children. The two most common causes are insufficient distance from motorized traffic and self-inflicted incidents (e.g. falls, operating errors). Adults stated that they tend to ride more slowly when transporting children, to avoid overtaking other road users, but also to ride on the sidewalk if this seems safer. When using a bicycle seat, 25% of children do not wear a helmet and when using a trailer or cargo bike, only every second child does. Our research contributes to a better understanding of the safety aspects of transporting children by bicycle. Possible safety improvements for cyclists and their passengers are derived and discussed.

Creating a Questionnaire Assessing Usability of Medical Devices used by Healthcare Professionals.

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Medical technology is constantly evolving and the complexity of medical devices is increasing (Senders, 2006). Medical device usability is essential for avoiding errors by healthcare professionals (Janß & Radermacher, 2014). The aim of the present study was to develop a questionnaire assessing the usability of medical devices used by healthcare professionals. Towards this aim, a large collection of 185 items was created to capture all relevant usability-aspects identified by Freier and colleagues (2022). A selection of 65 items with the highest relevance and comprehensibility was then evaluated by 304 healthcare professionals in an online survey. An exploratory factor analysis (EFA) was conducted on this data to determine the structure of the construct of usability and to select optimal items. After item reduction, a questionnaire with 17 items was obtained. It showed good reliability and comprised the dimensions Purpose, Feedback, and Learnability. While Purpose seemed to represent the general usability, Feedback and Learnability represented two more separable aspects of it. Given the fact that healthcare professionals often need to react to feedback from medical devices and lack the time to acquaint themselves with new medical technology, the latter two aspects seem particularly important.

AR-based Navigation to Virtual Stops in Demand Responsive Transportation: Where Do Users Need Information?

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The use of flexible pick-up locations promises a convenient travel experience in demand responsive transportation (DRT). Users book a ride on the smartphone and algorithms determine routing and pick-ups. Then, users must walk to the initiated virtual stop (vStop) in time to board the shuttle bus. Since virtual stops lack of real-world cues, navigation information must be clear and efficient. The novel vStop HMI concept addresses this issue by providing information in reference to the street environment with means of augmented reality (AR). However, AR also might shift user's focus who could unnoticeably walk into critical situations. Therefore, restricting AR information supply while walking could be promising. This study exploratively compares an AR-based vStop HMI with an information restriction method during navigation to a baseline without any information restriction. The experimental user study used a between subject design and was conducted in a virtual reality environment. Participants had to navigate to a vStop, solely relying on a simulated mobile AR device. User Experience metrics (location of information retrieval, Usability, Workload, and Acceptance) during task solving were captured. Study give practical implications for the use of AR in DRT use cases.

The Influence of AI Transparency on SMMs and UX in Human-AI Brainstorming

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Our research explores dynamics of shared mental models (SMMs) and user experience (UX) in human-AI collaboration, with a focus on transparency of AI's goal-aware behaviour. This research is a follow-up study, which builds on research on the quality fit of UX and SMM for examining human-AI collaboration in brainstorming. With the development of Large Language Models (LLMs) like ChatGPT3.5, understanding how AI agents influence team cognition and user interaction has become crucial for team performance and user satisfaction. This research explicitly reveals the origins and mechanisms behind the AI's goal-aware capabilities to the participants, thereby examining its impact on the perception on shared mental models and UX. In the planned experimental study, participants engage in brainstorming tasks with different versions of ChatGPT3.5. Each version varies in the degree of transparency about the source of the AI's goal-awareness, which is tailored to the users' preferences i.e., be-goals according to Hassenzahl (2008). The study evaluates the perceived SMM across five dimensions and facets of UX. The findings aim to foster our understanding of the optimal integration of AI agents in team stetting's for ill-defined problem-solving and ideation.

Driver gaze behaviour before lane changes

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Recent regulation for automated driving requires driver monitoring for presence, availability and attention. However, driver attention is solely based on gaze behaviour. Combining information of driver gaze with the vehicle world model could lead to better understanding of what the driver is aware of. The aim of this research was to investigate whether mirror usage prior to lane changes was affected by the presence and location of vehicles in the target lane. Two studies were performed on Dutch motorways, where participants (n = 21) drove a fixed route with an instrumented vehicle while their gaze behaviour was recorded. A systematic pattern of mirror fixation behaviour was found, in which drivers used their side mirrors most often about 5s before a lane change. A detailed analysis (n = 5) was performed to investigate the relationship between vehicle presence and fixation frequency and duration. Results indicated a positive relation between vehicle presence and fixation frequency and duration. Additional results indicated a negative correlation between both fixation frequency and duration in the left mirror and THW and TTC between ego vehicle and vehicles in the left lane. Our findings may improve driver monitoring by better estimation of driver situational awareness in the future.

Insights into the UX-focused Design of the User Interface for a Collaborative Maritime Robot

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In a world of increasing automation and a shortage of skilled workers, the CoboTank project aims to develop a collaborative robotic system for loading and unloading liquid cargo ships. The use case includes significant challenges due to time constraints, the handling of hazardous chemicals, and the physical demands placed on workers. A key aspect of the project is the efficient allocation of tasks between humans and robots, to keep workers constantly informed and reduce both physical and psychological workload. Furthermore, the project emphasizes a human-centred design approach for the interface (DIN EN ISO 9241-210) to ensure optimal usability and user experience. In a multi-stage research approach, hardware and software concepts were tested with participants from the maritime industry through focus groups and usability tests. The requirements analysis revealed specific needs for the use of robotic systems in the maritime context, which were influenced for example by external factors such as protective clothing during handling. Manual guidance was found to be the ideal principal for safe human-robot interaction enabling a sensitive and effective collaboration. In addition, participants preferred reduced designs that also subjectively aimed to improve control and situational awareness during human-robot collaboration.

Communication between automated vehicles and pedestrians using Augmented Reality

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When introducing connected and automated vehicles (CAVs) into the existing mobility and transport system, special attention must be paid to the interaction of CAVs with surrounding other road users (ORU). In order to meet this challenge, various solutions have been developed in the field of external human-machine interface (eHMI) in recent years. However, these are often visual eHMIs attached to the body of a CAV. The perceptibility of eHMIs is highly dependent on the situation (e.g. lighting conditions, visibility, distance to the CAV) and signals can hardly be adapted to the needs or wishes of the respective ORU (e.g., colour blindness). The present study investigates a new approach that enables communication between CAVs and ORUs using augmented reality (AR). In an online video study, 94 participants evaluated different AR design variants for communication with a CAV from the perspective of a pedestrian. The subjective willingness to cross and subjects' perceptions regarding traffic safety were collected. The results show the great potential of an augmented reality eHMI design.

Design of orthotic (helmet) for the treatment of infants with plagiocephaly

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Plagiocephaly is a condition that occurs primarily in infants and is characterized by an asymmetrical deformation of the skull, resulting in a flat back or one side of the head. The incidence of plagiocephaly is the most common condition of all positional head shape abnormalities, with an estimated incidence of 46%. As the use of such helmet therapy increases, it is important to consider usability in order to develop orthotic helmets that are comfortable for patients to use. In this study, we developed a corrective helmet for the treatment of plagiocephaly and conducted two usability evaluations with plastic surgeons. This evaluation is based on satisfaction with the device and SUS. In the initial design, device satisfaction increased from 4.0(0.89) to 4.53(0.50) after device improvement. In addition, the mean of the participants' scores on the SUS was 80, which was higher than the baseline of the SUS. As a result, the device has been proven to be a safe medical device for paediatric use. Through this study, a helmet for the treatment of plagiocephaly was designed, and in order to further improve usability, it is recommended that diversifying colours and patterns will increase usability as infants prefer lightweight and unobtrusive products.

Understanding and Addressing Diverse Mobility Needs: A Framework for CCAM Solutions

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In the realm of Connected, Cooperative, and Automated Mobility (CCAM), recognizing and accommodating the diverse needs of transportation-disadvantaged populations is paramount for equitable service provision. This study, embedded within the SINFONICA project, undertook an extensive literature review to describe the intricate interplay of psychological, social, and situational factors influencing mobility needs. Four critical groups of mobility needs—availability, accessibility, affordability, and acceptability—emerged as foundational elements for achieving transportation equity. Our research identified specific mobility needs for distinct user groups, including low-income individuals, the elderly, people with disabilities, migrants and ethnic minorities, young people, women, those in rural areas, and digitally non-connected individuals. Drawing on an extended version of Ajzen's theory of planned behavior, we developed a comprehensive theoretical framework encompassing 'Mobility Needs,' 'CCAM Design Requirements,' and 'Intention & Use.' This framework covers the dynamics between user characteristics, CCAM service characteristics, and the formation of intentions to use and subsequent actual use. Our findings offer a roadmap for designing CCAM solutions that address specific user needs, fostering inclusivity and enhancing the overall effectiveness of future mobility innovations. The framework provides a valuable tool for researchers, policymakers, and practitioners in pursuing more accessible, user-centric, and equitable transportation solutions.

Wait, What!? Improving Situation Awareness in Autonomous Driving Through Cooperation

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This research investigates the crucial role of situation awareness for drivers in highly autonomous vehicles, ensuring a smooth transition of control in case of a system failure, thereby averting potential accidents. Additionally, the study examines the importance of acceptance towards these vehicles for their successful integration into everyday traffic. We used a cooperative approach to explore whether interaction with the autonomous vehicle enhances situation awareness and influences acceptance. An online experiment was conducted with 126 participants using video-based scenarios. Results indicated that for the cooperatively controlled autonomous vehicle, situation awareness, measured through a tailored questionnaire, was higher than its non-cooperative counterpart. However, an interaction was identified when employing the Situation Awareness Rating Technique (SART). Acceptance showed no significant difference, although perceived ease of use - a subcomponent of the acceptance measure - demonstrated significant differences.

Distance perception in VR depends on object size and influences pointing performance.

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Previous research indicates that the perception of distance in virtual reality (VR) can differ from that in reality. The aim of our study was to investigate whether distance estimation in VR depends on object size and whether different distance perceptions influence performance in a pointing task. A virtual environment was created in which virtual cubes of different sizes regarding width and height (large, normal, small) appeared. Their position regarding the distance from the participants remained constant throughout the experiment. A cross representing the target was placed on these cubes. In a distance estimation task, the participants estimated the distance of these cubes by indicating the position of the cross with their right hand without visual feedback. In a pointing task, the participants were asked to point as accurately as possible at the cross. Here, the size of the cubes, their horizontal and vertical position, and the feedback (simultaneous vs. terminal) were manipulated. The distance to large and normal-sized cubes was estimated to be significantly closer than the distance to the small cubes. The further away the target was estimated to be, the greater the pointing error. Object size appears to have an influence on distance estimation, affecting the pointing accuracy.

Simulator-based connected mobility research: Opportunities, challenges and solutions.

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In an increasingly interconnected world, transport research must evolve from predominantly single-user simulations to more complex, realistic simulations where multiple participants in different transport modalities (drivers, cyclists, pedestrians etc) can interact with each other and with intelligent agents (autonomous cars, delivery systems, drones etc). This requires significant advances in the technical capabilities of the simulator systems in the areas of sensing, modelling and analysis. In this contribution, we elaborate the opportunities, challenges and approaches for such facilities based on two systems: a flight deck simulator linked with an air traffic control simulator, and a driving simulator linked with a pedestrian simulator. A particular challenge is to generate high-fidelity digital representations of human actors within a driving simulator environment, e.g. how to create a digital twin of a participant at a simulated road crossing, so that the twin appears in the simulation and is visible to another participant in a driving simulator. Such a setting allows for studies of safety-critical interactions between the two participants within a simulation environment. We demonstrate how to achieve such a solution using camera-based body tracking, in an environment where a participant can move freely without the impediment of a VR headset.

Optimising Collaborative Control: The Role of Haptic Feedback in Driver-Vehicle Interaction.

Nikol FIGALOVÁ, Juergen PICHEN, Martin BAUMANN
Ulm University, Germany

Improving collaborative driver-vehicle interaction is critical to enhancing joint human-vehicle performance in automated driving systems. This study investigates the role of haptic feedback, compared with auditory and visual modalities, in improving collaborative control in automated vehicles. Employing a driving simulator with 30 participants, the study analysed the impact of feedback types on drivers' mental workload, usability, experience, satisfaction, and trust in automation. The results indicated a preference for any form of feedback over no feedback, with auditory and visual feedback showing significant benefits. Interestingly, haptic feedback did not demonstrate a distinct advantage over other modalities. The findings point to the critical need for further research to optimize driver-vehicle interaction, particularly in haptic technology, to enhance the safety and efficiency of automated driving systems.

How to flow in manufacturing work – Rethinking gamification in designing manufacturing workplaces

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Gamification at work is currently finding its way into research and industry. It is expected to affect performance and motivation in a positive way. Flow experience is the state of complete absorption in an optimally demanding task and is known to have positive consequences on wellbeing and performance at work. Furthermore, flow is a central approach when designing gamification. In the present study, different gamification elements are applied to a manufacturing workplace. In an experiment with 89 participants, two similar assembly tasks—one with gamified assembly procedure and one without—are compared regarding flow experience and performance. Data show that flow is experienced more frequently during the gamified assembly. However, analysing the intensity of flow, the difference diminishes over the five assembly runs. Similar findings result for performance during the assembly progress. Analysing the differential effects of the gamification elements some approaches are seen as motivating while others are evaluated as rather negative. The results indicate that a good choice of gamification elements can have engaging effects, particularly in learning processes. The study offers an initial insight into how gamification is perceived in manufacturing work and how it can be applied taking into account the experience of flow.

Interaction of Autonomous Vehicles and Vulnerable Road Users: Is an Equal Treatment Fair?

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Autonomous vehicles (AVs) should be aware of the expectations and values of humans, to ensure smooth and acceptable interactions with vulnerable road users (VRUs). In particular, the question arises if equal treatment of various VRU groups (e.g., healthy adults, individuals with physical impairments, children) is perceived as fair. In a laboratory study (N = 126), participants imagined interacting with an AV as pedestrian (n = 61) or cyclist (n = 65) in video-based scenarios. They assessed the relevance of the values justice and equality, indicated whether they perceived equal treatment as fair, outlined advantages and disadvantages, provided recommendations for fair interactions, and then assessed once again whether they perceived equality as fair. The results show that the values were perceived as highly relevant. However, only 40% of the participants in the pedestrian condition perceived equal treatment as fair, compared to 59% in the cyclist condition. After responding to the questions about the advantages, disadvantages and recommendations, this proportion decreased significantly in the pedestrian condition, but not in the cyclist condition. Suggestions for fair interactions ranged from generally cautious behaviour by the AV to special consideration for certain groups. Overall, the results provide suggestions for the design of value-oriented, AI-based interactions.

Leveraging interactive preference learning to guide participatory design sessions

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Participatory design is valuable in early product development to quickly gauge sentiments towards product prototypes by directly integrating end-users in the design process. However, it can be difficult for some users to naturally contribute when presented with a set of complicated tools to manipulate candidate designs. Therefore, we examined the use of active preference learning as assistance for design space exploration in a sample use case (Head-Up-Display-Design in cars) to quickly estimate the overall preferences of participants by sequentially presenting key design variants for evaluation from a continuous parameter space. The goal of the study was to determine whether we are able to learn valid, meaningful preferences in short one-off design sessions. Hence, we compared the quality of the predictions and evaluated the subjective experience of the interaction when employing models based on active learning and Bayesian optimization against a random search baseline. Results indicate that active design assistance, compared to random search variants, is able to significantly better predict latent preferences (Cohen's kappa: 0.63 vs 0.12) and are perceived as significantly more engaging and rewarding (user engagement score: 3.68 vs 3.32). This highlights the potential of algorithmic design space exploration as an alternative interaction strategy for participatory design sessions.

Camera-monitor systems: The effect of horizontal camera displacement in on driver's gap acceptance

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Future vehicles are foregoing traditional side rear-view mirrors in favour of camera-monitor systems (CMS). This allows for flexible placement of the exterior camera at positions on the vehicle that do or do not correspond to traditional views through the mirror. We have previously shown that low camera positions can be dangerous. In contrast to vertical camera displacements, varying horizontal positions (farther to the front or farther to the back of the vehicle) have not yet been researched. Do they alter the driver's perception of gaps in moving traffic? In a laboratory experiment employing a last-safe-gap paradigm, we investigate the effects of horizontal changes in camera position. The task for participants is to choose the last moment at which a safe lane change could be initiated. We discuss the effects of the horizontal camera displacement, along with the visibility of the participant's own vehicle on gap acceptance. The insights can contribute to safer driving behaviour.

Advancing the CLAM Model through a Delphi Study in Collaborative Assembly Systems

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The evolution of Collaborative Robotics in Industry 4.0 underscores the need for optimizing human-robot interaction (HRI) in collaborative assembly settings. A critical aspect often overshadowed by mechanical safety concerns is cognitive ergonomics. Addressing this gap, our project proposes an enhanced version of the Cognitive Load Assessment for Manufacturing (CLAM) model, named "ProMentoHR," integrating insights from cognitive ergonomics into the design of Collaborative Assembly Systems (CASs). Inspired by recent methodologies in the field, we will employ a Delphi study, gathering expert opinions from diverse fields such as robotics, manufacturing systems, and work psychology. This iterative, consensus-driven approach aims to refine an upgraded CLAM model, focusing on accurate cognitive workload assessment in HRI contexts. ProMentoHR's development involves creating a user-friendly tool for CAS designers, emphasising ease of use for assembly system experts. The project will then conduct experimental validation through a case study in a realistic manufacturing environment, ensuring the tool's practical applicability and effectiveness in enhancing operator safety, well-being, and work efficiency in HRI scenarios. By harmonising physical and cognitive ergonomics, ProMentoHR aims to not only advance operators' interaction with industrial robots but also to bolster overall production performance.

"Why were you speeding?": A Self-Confrontation Study on Awareness and Reasons for Speeding

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Despite extensive speeding prevention efforts, including legislative enforcement, road design adaptations, and technologies like adaptive cruise control, speeding remains a large contributor to traffic casualties. Understanding drivers' awareness and subjective reasons for speeding could enhance intervention strategies, which could be based on: (1) the drivers' awareness of their behaviour and (2) the subjective reasons drivers provide when confronted with their behaviour. To investigate these two topics, a self-confrontation study (see Mollo & Falzon, 2004) was conducted: 25 participants recorded one of their usual drives, using GoPro cameras, capturing both the road view and their speed. Selected video segments were later reviewed with participants, focusing on their awareness of speed behaviour, either within the limits or above, and the underlying reasons for their speed choice. The study also explored general attitudes towards speeding, perceptions of its problematic nature, the acceptability of exceeding speed limits, and decision-making in speed choice. Preliminary findings suggest that most drivers who speed are aware of it, and they would attribute their behaviour to habits, a sense of safety or the need to adapt to traffic flow. The few drivers who did not speed usually expressed fewer reasons for their behaviour, mentioning their preference to stick to the rules without the need to question them.

Responsible Experience Design for privacy on the web: results of an Ethical Co-Design Workshop

Veronica HOTH, Stefan BRANDENBURG
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A prior investigation from 2022 showed that cookie consent banners designed with persuasive UI-elements known as dark patterns cause mistrust and annoyance among users. These design strategies are used to manipulate the user into selecting options that are not in their best interest which seems un-ethical. In interdisciplinary fields such as human factors/ergonomics (HF/E) and human-computer interaction (HCI), research is already underway to develop and disseminate ethics- and values-based methods for raising awareness of the consequences of technology on individuals, society and the environment. To contribute to this objective, we designed an ethical design method integrating the Value Sensitive Design Approach into the Human Centered Design Process. The goal of this participatory design workshop was to engage stakeholders in the design process of privacy interactions on the web. Following the guided design process, participants defined their requirements and values related to privacy, analysed the ethical consequences and finally co-designed a new interaction design solution for privacy on the web. The data collected in these workshops was evaluated using thematic analysis and shows the potential of the right method as a catalyst for ethical experience design and innovation.

Integrating validation into VR: An in-simulation validation approach to support participatory design processes in virtual reality

Duc Hai LE, Frank KÖSTER, Klas IHME
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Virtual reality (VR) enables complex and safe environments to experience, develop and design for human-machine interfaces (HMI). User-centred concepts such as participatory design (PD) allow active involvement of users during product development. However, limited knowledge of other user groups with different preferences and needs may leave users unsure about their overall design decisions. To improve the quality of user-created designs, we propose an iterative cycle combining design, experience and validation in an VR environment and test this in a user study for an exemplary use case of information presentation at train stations. In the VR environment, users can design information displays guiding their distribution on the platform. The validation is based on a behaviour-tree based agent system moving along the platform based on pre-selected parameters. Hence, for every design iteration, users can base their next decision on their own perceived behaviour, experience and the agents' distribution. We are currently evaluating the model in a between-subjects participant study comparing users' design choices and usability of the VR environment between groups (random vs. intelligent validation model, approx. N=30 participants). Our contribution will present the interactive VR environment for PD as well as the study's initial results regarding validation based on agent models.

External Human-Machine Interfaces for Interactions of Pedestrians with Highly Automated Vehicles in more Complex Road Traffic Scenarios: Can AR-based Interfaces Help?

Michael OEHL, Mara NUTTELMANN, Marc WILBRINK
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The advancement of highly automated vehicles (HAVs; SAE 4) in recent years presents both opportunities and challenges to interactions in road traffic. Research has shown that especially pedestrians may struggle with the loss of a human driver as they currently rely on explicit communication, e.g., hand gestures, in ambiguous situations of interactions particularly in low speed and short distance scenarios. External human-machine interfaces (eHMIs) may bridge this communication gap. However, research on their effectiveness especially in more complex traffic scenarios involving more than one HAV in interactions with a pedestrian is lacking so far and some challenges remain unsolved. Here, augmented reality (AR) may pose a promising remedy for drawbacks of conventional eHMIs. This experimental study aimed at investigating the potential of light-based and AR-based eHMIs in more complex road traffic interactions of HAVs with a pedestrian. 45 participants in a virtual reality study were instructed to cross a shared space with HAVs approaching from different directions. The HAVs communicated via light-based, AR-based, combined, or no eHMI and yielded to pedestrians or not. The eHMIs, especially those incorporating AR elements, significantly lowered crossing initiation times and mental workload, whilst improving subjective safety and understandability of the HAVs' behaviours.

The role of system and situation complexity during the usage of new ADAS systems

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New driver assistance systems enter the market, rising from simple cruise control towards hands off solutions and from highway assistance towards urban traffic light assistance. These systems should improve safety in today's traffic and further rise comfort in driving. They aim to get additional features and operation areas handling more complex situations including urban use cases. Hereby, information of the system and the situation has to be integrated by the driver. Therefore, two interacting complexity issues arise. Firstly, we must handle complex situations, secondly interact with more systems and underlying features. In this contribution we want to discuss the different aspects of system and situation complexity in urban and highway scenarios. The poster is divided into three parts. In part one, building upon existing literature, different aspects of complexity in this context are described. These include for example traffic density or road type for driving scenarios, additional interaction requirements and a switch to more supervisory tasks for assistance systems. Based on the insights of part one, different example use cases are described. In part three, the user's subjective complexity rating of the experienced situations and system features is illustrated referring to a driving simulator study (N = 88).

Executing organizational control in the management of primary care medicines

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The World Health Organization recently highlighted a need to ensure that the risks surrounding medicines usage are properly managed in healthcare, given the potential for medicines-related harm to occur. Previous studies have identified organizational control – aspects of the organization that guide task behaviour – as a key component of safety management. Therefore, it is important to consider how organizational control develops and is maintained in healthcare organizations. Our study aimed to examine organisational control in medicines management. The study setting was primary healthcare in England. Qualitative data were collected from 5 general practices and 1 primary care headquarters (57 hours of observations; 11 interviews), and 8 community pharmacies (57 hours of observations; 21 interviews). Grounded theory was used to analyse instances of organizational control in the data. Organizational control was found to comprise five properties: executing control; distributing control; controlling with insight; situating control; priorities for control. These properties account for the presence and functioning of controls across the organizations studied. Our findings highlight how healthcare staff implement control of medicines management activities, and thus maintain quality and safety. The capacity of staff to implement controls should be taken into account in the design, evaluation and improvement of primary healthcare work.

Crafting Tomorrow's Workplaces: Unleashing the Potential of Human-AI Teams in Safety-Critical Professions

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The integration of artificial intelligence (AI) is expected to enhance performance, efficiency, and safety, particularly in safety-critical professions like weld seam inspection. However, this raises the question of how workflows need to be designed to benefit from these opportunities. As part of the BMBF-funded HUMAINE project (funding reference: 02L19C200), a laboratory experiment was conducted with engineering students to evaluate the impact of AI-systems on well-being, attention, and performance in tasks resembling weld seam inspection. Using a single-factor design (N = 101), the inspection workflow varied across two experimental (AI pre- or post-inspection) and two control conditions (human-only, or AI-only). These conditions were assessed through three time-point questionnaires, measuring the workflow's impact on work perception. The results indicated that collaborative image inspection by humans and AI provides the best performance in quality compared to the control conditions and promotes the highest flow experience, while attention did not significantly differ between the groups. Additionally, the group in which AI initiated the inspection demonstrated the highest teamwork experience. Our results indicate that human-AI teams are most promising, especially with the AI as an active, not a "controlling", part of the workflow. They help maximizing AI benefits while addressing human needs and capabilities.

Developer and User Perspectives in Human-Robot Collaboration: Insights from the EU Horizon FELICE Project

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A human-centred requirements analysis is a prerequisite for developing and implementing successful human-robot-collaboration (HRC). However, technical developers often default to their own experiences rather than initially including concerns of possible end-users. We present and discuss results of two focus groups (technical developers and end-users) on the essentials for successful HRC using the example of a handover task in a manufacturing environment as part of the EU-Horizon project FELICE. FELICE aims at developing an algorithmic HRC support system for assembly line workers in a highly dynamic work environment. Both groups cite usefulness, reliability, and safety as the most important criteria for successful HRC, user trust, and acceptance. However, while technical developers emphasize the importance of correct timing and avoiding interruptions, as well as providing correct information during HRC, end-users indicate that HRC creates unsafe and stressful situations potentially caused by a lack of communication, low reliability and lack of practice and training. In summary, technical developers focus on technical requirements, while end-users prioritize the impact on themselves. The involvement of end-users before technical development seems to be important to appropriately address their concerns in line with prominent human factor models.

Concept for a future digital co-pilot from a teamwork perspective.

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Artificial Intelligence (AI) could be one enabler in air traffic management to facilitate future concepts like single pilot operations. The expected benefit is that AI could be able to take over whole task sets and provides assistance to the pilot that is better adapted to the needs of pilots and the situation compared to traditional rule-based automation. This motivates the project LOKI of the German Aerospace Center (DLR) to investigate the collaboration of human operators and AI in aviation use-cases. The work presented in this paper provides a vision for the development of a digital co-pilot and how to tackle crucial points in the human-ai-collaboration from a human factor's perspective. Therefore, the theoretical concept of human-AI-teaming (HAT) is reviewed to derive requirements for a future pilot – digital co-pilot – team. Existing guidelines from policy makers, certification authorities and aviation teamwork literature, as well as empirical evidence are integrated. A focus is set on analysing existing ideas for AI enabled assistance in the cockpit with regards to implicit roles and hierarchy. The paper concludes with an integration of these requirements into a high-level concept for the teaming of pilot and digital co-pilot and challenges of teamwork that need to be tackled.

Situational Control in Dynamic Environments reflected by Eye-movement Behaviour.

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Dynamic real-world environments are characterized by their unpredictability (Gonzalez et al., 2017). Within these environments, humans need to constantly exert control, whereby a loss of control can occur at any time. For support systems to maintain joint control and thus prevent possibly dangerous situations, it is crucial to detect early signs of control loss in humans, for which eye movements might be a convenient indicator. Eye-tracking systems are becoming increasingly efficient at identifying even subtle eye movements while being easy to integrate into other systems using cameras. Here we investigate changes in eye-movement behaviour elicited by control loss. We present an eye-tracking study that situates participants in the Dodge Asteroids environment (Heinrich et al., 2023), a computer game with the objective of steering a spaceship to avoid crashing into walls or comets. Participants face input noise, inaccurate control over the spaceship, and environmental drift, pushing the spaceship in either direction. We find that fixated target positions are aimed less far ahead the more comets and drifts are visible, and that fixations are located closer to the spaceship with increasing input noise. These specific eye-movement statistics reflecting situational control might be the one's support systems should start monitoring in collaborative setups.

Cogito ergo sum ... a Robot: Improving Human-Robot Interaction by enhancing Emotion detection with a Cognitive Architecture.

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Interacting with humans in a natural way is a goal that humanoid social robots cannot easily achieve. Robots often lack a kind of cognition that is comparable to that of a human. Therefore, it would be beneficial for human-robot interaction (HRI) if a social robot could be equipped with this kind of cognition to guide its actions and statements and make them more human-like. We propose a connection of the ACT-R cognitive architecture with a Pepper robot, in which an ACT-R model is used via interaction with a robot application to cognitively process and enhance a dialog between a human and the robot. The robot uses facial recognition to detect the current emotional state of the conversation partner and reports this to the ACT-R model for further processing. The ACT-R model then controls the verbal reaction of the robot in the interaction with the human and adapts it to the emotion that has just been recognized. To evaluate an initial implementation of this concept, we designed a study in which we compared a cognitive agent with which participants interacted with a non-cognitive agent to test whether they had a more transparent impression of the interaction. Results are discussed.

Questioning Trust in AI Research? Exploring the Influence of Trust Assessment on Reliance in AI-assisted Decision-Making.

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Trust is considered crucial for effective interaction between humans and artificial intelligence (AI), necessitating valid trust assessment methods. The 'mere measurement effect,' however, suggests that measuring attitudes, can influence subsequent decision, thereby biasing participants' reliance on AI. The objective of the present research was to examine the effect of trust assessment on reliance in the context of an AI-supported decision-making task. We designed an AI-supported task, requiring participants to decide on patterns in so-called Kandinsky Figures. In a scripted experiment with a 2x2 between-subjects design, N = 149 participants' trust was assessed at different times (before block 1 or block 2) and with different assessment extent (i.e., scale length). Participants' agreement with AI recommendation and task completion time served as behavioural trust indicators. We found no effect of trust assessment on behaviour and correlations between trust and reliance were notably low. Participants' reliance matched the instructed reliability level of the AI system and our findings did not suggest the presence of a mere measurement effect of trust assessment. Overall, while the conduction of trust assessment did not influence the reliance, our results question the conceptualisation of trust as general predictor for reliance, especially in comparison to instructed reliability.

User Participation in the Design of Trustworthy Human-AI Collaboration in Air Traffic Control.

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The introduction of AI-based systems is one of the core elements in the course of digital transformation in aviation. Human factors expertise is needed to find user-centred approaches of human-AI collaboration. The DLR project “Collaboration of human operators and AI systems” (LOKI) aims at developing concepts, demonstrators and prototypes for trustworthy human-AI collaboration in air traffic control. To consider users’ perspective in early design phases, two workshops with experienced air traffic controllers of Deutsche Flugsicherung GmbH (DFS) and Austro Control were conducted. The metaplan method was used to assess users’ expectations and their requirements on Human-AI collaboration. In both workshops, ten air traffic controllers participated. The workshops highlighted what users expect from trustworthy Human-AI collaboration in Air Traffic Control. The main results were users’ assessment which of their tasks could be delegated to an AI system and how the delegation of tasks to AI-systems should be designed. The workshops were a success among the participants as they provided insight into future requirements, responsibilities and tasks. Furthermore, they helped outline potential challenges in the interaction concept that must be solved to integrate AI systems successfully in aviation. These findings will be used for the concept design of prototypes.

CoSy: An AI-Enhanced Learning Assistant for Communication Training of Future Health Providers at the University of Lübeck

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Efficient communication is crucial in health professions, fostering better provider-patient relationships and treatment adherence. Teaching these skills comprehensively can be resource-intensive. Further, the inclusion of feedback on various parameters of paraverbal and verbal communication could be helpful. Thus, at the University of Lübeck, an interprofessional team is developing CoSy (Communication Support System) - an AI-enhanced learning assistant. CoSy aims to enhance specific patient-centred communication skills for students of the health professions. It offers visual feedback on paraverbal communication parameters such as proportion of conversation, voice volume and voice frequency over the course of the conversation. Integrated into the University's Skills Lab, CoSy undergoes iterative evaluations. CoSy is represented by a platform via which the learning assistant can be controlled, and the communication training and the data obtained can be organized. CoSy will be accessible to students, teachers, and eventually other universities. CoSy not only aims to improve communication training for future health professionals but also generates valuable German health provider-patient communication datasets for potential AI advancements. In addition to an introduction to CoSy, the results of the first formative evaluation of the use of CoSy in communication training will be presented. Prospects for possible further developments will also be given.

A proposal for the concept of Pro-adaptive Cognitive Assistive Technology

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Assistive Technology is becoming an integral part of our daily live, supporting people in different areas, for example while driving a car or cognitive demanding tasks at work or home. Yet, existing Assistive Technology often only considers the current situational context and capabilities of a user. Here, we propose the concept of "Pro-adaptive Cognitive Assistive Technology" (Pro-CAT), that adapts to predictable, temporal changes in the users' capabilities and contextual situation (e.g., general ageing processes, an expected course of a disease, learning progress during skill acquisition or environmental changes). Pro-CAT can have several advantages: 1. Better adaption of the users to the system in case of prospectively declining cognitive abilities; 2. Avoidance of "over-assistance" which could lead to unlearning of skills and incapacitation; 3. Predictive assistance might delay the onset of disability and increase acceptance rates. Among other components, a Pro-CAT requires a prognostic module that includes an individual ability model to prospectively predict typical learning, ageing and disease processes. A promising foundation to implement Pro-CAT is the "Human Digital-Twin" concept [1,2] that strives to model all relevant aspects of a human user and updates its parameters according to observed changes over time.

[1] Miller, M.E. and Spatz, E. (2022). A unified view of a human digital twin.
[2] Yujia Lin, Liming Chen, Aftab Ali, Christopher Nugent, Cleland Ian, Rongyang Li, Dazhi Gao, Hang Wang, Yajie Wang, Huansheng Ning (2022). Human Digital Twin: A Survey"

Interactions, Tasks, and Roles of AI-Systems in Anaesthesiology – A Team Perspective

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When referring to the role of newly proposed clinical applications of artificial intelligence (AI), recent work frequently used the term "human-AI team" to highlight the social role and effects of AI systems. However, AI systems have been developed to support anaesthesiologists for approximately four decades. In this work, we conducted a systematic literature review on AI systems in anaesthesiology and identify the spectrum of the role of AI within anaesthesia teams. In 49 included papers, we found a role spectrum ranging from minor task execution (e.g., detection of signals), over management and guidance (e.g., conveying spatial and timely orientation) to planning (e.g., prediction of conditions and evaluation of existing plans), decision support (e.g., reminders and reasoning), and automation (e.g., closed loop systems with full agency). The review showed, that despite a focus on task-orientation during the AI development, the functionality of each AI system entails a social role that prescribes how human team members interact with the system. However, the impact of the technology's social role within the team was rarely reflected. We call for conscious design decisions on the social role of artificial team members in human-AI teams along with the development of new methods that aid the design.

Using human motion prediction for path planning of mobile robots

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A particular challenge of the fourth industrial revolution is the design of collaborative workplaces for humans and robots. For example, in modern production scenarios autonomous mobile robots are used for the automation of transportation tasks. As in all collaborative work systems, the health of humans must never be endangered by the movement of machines. For this reason, fail-safe safety systems are usually implemented that trigger an emergency stop if there is a risk of collision. Although such systems meet the necessary requirements, this is usually accompanied by a significant slowdown in the production process. A promising way to avoid collisions more efficiently is through human movement prediction models. If such movement forecasts are integrated into the planning of robot navigation, prospective alternative routes can be calculated, which better ensures safety-critical distances between humans and robots and thus reduces the risk of collision. In addition, a previous study has shown that the detours caused by the integration of the predictions only result in a slight delay in the throughput of the mobile robots. In this article, this relationship will be investigated by differently parameterized prediction models using motion capture data in an application-oriented simulation.

Effects of a cognitive modelling approach on the transparency of robot behaviour

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For robots to collaborate properly with humans, the robot's behaviour must be understandable to human agents. In order to behave more explainable, the robot needs to consider not only its own models of the environment, but also the mental model of the human agent (Kambhampati, 2020). Therefore, a cognitive modelling approach could be used to implement a mental model in the robot so that the robot would be able to perceive and comprehend personal information such as emotional states or intentions. This would enable the robot to react more dynamically and individually to humans. In this 2x3 within factors- study, 20 participants had several conversations based on three different scenarios with both a robot equipped with a cognitive model and a robot without a cognitive model. The aim of the study was to improve collaboration between humans and robots by increasing the transparency of the robot's behaviour. Results show the extent to which test subjects perceive a robot as more transparent if it is equipped with a corresponding mental model and is therefore able to respond to situations and emotional states.

Emotion Recognition and Situational Awareness: Key factors for successful Human-Robot Interactions

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Robots often interact without taking human emotions or situational awareness into account, which can lead to communication problems and disruptions in task performance. Therefore, key factors such as natural communication and adaptive behaviour are crucial for successful human-robot interactions (HRI). The study investigates the effects of awareness functions on HRI, in particular whether they lead to an improvement over neutral communication styles. It will be investigated which functions such as emotion recognition are suitable and how bias can be avoided. The focus is on the behaviour of the robot in response to different emotional states of humans and how it behaves in difficult situations. A comparative study was conducted with the humanoid robot Pepper, with balanced trials with awareness of emotions and situations and without these skills. The study comprised a 2x3-in-factor analysis with 20 participants. Beforehand, suitable awareness functions were selected and adaptive communication styles were developed. The study evaluates the participants' perception of the differences in interaction with and without awareness and provides information on preference. The selection and configuration of the awareness functions were outlined. The results give insights on how future HRIs could be designed, especially with regard to emotion recognition and situational awareness of robots.

Chatbot-supported coaching in organizations: A field study

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Workplace coaching has become an established HRD practice in organizations worldwide. AI coaching has also developed rapidly, particularly in the form of chatbot coaching (CC) that uses conversational, automated software to mimic human coaching conversations. However, little is known currently about CC outcomes or implementation barriers and facilitators in the organizational context. Integrating different streams of the literature, including workplace coaching, media psychology, human-machine-interaction, technology adoption, and change, we conducted a qualitative longitudinal multi-perspective study. We interviewed 35 CC stakeholders from three global client organizations of a CC provider to explore their perspectives on CC outcomes, benefits, and factors that facilitate or hinder its success. Qualitative content analysis revealed that CC outcomes resemble human coaching in cognitive, affective, and behavioural changes. Organizations adopt CC for a range of different reasons. Prior coachee experience with coaching and chatbots, preparation to CC, usability and the bot's responses to emotions impact CC acceptance. Organizational commitment to learning and development, management support, openness to new technologies, and technical compatibility foster CC implementation success. We contextualize the ambivalences and tensions around CC within the broader frame of change dynamics, the automation-augmentation-paradox and human-machine-interaction and provide practical implications for designing, implementing, and assessing CC in organizations.

Systematic Review on Executive Functions and the Adaptation to New Technologies

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Humans differ in their acceptance of new technologies. This preregistered systematic review deepens the view of the connected human factor, seeking to illuminate cognitive processes involved in the adaptation process. Specifically, we explore the role of executive functions (EF), representing top-down mental processes integral to conscious decision-making and goal-directed behaviour. Empirical studies in the realm of EF and adaptation to new technologies fulfilled the inclusion criteria, which led to seven studies and a total of 1,222 participants being included among PubMed, Scopus, Web of Science, and PsycINFO. While some studies researched more than one EF, three focused on inhibitory control, and two offered valuable insights into cognitive flexibility. Two studies delved into (working) memory, two examined general executive functioning. Four studies showed a significant impact of executive functioning on the adaptation to new technologies. One study explored this relationship in the realm of farming technologies, two studies researched its role in communication, and another focused on its relevance in the context of health. In short, EF can contribute to understanding the human adoption of technologies. However, the synthesized studies have shown diverse methods and results, and no final conclusions can be made regarding specific technologies.

Biomedical Engineers' Attitudes Towards the Role of Human Factors in the Product Development Process for Catheter-based Therapies

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Objective. This study aimed to understand perceptions of biomedical engineers towards Human Factors (HF) within the Product Development Process (PDP) of catheter-based therapies. The research questions were: 1. How do biomedical engineers, and other industry stakeholders, perceive human factors and its role within the PDP? 2. What kind of user data are missing from the literature which are demanded by engineers during the development of new therapies? Methods. A questionnaire was developed and distributed at the 2023 Global Catheter Summit and 57 participants responded. Quantitative data was analysed in excel and qualitative data was thematically analysed. Results. The results suggested that project teams place value on HF activities but that there are several challenges in implementing these. Engineers often struggle to find the data and expertise they need to implement HF activities in a meaningful and impactful way, without compromising on timeline, budget, and other product development activities. User and context specific data, torque strength and dynamic force data were highlighted as key gaps in user data. Conclusion. Restrictions to the smooth and effective implementation of HF activities were identified. The study identified key user data being sought by engineers which are not readily available in the literature.

What distracts healthcare professionals in their day-to-day work?

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To develop safe and effective medical devices, it is important to know who will use the product where, how and what will influence their work. In a study published in 2023, Nasri et al. [1] focused on users' perception of distractions in the operating room. Building on this research, we wanted to learn, if their results are also transferable to the work of other healthcare professionals (HCPs) to allow us to better simulate realistic settings during summative usability studies. We adapted Nasri et al.'s questions and included them in an ongoing online questionnaire, which has been completed by a total of 64 HCPs from Germany and the USA to date. Our sample includes, for example, HCPs from interventional radiology, oncology and the OR. Results show differences in the frequency of distraction occurrence and users' personal perception, however the impact on their workflow is similar. Initial results give insight into easy-to-implement distractors: Auditory distractors are frequent and have an impact. Such distractors can be simulated and should be incorporated in summative studies. The results also show the frequency and impact of further types of distractors. This presentation will discuss the data and also how use the results.

The role of Human Factors in Human-Robot Interaction: Experiences from healthcare, education, and workplace settings

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This work explores the contributions and challenges of human factors' approaches in human-robot interaction research. As robots permeate diverse sectors of life, understanding human-robot relations in the real world becomes essential. We present examples from empirical studies performed in healthcare, education, and workplace environments. In healthcare, our analysis delves into how humanoid robots can support both patients and staff, highlighting aspects such as trust and expectations. In the educational domain, our research examines the potential impact of robots in school settings, both inside and outside the classroom. We discuss how robots could support teachers as well as enhance learning experiences for students. The role of social and emotional factors in student-robot interactions is also discussed, showcasing its benefits and risks. Lastly, we address the integration of companion robots in the workplace. These robots, designed to interact socially, could influence workplace dynamics, productivity, and well-being. We present a case study illustrating the challenges in such interactions, focusing on acceptance, robot control, and requirements for long-term interaction. We argue that human factors approaches are relevant for contextualising and promoting the success of implementation projects with robots in the real world. Nonetheless, they carry limitations that can be mitigated through multidisciplinary approaches and complemented by traditional experimental research. instructions for use (IFU). Their reasons for looking at the instructions vary. 60% of users report reading the IFU before first use.

What is required for human-centred design in primary care medicines management?

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In the face of demographic changes, multidisciplinary working and greater reliance on technology, the delivery of primary healthcare has become increasingly challenging. Thus, it is more important than ever to ensure that the different elements that contribute to work system effectiveness in this setting – the people, tasks, tools, technologies, and the working environment – are properly aligned. We report the initial findings of a project to examine how the principles of human-centred design apply to medicines prescribing in primary care. In the first stage of this project, we carried out structured interviews with a purposive sample of primary care prescribers: 14 general practitioners; 4 prescribing pharmacists. The interview format followed Militello & Hutton's (1998) Applied Cognitive Task Analysis method. It elicited participants' accounts of the cognitive skills that they use to accomplish prescribing, followed by their responses to simulated prescribing tasks. The findings suggest that the prescribing task presents a considerable degree of uncertainty about the optimal course of action; while prescribers are unable to eliminate this completely, they employ a range of cognitive skills and expertise to reduce uncertainty as much as possible. We are currently carrying out further work to evaluate the use of computer-based decision support for this task.

Giving up on privacy? Impact of resignation, social norms and privacy indications on app data disclosure

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Despite users' privacy concerns, their actual privacy behaviour is often associated with increased app data disclosures. Social influences such as app recommendations through friends or other users are seemingly one reason for this contradictory behaviour. However, some users also seem to resign on their privacy protection online. The question remains as to how users can be supported in their app privacy decisions and to what extent they incorporate easily-understandable privacy indications (e.g. privacy locks) in social situations or when experiencing higher resignation. In an experimental scenario-based online study (N = 149), we investigated how social norms, users' resignation as well as low and high levels of an easily-understandable privacy indicator within an app store affect users' probability of data disclosures to the app. We discovered that participants would disclose less data to apps at low compared to high levels of privacy, suggesting that users tend to utilize the privacy indicator into their app data disclosures. However, regardless of the privacy indicator provided, higher levels of resignation and social norms led users to compromise their privacy. Based on our findings, we suggest implications for future research and interventions.

SmartUse – Developing and validating a short scale for assessing users' perceived mobile app usability

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Aim of the present contribution was to develop and validate an economic usability scale assessing users' perceived usability when interacting with mobile applications (SmartUse). Therefore, a set of 51 Items has been constructed and evaluated in an online survey using a charging app for electric vehicles. Seventy-two participants assessed the app's usability after watching four videos showing several tasks embedded in scenarios. Participants completed the SmartUse and different validation scales, namely SUS, VisAWI-S, and the Satisfaction sub-scale of the USE. The resulting version of the SmartUse consisted of 12 items scattered evenly across two factors, clarity of design and ease of interaction, and showed high correlations with the SUS and moderate to high correlations with VisAWI-S and USE Satisfaction. A second online survey using another charging app was conducted with 68 participants, of which 12 had already participated in the first study. The results obtained small adjustments to the scale and proposed potential for further development, e.g., testing the SmartUse in a setting with real user interaction.

Exploring multimodal human-machine interfaces to warn distracted and older drivers of crossing pedestrians

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Vehicle-pedestrian interactions are safety critical, especially when drivers are distracted or have reduced physical or mental capacities due to age. The European project HEIDI aims at increasing the safety of these interactions taking a user-centred approach to design a cooperative (internal and external) human-machine interface (HMI) that coordinates the stakeholders, adapting to drivers' and pedestrians' needs. Two internal multimodal HMIs were designed to inform, warn, and instruct two driver categories with different needs: younger distracted, and older drivers. Each HMI consisted of multiple components (head-up display icons, LEDs, sound, speech) and the provided warning messages escalated depending on the monitored driver reaction and state. To evaluate the HMI prototypes, two driving simulator studies were conducted with 10 drivers aged <50 years in attentive and distracted state, and with 5 drivers aged 70+ years. Subjective and objective data (questionnaires, interviews, driving performance) was gained to explore the usability, safety, and acceptance of the HMIs. Results confirm that both HMIs were effective in warning and informing the respective drivers about incoming pedestrians. Our results provide insights on compatible HMI features for differing user needs and suggestions for effective pedestrian warning systems.

The Effects of Nuisance Alarms on Trust in App-Based Warning Systems

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Due to climate change alone, it is foreseeable that number and severity of disasters will increase. App-based warning systems notify populations of upcoming hazards. Their design is critical to ensure timely reactions to save lives, cultural goods and property. Users' trust development in warning systems is highly dependent from prior experiences with the system. Frequent nuisance alarms (=false alarms) can lead to non-reactions which is extremely dangerous in emergencies. However, trust development in warning systems has neither been researched over a longer time period nor in field studies. Thus, we apply the trust model of Meeßen et al. (2020) and examine the effects of app experiences and nuisance alarms over time. We combined online and in-app surveys (after app-based alarms during a two-week time period) in a longitudinal design. We applied a 2 (nuisance alarms: variable vs. constant nuisance alarm) x 2 (responsibility diffusion: with vs. without) x 1 (number of nuisance alarms) mixed design. By now, data collection is terminated (N=173) and we will perform preregistered analyses (see https://aspredicted.org/RJW_DWL). We derive implications for the design of warning systems and their sensitivity. Based on this, future research can test interventions to reinforce trust and motivation in warning systems.

The influence of AR-design aspects on intrinsic cognitive load and secondary tasks

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Leveraging swift technological progress, Augmented Reality (AR) has become one of the key enabling technologies in the era of Industry 4.0/ 5.0. Yet, there is still a lack of evidence-based decision-making for the design of AR-based interfaces for the use in organizational and manufacturing contexts. To address this gap, we studied N = 110 spatially dispersed working dyadic teams, in a controlled laboratory setting, assessing the impact of 2D vs. 3D AR-superimpositions and the presence vs. absence of a progress-bar on intrinsic cognitive load (ICL) and secondary task execution. Teams operated a simulated wastewater treatment plant as an individual task (IT) and in parallel as an interdependent team task (TT). Our findings suggest, that combining 3D superimpositions with a progress bar significantly increases ICL. This aligns with the result, that the implementation of a progress bar led to lower secondary task execution in both IT and TT. Intriguingly, in the IT, the negative impact of the progress bar was positively moderated by 3D superimpositions. This indicates a potential for 3D superimpositions to alleviate or counterbalance the adverse effects of a progress bar, offering insights into AR interface design considerations for optimizing cognitive load and task performance.

Comparison of a test track and a video study on drivers' gap acceptance as a basis for intuitive automated vehicle driving functions

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Traffic as a social system requires the coordination of different road users, specifically in parking areas with a low amount of statutory regulations and a diversity of traffic participants. By anticipating the development of driving scenes and adapting manoeuvres, road users maintain individual safety margins (i.e., accepted gaps in traffic flow, GA) around their own entities that are influenced by various factors. To provide intuitive interaction capabilities in automated vehicles (AVs), GA parameters of manual drivers could be derived as a basis for AVs' behaviour. Previous studies that aimed on deriving GA parameters from manual driving merely applied video-based or simulation approaches. Therefore, a test track study with N = 20 participants was conducted to increase the external validity of results. The effect of type and speed of approaching interaction partners on drivers' GA when initiating parking manoeuvres was examined. The results revealed comparable GA-trends with previous video-based studies. However, overall higher GA values were revealed for the conducted test track study. The findings could provide a basis for intuitive driving parameters in AVs when initiating parking manoeuvres. In addition, the results highlight the significance of applied methodological approaches in AV research.

Evaluation of the effectiveness of advanced distraction warnings triggered by driver monitoring systems to mitigate visual distraction

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Driver monitoring systems will be a standard safety feature to mitigate driver distraction. Advanced driver distraction warnings prompt drivers in real time to keep their attention on the road. The aim is to make drivers aware of being distracted and encourage them to adjust their gaze behaviour accordingly, i.e., reduce long glances and short repeated glances away from the road. Previous research has primarily focused on the technical implementation of detecting visual distraction. To date, however, empirical evidence in lacking on, whether and how distraction warnings influence drivers' behaviour. Therefore, a driving simulator study was conducted, to evaluate the effectiveness of driver distraction warnings. Fifty-seven drivers performed several use cases via touch on the central display while driving. For half of the participants, the monitoring system was active and issued warnings when they were visually distracted, while the other half received no warnings. Distraction warnings did not significantly influence the time, drivers took to complete the use cases. Conversely, warnings also did not prevent drivers from being visually distracted. Neither long glances nor short repeated glances were significantly reduced by the warnings. This indicates that advanced driver distraction warnings did not positively alter drivers' operating and gaze behaviour.

Neuroergonomic workload analysis for mobile workplaces using EEG

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In the era of smart devices, multitasking with visual information while walking is a daily norm. Yet, the cognitive strain of visual tasks during movement in mobile work settings – such as logistics warehouse commissioning - remains underexplored. Therefore, we investigated the effect of walking and balancing on a demanding visual working memory task in our interactive gait laboratory. By applying neuroscientific methods (64-electrodes mobile EEG) we could examine cortical activation during the processing of visual information in high temporal resolution under various motor demands. We collected questionnaire, response, and EEG data from 25 subjects who performed a visual cued task-switch task that was projected onto the treadmill belt. During cognitive task execution, we manipulated locomotor (standing vs. walking) and balance load (no tilting treadmill movements vs. continuous tilting) in a block-wise manner. Results showed significantly increased workload demands for tilting and tilting*walking conditions in questionnaire data (NASA-TLX), behaviour (response times, accuracy), and event-related EEG components (N2, P3). This study emphasizes the crucial role of considering locomotor tasks as demanding secondary tasks during visual information processing—a vital insight for workplace psychological risk assessment.

Attention and crash involvement – an in-depth analysis

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The purpose of this study was to increase knowledge about how different attention related challenges contribute to crash involvement as well as the interplay between attention, the road environment, and the vehicle. The study was done by the Danish in-depth accident investigation board. This study is based on data from 321 Danish road traffic crashes. The crashes were in-depth analysed using an interdisciplinary approach (road engineer, police officer, medical doctor, psychologist, and car inspector). In 119 (37%) crashes the attention of the road user was the key crash factor. In the majority of these crashes (40%) the road user was a car driver, in 22% a van driver, in 13% a truck driver, in 15% a moped/MC rider, and in 10 % a pedestrian or a cyclist. Three main groups of attention-related challenges were identified: 1) Level of attention too low (e.g., fatigue), 2) Inattention due to distraction (e.g., secondary tasks engagement), 3) Unfortunate attention allocation (e.g., overlooking road users from other directions). Results will be presented focusing first on the interplay between attention and road traffic situation (high vs low attention demand) and second on different road user groups (e.g., children/youth, and older road users).

Robotic arm simulator for training machine operators and evaluating control capabilities: Design and experimental validation of closed-loop controlled aiming movements

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Robotic arm operators are essential in industries like forestry, construction, and logistics, where their performance is critical for task efficiency and safety. However, specialized simulation environments for analysing operator capabilities of operators are scarce in human factors research. IfADo in collaboration with the chair of computer graphics at TU Dortmund developed a test platform for a kinematic simulation of a robotic arm with four degrees of freedom. Operated with two joysticks, this system is used to research operator performance and skill acquisition of aiming movements performed with the robotic arm to improve training. The simulator's design and the virtualization are described in detail, emphasising its flexibility in using different control schemes and its ability to provide continuous auditory and visual feedback about movement parameters. The usefulness for assessing and analysing control skills is demonstrated in a validation study focussing on a specific control scheme (joint control) for a harvester control unit. This empirical study involved 36 participants that were novice to the task and performed 32 aiming movements resembling a Fitts tapping task of which speed and accuracy was evaluated. The results suggest the simulator's suitability for testing operator skills and could provide a low-cost option for training centres.

Multitasking while driving: The effects of cognitive load on decision making while driving

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For human drivers to work efficiently and safely with semi-automated vehicles, these vehicles must act understandably and predictably. To develop such behaviour, understanding human reasoning and decision making in traffic is crucial. Across different domains, decision making has shown to be influenced by factors such as cognitive load and the resulting momentary cognitive capabilities of the human. Using an MR-compatible driving simulator, we investigated the effect of cognitive load on decision making while driving in an exploratory study (n=12). We employed a 2 x 2 within-subject design in which we varied the factors driving autonomy and cognitive load. Participants drove along and urban scenario and intermittently encountered a busy Y-intersection, which they were instructed to cross quickly but safely while performing an auditory n-back task throughout the entire course. We measured behavioural, eye-tracking and brain-imaging data to determine how cognitive load impacts the decision making while driving. Our preliminary analyses reveal that driving autonomy may influence the driver's cognitive load. Furthermore, our results highlight that different participants might employ different strategies to safely navigate traffic. Understanding the contribution of cognitive load on the different facets of decision making while driving may provide guidance regarding which situations benefit from increased automation.

A neural network to determine train operator's compliance with driver advisory systems

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In the European Union, the transport sector accounts for 25% of all greenhouse gas emissions. A key strategy to reduce transport-related emissions by 90% by 2050 involves shifting transportation from road to rail. This shift places significant demand on European railways to enhance capacity and energy efficiency while maintaining economic viability. Driver Advisory Systems (DAS), emphasizing eco-friendly driving, offer substantial potential for energy savings and capacity optimization in rail traffic. However, the efficacy of DAS depends heavily on train operators' adherence to the driving advice provided. To address the absence of a reliable method for assessing compliance with DAS, this study developed a neural network to analyse GPS data from train journeys. The network classifies driving regimes and evaluates the operators' compliance with DAS. The neural network achieved a classification accuracy of 96% for driving regimes and 89% for adherence to driving advice. Utilizing the neural network to classify driving data can be a valuable tool in providing train operators with reliable feedback on their driving performance with DAS. This support enhances the train operators' efficient interaction with DAS, contributing to the reduction of greenhouse gas emissions in rail operations.

Cybersecurity within Organizations: Proposal of a Cybersecurity Activity Analysis Model

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Cybersecurity is a major challenge for organizations due to its transversal nature across various activities. Security breaches are often attributed to human error (cognitive biases). Literature suggests that organizational constraints (time pressure) can play a crucial role in creating cyber risks (De La Garza et al., 2022). To understand how constraints related to professional activity impact cybersecurity activity, we will use Hunter's (2022) Joint Activity Model based on Engeström's Activity Theory Model. It suggests the coexistence of activity systems sharing a common subject (person involved in the activity). This allows us to observe how elements of one activity system, like its rules, will constrain the neighbouring activity system. This modelling of cybersecurity will be characterized through interviews with the information security department at the Université Bretagne Sud (UBS), and by identifying contradictions in peoples' activity systems. The aim of this modelling is to better understand the limitations of cybersecurity within organizations and to use it as a foundation for groups to co-construct solutions to overcome these contradictions.

Auditory Detectability and Evaluation of Mobile Robots in Social Environments: Findings from a laboratory experiment and outlook to a follow-up field study

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Mobile robots find increasingly application in bustling environments such as healthcare or public spaces. However, they often operate outside direct human view, prompting the need to decipher how detectable their emitted sounds are to improve human-robot-interaction. In a laboratory experiment, we investigated differences regarding the detectability of robot sounds between two robot types (wheeled: continuous gear noise, quadruped: discontinued noise) with varying background noise (low, high) and cognitive engagement (with/without secondary 1-back task). 18 participants completed a detection task in an acoustic VR simulation. The distance at which participants reliably detected the robot sound was determined using an adaptive procedure in a within-subjects design. We found that 1) a quadruped robot's sound was detectable at higher distances and was perceived as less annoying compared to a wheeled one, 2) with increased background noise, the auditory detectability diminished, particularly for the wheeled robot, and 3) the cognitive engagement played a minor role for detectability. In the presentation, we will provide an outlook on the planned VR and field studies, e.g., testing the external validity of our laboratory findings. Based on this, we will develop human-centred auditory robot design for a seamless integration of robots in public settings as part of the BMBF-funded project ZEN-MRI.

Will they, or won't they? – Factors for Anticipating Pedestrian Crossing Decisions for Improved Traffic Safety and Passenger Comfort in Automated Driving

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The ongoing development in the field of automated vehicles is leading to a change in the dynamics of urban road traffic. To enhance the acceptance of this new technology, research has focused on improving passenger comfort and safety of vulnerable road users, especially pedestrians. Our research aims to integrate an understanding of pedestrian behaviour into automated vehicle decision processes. By avoiding sudden decelerations, we seek to improve passenger comfort on the one hand and on the other enhance pedestrian safety through the use of deceleration as an implicit communication signal. Our research centres on pedestrians' decisions to cross a road in front of approaching vehicles, considering perceived speed and distance. Using 360° videos in a VR headset, we conducted a study with 35 participants in an urban setting, where participants estimated approaching vehicle speeds and determined the last safe moment to cross. Preliminary findings indicate that pedestrians are unable to accurately percept speeds of approaching vehicles, tending to underestimate speeds above 30 kph. While crossing decisions were deemed safe for a slim majority, they deteriorated with higher speeds (60+ kph). Consequently, automated vehicles need to anticipate early signs of unsafe crossing decisions and adjust their speed during pedestrian interactions.

Measuring human sensitivity to foam stiffness in car seats

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The foam stiffness of car seats stands as a crucial factor in ensuring optimal comfort and safety for occupants influencing the overall ergonomic design, pressure distribution, and impact absorption. Understanding human sensitivity to foam stiffness is paramount as it directly correlates with comfort levels and fatigue reduction. Optimizing the conflicting requirements of packaging, design, costs and perceived comfort during the seat development process requires objectively measurable comfort-related variables. The presented study investigates the human capacity to discern variations in foam stiffness within visually identical car seats mounted on an interior mockup. Ten participants evaluated five car seats featuring only different foam stiffness levels, focusing on their ability to perceive and discriminate between these variations. A two-alternatives forced choice method was used, where participants consistently identified the seat that felt stiffer in pairwise comparisons. The seat pairings were tested multiple times by each participant leading to a total sample size of 160. It was found that the differential threshold for foam stiffness is 14.8 Newton. The findings shed light on the human ability to detect changes in foam stiffness as low as 7.7%. Exploring this sensitivity unveils insights into enhancing seat design, guidelines for end-of-line quality control, and refining automotive ergonomics.

Perceived degree of crowding and quality of public transport: The importance of including the third gender

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In order to achieve a significant shift from private cars to public transportation (PT), the latter has to be tailored to the needs of all passengers. In this large-scale study (N = 2071) the correlation between perceived degree of crowding (PDC) of PT and quality aspects of the trip (e.g. safety and comfort) was investigated. The survey was conducted using QR codes displayed in PT vehicles in the federal states of Berlin and Brandenburg. Participants provided demographic information and rated PDC as well as the quality of the trip. Results showed a medium to high correlation (r = 0.3 to r = 0.7) for PDC with all items of the trip evaluation. Multivariate regression analysis showed that PDC had by far the greatest influence on the trip evaluation items with 53% explained variance. Gender analyses with three statistically matched groups (male, female, non-binary) of equal size (N = 89) revealed that persons who identified as non-binary perceived PT trips as less safe, less pleasant and more stressful than the other groups. The relevance of considering the views and needs of so far under-researched groups is highlighted by the results.

Understanding Human Ability and Intention to improve Cooperative Automated Driving Takeovers following a Pattern Approach

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As autonomous capabilities and machine intelligence increase, so do the needs and possibilities to cooperate with these systems. A natural way to design cooperation is to use the structures of mental models already established in our minds by human-human or human-animal cooperation. These cooperation designs follow certain patterns to provide solutions for certain use cases. By using interaction patterns, we trigger and form mental models in the human mind, which already uses patterns. This paper provides a detailed description of the structure of interaction & cooperation patterns and events, followed by a system model for the pattern approach applied to human-AI cooperation. Using the use case of a control transition to the human triggered by a takeover request (TOR) as an example, this paper shows how to model patterns in an application of cooperative highly automated driving. The pattern models are used to detect human abilities and intents to act according to a pattern. This detection can be used to build up the machine's model of the human , and with that allow the machine to react and adapt better to the human behaviour,

Exploring How Pedestrians React to Robots in Public Spaces: An Eye Tracking Study in the Field

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The use of robots is becoming increasingly common, not only to enhance productivity in industrial settings but also to enter public spaces, exemplarily taking over tasks like cleaning, delivery, or security. This integration has stirred curiosity and occasional conflicts, particularly when robots share paths with pedestrians. A video observation study for static humanoid robots showed that 50% of passersby ignored the robot, while 35% of them noticed it (Hayashi et al., 2007). When the robot is in motion, the ratio of passersby noticing the robot on the first encounter increased to 63% in a cleaning robot study (Babel, Kraus, & Baumann, 2022). In this case, pedestrians need to perceive, comprehend, and project the intentions of robots to avoid potential collisions. In this field experiment, we explore the temporal and spatial distribution of pedestrians' visual attention when they encounter an actual autonomous cleaning robot in a public space. Participants (N = 29) wore eye-tracking glasses and experienced a route either with or without spatial conflict. The data analysis is currently carried out. The expected results of the study will reveal how individuals allocate visual attention and adjust their behaviour to react to the robot.

Drone size matters: The impact of the size of unmanned aerial vehicles in overflight scenarios on risk assessment in the manufacturing context

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The deployment of unmanned aerial vehicles (UAVs) in manufacturing poses various physical risks, such as collisions, while there is limited evidence on psychological risks and perception of risk by employees. The present online vignette study investigated how the size of the UAV affects identified risks, user experience, trust, and human-UAV interaction risk assessment. N=160 participants each viewed one of three videos depicting an assembly worker producing terminal strips. The control group (CG:N=59) received a video in which the UAV stood next to the employee, while in the experimental groups one and two, the employee was flown over by a small (EG1:N=49) or a medium-sized UAV (EG2:N=52). After the video exposure, participants listed perceived risks, evaluated their potential extent and probability of damage, and completed multiple questionnaires. The calculated one-way ANOVAs show that significantly more risks were identified in both EGs than in the CG. The most frequently named psychological risks included noise, distraction and surveillance. Additionally, EG2 experienced significantly lower trust in UAVs. Both EGs reported a lower user experience and higher risk assessment than the CG. The results expand existing risk assessments of UAVs to include human factors that should be taken into account during technological implementation in organizations.

“Is this how you like it?” Influence of traffic context on the perception of appropriate driving performance in automated vehicles

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With the diffusion of automated vehicles (AV), the drivers’ role will change from active drivers to passive passengers. In this role, they will have the opportunity to focus on secondary tasks such as work or leisure activities and won’t have to focus on the road. As a result, the actual traffic situation will be less present to them. In the event of sudden changes in this situation, the necessary effort to regain situational awareness might reduce the subjective appropriateness of driving performance (SADP) of an AV. To nuance our understanding of this effect, we conducted a driving simulator study (N=22). We investigated the influence of situational context on the perceived SADP when being driven in an AV. The subjects were asked to read articles while being driven on a highway and subsequently evaluated the SADP. We systematically varied initial speed, Time-To-Collision (TTC), number of lanes, traffic density and forest on the edge. The applied TTC had a negative influence on people’s SADP ratings. With smaller distances to cars travelling in front of the ego vehicle subject’s ratings decreased. The findings can support the improvement of automatic driving behaviour for diverse context factors to increase the overall appropriateness of driving styles.

Potayto, Potahto? Construct validation of job insecurity with digitalization context

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Smart technologies, artificial intelligence, robotics, and automation (STARA) can revolutionize the labour market by substituting human labour. STARA Awareness has been introduced to capture employees' affective appraisal of the impact of STARA on their employment without a thorough validation and overarching theoretical framework. Therefore, we examined the internal structure of the suggested measurement instrument, the differentiation from cognitive and affective job insecurity (JI), potential antecedents, and its long-term trend. We conducted two cross-sectional (N1 = 215, N2 = 224) and one longitudinal study (N3 = 233) with German employees from diverse branches. Based on content criticism and poor measurement model fit in Study 1, we adapted the questionnaire and redefined the construct in terms of affective automation-related job insecurity (AAJI). Our results indicate that AAJI is weakly positively related to cognitive and affective JI but empirically different. We identified the objective substitution potential of occupation, the use of STARA as positive predictors, and core self-evaluations as a negative predictor of AAJI. Latent growth curve models reveal no linear change of AAJI over one year but different trajectories as a function of use of STARA. Thus, AAJI represents a novel construct with its distinct nomological net and high stability

Towards a Level of Automation Experience Taxonomy

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The design of automation solutions has been discussed and studied for decades in the context of human factors and ergonomics. As a rule, scientific work in this research area is not based on simple all-or-nothing approaches, but on differentiated models of automation. Over time, taxonomies and level systems of varying scope have been developed. However, these have themselves become the subject of scientific debate, for example about usefulness and comprehensibility. The need for human-centred automation models has also already been expressed. However, this is mostly in connection with humane work design and performance orientation. In this contribution, we argue that from the user's point of view, it is not the technical level of automation that is relevant, but rather the automation experience. The latter is not necessarily directly related to the former, i.e. higher levels of automation do not necessarily mean improved automation experience. To this end, this previously rather unspecific term automation experience is first discussed. Subsequently, different examples, including the SAE J3016 standard for vehicle automation, are used to demonstrate the need to change from a primarily performance-oriented perspective on automation to one that emphasizes human well-being and self-fulfilment.

Teamwork in future control room systems - perspectives from individuals in academia, industry, and operation

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The energy system is undergoing significant changes, affecting both the power generation and the electric power control systems, which are supervised and run by human operators. The purpose of this paper is to present possible implications of how operators in nuclear power and electric power control room systems respectively might collaborate in the future, in relation to today. A semi-structured interview study was conducted with 15 individuals from academia, industry, and operation. Their expertise was linked to process control in nuclear power plants and electrical power systems respectively. The interviewees anticipated increased automation in future control systems, driven by economic and safety reasons. Staff reductions could lead to operators managing multiple simultaneous processes or additional tasks, potentially moving decision-making from the control room to a centralized centre. Automation was envisioned as not only replacing tasks but also becoming a collaborative entity. To conclude, there seem to be a divide in perspectives with researchers and MTO experts envisioning more radical changes in organizational teamwork compared to those closer to daily operations. Reasons might be that operational staff more see the need for solving their current challenges, whilst researchers and MTO-experts are more prone to view further ahead into the future.

Musculoskeletal Disorders (MSDs) in Automobile Repair Centres in Korea

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A survey was conducted on musculoskeletal disorders at a vehicle repair centre directly managed by one of Korea's three major automobile companies. The investigation consisted of safety training for all employees, a questionnaire survey, an on-site hazardous factor investigation, and a medical examination. As a result of a survey of 414 mechanics, the average pain complaint rate was slightly higher than that of general manufacturing workers, and the results of medical examinations also showed that there were more workers in need of higher-level medical treatment than the overall manufacturing comparison group. As a result of ergonomic analysis of 103 field tasks, uncomfortable posture, excessive force, repetitiveness, and static low posture were identified as the main causes.

Effects of sequential human redundancy on task effort and task outcome

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Redundant tasks, such as double-checking mammograms, are designed to increase reliability. However, this aim might be antagonized by social loafing (SL), i.e., a reduction of individual effort caused by the team setting. In two laboratory studies we investigated whether different forms of redundancy reduce task effort and impact task outcome. In each experiment, about 20 participants inspected images alone for rare targets, while 40 participants worked in teams of two, either performing the first or second inspection. We measured inspection time and area (task effort), and detected targets and false alarms (task outcome). While there was no transfer of target markings in Experiment1, second inspectors in Experiment2 saw marking set during the first inspection. We expected SL for all members of a team except for participants who thought their marks were transferred to and judged by their team partner. In Experiment1, data revealed no indications of SL, and first inspectors even detected more targets than solo inspectors. In Experiment2, teams clearly adapted their behaviour. First inspectors spent significantly more effort than solo inspectors, while second inspectors spent descriptively a little less effort. As there was no significant reduction in effort in either experiment, teams outperformed solo inspectors in both experiments.