Human Factors and Ergonomics Society
EUROPE CHAPTER

Annual Meeting 2022

"Enhancing Safety Critical Performance"

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Torino - Italy

BOOK OF ABSTRACTS

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WEDNESDAY APRIL 20th

SESSION 1: AUTOMATION 1

The Influence of Anthropomorphism on the Dynamics of Trust in task related Human-Robot Interaction

Eileen Roesler, Dietrich Manzey, Linda Onnasch
Technische Universität Berlin, Germany

A central challenge for successful human-robot interaction (HRI) is the adequate and dynamic calibration of trust in the robotic counterpart. This adaptation is strongly influenced by robot-related factors such as a robot's reliability or design. Whereas robot errors are expected to decrease trust, an anthropomorphic robot design is assumed to mitigate error effects. However, this assumption is mainly based on insights of social HRI. The current lab-based study investigates if this holds true for task related HRI, too. A 2 (anthropomorphism) x 4 (interaction experience) mixed design, in which 43 participants performed a sorting task with a robot via voice commands was realized. Besides adjustments in subjective measures of trust, also adjustments in the subjects' behaviour were recorded using speech outcome. The results showed the expected dynamics of subjective trust. Furthermore, it was found that subjects generally perceived higher trust towards the technical robot compared to the anthropomorphic robot. Contrary to our expectations, no positive effect of anthropomorphism on error forgiveness was found. Additionally, no behavioural adaptation based on the error experience took place. In summary, the results shed light on trust dynamics in HRI. The results further suggest that anthropomorphism might not always be beneficial outside of social HRI.

Adaptable automation and its effect on perceived competence and autonomy

Michèle Rieth, Linda Onnasch, Vera Hagemann
University of Bremen, Germany

Adaptable automation (AA) represents a promising approach to utilize the advantages of conventional automation approaches and at the same time counteract unintended consequences that are associated with static automation concepts (e.g. skill decay, loss of perceived autonomy and competence). The latter seem to be most likely when automation crosses a critical boundary from information automation (IA) to decision automation (DA). This experiment systematically examines the mostly theoretically postulated advantages of AA compared to static automation. We hypothesize that perceived competence and autonomy is significantly higher under AA and static IA than under static DA, that satisfaction with the automation support is significantly higher under AA than under IA and DA, and that there are significant differences in the role perception between the groups. In the planned online study, participants have to manage a dynamic traffic scenario by controlling intersections with automation support in a dual-task paradigm. We use three different conditions, in which one of the three assistance systems is applied: IA, DA, or an adaptable solution in which participants can switch between the two types of automation. Data acquisition will be finished in January. Results will be presented and discussed in Turin.

Critical decision making with a highly automated UAV – A case study

Nicolas Maille
ONERA, France

In transportation and aerospace, more automation and autonomy are continuously added to systems. The ability of human operators to effectively monitor and interact with these systems, poses significant challenges. This research focuses on critical decisions that largely rely on the system capabilities but need to be validated and taken upon the operator responsibility. We investigate, in the context of UCAVs (Unmanned Combat Air Vehicle), how the communication strategy of the semi-autonomous systems modifies the opera-tors' understanding of the situation and the final decision. A user-study has been performed in an immersive simulator with an ecological 30 minutes military scenario where the operator had to manage a full mission, including an unexpected fire decision. The experiment embraced the use of physiological measures (ECG, EDA) and an eye tracking setup. The paper reports results related to the decision-making performances and analyses of physiological parameters. It appears that the communication strategy does impact the situation awareness of the operator, the decision taken, and the evolution of the physiological parameters.

Effects of risk on operator's verification in interaction with information and decision automation

Steffen Hösterey, Linda Onnasch
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A copious amount of research has demonstrated that the degree of automation of assistance systems for cognitive tasks can have distinct effects on operators' behaviour. Various studies have found that operators supported by later stages of automation (decision automation) invest less resources in automation verification compared to earlier stages (information automation). However, these studies were conducted in laboratories without the incorporation of one of the most important contextual factors: risk. The question therefore remained whether participants aided by a highly automated assistance system also invest less resources under high risk. In a virtual reality multi-task paradigm risk was varied by the altitude participants had to conduct their task in (0.5 m vs. 70 m above the ground) including the possibility of virtually falling in case of an error. Results replicated previous findings and showed that participants supported by decision automation afforded significantly less resources in automation verification compared to participants working with information automation. However, this detrimental effect was distinctly attenuated under high risk. This might imply that negative consequences of higher degrees of automation in the real world might have been overestimated by studies not including risk.

SESSION 2: SURFACE TRANSPORTATION

Do you bike virtually safe? An explorative VR study assessing the safety of bicycle infrastructure

Marc Schwarzkopf, André Dettmann, Jonas Tretzl, Angelika C. Bullinger
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Driven by the mobility transition towards a more ecological modal split, bicycles are becoming more popular in means of transportation in cities. Therefore, bicycle infrastructure should become an increasing focus of urban planners. When designing infrastructure measures for cyclists, user acceptance, especially subjective safety and comfort experience, are an important reason for the usage. To evaluate such factors in advance and derive the corresponding design requirements for urban planners at an early stage, the use of virtual reality (VR) can help to evaluate planned infrastructure measures. This paper presents an experimental design to evaluate infrastructure measures for cyclists in a VR study with 30 participants in an urban context. Subjects were presented 18 infrastructure measures in VR which were previously evaluated by an expert focus group for objective safety and divided into three safety categories. The images were randomized, and subjects were asked in a structured think-aloud procedure to provide statements about the subjective assessment, as well as reasons for their decision. In this paper, we present the study design and the results regarding reasons for or against specific infrastructure measures and will conclude with a methodological discussion regarding infrastructure assessment via virtual reality to aid urban planners and authorities.

Braking Bad – How E-Scooter Ergonomics Relate to Riders' Braking Behaviour

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Technical University of Denmark, Denmark

The crash risk of e-scooter riders in Germany is significantly higher than for other road users, and approximately half of registered e-scooter crashes are single vehicle crashes where no other road user is involved. To prevent crashes and reduce their severity, too little attention has been paid to ergonomics of e-scooters, especially when considering the different types of braking systems. Available e-scooter models in Germany differ in the equipped type of brake lever (hand lever, foot brake) and coupling of brake levers to front and rear wheels. Hence, we investigated how the brake-system configuration relates to braking preparation in e scooter users. In a combined observation and questionnaire study, 2972 shared e scooter riders were video-observed at three locations in Berlin, and 156 e scooter riders were surveyed online about their knowledge on e-scooter brake systems. Observed e-scooter riders significantly preferred the left-hand brake lever over other available levers, regardless of whether the left-hand lever was connected to the front or rear wheel. Only one-third of survey respondents correctly identified the braking system of the last shared e-scooter they used. Hence, we advise to connect the left-hand brake lever to the more effective front-wheel brake, and to prominently mark the brake-lever-to-wheel-coupling on e-scooters.

In-depth analysis of van crashes

Mette Møller, Rikke Rysgaard
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Human injuries from van crashes are generally more severe, resulting in more fatalities compared to car crashes. This study conducted an interdisciplinary in-depth analysis of 23 crashes involving vans (>2000 kg) causing fatal or serious injury. The crashes included 1 single-vehicle crash and 22 crashes with two parties or more. All van drivers were professional drivers and males between 18 and 79 years old. The majority of the crashes were rear-end crashes (52%) or head-on collisions (22%). Human factors such as inattention, distraction, fatigue, and speeding were the key crash factors. Inattention and distraction (mostly up to 20 seconds) were prevalent in crashes occurring in simple and monotonous traffic conditions on straight roads, and good road conditions. The inattention or distraction caused the driver to overlook changing traffic conditions that were otherwise easily detectable. Phone use, passengers, or elements along the road were associated with distraction. Fatigue was related to long workdays, night-time driving, and sleep deprivation. Time pressure and risk-propensity were associated with speeding. Results indicate that increased use of safer vehicle technology, road safety policies, improved work conditions, and increased focus on safe behaviours among professional drivers are all relevant preventive measures.

Do drivers want to enhance their safety-critical behaviours? A study on the acceptability of driving monitoring and feedback

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Interventions that enable people to improve their (safety-related) behaviour do not necessarily lead to an improvement in behaviour. Presumably, people change their behaviour only if the perceived benefits of the new behaviour outweigh the perceived costs of the intervention. The topic of behavioural change is particularly relevant in the field of driving, especially in the current age of technological advancements such as monitoring and feedback systems. While the use of these systems has been shown to have a positive effect on behaviour (e.g., safer or more eco-friendly driving style), their acceptability has not yet been investigated extensively. A questionnaire study was conducted online, collecting opinions of a representative sample of 628 Dutch drivers to obtain insights on monitoring and feedback systems acceptability and its determining factors. Results showed that participants are moderately enthusiastic about the prospect of being monitored and assessed: on average, their opinion was between neutral and slightly positive. This finding can be explained by respondents' views on their own driving behaviour (i.e., many drivers rated themselves as good drivers already) and by low sensitivity to data collection (i.e., respondents indicated to be habituated to data collection online). In conclusion, the moderate acceptability of driver monitoring and feedback systems suggests that drivers see little net value in such technology. Future developments should be aimed at improving the benefits and reducing the costs experienced by drivers.

SESSION 3: HUMAN-ROBOT TEAMS

ITen seconds to go! – Effects of feedback systems in human-robot collaboration

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Human-robot collaboration (HRC) aims to increase efficiency and flexibility in production sites. The implementation in factories is, however, accompanied by risks of physical contact with robots and resulting injuries in case of system failures or workers' misconduct. One assumed reason for such safety-critical behaviour is overtrust in systems' capabilities. The question remains, if feedback systems can optimize trust levels and enhance workers' safety and productivity. In the paper, we present a study in the industrial context examining the effects of a user-evaluated feedback system for fenceless HRC based on LED lighting and an information display. In the experiment, 48 participants performed a realistic collaboration task with a heavy-load robot in a pseudo-real world test environment. Dependent variables were assembly time, recognition of system failures and trust in automation. Independent variables were varied: robot feedback between groups, occurrence of system failures during collaboration and time pressure within groups in a balanced design. Results showed that the feedback system did not affect assembly time. Furthermore, system failures were more frequently detected, and (over)trust was reduced if the feedback system was applied. We discuss the potentials of feedback systems for workers' safety enhancement and the development of an appropriate trust level in HRC.

Humans can't resist - reflexive cueing with robot stimuli

Linda Onnasch, Eleonora Kostadinova, Paul Schweidler
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In human-human interaction a key aspect of coordinated behaviour is joint attention. To investigate whether this effect can be imposed by robots, too, we conducted an online study using a modified spatial cueing paradigm. The cues were either non-social stimuli (arrows), pseudo-social stimuli (robot eyes) or human eyes as real social stimuli. We additionally compared paired stimuli (e.g. two eyes) against single stimulus conditions to further differentiate what might benefit attention: The eyes as a social cue or the spatial information that is transferred using two stimuli. Results support the assumption, that pseudo-social stimuli have the potential to facilitate human-robot interaction as they trigger reflexive cueing. To our surprise, actual social cues did not evoke reflexive attentional shifts. We suspect that the robot eyes were human-like enough to find the hoped-for effects while being much easier to perceive than human eyes, due to a high contrast imagery design. Moreover, it does not seem to make a difference for reflexive cueing if a single cue or paired cues are presented. This might be a first indicator that the benefits of joint attention are mainly due to the social nature rather than the additional spatial information that is revealed by two cues.

Supporting spatially dispersed teams with AR-based Avatars: Increasing co-presence by interacting avatars

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The temporal coordination of interdependent subtasks is a significant aspect of teamwork processes. Due to a shared visual context, side-by-side teams usually coordinate these subtasks efficient in time because of concordant mental models about the current team task-related process state (task state awareness/ TSA). In contrast, spatially dispersed teams typically exhibit a lower level of TSA due to a lack of shared external cues, from which process-relevant information could be derived. This leads to reduced temporal coordination and impaired joint action, which can affect factors like e.g., awareness, mental workload, and performance. Against this background, we developed an AR-based UI for the Microsoft HoloLens1 that displays the team partner as an avatar, thereby creating the perception of a shared visual context. A within-group study with N=24 participants was conducted to measure the effects of an avatar's pointing gesture on the perception of co- and social presence as well as on processing/ reaction time and performance accuracy. Post-hoc tests indicate that, compared to an inactive avatar, an actively pointing avatar increased the perception of co-presence while decreasing processing time. No significant effects were found for the perception of social presence and performance accuracy.

Development of Teamwork Processes, Collective Orientation and Stress during a simulated Mars Mission in the Crew and Support Teams

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How does stress evolve in High Responsibility Teams (HRTs) and how do HRTs react to this in relation to adaptations in their team processes and their development of collective orientation? The experiment INTERTEAM was executed during the AMADEE-20 analogue Mars mission hosted by Austrian Space Forum. Six analogue astronauts (AAs) emulated selected aspects of human Mars mission in isolation for four weeks in the Negev desert. They were supported by On-Site-Support in Israel and Mission-Support-Centre. All teams were HRTs and experienced a lot of stressors while working highly interdependently in complex situations. To face these challenges, collective orientation, and team processes (transition, action, interpersonal) are significant for successful teamwork and performance. As the AA-team was stable over time, it was expected that this team adapts its team processes more effectively to evolving stress than the other teams. Variables were assessed six times. Preliminary results show that the AAs developed stronger team processes over the course of the mission and mostly experienced less stress compared to the other teams. Stress correlates negatively with transition and interpersonal processes in all teams. The collective orientation of AAs is constantly higher compared to the other teams. Detailed results will be discussed at the conference.

SESSION 4: HIGHLY AUTOMATED VEHICLES 1

Manoeuvre design in automated driving: Investigation of on-ramp situations under the variation of safety distances and traffic flow

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When designing automated driving styles, defensive driving styles lead to higher user ratings than dynamic driving styles. However, a dynamic driving style can be helpful for “drivers” in specific situations (e.g. on-ramp situations) to perceive the drive as more natural and understandable. To examine the specific manoeuvre design in this scenario, a driving simulator study on a highway was conducted with 36 participants. The subjects experienced 12 on-ramp situations in which the automated vehicle reacted to a merging vehicle by either changing lanes, by braking or by no reaction. Also, the distance to the merging vehicle and traffic flow were varied. In each situation, participants were asked to assess the experience using thinking aloud and a handset control (desire for reaction). After each situation, participants were also asked to rate their trust and acceptance in the manoeuvre design. Finally, an interview was conducted. In conclusion, the decision to change lanes was preferred, resulting in higher acceptance and trust ratings. The speech protocols and handset control indicate that automated cars should react as early as they recognize a merging vehicle on the on-ramp. In contrast, when traffic was high, the decision to brake was rated as good as to change lanes.

Evaluation of Imminent Take-Over Requests With Real Automation on a Test Track

Philipp Wintersberger, Clemens Schartmüller, Shadan Sadeghian Borojeni, Anna-Katharina Frison, Andreas Riener
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Most experimental results addressing driver takeover were obtained in simulators. We investigated takeover, driving, non-driving related task (NDRT) performance, and trust of conditionally automated vehicles (AVs) in critical transitions on a test track (N=22 participants). The aim of the study was to validate relevant findings obtained in simulators while uncovering effects of motion cues and real risk. We varied NDRT modality (reading on a handheld device vs. auditory) and takeover timing (cognitive load) on two levels. We evaluated takeover and NDRT performance as well as gaze behaviour. Further, trust and workload were assessed with scales and interviews. Our results show that reaction times were significantly faster than in simulator studies. Further, reaction times were only barely affected by varying visual, physical, or cognitive load. Post-takeover control was significantly degraded with the handheld device. Experiencing the system reduced participants' distrust, and distrusting participants monitored the system longer and more frequently. NDRTs on a handheld device resulted in more safety-critical situations. The results confirm that takeover performance is mainly influenced by visual-cognitive load, while physical load did not significantly affect responses. We conclude that conditionally AVs should be designed in a way to maintain drivers' situation awareness. (Published in Human Factors, Dec2021)

Humanising Regulation on AVs

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A new and exciting playground has emerged for Human Factor specialists. And it is a bit of an odd one: the United Nations. The United Nations Economic Commission for Europe (the UNECE) in Geneva has different Sectoral Committees of which one is the Inland Transport Committee. This committee is host to working parties such as Global Forum for Road Traffic Safety (WP.1) and the World Forum for the Harmonization of Vehicle Regulations (WP.29). So there exists an international body setting regulations on ADAS and automated driving systems (ADS), both as regards user regulations and as regards the vehicle itself. Human Factors topics all over, one might think. However, that has not been the same in practice. This presentation explains the past lack of human factors focus and expertise in international regulations preparing the way for automated road vehicles. It describes how a new informal international grouping, HF-IRADS (Human Factors in International Regulations for Automated Driving Systems) has attempted to ameliorate the lack of expert human factors involvement in the intensive work of UNECE on automation. A particular focus of the presentation will be the structured approach that has been adopted to identify the variety of roles that might be required of a human interacting with a vehicle equipped with automation and the consequences of those roles for the design of vehicles with automation.

Human Factors and Ergonomics Society
EUROPE CHAPTER

THURSDAY APRIL 21st

SESSION 5: AVIATION & MARITIME HUMAN FACTORS

Diver's executive functions at 30 m water depth and after return to surface: Are they impaired, and for how long?

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The nitrogen in our atmosphere can exert narcotic effects when breathed under increased environmental pressure. The effects of this so-called inert-gas narcosis (ING), such as conspicuous behaviour and feelings of excitement, can be observed in divers going to depths of 50 meter and more (Clark, 2015). ING can affect cognitive performance already at lesser depths. Steinberg et al. (2017), for example, showed a selective impairment of inhibition processes at 20 m water depth. Balestra et al. (2012) observed that the critical flicker fusion frequency is not only decreased during a 33 m dive, but up to 30 minutes post dive as well. In three experiments with 20 participants each, we tested whether executive processes for memory-updating (2-back task), task-shifting (number-letter task) and response inhibition (Stroop task) would be impaired under 30 m hyperbaric conditions as compared to atmospheric conditions. Follow-up measurements were performed up to 45 minutes post-dive to assess possible after-effects of ING. Pressure was applied in a hyperbaric chamber in dry conditions as well as in submerged scuba conditions. Contrary to our expectations, participants showed performance improvements during the dive. Trainings effects tended to be stronger in dry conditions, and did not occur for response inhibition in submerged conditions.

The occurrence of miscues by decision support systems: A study with airport security screeners supported by automated explosives detection systems for cabin baggage screening

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At airport security checkpoints, explosives detection systems for cabin baggage (EDSCB) as decision support systems (DSS) support security operators (screeners) by highlighting areas in X-ray images that might contain explosives. However, EDSCB sometimes make mistakes, resulting in three types of failures: misses, false alarms, or miscues. When the EDSCB displays a miscue, operators experience a false alarm, but another prohibited article (e.g., a gun or knife) is located elsewhere in the bag. The screeners potentially miss other prohibited articles because they are too focused on the EDSCB alarm. This study examines the effects of each different failure type. We tested 115 professional airport security screeners with realistic X-ray images of cabin baggage in three experimental conditions: Miscue prone, false alarm prone, or multiple failures. Screeners had to detect bombs, guns, and knives and were supported by EDSCB. Results show that screeners missed more knives when EDSCB miscues occurred than when EDSCB did not alarm at all. Also, miscues misled screeners into thinking that X-ray images

contain bombs while missing other prohibited articles. We conclude that miscues of DSS harm operators' detection performance during a visual inspection task and that miscues are a problem to be considered when working with EDSCB.

Artificial Intelligence (AI) implementation in aviation industry. The transition from Extended Minimum Crew Operations (e-MCO) to Single Pilot Operations (SiPO)

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a) Concise statement of the research: This review examines Artificial Intelligence (AI) technology deployment of learning processes in projects for future civil aircraft design –production and certification. AI is examined as a key enabler to support emerging risks detection; risk classification of occurrences; and Safety Risk Portfolio design and prioritization of safety issues. (b) Brief discussion of the sources: A review of the existing literature of the existing AI use, structured the proposed AI implementation research in cockpit design and potential users reactions. Interviews with Subject Matter Experts and questionnaires (disseminated to a group of professional pilots) examined AI implementation in cockpit design and operations. Results were analysed and evaluated the suitability and significant differences of e-MCO and SiPO. (c) A summary of major conclusions: Results indicate the AI implementation challenges – limitations and resistance of users in the transition from Multi Crew Operations to e-MCO. Finally, the findings anticipated that AI would be a solution to deal with real-time data flows and enable real- time risk management. (d) Keywords: Artificial Intelligence (AI), Extended Minimum Crew Operations (e-MCO), Single Pilot Operations (SiPO), cockpit design, ergonomy, decision making.

Pilot's representation of dynamic situation in aviation, toward a visuospatial anticipation span

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In aeronautical context, operators are confronted to complex dynamic situations in which they must represent the spatial state of several events and their possible evolutions. For example, a pilot in dense air traffic must be able to anticipate multiple trajectories to avoid collision. There is no description in the literature of a visuospatial anticipation span, i.e., how many dynamic events is an individual able to anticipate simultaneously? The objective of this study is twofold: (1) to set up a research protocol that objectively measures a visuospatial anticipation span and (2) to determine its limit. This study is based on the representational momentum paradigm (Freyd and Finke, 1984), which classically measures the ability to anticipate the movement of a single target (Hubbard and Bharucha, 1988) or a scene (Blttler, 2010). The originality of this study is that 21 participants had to recall the position of five targets moving simultaneously in different directions. The results show for the first time that the individual is able to anticipate the trajectory of five events. These results are encouraging for improving human-vehicle collaboration through the development of adaptive autonomous systems.

The effects of workload and time on task on detection performance in X-ray cabin baggage screening

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At airport security checkpoints, security officers (screeners) inspect X-ray images of passenger baggage for prohibited items. EU regulation limits continuous inspection to 20 minutes, thereafter screeners typically change to another task at the checkpoint. For various reasons, it is discussed whether screeners can inspect X-ray images for longer periods of time and how this affects their performance and well-being. We conducted a field study at a European airport in which two groups of screeners inspected x-ray images of cabin baggage over a four-month period. One group analysed x-rays for 20 minutes (control group), while the other group analysed x-rays for up to 60 minutes (experimental group). The two groups did not differ on average performance measures (hit rate, reject rate, or processing time). The examination of the longer screening sessions conducted by the experimental group revealed that when the workload was low or average, the screeners were able to maintain their performance for up to 60 minutes. However, when the workload was high, the hit rate dropped significantly. Our results imply that, depending on the workload, longer screening sessions between 30 to 40 minutes could be tested and introduced.

SESSION 6: AUTOMATION 2

Under Pressure - Effects of Time Pressure and Automation Support in a Simulated Medical Visual Search Task

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Time pressure usually impairs visual search performance. However, providing support by a highly reliable automation has been shown to reduce or even reverse that effect. One possible reason is that depending on an automation can compensate typical time-pressure associated performance decrements. To study this effect in more detail, we used a paradigm where participants sequentially uncovered parts of a simulated medical image in search of critical targets. In two experiments, participants had to perform the task either manually or with a highly reliable automation support. Time pressure was manipulated within-subjects in two ways (i.e., trialwise and blockwise). Performance was always worse under high compared to low time pressure in the manual condition, but no differences emerged with automation support. An analysis of search behaviour further revealed that participants inspected less of an image when under time pressure and when receiving automation support. Critically, however, the joint performance of human and automation was always worse than that of the automation alone. These findings suggest that highly reliable automation support can help reducing the negative effects of time pressure but also that automation support might generally be used sub-optimally.

An Experimental Study on Workstation Characteristics in Industrial Human-Robot Collaboration

Federico Fraboni, Luca Gualtieri, Matteo De Marchi, Gabriele Puzzo, Luca Pietrantoni, Erwin Rauch
University of Bologna, Italy

Collaborative robotics drives many work environments, particularly manufacturing, towards profound changes affecting workers' conditions. However, Human Factors and Ergonomics issues in industrial Human-Robot Collaboration (HRC) are overlooked. The present contribution aims to assess how collaborative workstation characteristics and HRC patterns can affect workers' perceived cognitive workload, usability and acceptance. An experimental study was conducted in a dedicated collaborative workstation at the Smart Mini Factory Laboratory of the University of Bolzano. The experiment executed an assembly task in three different and sequential scenarios in which workstation features were manipulated. The experiment involved 14 participants who were asked to collaborate with a low-payload collaborative robot to complete a pneumatic cylinder assembly. Results showed that in Condition B and C (with the implementation of gesture control interface, human-like trajectories for robot movement and increased clarity of workstation layout), participants experienced lower workload, higher usability and acceptance compared to Condition A. Implications for the design of the workstation and the improvement of workers experience and performance are discussed.

Human-automation interaction challenges in remote operation of heavy vehicles – findings from a simulator study

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Fully automated driving has posed greater challenges than expected, and remote operation of heavy vehicles is increasingly getting attention. Therefore, human remote operators may have an important role in compensating for the technological shortcomings in vehicle automation. This poses challenges on how to design the work of human remote operators of automated heavy vehicles. In this paper, we present findings from a research project performed in collaboration between RISE Research Institutes of Sweden and Scania. In the project, requirements on remote operator work were explored by means of a simulator study. Before the study three main operator tasks were defined: monitoring, assistance, and remote driving. The simulation took place in a hub-to-hub transportation scenario where operators were tasked to handle ten trucks driving on public road and in confined areas (transportation hub). Fifteen participants completed the study. The results provide examples and insights on classical automation related challenges in a new context – remote operation of heavy vehicles. Instances of challenges with situational and mode awareness, out-of-the-loop, trust and attention management were found and are discussed in relation to HMI design and requirements. The paper also discusses the importance of considering work organization around remote operation of several vehicles.

Mind the automation knowledge gap – Public and Experts' acceptance of unattended train operation

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Automation in rail transport offers a number of opportunities to improve capacity, flexibility and resilience while maintaining highest safety standards. However, these benefits only become effective if people accept these automated systems. Knowledge and experience haven proven to play an essential role in accepting technological innovations like automation, thus might be also relevant in railways. The study focuses on the impact of railway automation knowledge on acceptance and discusses possible implications for interventions. Technology acceptance, including the intention to use unattended, automated urban and intercity rail transport, was assessed in a representative survey for Germany (N = 1462) and specifically in an expert workshop on automation in rail transport (N = 61). The analyses show that willingness to use unaccompanied rail transport is higher than non-rail transport, regardless of knowledge and expertise. However, the acceptance of unattended railways is higher for experts than for the public. In addition, the intention to use as an indicator of acceptance among the public is clearly overestimated by the experts. We need to take this knowledge gap into account when developing interventions to increase the acceptance of automated railways and, if necessary, implement targeted measures to promote knowledge transfer when introducing these systems locally.

SESSION 7: HUMAN FACTORS IN HEALTHCARE

Do Human Factors and Ergonomics (HFE) methods actually work? Testing the reliability, validity, and usability of HFE methods in healthcare practice

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In healthcare, state-of-the-art Human Factors and Ergonomics (HFE) methods are overlooked in favour of older methods such as Root Cause Analysis (RCA). Bridging this 'research-practice' gap is critical to support the delivery of safe and efficient healthcare; however, it is not clear whether newer methods are usable in practice. This study aimed to assess the reliability and validity of state-of-the-art risk assessment and accident analysis methods when used by healthcare practitioners and identify barriers preventing their use in practice. We provided training to 70 healthcare practitioners from Queensland, Australia in Net-HARMS (Dallat et al., 2018) and AcciMap (Svedung & Rasmussen, 2002). The reliability and validity of each method was assessed when used by participants to identify patient medication administration risks (Net-HARMS) and analyse a medication administration failure incident (AcciMap). Participants were also asked to describe barriers that prevent use of the methods in practice. Participants achieved only moderate levels of intra and inter-rater reliability and criterion-referenced validity and reported various personal barriers (e.g., analyst skill and experience), work barriers (e.g., time and workload constraints), and organisational barriers (e.g., mandated use of other methods). The findings highlight the need for further work to support the reliable and valid use of state-of-the-art HFE methods in practice.

Towards Fast AI-Infused Human-Centred Contouring Workflows for Adaptive Proton Therapy in the Head and Neck

Nicolas Chaves-de-Plaza, Prerak P Mody, Klaus Hildebrandt, Huib de Ridder, Marius Staring, René van Egmond
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Delineation of tumours and organs-at-risk permits detecting and correcting changes in the patients' anatomy throughout the treatment, making it a core step of adaptive proton therapy (APT). Although AI-based auto-contouring technologies have sped up this process, the time needed to perform the quality assessment (QA) of the generated contours remains a bottleneck, taking clinicians between several minutes up to an hour to complete. This paper introduces a fast-contouring workflow suitable for time-critical APT, enabling detection of anatomical changes in shorter time frames and with a lower demand of clinical resources. The proposed human-centred AI-infused workflow follows two principles uncovered after reviewing the APT literature and conducting several interviews and an observational study in two radiotherapy centres in the Netherlands. First, enable targeted inspection of the generated contours by leveraging AI uncertainty and clinically-relevant features such as the proximity of the organs-at-risk to the tumour. Second, minimize the number of interactions needed to edit faulty delineations with redundancy-aware editing tools that provide the user a sense of predictability and

control. We use a proof of concept that we validated with clinicians to demonstrate how current and upcoming AI capabilities support the workflow and how it would fit into clinical practice.

Nurses' Annoyance of Medical Device Alarms

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ICU nurses are stressed due to their working conditions. Medical monitoring devices aimed at supporting nurses in their clinical workflow ironically add to their stress. Excessive number of medical alarms generated by monitoring devices desensitize nurses to alarms. Nurses do not hear the alarms, turn the volume down, or turn them off completely. This situation is called alarm fatigue in the literature, and is characterized by stress on nurses and threats to patient safety. One aspect of alarm fatigue is feelings of annoyance. Nurses report being annoyed by medical alarms, and annoyance ratings are correlated with increasing noise levels. Literature on noise annoyance distinguishes between acoustic and non-acoustic predictors of annoyance. There is a knowledge gap on which of these factors play role in nurses' annoyance by medical alarms in the ICU context. In this study we distinguish between sensory unpleasantness, caused by acoustic factors; and cognitive annoyance, caused by non-acoustic parameters. We aim to identify which non-acoustic parameters lead to annoyance in nurses beyond unpleasantness. By doing so, we aim to inform alarm and system design to reduce negative emotions caused by medical alarms.

Visualising real-time social network data to promote healthcare teams: Team-technology interaction as a trigger to a digital intervention's acceptance and transfer intention

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COVID-19 pandemic stressed the need for implementing remote interventions to promote workers' health and performance. This is topical in healthcare, where the pandemic exacerbated psychosocial issues like work overload, lack of support, and poor communication at team level. The EU H-WORK project delivered an 8 months digital-based group-level intervention to 7 teams from 3 departments of a large Italian public healthcare institution (N = 67). The intervention deployed a software allowing real-time visualisation and analysis of communication patterns based on workers' survey responses. Visualisation of social network data guided the formulation of action plans to promote teams' health and performance, providing insights into main barriers and facilitating factors for teamwork. This study aims to test whether perceived team-technology interaction quality affects participants' acceptance of the intervention and intention to transfer its learnings to daily work. In turn, acceptance and intention to transfer are expected to act as intervention mechanisms determining increase on team performance (reflexivity, autonomy, participation) and coordination from pre- to post-intervention. Quantitative process and outcome measures were used and a serial mediation path analysis will be performed. The results will be discussed in terms of management practice and occupational health, as well as implications for digitally-based intervention design.

SESSION 8: HIGHLY AUTOMATED VEHICLES 2

Being chauffeured in the Vehicle-in-the-Loop: Passenger interactions with vulnerable road users at an urban junction

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Human factors research on highly automated vehicles (HAV; Level 4) is currently moving its focus toward the urban driving environment. In the AFiM project (Automated Driving in Mixed Traffic, German Federal Ministry of Transport), we investigated interactions between HAVs and vulnerable road users (VRUs) in urban mixed traffic, looking at typical space-sharing conflicts at an urban junction from the passenger's perspective. To examine how various passengers perceive risk, discomfort, and driving behaviour when approaching the junction, we conducted a Vehicle-in-the-Loop (ViL) study at a test site. In a repeated measures design, ten passengers experienced the conflict in a simulated driving environment through virtual reality goggles, while experiencing the kinematics of a real vehicle. While approaching the junction with a crossing pedestrian and cyclist at a speed of 30 km/h and 50 km/h, passengers triggered the HAV's braking onset at their ideal and in a second drive at their last, acceptable point. Ideally, passengers preferred subjectively harmless interactions with VRUs, and in the second drive unpleasant interactions at maximum. Driving data analysis revealed passengers' preferences for large safety margins to VRUs. The ViL opens up new possibilities for the investigation of mixed traffic interactions.

Designing sounds to support visual HMI for automated vehicles: A study for truck drivers

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Highly automated vehicles require a new approach for human-machine interaction. Sounds can provide contextual cues and alarms to improve situational awareness and user experience. In this study, we designed sounds to support the visual interface in critical scenarios for highly automated vehicles (SAE level 3). Among them, the driver's state adaptive sounds are also included. The sounds applied to the context for truck drivers in the H2020 HADRIAN project. The design process was to (1) design the sounds according to the visual wireframe, (2) validate that the sounds are perceived by users as intended by design, and (3) evaluate the effect of the sounds. The quantitative analysis of the validation results with 17 truck drivers indicated that the sounds evoked the correct function and urgency level. In particular, the sounds of dangerous situations were recognized by clearly separating these from other sounds. In order to evaluate the effect of sounds, the visual-only interface and sounds with the visual interface are compared with it in a video simulator study. The study provides guidance on the sounds design with a user-centred approach for highly automated vehicles. Furthermore, it aims to provide insight into the method of sounds validation and evaluation.

User experience of a self-driving minibus - Reflecting vision, state and development needs of automated driving in public transport based on passenger surveys in the project HEAT

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Beside sharing, electrification of drives and on-demand operations, the idea of using automated vehicles in public transport is one building block that is often included in conceptions of a more sustainable and yet efficient future mobility system. If successfully implemented, it could allow new public transportation services where this is not economically feasible at present. The success of such services will crucially depend on their actual use by the population, which is in turn determined by perceptions of their usefulness, ease of use, safety, and attractiveness. We provide insights on user perceptions of an urban self-driving minibus service in the project HEAT (Hamburg Electric Autonomous Transportation) from two phases of pilot operation in 2020 and 2021. Based on data from passenger surveys (n = 225, and n = 479) that were conducted directly after the ride, we analyse and compare the status of progress and identify further development needs from a user perspective. Results show positive attitudes towards using driverless vehicles in public transport, but also a need to further improve system performance in order to create a viable mobility alternative. We point out and discuss measures how performance could be increased.

The Influence of Vestibular Feedback on Transitions between different Levels of Automation

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The driver's tasks and responsibilities vary in a multi-level automated driving car. The higher the automation level, the more passive the role of the driver becomes. While drivers have to monitor the system and the environment in assisted and partially automated driving, they can engage in non-driving related tasks during highly automated driving. To support drivers in their tasks and increase their mode awareness, the system should provide comprehensible and comfortable feedback about the system's state and intentions. For this purpose, two different feedback concepts, one having active vehicle motions and one without motions, were implemented. A driving study (N=47) on a highway was conducted using a test vehicle simulating partially and highly automated highway driving. Depending on their experience with adaptive cruise control (ACC), participants were split into three groups and experienced manual, partial and highly automated driving as well as transitions between these levels. The results revealed that both concepts generated high scores of trust, acceptance, and comfort. Pre-existing experience with ACC showed no significant effect. However, visual-auditory feedback with additional vehicle motions could significantly increase the predictability of the automated vehicle's behaviour. Moreover, in assisted driving visual-auditory-vestibular feedback was perceived as more relieving than without vehicle motions.

KEYNOTE

Neuroergonomics for flight safety

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The emerging field of research, known as Neuroergonomics, maintains that in order to investigate complex real-world behavior it is necessary to understand the processes within the context of the underlying interacting brain networks rather than under reduced isolated conditions that only occur in the laboratory. This discipline promotes the use of highly portable devices (eg. functional near infrared spectroscopy, electroencephalograph) to determine the neural correlates of perceptual, motor, and cognitive processing in highly ecological environments. Aviation operations constitute an ideal paradigm to implement this approach. The objective of this talk is to present recent advances in Neuroergonomic research addressing pilot's failure of attention, decision making and social interactions as well as the design of cognitive countermeasures. We will also discuss the challenges of implementing neuroadaptive technology in the cockpit to improve human-machine teaming for safer operations.

FRIDAY APRIL 22nd

SESSION 9: EVALUATING HUMAN PERFORMANCE AND USER EXPERIENCE

Design Insights for a Videoconferencing Intervention to Facilitate Social Connectedness for Older Adults

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The experience of social isolation has tremendous implications for older adults across the world. Social disconnectedness and loneliness have ramifications that impact the social, physiological, and psychological dimensions of wellbeing. Technology advancements, such as videoconferencing, present a unique opportunity to connect individuals and facilitate meaningful social connections. However, platforms readably available are often not designed to meet the specific needs of older adults. Furthermore, videoconferencing is a tool and not an intervention in and of itself. Therefore, developing interventions that effectively apply videoconferencing is essential to ensure the effectiveness and efficiency of its application. Through our project we aimed to accomplish two goals: (1) provide design recommendation for development of a videoconferencing platform for older adults, and (2) develop an intervention that promotes and enables opportunities for meaningful social connections. In this pilot project, we applied a mixed methods approach to understand the diverse needs of older adults and strategies to optimize intervention delivery through a videoconferencing platform. Our findings provide recommendations to inform the development and optimization of videoconferencing platforms for older adults. Furthermore, we provide insights for designing, delivering, and implementing interventions to promote social connectivity and reduce feelings of loneliness.

Understanding Older Adults' Willingness to Adopt a Digital Health Application

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Older adults are often neglected as target audiences for technology innovations despite their unprecedented growth in the global population. Understanding the human factors involved in usage, as well as the design and acquisition of technology among older adults is pivotal. By identifying and understanding the facilitators and barriers to health technology adoption we expect to improve the design of these digital solutions, which may increase older adults' ability to independently manage important life tasks (e.g., medication-taking or monitoring chronic conditions). The goal of this study was to assess how older adults adopt new digital health applications. We interviewed 17 older adults to explore their motivations and potential barriers to using these applications. We found that they had low motivation for adoption despite having positive perceptions towards health technology. Many perceived themselves as healthy and thus that health technology applications are currently irrelevant to them. By perceiving the benefits of these applications mainly at reactive stages, they fail to adopt these applications as part of health prevention. We present these findings and propose a tailored version of

the Technology Readiness Index (TRI) 2.0, specifically to assess older adults' willingness and usage of health technology apps (TRI 2.0-Health).

Non-technical skills in firefighting – development, implementation, and evaluation of a team training for enhancing safety critical performance

Lena Heinemann, Fabienne Aust, Maik Holtz, Corinna Peifer, Vera Hagemann
University of Bremen, Germany

During firefighting operations, critical situations and accidents caused by human errors or poor teamwork processes occur repeatedly. For making operations safer and less stressful for firefighters, a team training based on scientific standards was developed. The first step was to use interviews (n = 27) and a document analysis to identify teamwork stressors and resources during firefighting operations. These data were categorized and transformed into an online survey that examined the frequency and intensity of stressors and resources experienced by firefighters. A nationwide survey was then conducted to prioritize the identified stressors and resources (n = 747). Based on this, a target-group specific team training for firefighters was developed, divided into five modules: communication, shared mental models, cooperation/support, decision-making and leadership. Team skills are trained with the help of practical exercises and case studies. In addition, a guided debriefing was developed which contains team-oriented content and encourages reflection. Results to date indicate that the training is perceived as useful and understandable. To further evaluate the effectiveness of the training, a non-technical rating system was developed and applied to assess the newly learned skills. Data from the questionnaires and from the rating system will be presented.

The influence of symptom checkers on users' trust and performance

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To make patient journeys more efficient, patient-facing decision support systems (symptom checkers) are designed to help laypersons decide whether and where to seek care (triage). Although previous studies have shown that symptom checkers––albeit few––can outperform human decision makers, studies examining how people interact with them are scarce. We examined the effects of basic symptom checker features––their framing and their accuracy––on users' trust and triage performance. In a first experiment, n = 494 participants self-triaged a case vignette and then received contradicting advice from a symptom checker, framed as anthropomorphic (using a portrait of a physician), artificially intelligent (using the label "AI") or neutral (no specification). Participants' trust was high and did not differ between conditions; most (384/494; 78%) followed the symptom checker advice, even when confident in their own appraisal. In a second experiment, n = 160 participants triaged case vignettes, receiving advice from a symptom checker with perfect or mediocre (67%) accuracy, or no advice. Both symptom checkers improved participants' triage capability, however reliance was also high when their advice was incorrect. Initial evidence suggests that laypersons tend to trust symptom checkers and may benefit from using them, even if their advice is not perfect.

SESSION 10: HIGHLY AUTOMATED VEHICLES 3

How am I supposed to know? - Conceptualization and first Evaluation of a Driver Tutoring System for Automated Driving

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Drivers experience difficulties when interacting with automated driving systems. The need for driver training is generally acknowledged, but training is limited so far – leaving the driver to learn by "trial and error". We test an adaptive tutoring system (ATS) in a driving simulator study. The ATS concept is based on thinking aloud data from a field study with 100 participants interacting with SAE level 2 systems and a task analysis to describe knowledge and skills required by the driver. These in-depth analyses allow to define the tutoring content and construct a truly adaptive tutoring system. The ATS is designed to support drivers in learning how to calibrate their level of trust and reliance strategy to different driving contexts and system reliability levels. Two groups of ten participants drive in low- and high-risk scenarios, where one group receives the tutoring ("tutoring group"), and the other group only written information ("baseline group"). Calibration of trust and reliance strategy are assessed by changes in subjective trust ratings, monitoring behaviour and system usage from low- to high-risk scenario. It is hypothesized that the tutoring group is better able to perform this calibration process from low- to high-risk driving scenario compared to the baseline group.

Sleeping during highly automated driving – target groups and relevant use cases of an in-car sleeping function

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In highly automated driving (SAE Level 4), the driver will be no longer responsible for driving and can sleep during the ride. This opportunity is likely to change user needs. Our work focuses on the first phase of the user-centred design approach and aims to identify the target groups who are willing to use the sleep function and the relevant use cases. First, we conducted an online survey with N=264 participants to investigate the characteristics that describe the future users of the sleep function. To derive relevant use cases, N=7 participants of the online-survey with a high intention to sleep during automated driving were invited to a subsequent interview study. The online-survey identified predictors for a high intention to use a sleep function, such as young age and a high frequency and duration of sleeping as a passenger in public transport or cars. However, the results showed that there is no distinct target group. The interviews revealed that the wish to sleep during automated driving is related to the individual's current mobility behaviour and the personal desire to enhance comfort during inconvenient trips. We derived exemplary use cases. Future research should identify requirements for comfortable sleep during highly automated driving.

Evaluation of two training protocols for highly automated vehicles

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Research in vehicle automation documented the human factors issues raised by automation, such as impact on driver attention, situation awareness, or overreliance on automation. Hence, providing drivers with the knowledge and awareness about the potential impact of automation became a priority challenge. The current study investigated drivers' evaluation of two training modules for highly automated vehicles (AV) in an on-road study using a wizard of oz AV (n= 26) as part of the Drive2Thefuture project (Horizon 2020). A basic training module informed the drivers merely about the basic functioning and the use of the vehicle, while an advanced training module provided additional information on broader issues, such as the limitations of automation, the effect of automation on human cognition and behaviour. The results showed that the advanced training generated an increase in trust, was perceived clearer and easier to understand, but did not increase acceptance of AV. Qualitative analyses revealed a higher interest and need for information about the use of the vehicle (basic training) than the impact of automation (advanced training), although participants considered it useful to be reminded of the impact of automation. There was a consensus on the need for a practical training when buying an AV.

I also care in manual driving - Influence of type, position and quantity of oncoming vehicles on manual driving behaviour on rural roads

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Many studies suggest that automated vehicles should drive like a human driver, e.g. moving to the right edge of the lane when meeting oncoming traffic. To generate naturally looking trajectory behaviour, more detailed studies on manual driving are necessary. The authors report on a driving simulator study investigating twelve different oncoming traffic scenarios. 40 subjects experienced scenarios with variations in type of vehicle (trucks, cars), quantity (one, two) and position (with/without lateral offset) – each on a lane 3.00 m or on 2.75 m wide respectively. Results show that subjects react to oncoming traffic by veering to the right edge of the lane. We also found that quantity, type, and position of oncoming vehicles influence manual driving be-haviour. Trucks and vehicles with lateral offset to the road centre led to significantly greater reactions and hence to more lateral distance between the ego and the oncoming vehicle. From this study on manual driving, we recommend an adaptive autonomous driving style which adjusts its trajectory behaviour on type and position of oncoming vehicles. Thus, our results help to design an accepted and trusted trajectory behaviour for highly automated vehicles.

POSTERS

Patterns of risk-taking behaviours among motorcyclists at signalized intersections in Taiwan

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Motorcyclists are the fastest-moving vulnerable road users, which made them overrepresented in road injuries and fatalities. In Taiwan, motorcyclists account for approximately 60% of total road fatalities each year, but little is known about the prevalence of risk-taking behaviours among motorcyclists. In the present study, a roadside observation was carried out to examine their unsafe riding behaviours, such as secondary task engagement, helmet non-use, and traffic violations. 4030 motorcyclists were observed at three signalized intersections in Tainan, Taiwan: 593 in a residential district, 1034 in a business park, and 2403 in the city centre. 7.3% of them were engaged in at least one secondary task, with phone use (3.5%) being the most common one, followed by chatting with others (1.6%). Although nearly all riders were helmeted (98.9%), the majority of the riders used non-standard helmets: 65.2% wore an open-face helmet, 21.0% half helmet, and only 12.6% full-face helmet. 5.9% of all motorcyclists were observed breaking at least one traffic rule at the intersections, and the violations that occurred the most often were turn signal neglect (2.8%) and red-light running (2.6%). These risky riding behaviours were also associated with contextual variables and rider characteristics. The likelihood of distracted riding increased at a red light, in the city centre, when riders were younger, male, delivery workers, and riding with an adult passenger. Traffic violations were more frequent in the city centre, in the afternoon, and on a two-lane road. Furthermore, risk-taking behaviours were more prevalent in un-helmeted riders. Observations in different weather conditions, more traffic contexts, and locations are recommended for future studies to further understand their impact on motorcyclists' adaptive riding behaviours.

Can autonomous agents lead to human-autonomy teaming? – A view into the field and implications for research and practice

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Today, due to technological advances, technology is no longer just considered as a tool, but increasingly as a team member for humans. Accordingly, there is a growing research interest in the topic of human-autonomy teaming (HAT). However, a more in-depth analysis from an experts' point of view on HAT, considering different industries, has been missing so far. This study contributes to this gap by analysing the practical reality and feasibility of HAT from an experts' perspective. We aimed to find out whether the topics discussed scientifically are also practically relevant, to identify requirements for successful HAT, and to derive further research needs. Guideline-based interviews with 28 experts from different industries were conducted and compared to the results of our literature review. The results showed that the topics discussed scientifically are also practically relevant. The concept of HAT is hardly applied in the field. Today's technology is far from being able to meet the practical requirements for successful HAT. Identified key aspects for successful HAT were converted into a model which can serve as a guidance for future research and practice. Future research needs with practical impact exist especially in the area of heterarchy, system knowledge, and anticipation of mental models.

Cookie Banners and Trust: UX design for privacy policy and trust

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Cookie consent banners are mandatory for most websites because of the introduction of the General Data Protection Regulation (GDPR) in the EU. Cookie banners often apply persuasive user interface (UI) design elements nudging users to consent to data storage without reading the consent notice to reduce the interruption of the user flow. This study investigates if persuasive UI elements like dark and white patterns affect user experience and trust. We conducted an online experiment with 56 participants comparing the effects of a non-persuasive cookie banner vs. two types of dark patterns vs. a white pattern design that nudges users into denying data tracking. The results revealed that dark patterns lowered the users' positive emotions. The white pattern led to more positive emotions. When considering the user's affinity to technology, the UI design affected usability and usefulness. Persuasive design patterns affected the participants' trust when UX and their affinity to technology were considered. The results indicate that dark patterns reduce User Experience. However, trust does not seem to be affected by UI design. Based on the results, we conclude that users may be sensitive to UX design features, UI design alone does not affect user trust.

Risky decision making due to goal conflicts in firefighting – debriefing as a countermeasure to enhance safety behaviour

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Firefighters act within extreme environments often under threatful conditions and are repeatedly exposed to goal conflicts (e.g., self-protection vs. mission objective) during missions. But what are the consequences of the experienced safety and task goal conflicts, and which countermeasures could help to reduce the occurrence of these conflicts? In an online-survey 336 firefighters were asked about experienced goal conflicts, risky decision making, debriefings and the frequency of difficulties in teamwork during firefighting. Hypotheses were analysed with multivariate regression and mediation analyses. Data shows that goal conflicts lead to risky decision making and unsafe acts. Debriefings lead to less goal conflicts mediated by less frequent difficulties in teamwork (communication, leadership, shared mental models). Results indicate that debriefings are a valuable tool to reduce difficulties experienced in teamwork in missions and can therefore have an impact on the experience of goal conflicts. Less goal conflicts lead to less unsafe decisions and thus a safer working environment. It can be recommended to conduct debriefings after missions, with an increased focus on team aspects.

Supervising Highly Automated Shuttles: A Case Study of On-Board Operators' Workplaces across Three Real-World Laboratories

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A safer, eco-friendlier, and more inclusive mobility could be achieved with highly automated vehicles (HAVs). Across Germany, a plethora of real-world laboratories with highly automated shuttles providing

novel mobility solutions in real-world settings has been implemented recently. However, technological and legal restraints required a steward on board of the HAV in all of them. The on-board operator's task was overseeing driving operations and intervening if necessary, i.e., when the automation's capability did not suffice to maintain safe operations. Three HAV projects are presented as case studies focusing on the on-board operators' workplaces, their tasks, typical scenarios, and interactions with the driving automation to resolve these scenarios. After analysing the operational contexts, structured interviews with on-board operators were conducted. Additionally, observations of HAV operations in the supervised shuttles were carried out. Results showed a highly similar task structure of on-board operators across the different contexts despite striking differences regarding the HAVs' capabilities of automation and frequency of manual interventions. In addition, the setup of workplaces varied substantially, particularly regarding the transparency of the automation's decision-making process and ways to interact with the automation. Implications for designing on-board operators' workplaces from a Human Factors perspective and related research will be discussed.

Deep learning for human posture classification in safety critical areas

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Human Activity Recognition (HAR) is a research area, which deals with automatically identifying human movements from a variety of sensor data. HAR is exploited in the field of human-computer interaction such as social care [1] or industrial settings [2], since it acts as a powerful tool to understand human movements and proactively supports them with dynamic feedback. In the past, traditional machine learning approaches, with manual feature extraction, have been used for HAR problems [3, 4]. However, these methods require domain knowledge and may hinder generalization performance [4]. Therefore, deep learning methods provide an efficient way of automatic feature extraction without any domain knowledge [3, 4].

One potential application of HAR could be automatic detection of motion states in control rooms. For instance, HAR could be utilized as input for adaptive user interfaces, thus evaluating and optimizing human computer interaction. Another potential application could be the control of a robot swarm [5]. The following study provides a first approach for HAR in safety critical areas. Therefore, an individual setting for data acquisition was designed for recording motion data from five defined postures (sit, stand, lie, walk, or kneel). As a second step, a neural network, based on supervised learning, convolutional and long short-term memory (LSTM) recurrent units, was trained to classify these postures. The network uses motion-tracking parameters (joint angles) as input, acquired from IMUs of XSens MVN Awinda.

References

1. Park, S. U., Park, J. H., Al-Masni, M. A., Al-Antari, M. A., Uddin, M. Z., & Kim, T. S. (2016). A depth camera-based human activity recognition via deep learning recurrent neural network for health and social care services. Procedia Computer Science, 100, 78-84.

2. Stiefmeier, T., Roggen, D., Ogris, G., Lukowicz, P., & Tröster, G. (2008). Wearable activity tracking in car manufacturing. IEEE Pervasive Computing, 7(2), 42-50.

3. Ordóñez, F. J., & Roggen, D. (2016). Deep convolutional and lstm recurrent neural networks for multimodal wearable activity recognition. Sensors, 16(1), 115.

4. Wang, J., Chen, Y., Hao, S., Peng, X., & Hu, L. (2019). Deep learning for sensor-based activity recognition: A survey. Pattern Recognition Letters, 119, 3-11.

5. Hasbach, J. D., & Bennewitz, M. (2021). The design of self-organizing human–swarm intelligence. Adaptive Behavior, 10597123211017550.

Ready, set, go! Sequence models to identify (start-) trigger and interaction points during collaboration tasks with care robots

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In the near future, robots are expected to increasingly enter the healthcare domain to support caregivers in their daily routine. To identify burdensome tasks that should be performed by care robots and to ensure a user-centred design, the caregivers' perspective is necessary. With a qualitative research approach with semi-structured interviews, 19 caregivers were interviewed in two constitutive online studies. We aimed to identify tasks for a possible robot deployment and individual steps that are needed for a successful execution of the task. Sequence models – the basis of task analysis – were used to chronologically order the individual steps to accomplish a goal and to identify trigger and interaction points with potential interaction partners of a robot. Based on the interaction points, the identified tasks can be divided into caregiver and patient-related tasks on the one hand, and high and low autonomous tasks on the other. Overall, a high degree of autonomy is desired for tasks that provide both physical (patient mobilization) and mental (reminder function) relief. It was, however, emphasized that the aim should be relief and not substitution. Based on the trigger points, voice commands as start-triggers were overall favoured as preferred mode to activate and interact with a robot.

Investigating Pedestrians' Interactions with Automated Buses: How Do External and Dynamic HMIs Affect Trust?

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Pedestrians as vulnerable road users highly depend on the communication with other road users. This also applies to their future interaction with automated vehicles (AVs), especially with larger sized AVs, as miscommunication can have serious consequences. Current research manifested that pedestrians need implicit communication, e.g., vehicle dynamics. Additionally, explicit communication is needed to clarify misunderstandings before they actually result in accidents. Two communication tools exist for AVs and stand in focus of this study: Dynamic Human-Machine Interfaces (dHMIs) for implicit communication and external Human-Machine Interfaces (eHMIs) for additional explicit communication. The interplay of both means of communication has not yet been sufficiently researched for larger sized vehicles. This experimental online study (N=120) addressed pedestrians' interactions with an automated bus on a shared space and focused on possible negative effects on pedestrians' trust ratings when the eHMI contradicted the dHMI (non-matching condition). Results revealed that pedestrians' trust ratings were surprisingly high in the non-matching condition which represented a high-risk traffic scenario for them. These findings provided insights into possible negative effects of eHMIs when they do not match vehicle

behaviour (dHMI). An outlook on possible derivations for the design of a safe human-machine interaction between pedestrians and larger AVs is given.

Challenging the Perfect Automation Schema - Evidence for Increased Trust in Human Support Agents

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In various domains, humans are supported by automated systems. Earlier research has suggested that trust in automated agents differs to trust in other humans. Whereas there is a plethora of research studying trust in automation, little evidence is available which takes more sophisticated artificially intelligent agents into account. This study investigated the influence of different support agents (human, decision support system, artificial intelligence) and the effects of a failure on trust. Furthermore, the preference for one of these different agents was evaluated from two different perspectives, (1) as a support agent for own decision making, (2) as the relevant agent evaluating oneself. Based on the perfect automation schema, we assumed that trust from the perspective of a user was more pronounced in technical than in human support but less affected by failures case of human support. We expected the same pattern of results when being assessed oneself. Three experiments (N=300 each) with different task contexts (i.e., loan assignment, x-ray diagnostics, chemical plant) were conducted. Surprisingly, they revealed that participants trusted the human advice more than the automated ones. Participants preferred the automation as support agent for own decision-making but preferred to be judged themselves by an automated agent.

Criteria for the evaluation of interaction behaviour of drivers in a bottleneck scenario

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Communication and cooperation between road users are essential for road safety and need mutual understanding to be successful. This also applies to autonomous vehicles, which is why their design requires an in-depth knowledge of human interaction behaviour. Acquiring this knowledge in turn requires methods and criteria with which interaction behaviour can be studied. By focused interviews we aim at identifying potential criteria for the description and evaluation of cooperation in a bottleneck scenario. Participants were presented with short video sequences of motorists passing through a narrow passage and asked to comment aloud on the videos and to describe and evaluate drivers' behaviour. For qualitative analysis, the interviews were coded, distinguishing in particular between the description and evaluation of behaviour. Particularly relevant for the evaluation of the bottleneck scenario seem to be the time delay with which drivers arrive at the narrow passage, as well as the arrival and departure order (who arrives first and who passes the narrow passage first). In addition, the majority of participants addressed the clarity of drivers' behaviour. These aspects are promising criteria for the evaluation of interaction behaviour in a bottleneck scenario.

One design fits all? Evaluating highly automated vehicles' communication strategies for different vehicle types and pedestrian age groups

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This research deals with the design of external Human-Machine Interfaces (eHMI) for two different vehicle types (car vs. bus) focusing on the interaction between highly automated vehicles (AV) and pedestrians of different age groups. AV need to be able to communicate with their surrounding traffic environment and their messages should be universally understood. The question that arises is how TP's information needs may differ for different vehicle types, how this needs to be considered in the eHMI design and if different TP age groups, especially elderly, need other information for a safe and accepted interaction. However, little research addressing this question was done so far. Results of our current experimental online study (N = 229) in a shared space setting indicate an overall good implementation of the eHMI communication strategies that have been previously developed and evaluated for a car for a highly automated bus as well. In terms of a universal design this was true for all age groups. As vehicle type had a significant effect on the feeling of safety and the affective valence in interaction, eHMI might have an especially beneficial effect when interacting as a pedestrian with a large vehicle, i.e., here with a bus.

Human variability and vulnerability in disaster risk reduction

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Recent natural and manmade disasters have shown gaps in the level of preparedness of European society for disasters, highlighting the importance of increasing risk awareness, which ensures a direct positive impact on citizen and organisational resilience among people and decision-makers in Europe. Understanding how to define common metrics with respect to different disaster scenarios, and how to measure, control and mitigate the impact on the populations, particularly on vulnerable groups is a EU priority. The European research project CORE (sCience& human factOr for Resilient sociEty) is defining a crisis modelling framework able to describe disaster scenarios and dynamics according to human, social and societal variables and organizational aspects under cascading effects. In this context, specific indicators to assess the extent of consideration of specific needs linked to human variability and consequent possible vulnerability need to be defined. The contribution will discuss the taxonomy and definition of vulnerability indicators developed within CORE project, under the inclusive and human centred perspective. This system of indicators is intended to assess the level of awareness and preparedness to disaster scenarios (earthquake, terrorist attack, flash flooding, tsunami, wild fire and pandemic) of individual citizens, first and second responders, public institutions involved in disaster warning and management.

Providing contextual information about ADAS limitations in real-time through a driver-vehicle interface

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Advanced Driver Assistance Systems (ADAS) have the potential to improve traffic safety and efficiency. However, there are challenges with these systems in terms of their limited ability to adapt to the driver and the driving situations. If not addressed, these limitations could lead to poor driver experience and decreased use of these systems. In this paper, we present findings from a research project being performed in collaboration between RISE Research Institutes of Sweden, Aptiv and Smart Eye. The aim of this particular study is to investigate how integration of multiple ADAS data sources can improve the driver's experience, trust and acceptance of the vehicles ADAS. A driver-vehicle interface was designed with capabilities to 1) show what the vehicle is perceiving combined with road map information, 2) inform the driver about limitations in the vehicles ADAS in real time and in relevance to the surrounding environment, and 3) warn the driver of inattentiveness. 9 participants experienced the drive-vehicle interface whilst driving on public roads. The results show insights in participants user experience, trust and acceptance of the driver-vehicle interface and the vehicles ADAS, which is discussed in the present article.

Towards a Generalized Scale to Measure Situational Trust in AI Systems

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Situational trust is an important dimension that relates context- and situation-dependent factors to automation performance. Holthausen et al. (2020) have proposed the STS-AD, a 6-item scale to measure situational trust. However, the scale is tailored to the domain of driving automation. We have formulated a more neutral wording of the scale so that it can be applied in other scenarios. To validate this extension, we conducted a dual-task decision aid study with 23 participants. Study participants were exposed to two different types of automated systems (an automated vehicle and an AI-supported baggage scanner) implemented in form of a Unity3D game, where we varied automation performance in a series of trials. After each trial, participants completed the situational trust scale. Results confirm high internal consistency of the scale and suggest it to be a valid measurement for situational trust that can be used in multiple scenarios. Further, participants' trust in the automated vehicle was more sensitive to degrading automation performance than in the baggage scanner scenario. Further, the automated vehicle was monitored more frequently, while participants completed more secondary tasks with the baggage scanner. Further developments of the situational trust scale will become important given the increasing use of AI systems.

Driver behaviour around unpredictable cyclists

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Driving in an area with many cyclists is difficult. Cyclist behaviour can be very diverse and unpredictable when they behave properly, let alone when they disobey rules, which they tend to do more often than drivers. The consequences of errors in the interaction with cyclists, or any vulnerable road user for that matter, can be quite serious, making the interaction even more critical. Studying driver behaviour in interaction with cyclists is therefore both an interesting and a difficult endeavour. In our current research we have studied the behaviour of drivers around cyclists that behave typically unpredictable, for example by swerving into the middle of the road when a driver is about to overtake the cyclist. We try to explain driver behaviour in these situations, to better understand their behaviour around different types of cyclists, whether different infrastructural solutions make the interaction between vehicles and vulnerable road users safer and to develop a model for autonomous cars that can be used in traffic simulations and bicycle simulators.

An Eye Tracker Study on Cognitive Ergonomics in Human-Robot Collaboration

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Industry 4.0 aims to improve working conditions as well as operational efficiency with the implementation of Human-Robot Collaboration (HRC). In HRC, human operators and robots work simultaneously on the same product, sharing the same working space without safety fencing. Collaborative applications aim to support humans by improving ergonomics and operational efficiency, complementing the strengths and weaknesses of both robotic and human users. In HRC, assessing operators' safety risks and performance due to high cognitive workload is crucial. Previous literature found a strong relationship between cognitive workload and gaze behaviour metrics during Human-Robot interaction and the critical role of stress in influencing task performance. The present work aims to investigate operators' cognitive workload and perceived stress during the interaction with robots in assembly lines considering gaze behaviour. Data were collected from 14 participants who completed a task in the assembly line in three different trials. The gaze behaviour was recorded in each assembly task through an eye-tracker, while perceived stress was assessed with unstructured interviews at the end of each trial.

How media reports influence drivers' perception of safety and trust in automated vehicles in urban traffic

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Automated vehicles are expected to bring benefits not only to their drivers, but also to traffic safety and the environment. For this to happen, drivers must be willing to use automated vehicles which depends on whether they perceive them to be safe and trust them. One source of information that influences how automated vehicles are viewed is media coverage, such as newspaper or magazine articles. To

investigate the impact of media reports on perceived safety of and trust in automated vehicles, we conducted an online experiment. After presenting the features of a Level-3 automated vehicle, participants' (N=114) initial safety perceptions and trust were measured, along with other variables. Participants were then randomly assigned to read one of three newspaper articles that portrayed automated driving in the city as either positive, negative, or neutral. Next, perceived safety and trust were measured again. Finally, participants experienced an automated drive through urban traffic and the dependent variables were assessed one more time. Results indicate that information from the media report significantly influenced trust and perceived safety, especially the negative report. However, after experiencing the automated ride trust recovered back to the initial level and perceived safety even increased.

Characterization of action optimality criteria as a function of task difficulty and its sensitivity to workload

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Design choices of flight assistance functions are strongly guided by the level of workload (WL). Quantifying WL through physiological measures is not straightforward and few models exist to explain the mechanisms behind it [1]. The effectiveness of assistive devices depends on the understanding of the sensorimotor system, specifically, movement optimality (OPM). OPM represents how the nervous system manages the trade-off between action performance and the cognitive cost related in its execution. It can be quantified through biomechanical criteria [2]. The aims of the study are (1) to identify the relationship between task difficulty (ID) and OPM, and (2) to compare biomechanical criteria to subjective measures of WL in different ID conditions. 40 participants performed a reciprocal version of Fitts' task [3]. The participants are instructed to alternatively reach two targets by operating a sidestick along the medial-lateral axis, for 5 levels of ID are tested. Biomechanical criteria are calculated from kinematic and EMG recordings made on the participant's arm. Results show that ID increase implies (1) decrease of performance, (2) appearance of nonlinearities in movement kinematics, (3) a noisier EMG signal in the co-activation distribution. These results validate the hypothesis that biomechanical criteria quantify cognitive workload used in system design ergonomics.

References

[1] Roscoe, A. H., & Ellis, G. A. (1990). A subjective rating scale for assessing pilot workload in flight: A decade of practical use (No. RAE-TR-90019). ROYAL AEROSPACE ESTABLISHMENT FARNBOROUGH (UNITED KINGDOM).

[2] Berret, B., Chiovetto, E., Nori, F., & Pozzo, T. (2011). Evidence for composite cost functions in arm movement planning: an inverse optimal control approach. PLoS computational biology, 7(10), e1002183.

[3] Fitts P.M., Peterson J.R. (1964), Information capacity of discrete motor responses, Journal of Experimental Psychology 67, 103–112.

Understanding the link of affinity for technology interaction and working demands and resources

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Modern work is often highly technology-based. For humane and individual work design, technology-related human characteristics, such as affinity for technology interaction (ATI), are therefore becoming increasingly relevant. From the perspective of occupational safety and health, this raises the question of how affinity for technology and working conditions are connected. To assess this question, we use data from our survey "Digitalisation and Change in Employment (DiWaBe)", jointly designed by four German research organisations. The survey was conducted via telephone including more than 8000 employees as a random stratified sample. The questionnaire included technologies (like mobile ICT) and key dimensions of physical and psychological stressors and resources. Results showed slightly increased ATI level for employees with higher job qualification level, while older employees scored lower ATI levels.A regression analysis revealed high technology affinity to be associated with higher levels of interruptions and multitasking at work, but also more job control and less repetition of work processes. In terms of physical demands and risks, high technology affinity was linked to less physical stress but more prolonged sitting. The contribution shows the importance of affinity for technology for assessing work design and discusses possible explanations and implications for occupational practice.

A Taxonomy to Describe Task Allocation Processes in Human-Autonomy Teaming

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The allocation of tasks is recently regarded as a designable, flexible process within work organization (Tausch et al., 2020; Komenda et al., 2021). This allows for consideration of situational affordances and human needs, resulting in real human-autonomy teaming (HAT, Rieth & Hagemann, 2021). Building on Tausch et al.'s research (2020), we developed a taxonomy to describe allocation process characteristics and their possible manifestations. It is meant to describe, classify and compare allocation processes and help design them context-appropriately. In our classification, there are six designable features: the allocation's point in time, dynamics, agents involved, influence of workers, decision criteria and process design consequences. In addition, context characteristics determine their configuration and affect process perception by workers: complexity of the allocation, work context, team composition, worker characteristics and allocation outcomes. Research has recently focussed on worker influence effects in allocation. We broaden this research looking at and comparing effects of all allocation process characteristics under different context factors. For this, we conduct online vignette studies manipulating, e.g., different work contexts like HRI or human-AI-teaming. Our goal is to give advice on how to design task allocation processes in different situations. This shall enable employers to create efficient and humane HAT.

To trust or not to trust - Comparing two trust in automation scales when assessing an external HMI in automated vehicles

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Due to increasing automation of system functions in various domains, the human-machine interaction becomes more relevant. An essential determinate is users' trust in automation to ensure the acceptance as well as efficient and safe interactions with automated systems. The concept of trust in automation can be efficiently assessed by questionnaires. However, there is a variety of inventories to collect users' trust. The current study compared two scales to collect trust in automation that were applied to evaluate users' trust in a valid and an invalid external HMI as means of communication in automated vehicles. Therefore, the unidimensional Trust in Automation Scale by Jian et al. (2000; 12 items, 7-piont Likert scale) and the multi-faceted Trust in Automation Scale by Körber et al. (2019; 6 facets, 5-piont Likert scale) were compared. The data showed comparable results between the inventories for participants' trust ratings (i.e., increased trust levels when experiencing a valid system; decreased trust levels when experiencing an invalid system). The findings revealed that either the Jian Trust Scale (e.g., higher internal reliability) or the Körber Trust Scale (e.g., multi-faceted allowing for more detailed interpretation of the results) might be more advantageous depending on the research issue, such as repeated measures.

Handling the challenges of analysing complex data scenarios - A case study for translating a prediction model for driving manoeuvres into reusable code and results

Matthias Graichen, Lisa Graichen

Analysing and modelling behavioural data from driving studies can be challenging and often entails numerous steps of data handling, preparation and aggregation before the final data modelling and extraction of results can be performed. Usually, in research papers these data steps are only briefly described due to the natural limitation of words and intended focus on the related research questions. Comparatively, research papers on modelling behavioural data from other domains, such as automotive engineering, summarize these steps using abstract algorithmic sequences or mathematical formulas. For early career researchers or experts from other domains, with only limited experience in technical implementations of complex data processing pipelines or algorithms, these kind of papers can be discouraging for further investigation. However, being able to (re-)implement these data processing steps can be a crucial requirement to reproduce published results, extend previous research or reuse analytical models for other research purposes. Based on previous research activities, this work presents a step-by-step guide to translating an algorithm for predicting driving manoeuvres at intersections into reusable code by means of public map data and freely available tools such as databases and open-source programming languages. The aim is to help readers get started with similar projects.

Criteria Catalogue for Human-AI Teaming Workplaces

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Artificial intelligence (AI) has recently received increased attention as it can increasingly be applied in work practice. The implementation of AI entails fundamental changes in the professional world and in the design of work processes. Due to the early stage of AI development, newly developing work systems can be designed prospectively from an occupational and organisational psychology perspective. A promising approach in this context is to implement cooperation between humans and AI (Kluge et al. 2021). Within the BMBF-funded research project "HUMAINE" (funding code: 02L19C200), criteria for the conversion to human-AI work processes are developed that promote motivation, identity, and vigilance. The criteria are derived on the basis of literature reviews, e.g., on responsibility for work results and human-centred design. Subsequently, these criteria will be validated and refined by interviews with experts and work observations in practice. The identified criteria are used to create a catalogue providing impulses for fair and human-centred AI development and its implementation. This catalogue ensures that the needs and motives of humans are considered in human-AI interaction in order to increase the social acceptance of those affected during AI implementation and long-term use.

Ten Criteria for Drawing Informed Inferences from Studies on Non-Driving Related Tasks in Automated Driving

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Plenty of studies have investigated so called non-driving related tasks in the context of automated driving. For instance, researchers investigated effects of non-driving related tasks on both driver state during active automation phase and driver behaviour in the takeover process. Such a vast landscape provides a pleasant basis to draw informed inferences and for practitioners to make qualified decisions. The same vast study landscape might as well appear confusing and inconclusive. Different studies indicate different or even contradicting results depending on specifics of the study design. It is important to understand the reasons for these differences for further scientific research, but also for decisions related to applications. For authors, revealing the reliability and validity of the conducted experiment becomes increasingly important in light of accumulating publications on the topic. While reviewing literature for a meta-analysis, we summarized ten criteria that may guide both readers and authors of experimental studies in the context of automated driving, especially when implementing non-driving related tasks. These criteria are designed to facilitate and enhance inferences from a vast study landscape, and can also be used by authors as a checklist for a thorough report on their experiment.

The times they are changin' - A cognitive task analysis describing the change of the driver's role in different levels of automated driving

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With increasing automation, the role of the driver and the tasks they perform will change. Existing task analyses exploring different automation levels often emphasize driver's tasks on an abstract and general level. In the context of developing a tutoring app for teaching knowledge for automated driving, we performed an analysis to identify knowledge and skill requirements, as well as the driver's role, based on self-defined concrete real-world scenarios. We utilized SAE J3016 descriptions, supplemented it with input from literature and empirical studies and conducted a hierarchical cognitive task analysis based on established models, such as CommonKads, SCTA and SAFE. Unlike common general descriptions of human factors challenges in literature, the results of our analysis allow an in-depth and concrete description of how required knowledge and skills change across levels of automation. We describe for every scenario and different levels of automation responsibilities, monitoring requirements, possible secondary task engagement, risks, required skills and knowledge. We also highlight requirements for a safe transition of control and show how many steps are needed for the driver to act as a fallback-ready user. Results imply recommendations for design of automated driving systems, such as information assistance, calibrated monitoring needs and takeover assistance.

The effect of time pressure on user experience on-board an AV on public roads

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As the automation of the driving task progresses, understanding drivers' feelings, experience, and needs while interacting with an automated vehicle (AV) gains greater importance. The current study (n= 24), aimed tackling user experience and drivers' emotions while interacting with an AV of level 4 in an on-road study with a wizard of oz AV as part of the SUaaVE project (Horizon 2020). We manipulated external factors by introducing time pressure in one group, compared to a control group. The results revealed that while the pragmatic quality of AV was evaluated similarly by both groups, the hedonic quality of AV, inducing curiosity to use, was lower under time pressure. Driving experience induced positive emotions in both groups, but this effect was smaller under time pressure. Qualitative analysis of interviews revealed four negative themes underlying drivers' emotional experience, that is, frustration, fear, system misunderstanding, and boredom, and three positive themes, that is, serenity, surprise, usefulness of AV. Our results indicate that the user experience of AV remains rather positive under normal conditions. However, adverse external conditions, such as time pressure, are likely to reduce the quality of user experience on-board an AV.

Mid-air haptic feedback: (re-) exploration of air vortex rings as an alternative to ultrasound feedback systems

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Mid-air haptic (MAH) feedback systems have been shown to allow for more immersive experiences and improve the usability of gesture-based interactions. Ultrasound feedback systems are at the focus of current research as they deliver high resolution and instantaneous feedback. They come with two major drawbacks: limited interaction space and weak feedback intensity. Although having a lower resolution, feedback systems providing MAH feedback via air vortex rings promise to be better suited for interaction scenarios that require adaptive interaction spaces and high feedback intensities. In this

paper, we report on air vortex rings as an alternative to ultra-sound -based MAH feedback systems. We present a user study (n = 20) using an integrated dual-task design within take-over requests in autonomous driving scenarios. Reaction behaviour and take-over quality were measured to quantify objective performance. Participants rated both the subjective perceivability of the haptic feedback provided and the take-over manoeuvre in general. We observed similar objective performance of vortex rings compared to ultrasound feedback. On the subjective level, data shows mixed results: feedback via vortex rings felt more intrusive and in part unpleasant to participants but was perceived to have a higher intensity. We conclude with an outlook on increasing feedback resolution of vortex ring systems.

Self-triage capabilities of laypersons: Implications for use cases of decision support systems

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To reduce overcrowding of emergency departments, decision support systems could be used to guide patients towards the appropriate care facility, that is, to help them decide if and where to seek care (self-triage). However, it is unknown when laypersons would benefit most from decision support. We analysed open-access data from 91 laypersons, each triaging 45 case vignettes, resulting in 4,095 appraisals with respect to two yes/no decisions–if a healthcare professional should be sought and, if so, if emergency care was required. We also re-assessed how certain they were concerning their decisions. Most laypersons correctly identified when to seek medical care (mean sensitivity = 91%) but struggled identifying no-care cases (mean specificity = 47%). Conversely, they were better at ruling out non-emergency cases (mean specificity = 90%) than detecting emergencies (mean sensitivity = 68%). Although participants who were uncertain about their appraisal were more likely to err (336/714; 47%) than those who were certain (1267/3381; 37%), most errors occurred in appraisals of which the participants were certain (1267/1603; 79%). Thus, for maximum impact, symptom checkers should be designed to assist all users––independent of their self-perceived competencies––in identifying (a) no-care cases and (b) emergencies that require immediate medical attention.

Design for non-compliant users

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Interaction bar down – Motivation up. Introduction. How to handle users who are not fully engaged in using your device? – Make it invisible! Hide the device in their daily routine and make the remaining interaction fun to use! Engagement of non-compliant users. Especially for medical devices, where a high user compliance can be essential for a good medical outcome, one needs to take special care of non-compliant user groups like small children, people with low motivation or even cats. To assess their needs and design a device that requires as little change of existing routines as possible will improve the chance of a safe and effective usage. In addition, supporting a behaviour change towards an increased compliance can improve the outcome. Achieving this requires a close interaction with the users in an iterative way throughout the entire development process. Conclusion. When you have to assume that your user is in a state where not 100% compliance can be expected try to use existing routines to integrate your device in, e.g. exchange standard glasses with glasses containing extra treatment functions. Also try to improve the motivation by using ‘sparks’ (triggers) and providing contact to support groups, based on the Fogg Behaviour Model.

A Model for Ergonomic Risk Assessment of Older Workers through Wearable Technologies

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Ageing of working population poses a remarkable impact on companies. Changes associated with age can have implications on the ergonomic risks and with adaptation of the worker to the workplace. Ergonomics assessment models are based on the determination of the risk associated with performing tasks, considering average reference values for the functional capacities of workers. Therefore, these models do not consider the change of individual capabilities that is associated with age. The European BIONIC project focuses on defining a network of body sensors network (BSN) integrated in the workwear to monitor the older worker, the purpose being to obtain a precise assessment of the risk level associated to each of the tasks they perform and enabling the design of workplace interventions adapted to the needs and fitness levels of specific ageing workforce. In addition to the technological integration of the system, it has been necessary to develop a specific model for ergonomic evaluation adapted to the specifics characteristics of older workers. This model is based on an individualized analysis that allows to compare the characteristics of the person with those of the job and, in this way, detect the degree of adjustment between both. This way, in addition to the ergonomic assessment, if the worker has issues related to their physical fitness, the resultant mismatches will allow to prioritize the existing risks in accordance to each individual's situation.

Assessment of riding pleasure on electric bicycles

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Electric bicycles have become more and more popular over the last decade, whereby riding pleasure is considered as crucial for their acceptance. However, to the authors' knowledge, there has been no suitable method implemented yet to assess riding pleasure on electric bicycles. Therefore, we present an item-based questionnaire as a method to assess riding pleasure. We conducted user interviews (n1 = 23) to determine items which either describe or influence riding pleasure. Given the findings, we quantified riding pleasure by combining the state of mental activation a and well-being w. Furthermore, we identified power p, handling h and physical effort e as subordinated influencing factors. Subsequently we examined the influence of p,h,e on riding pleasure in a quasi-naturalistic cycling study (n2 = 80). Based on our results, we derived a model which implements riding pleasure r_p as an explicit function of power p, handling h and physical effort e. Results are shown in this contribution.

Psychological Fatigue Indicators implementation in Airline Fatigue Risk Management Systems

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(a) Concise statement of the thesis: The current review examines the utility of incorporating psychological fatigue items in fatigue self-report and survey questionnaires and investigates the hypothesis that such additions will improve these instruments.(b) Brief discussion of the sources: A

review of the literature (vertical reading of related journals) and interviews with Subject Matter Experts were conducted, and findings were incorporated into developing a questionnaire that includes psychological fatigue items. The instrument was disseminated to a group of professional pilots. Results were analysed and evaluated the suitability and significant differences of physiological and psychological fatigue levels. (c) A summary of significant conclusions: Results indicate that current fatigue reporting and survey instruments, while suitable for identifying physiological fatigue, are insufficient to detect psychological fatigue. This can lead to underestimating overall fatigue levels experienced by crews, especially when psychological fatigue is prevalent. Potential improvements to these instruments, designed to address this shortcoming, and implications for airline Fatigue Risk Management Systems (FRMS) and Safety Management Systems (SMS) are discussed. (d) Keywords: Fatigue, FRMS, SMS, Aviation Safety, Physiological Fatigue, Psychological Fatigue.

How emotions influence conflict detection of Air traffic controllers

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The goal of this study was to test whether and how emotions influence air traffic controllers (ATCs) on conflict detections. ATCs were asked to monitor dynamic aircrafts and to respond whether there is or not a conflict. Stimuli were obtained with EuroScope3.1d-software. The task difficulty was controlled by manipulating the number of aircraft (i.e., 7 or 17 aircraft). For each stimulus, the position, altitude and speed of aircrafts were controlled. Half the stimuli included a conflict between two aircraft and the other include any conflicts. Each stimulus was presented during 3000ms and preceded by neutral (e.g., mushrooms) or negative (e.g., mutilated body) pictures presented during 1500ms. Participants were faster to respond on stimuli that included aircrafts' conflicts than stimuli without conflicts. Results showed that participants performed better for harder than easier stimuli. Most interestingly, participants improved their performance under negative emotions compare to neutral emotions for harder stimuli. These findings suggest that emotions influence conflict detection for ATCs and that effect of emotions interact with the difficulty of stimuli and the presence of conflicts. They have important implications for understanding the role of emotions on conflict detections, and more generally on how emotions influence aviation safety decision-making.

Safety and Human Factors implications of RPAS introduction in controlled airspace: a case study

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Remotely Piloted Aircraft Systems (RPASs) represent the new frontier of air vehicle for both delivery of goods and transport of people. The Air Traffic Management (ATM) is a complex socio-technical system relying on cooperation among human actors (Air Traffic Controllers and Pilots) and distributed architectures, where pieces fit together to ensure at the same time the highest safety performances and smoothness of traffic flows. The introduction of RPASs, with possible different human roles, increases the complexity of this system and needs to be properly evaluated from a safety and Human Factors (HF) point of view. This paper discusses the approach and present results of Safety and HF evaluations, on the RPASs integration into controlled airspace A, B and C with a focus on Terminal Manoeuvring Areas (TMAs) and airports, conducted within the INVIRCAT European research project. Several safety and HF

validation objectives was identified within the project and assessed through Real Time Simulation (RTS) campaigns involving aerospace research centres in Netherlands, Germany and Italy; the proposed paper will focus on the activities conducted in Italy. This work has received funding from the SESAR Joint Undertaking with grant agreement No 893375 (INVIRCAT project) under European Union's Horizon 2020 exploratory research programme.

Agricultural safety in Human-tractor interaction: novices and experts evaluation of usability and attitudes toward the adoption of a new Foldable ROPS supporting device

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Tractor rollover is the main cause of fatal injuries in agriculture. The Foldable Rollover Protective Structure (FROPS) is fitted on tractors to prevent the risks to the driver. However, a number of deaths occurs during tractor rollovers when the FROPS was either removed or folded-down. Previous studies found that operators consider FROPS handling as a time-consuming, strenuous and/or an uncomfortable operation. To facilitate the raising and lowering operations, we developed a FROPS supporting device (rod + gas spring) adopting a User-Centred Design (UCD) approach. In the present paper three groups of novice-novice, novice-expert and expert-expert users were asked to raise two rear mounted FROPS: a traditional one and a second one equipped with the new supporting device. A questionnaire assessed the usability (effort, feelings of discomfort, temporal demand and satisfaction) and attitudes toward the adoption of the supporting device. All groups reported less physical effort, more stable postures, higher levels of satisfaction in handling the FROPS equipped with the supporting device, and the participants declared to be willing to adopt the device on their tractors when commercially available. The developed handling system showed to be effective in making the FROPS easier to be operated, encouraging a safe human-tractor interaction.

Usability and Acceptance of Lower-Back Support Occupational Exoskeletons: The XSPINE project

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Among the diverse occupational health problems, work-related musculoskeletal disorders (WMSDs) can be considered the most relevant and pervasive in many work environments. Literature shows a strong link between WSMD and decreased workers' well-being. Occupational exoskeletons are seen as a possible solution to mitigate WMSDs impact by providing ergonomic support and enhancing workers' physical capabilities. However, further evaluations and benchmarking methods are needed to assess their effectiveness across various industry sectors, and low user acceptance rates preclude their widespread adoption. The European project XSPINE aims at identifying a baseline set of design and performance criteria to facilitate benchmarking of different exoskeletons and requirements regarding usability and acceptance. Two lower-back support occupational exoskeleton prototypes have been developed and tested by considering perceived usability. The tests have been conducted at the Eurobench H2020 project facilities in Spain. Participants were asked to conduct different tasks using each prototype and rate them on the System Usability Scale (SUS), Van der Laan's System Acceptance Scale and an adapted version of the Local Perceived Discomfort Scale. Participants reported decreased physical discomfort in the lower back and moderate-to-high ratings of perceived usability. Moreover, user acceptance appeared to be influenced by perceived usability and the level of discomfort.

Dynamic replanning assisted by intelligent system: from observed behaviour to operator's intent.

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The implementation of intelligent assistant systems for aeronautical operators requires the design of tools that remain at the service of human decision-making. One way could be to personalize interactions from the mental representation of the problem, but this requires being able to model the intention of the operator. In this paper, we hypothesize that the observation of the user behaviour can be used to model their decision-making process. We propose a qualitative study of a flight plan re-planning task of an operator-AI team in a micro-world environment. Twenty-four participants carried out twenty missions in different scenes. To identify a link between task execution and operator's intent, we conducted self-confrontation interviews with four participants about two missions, where they explained the approach taken to achieve the replanning. The results suggest that the replanning tools used provide clues to differentiate between exploration and exploitation phases. We propose a methodology to follow the evolution of the space of the solutions studied as the interaction progresses. Taking such indicators into account could make it possible to identify the operator's strategy as it is deployed, and support it by proposing, if necessary, either types of solutions not studied, or optimizations of identified privileged plans.

Evaluating contactless user guidance techniques interactions for fingerprint scanners - A usability study

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Capturing biometric fingerprints is the most widely used and secure forms of identity authentication. Currently, the development of contactless scanners aims to further increase hygiene standards and improve security procedures. However, they require an exact positioning of the hand within the housing shape. To realize that, the user guidance has to instruct the user to find the exact spatial position and adjust it in case of a deviation. For the application in an international context it needs to be designed to be cross-cultural in terms of symbols or text and usable without prior knowledge. To achieve an intuitive and highly usable user guidance, we developed three different user guidance techniques, which differed in terms of information density and hand representation. This paper presents an experiment with 26 participants to evaluate the susceptibility to touch, hand posture and spatial positioning. Furthermore, the subjects were asked to give qualitative assessments of the variants. Results show that users preferred a live representation of the hand and a low information density. In addition, we discuss how housing shape and the user guidance influence concept understanding, intuitiveness, and interaction performance. The paper will conclude with a methodological discussion regarding the evaluation of contactless interaction.

Yes, I can: Refresher intervention for non-routine situations in highly automated work environments

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The use of automation in high-risk industries can make work processes more efficient and workplaces safer but poses new challenges for operators. The ad-hoc application of relevant skills in non-routine situations is impeded by a lack of application of previously learned skills for an extended period of time. This infrequent use can lead to a difficulty in recalling relevant skills and to decay. One way to mitigate decay is through refresher interventions, however, research on the effectiveness of these in highly automated and high-risk work environments is limited and the applicability of previous results in the field has not yet been investigated. Therefore, a field study is planned, to test the effect of a refresher intervention composed of different modules. In a pre-post-post quasi-experimental design, two groups at a chemical/pharmaceutical site will be tested regarding their skill level (pre), maintenance and transfer (post) considering a non-routine task. Both groups at one site will receive the refresher intervention at different time points between pre and post testing. It is assumed that the effectiveness of different modules within the refresher intervention is influenced by individual differences including experience and learning style. The presentation provides insights into the study design and first results.

Effect of task difficulty on dismounted soldiers' subjective cognitive load

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The increasingly sophisticated equipment used by dismounted squad leaders can lead to situations of cognitive overload. In order to measure it, we built an experimental set-up that replicated the activity of squad leaders in real-world situation. Four tasks, each one presented at three levels of difficulty, were performed by the participants (all squad leaders of the French Armed Forces): a progression task, an orientation task, an audio message transmission task and a shooting task. The aim was to ensure that the three levels of difficulty of the tasks were clearly distinguished from one another, from the point of view of the perceived cognitive load. We measured subjective cognitive load (using the NASA-TLX and a visual analogic scale) and assessed usability and sense of presence of the set-up. The results showed a moderate score for usability and sense of presence of the set-up. Participants perceived an overall higher level of cognitive load as the difficulty of the task increased, but the increase in load that we expected to generate between the low and medium levels was not perceived. This led us to modify the content of the task, to make the measures more sensitive to variations in the complexity of the task environment.

References

Albentosa, J., Remigereau, A., & Darses, F. (2019, November). An evaluation of the subjective mental load of dismounted soldiers as a function of the procedures they follow. In Longo, L. & Leva, C. (eds). H-Workload 2019, the 3rd. international symposium on human mental workload. Work In progress. Sapienza, Universita di Roma, 14-15 November, 2019, pp. 33-39.

Hollands, J. G., Spivak, T., & Kramkowski, E. W. (2019). Cognitive load and situation awareness for soldiers: Effects of message presentation rate and sensory modality. Human factors, 61(5), 763-773.

Chérif, L., Wood, V., Marois, A., Labonté, K., & Vachon, F. (2018). Multitasking in the military: Cognitive consequences and potential solutions. Applied cognitive psychology, 32(4), 429-439.

An on-road investigation of driving behaviour of drivers with and without ADHD

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There is large agreement in the literature that drivers with ADHD are at greater risk for road accidents than their peers. However, the underlying mechanisms of their increased risk are unclear. In this respect, natural driving studies (NDS) that enable to monitor a wide range of on-road kinematic events (e.g., hard braking, swerving) and traffic violations (e.g., speeding, running red lights), might be of great value. Nevertheless, they are currently scarce. We conducted an NDS on transport drivers in the Israel Defense Forces (IDF). Drivers in the ADHD group (N=25, males) had ADHD diagnosis on their medical records. Drivers in the control group (N=146, males) had neither self-reported on ADHD nor had this diagnosis on their medical records. Our preliminary results show that the ADHD group had significantly more hard braking events (M=10.40) and more speeding violations (M=1.94) per 1000 km than the control group (M=4.87, M=0.91, respectively), $p<.001$ for both effects. These preliminary results already point to differences in driving behaviour between drivers with ADHD and their peers. In further analyses, we would explore additional on-road behaviours and test the predictive power of distinct ADHD symptoms (hyperactivity vs impulsivity) on these behaviours.