Human Factors and Ergonomics Society
EUROPE CHAPTER

# Annual Meeting 2023

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## LIVER BUILDING

## LIVERPOOL – UNITED KINGDOM

# ABSTRACTS

Human Factors and Ergonomics Society
EUROPE CHAPTER

# Organization Committee 2023

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# WEDNESDAY APRIL 26th

# SESSION 1: AUTOMATION & UX

## Predictive robot eyes improve task performance but don´t affect trust

Linda Onnasch, Max, Wieser, Paul Schweidler
*Technische Universität Berlin, Germany*

Industrial collaborative robots are becoming more flexible and perform variable action sequences. For human-robot interaction this can have detrimental effects, as the robot's actions become more difficult to predict. In human interaction, eye gaze intuitively directs attention and communicates subsequent actions. Whether this mechanism can benefit the interaction with robots, too, is not well understood. This study therefore investigated the impact of anthropomorphic eyes as directional stimuli in robot design. 42 participants worked on two subsequent tasks in an embodied human-robot interaction with the industrial robot Sawyer. The study used a between-subject design and presented either anthropomorphic eyes, arrows or a black screen as control condition on the robot's display. Results showed that neither the implementation of directional stimuli nor the anthropomorphic design in particular led to increased trust. But anthropomorphic robot eyes improved the task performance in terms of prediction speed, whereas these effects could not be found for non-anthropomorphic cues (arrows). Anthropomorphic eyes therefore seem to be better suitable for an implementation on a robot in industrial environments.

## Affect-enhancing speech features for different types of robots

Kim Klüber, Linda Onnasch
*Humboldt-University of Berlin, Germany*

According to the theory of mind, attributions of experience and agency to robots determine how we treat them. Whereas agency is associated with the perception of intentional behaviour and accountability, experience leads to sympathy and forgiveness. As the implementation of robots in unstructured environments is error-prone, especially an increase in experience attributions is beneficial for user acceptance. One strategy to increase the experience attributions is affective robot communication. In our online study, 60 participants listened to audios in which robots introduced themselves. The synthesized speech in the audios differed in regard to prosody (with vs. without) and verbal content (emotional vs. non-emotional). Half of the participants were presented with an anthropomorphic, the other half with a mechanical robot picture while listening. Results showed that emotional words and prosody increased the experience attribution to robots. This effect was found for both robot types, although prosody led to even higher experience ratings for technical robots. However, not only experience attributions were affected but prosody also slightly increased attributions of agency. Overall, our study identified affect-enhancing speech features that can be used to increase the acceptance of robots. However, further studies should replicate these findings in a laboratory setting with embodied robots.

## The impact of anthropomorphic system design features for sense of agency in automation technologies

Tina Frenzel, Josephine Halama
*Chemnitz University of Technology, Germany*

A substantial part of conscious mind is the sense of agency (SoA). SoA describes the subjective experience of control over actions and sensory outcomes. The interaction with automation technologies changes the users' role from operator to observer and actions are rather caused by another agent than self-caused. Hence, the question arises how SoA can be maintained to prevent out-of-the-loop performance problems and encourage a positive user experience. The exploratory online experiment (N = 52) investigated how anthropomorphic cues in system design affect users' SoA in automated processes. Therefore, videos showing externally controlled actions were presented and SoA was implicitly measured by intentional binding of action initiation and action outcome. By manipulating anthropomorphic cues (within-subjects) flanking the automated actions, we compared four conditions: no cue vs. auditory cue 1 (computer-generated voice) vs. auditory cue 2 (human voice) vs. visual cue (human hand). In the ANCOVA, we controlled for observers' affinity for technology. Except for human voice, cues supported SoA ($\eta^2_p$ = .06), whereas affinity for technology showed no significant influence on SoA ($\eta^2_p$ = .01). In conclusion, these findings highlight the potential of anthropomorphic cues in system design to promote SoA in the interaction with automation technologies and identify directions for further research.

## A descriptive model of responses in aided signal detection in a cyber security scenario

Joachim Meyer
*Department of Industrial Engineering, Tel Aviv University, Tel Aviv-Jafo, Israel*

Unsafe user behaviour, such as opening email attachments with hidden malware, is a major vector for introducing threats into systems. Security software can notify users about possible threats. We examine the effects of the users' ability to distinguish between threat and no-threat events and their risk and loss aversion when aided by security systems with different threshold settings. In a laboratory experiment, 90 participants classified stimuli as threats or no threats, based on information they received about the stimuli and on the output from an alerting system. Conditions differed in the d' of the information the user had (the user's "knowledge"). Users performed the task without the decision aid and with the decision aid that had two different thresholds in different blocks. We compared the results to the predictions of a normative model and to descriptive, Prospect-Theory-based models, which differed in parameters of loss aversion and risk aversion. Best fitting results were found for a neutral risk attitude and loss aversion that doubled the weight of losses, compared to the weight given to equivalent gains. The results demonstrate the value of integrating models from behavioural decision making in the analysis of human-systems integration.

# SESSION 2: SURFACE TRANSPORTATION 1

## Driving behaviour of automated vehicles as implicit communication signals for pedestrian road crossing estimation and behaviour

Kai Tian, Tzigierasz Athanasios, Chongfeng Wei, Yee Mun Lee, Matteo Leonetti, Natasha Merat, Richard Romano, Gustav Markkula
*Institute for Transport Studies, University of Leeds, United Kingdom*

Previous research has shown the crucial role of implicit signals in pedestrians-AV interaction. However, it is still unclear how pedestrians estimate vehicle behaviour and make crossing decisions when facing a vehicle with different braking behaviour. This study investigated the effect of implicit signals (time to collision, vehicle speed, and braking behaviour) across a wide range of simulated traffic scenarios through a comprehensive analysis of pedestrian crossing behaviour and estimates of approaching vehicle behaviour. Results showed that pedestrians could recognise different braking behaviour and match their estimates with their crossing decisions. Pedestrians crossed the street earlier and estimated yielding behaviour more accurately in early-onset braking scenarios than in late-onset braking scenarios. Vehicle speed significantly affects pedestrian estimations, with pedestrians tending to perceive low vehicle speed as yielding behaviour. We showed that visual cue, tau_dot, is associated with the detection of vehicle-yielding behaviour, but may not be its simple immediate value. Finally, pedestrians use different strategies or cues when crossing the road early versus late in the course of vehicle yielding. Our findings reveal in detail the impacts of implicit signals on pedestrian crossing decisions and have implications for road crossing safety and the development of AVs.

## Comparing participants' risk perception and sensed presence while driving in CARLA and a self-developed remote driving testbed

Son Le Quang, Avinoam Borowsky, Yisrael Parmet, Shai Arogeti
*Ben-Gurion University of the Negev, Israel*

While automotive research plays a significant role nowadays, most on-road and natural studies activities demand costly platforms and involve safety issues. A large variety of driving simulators proposes an alternative to reduce monetary costs and guarantee safety. However, no matter how sophisticated driving simulators are, they still cannot reflect the actual complexities of the physical world. In this study, we evaluated a self-developed remote driving testbed platform to be used as a hybrid solution that combines the strengths of the simulator and actual vehicle driving in the real world. To increase the external validity of the remote driving station, we implemented a driving torque mechanism. This study introduces an empirical experiment comparing participants' perceptions and behaviour in two driving platforms. The first includes our developed testbed consisting of a remote station and a toy-car driving on a 1:10 scale circular road, and the second includes the CARLA driving simulator. The experimental results demonstrated the sense of risk the drivers in the testbed experienced versus the risk-free experience when driving a conventional simulator. The risk-free experience influenced drivers' confidence and sensed presence. Also, the participants rated the testbed as more realistic than the high-end graphical driving simulator.

## Towards user friendly autonomous on-demand mobility: Insights from a Wizard of Oz pretest

Fabian Schlichtherle, Sven Hornburg, Mario Rieker, Wolfram Remlinger
*University of Stuttgart, Germany*

Wizard of Oz (WoOz) experiments are a good and long-proven means of testing technologies whose degree of realization has not yet progressed far enough. This also accounts for the field of highly automated vehicles where especially driver vehicle interaction in passenger cars has extensively been the focus of attention. One aspect of WoOz research in the automobile context that has received much less awareness to date is shared automated vehicles (SAVs) as part of ride-pooling services. Findings from previous research on human vehicle interaction in WoOz environments have provided valuable insights. However, fundamental differences in the interior layouts as well as use cases and user groups of both, passenger cars and SAVs, make it necessary to extend the application of this research method. We report about a preliminary test in which we realized the entire usage process of a trip with an autonomous ride-pooling service including multi-passenger-interaction as a WoOz experiment. Emphasis was mainly laid on questions regarding technical realization as well as interface design aspects. Results indicate that WoOz is a suitable method to investigate user needs in SAVs and that this technique is a useful addition to a user centred design approach.

## Artful journeys: improving the traveller's experience

Yvonne Barnard, Paul Timms
*Institute for Transport Studies, University of Leeds, United Kingdom*

Transport planners usually focus on getting travellers from A to B efficiently and safely. However, travellers are not parcels: art can enhance their experience of travelling. Making journeys by public transport or by walking more enjoyable is stimulating sustainable travel. Over 7 years we supervised 11 international students on the Institute for Transport Studies' Transport Master programme doing their dissertation on Art and Transport. They investigated different art forms and different transport modes in different countries: visual arts, design, and music, in metro and rail stations, busses, airports, and on streets. User surveys, brainstorm sessions, interviews, and gathering images on social media were methods used. Several students made own designs, projected on pedestrian routes. A wide range of ways to improve travel experience emerged. A Brazilian university started an art and transport project inspired by this work. Based on these dissertations the paper will discuss how art can contribute to the travel experience, the many forms art in transport can take, and research methods to explore this topic. If 'Art and Transport' is not a traditional Human Factors topic, looking at this aspect of travel is exciting and inspiring.

# SESSION 3: HEALTH

## Effects of information relevance communication on novices' experience and performance with a cooperative ultrasound diagnosis system

Tim Schrills, Marthe Gruner, Thomas Franke
*Institute for Multimedia and Interactive Systems, University of Lübeck, Germany*

Novices may particularly benefit from medical artificial intelligence (AI) in diagnostic tasks, e.g. in ultrasound-based diagnosis. However, novices often have limited domain knowledge, which hampers their ability to understand how a medical AI processes information and could negatively affect cooperation. The present research investigates the effects of communication of diagnostic information between human and medical AI. Based on an initial experiment with ( N = 30) laymen we designed interactions highlighting the users' influence on information (i.e., short ultrasound video recording) used by the system. To this end, we identified information, that 1) is under the user's control and 2) where the quality cannot be monitored by the system. In a second between-subject experiment, medical novices were either instructed to proactively apply wrong levels of pressure within the ultrasound examination and to observe effects on the system information processing or only received basic instructions to conduct the examination. We examined perceived traceability and the relation between reported confidence and performance in terms of diagnostic quality. First results (N= 29) indicated that instruction to explicitly manipulate the information provided by novices' own actions and to observe effects on the system impacts the development of perceived transparency and confidence.

## Wrist worn accelerometers to characterize upper limb use in health care workers

Micaela Porta, Bruno Leban, Giulia Casu, Massimiliano Pau
*Department of Mechanics, Chemical and Materials, University of Cagliari, Italy*

Due to the continuous exposure to highly demanding physical tasks during patient care activities, health care workers (HCW) are prone to develop upper limb (UL) work-related musculoskeletal disorders (WRMSD). However, to date little attention has been dedicated to investigating risk factors for UL-WRMSD. To partly overcome such research gap, this study aims to test the feasibility of use of a simple measurement setup based on two wrist-worn accelerometers to characterize HCWs' UL use during the performance of regular working tasks. Thirty-two professional HCW (27 females, 5 males), full-time employed at the Hospital of the University of Cagliari (Italy) were monitored for 4 hours of a regular shift using tri-axial accelerometers while their activities were simultaneously classified by an observer. Acceleration data were processed to calculate duration and intensity of use for each limb and symmetry of use. The results show that patients-hygiene task requires the most intense UL use with respect to meal distribution and patient transfer. Moreover, meal distribution is associated to a marked unbalanced use of the UL while patient transfer is the most symmetrical and less intense task. Such data may provide important quantitative information to better assess the risk of UL-WRMSD, and plan suitable ergonomic interventions.

## Effects of performance transparency in symptom assessment applications on the detection of medical emergencies

Marvin Kopka, Kai Michel Koch, Markus A. Feufel
*TU Berlin, Germany*

Symptom assessment applications (SAAs) may help laypeople decide where and how urgently to seek care. Although SAA accuracy is less than perfect, few studies have examined their impact on decision performance. We conducted a 2x2 between-subjects experiment with 80 US-Americans. They were given 10 medical case vignettes (= 800 appraisals) and asked to identify medical emergencies without SAA; then they received advice by an SAA accompanied by (1) no information, information about (2) SAA performance, (3) human performance, or (4) both and had to decide again. Participants' performance increased after receiving SAA advice (1 more case on average, $p < .001$). Information about human performance reduced accuracy (67%) compared to the control group (79%, $p = .003$), whereas information about SAA performance (78%, $p = .71$) and combined information did not (79%, $p = .82$). When given information about human average performance, laypeople seem to overestimate their capabilities, but this effect disappears when also given SAA performance. Thus, laypeople need a method to calibrate their own performance expectations when identifying emergencies assisted by an SAA.

## Comparing four explanation types for an AI-based smart healthcare system in explainability evaluation measures

Wookjae Lee, Kihyun Park, Kitae Hwang, Gayoung Ban, Sungmin Kim, YoungHee Song, Woojin Park
*Seoul National University, South Korea*

Various AI-based smart healthcare systems have been developed, but they are not gaining a wide acceptance. One of the hurdles to their use has been the opacity of the underlying AI models. To remedy the situation, human-centred explanations need to be designed and provided to the users to help them better understand the AI models in terms of purpose, process and performance. Nonetheless, relevant research is currently insufficient. To help design effective explanations for AI-based smart healthcare systems, this study aimed to comparatively evaluate four different explanation types in terms of a set of explainability evaluation measures, in the context of an AI-based chronic low back pain (CLBP) diagnostic system. The four explanation types were: no explanation (baseline), example-based explanation, feature attribution and decision tree. A total of 46 lay users participated in a scenario-based experiment. Two possible diagnostic outcomes (positive vs. negative) were considered. For both diagnostic outcomes, the decision tree type was found to be better than the other explanation types in all explainability evaluation measures. Also, significant explanation type × diagnostic outcome interactions were found for some of the measures. Practical implications of the study results for the design of explanations for smart healthcare systems are presented.

# SESSION 4: TELEOPERATION

## Effects of simulated time delay on teleoperators' performance in inter-urban conditions

Assaf Botzer, Oren Musicant, Shraga Shoval
*Department of Industrial Engineering and Management, Ariel University, Israel*

Time delay in communication networks is a major challenge in remote controlling of vehicles (i.e., teleoperation). We investigated teleoperation performance in a simulated task that required negotiating other road users, at relatively higher driving speeds, and at relatively short time delays (50ms, 150ms, and 250ms) which characterise the 5G era. Participants (N=72) followed a lead vehicle on a curve, responded to a sudden brake of the lead vehicle, and concluded with highway driving among other simulated road users. At the end of the session, participants completed the NASA-TLX. We found that on the curve, speed and distance to the lead vehicle varied more at 250ms than at a 50ms time delay. Swerving was stronger at 250ms than at a 50ms delay on both, the curve, and the highway, and crashes were 20% (not statistically significant) higher at the 250ms than at the 50ms delay. Finally, participants rated the 250ms delay higher than the other two delays on almost all dimensions of the NASA-TLX. Our findings suggest that teleoperation performance can be affected by delays as small as 250ms (but probably not as small as 150ms). Solutions may include streaming the road videos in lower resolution and using stronger graphical processors.

## Remote Operation as a Key Enabler for Autonomous Driving: User-Centred Design and Expert Evaluation of a Prototypical Workplace for the Technical Supervisor

Andreas Schrank, Fabian Walocha, Nils Wendorff, Hoai Phuong Nguyen, Florian Rudolph, Michael Oehl
*German Aerospace Center (DLR), Institute of Transportation Systems, Braunschweig, Germany*

Remotely operating vehicles utilizes the benefits of vehicle automation when fully automated driving is not yet possible. A high level of safety and availability is ensured from afar by a human operator who supports the vehicle automation when its capabilities are exceeded. The remote operator thus fulfils the legal requirements in Germany as a Technical Supervisor to safely operate highly automated vehicles at SAE 4. To integrate the remote operator into the automated driving system, a novel user-centred human-machine interface (HMI) for remote operation workplaces was developed and initially evaluated (Kettwich, Schrank, & Oehl, 2021). The insights gained in this process were incorporated into the design of a prototypical workplace for remote operation. This workplace was now tested by 38 participants meeting the professional background criteria for the role of Technical Supervisor using typical simulation scenarios. Even under elevated workload induced by simultaneously engaging in a secondary task, participants were able to obtain sufficient situation awareness and quickly resolve the scenarios. The HMI yielded favourable usability and acceptance ratings. Participants were particularly satisfied with its ergonomics and the interaction design. The results of the study inform the workplace's iterative development and further research on the remote operation of automated vehicles.

## Effects of Camera Position on Teleoperators' Performance

Oren Musicant, Assaf Botzer, Shraga Shoval
*Ariel University, Israel*

Camera position in remote controlling of vehicles (i.e., teleoperation) can affect teleoperators' performance through its effects on teleoperators' estimation of distance and their perception of the spatial positions of objects relative to each other. We investigated teleoperators' (N=91) performance in a simulated urban driving task with egocentric (as if the camera is where the driver would sit) and allocentric (as if the camera is on the roof) video images. The task required negotiating road geometry and other road users. At the end of the session, participants completed the NASA-TLX. We found that right, and left turns were completed significantly faster with an allocentric than with an egocentric perspective. The faster completion of turns with the allocentric perspective appeared to come at the cost of significantly stronger barking and greater speed variance. Nevertheless, there were no more crashes with the allocentric than with the egocentric perspective. Finally, there were no significant differences on the NASA-TLX ratings of the two camera position sessions. Therefore, we conclude that allocentric perspective may improve teleoperation efficiency without compromising its safety or increasing the teleoperators' perceived workload.

# THURSDAY APRIL 27th

# SESSION 5: SURFACE TRANSPORTATION 2

## Optimising train-track operations through early human factors analysis: A case study of strategic human factors interventions in a safety-critical railway innovation project

Richard Bye
*Network Rail, United Kingdom*

With rising infrastructure costs and post-pandemic shifts in the nature of work, Network Rail (the owner and operator of the GB rail infrastructure) must find safer, better, cheaper and faster ways to enable the improvements that are necessary to safeguard the future of the railway. As progressive thinkers in the areas of safety management, system resilience and sustainable human performance, human factors and ergonomics specialists are uniquely placed to draw on hindsight, insight and foresight to help design the transport systems of the future. But operating in the liminal spaces between too early (where there's nothing to test) and too late (when the architectural constraints are fixed) requires new methods, new metrics and new mindsets. This applied case study will illustrate the value of human systems engineering interventions made during the early investment phases of a disruptive train control system innovation project. Aligning a human factors case with a business case necessitates efficiency-thoroughness trade-offs and requires demonstrable evidence that it's possible to blend rapid prototyping, desk-based research and human-centred hazard analysis with educated guesswork to provide a decision making framework that will support investments in new technology. A summary of work completed to date and future plans will be presented.

## Effects of Video Quality on Perception and Reaction Time in Video-based Remote Train Control

Niels Brandenburger, Friedrich Maximilian Strauß, Anja Naumann
*German Aerospace Center, Germany*

High grades of railway automation feature autonomous and automatic train service in combination with human remote control and recovery in cases of disruptions. For human remote control, video footage is a crucial information source and questions what minimum video quality is required to ensure accurate visual perception arises. Research showed various factors to determine human perception of video footage, most notably frame rate and bitrate. Yet, it remains unclear, how these metrics interact and effect visual perception and subsequent reaction times. This study aimed at establishing the effects of framerate and bitrate on perception accuracy and reaction times in a choice-reaction time setting. Higher bit and frame rate were hypothesized to go along with more accurate perception and faster responses. With data collection ongoing, so far 18 participants were shown 36, 10 seconds long video sequences showing the front view from a train cab with light signals and distance markers as target stimuli. Video quality was manipulated in bitrate (24795, 6000, 1000 bps) and frame rate (25, 15, 5 fps). Participants indicated light signal colour and distance marker values. Preliminary analysis supports the hypothesized effects. A finalized analysis will be presented and implications for remote control in railway automation discussed.

## Impact of human factors and ergonomics in head-on collisions

Mette Møller, Rikke Rysgaard
*Technical University of Denmark, Denmark*

Head-on collisions is the second most common cause of fatal injury in road traffic crashes in Denmark. In this study, the Danish In-depth accident investigation board did an interdisciplinary in-depth analysis of 28 head-on-collisions occurring on rural roads (speed limit 80 km/h).
All crashes involved two motor vehicles. We excluded crashes associated with suicide. Only one crash occurred while overtaking. In all other crashes, the driver non-intentionally entered the wrong lane. The analysis revealed being asleep, being on the phone and impairment as key human factors preventing the driver from maintaining control over the vehicle, realizing that he/she was entering the wrong lane, and correcting the unfortunate behaviour to avoid the crash. Among the counterparts speeding and inappropriate avoidance manoeuvres contributed to the occurrence of the crashes. Ergonomics such as incorrect seating position (e.g. seat too low or too close to the steering wheel) increased the injury severity degree. Similarly, crashes with approximately 10% overlap of the fronts of the vehicles were associated with increased injury severity degree due to unfortunate vehicle construction.
The results identify human factors and ergonomics as key factors for the occurrence and severity of head-on collisions.

## Promoting sustainable mobility by behaviour-based design

Giorgia Tempestini, Francesco Di Nocera
*Sapienza University of Rome, Italy*

The increasing use of private transportation has negatively impacted not only the environment but also the citizens' quality of life, health, and sociality. Although it is not possible to isolate a single behaviour to be considered as the cause of such a broad and complex outcome, several behaviours have contributed to the emergence of negative outcomes. That is why it is important to analyse behavioural patterns so as to modify problem behaviours in favour of others that are more beneficial. The present research project has a twofold objective: 1) to understand whether the gamification methodology is effective in implementing desirable behaviours from the perspective of sustainability; 2) to provide knowledge to individuals about these issues to raise awareness of the use of alternative means of transportation. These objectives have been pursued by designing a card game that participants were asked to play as a group, having the goal of reaching destinations, choosing the vehicles by which to move: bicycle, with standard travel times, and automobile, susceptible to delays due to traffic. Sustainable behaviour was negatively reinforced with a variable ratio reinforcement schedule. The sustainable choice has been adopted more frequently, and this result could have important implications for both the communication and the actual implementation of these behaviours.

## Pedestrians make riskier road-crossing decisions for accelerating electric compared to internal combustion engine vehicles

Marlene Wessels, Daniel Oberfeld-Twistel
*Johannes Gutenberg-University Mainz, Germany*

To cross a busy road safely, pedestrians must accurately judge the movement of oncoming vehicles. We recently showed that pedestrians' estimation of how much time remains until the arrival of an accelerating vehicle differs between conventional (ICEVs) and electric vehicles (EVs). Here, we investigated whether the difference in the vehicle-specific sounds might also lead to riskier road-crossing decisions in interaction with EVs compared to ICEVs. In an audio-visual VR-simulation, a single vehicle approached the participants along a road. Simultaneously, we presented highly realistic auralizations of the sounds of an ICEV or an EV with and without AVAS, recorded from real vehicles on a test track. In two experiments (Exp. 1: with the original trajectories recorded on the test track, Exp. 2: with simulated trajectories), we found that for accelerated approaches, the probability of road-crossings that would have resulted in a collision was 1) higher than for constant-velocity approaches, 2) lower for ICEVs than for EVs with and without AVAS, 3) but similar for both EVs. For constant-speed approaches, no significant effect of vehicle type was observed. Overall, these experiments indicate that pedestrians' road-crossing decisions benefit significantly less from the sound of accelerating EVs compared to ICEVs, even with activated AVAS.

# SESSION 6: WORKLOAD

## Effects of modified leg mechanics on cognitive performance and workload during dual-task walking

Norman Riedel, Michael Herzog, Thorsten Stein, Barbara Deml
*Karlsruhe Institute of Technology - Institute of Human and Industrial Engineering, Germany*

Mobile exoskeletons as assistive walking devices can modify body mechanics due to their own weight and restricted range of motion, becoming a potential physical and cognitive load for the user when the support is insufficient or the power supply has failed. This study investigates the effect of modified leg mechanics on cognitive-motor interference in a controlled dual-task walking setting. Sixteen healthy young adults walked on a treadmill at their preferred walking speed with and without weights attached to their thighs and shanks while performing a visual-verbal Stroop test and a descending subtraction task. The dependent variables examined were performance on secondary tasks (correct response rates and dual-task effects) and perceived physical and cognitive workload (NASA-TLX). Results show a significant decrease in cognitive performance when walking with weights in the subtraction task, but not in the Stroop test. This suggests that walking with modified leg mechanics primarily demands working memory rather than inhibitory control. The perceived cognitive workload increased for both tasks when walking with the weights. These results indicate that modified leg mechanics may impose a cognitive load. Additional analysis of the motion data may provide further insight into task prioritization and gait strategies during walking with modified leg mechanics.

## Dynamics of ECG and EEG Based Workload Measures Across Tasks

Felix Schroeder, Stephen Fairclough
*Liverpool John Moores University, United Kingdom*

Classifying mental workload during task performance requires high levels of sensitivity and temporal resolution, especially for safety-critical applications. The slow response time of ECG based metrics to changes in mental workload may pose a risk in time-sensitive contexts that could be alleviated by using rich neurophysiological metrics instead. This study employed a rapid auditory probe methodology wherein probe related EEG activity was analysed for changes induced by mental workload. Participants were exposed to about two pure tones per second while performing two common experimental tasks - a well-controlled but artificial working memory task (n-back) and a more ecologically valid and complex multi-tasking paradigm (MATB). Mental workload was manipulated by varying the n-back span (1-back, 3-back, 6-back) and creating three levels of multitasking demand by manipulating the parameters of the MATB. The participants (6 male; 14 female) were trained in both tasks a day in advance. On the second day, 64-channels of EEG were measured alongside ECG data and subjective self-report measures of mental effort. For the current paper, we will compare the sensitivity of EEG- and ECG-based markers of mental workload across three levels of difficulty, in the context of both working memory and multitasking tasks.

## EEG and behavioural correlates of attentional processing in naturalistic environments

Magnus Liebherr, Andrew W. Corcoran, Phillip M. Alday, Scott Coussens, Valeria Bellan, Caitlin A. Howlett, Maarten A. Immink, Mark Kohler, Matthias Schlesewsky & Ina Bornkessel-Schlesewsky
*University Duisburg-Essen, Germany*

The ability to regulate one's attention in accordance with fluctuating task demands and environmental conditions is becoming increasingly relevant in our increasingly technological world (e.g., in highly automated driving, collaborative robots etc.). Although the electrophysiological correlates of attentional processing have been extensively studied in the laboratory, relatively little is known about the way they unfold under more variable, ecologically-valid conditions. Accordingly, this study employed a 'real-world' EEG design to investigate how attentional processing varies under increasing cognitive, motor, and environmental demands. Forty-four participants were exposed to an auditory oddball task while (1) sitting in a quiet room inside the lab, (2) walking around a sports field, and (3) wayfinding across a university campus. In each condition, participants were instructed to either count or ignore oddball stimuli. While behavioural performance was similar across the lab and field conditions, oddball count accuracy was significantly reduced in the campus condition. Moreover, event-related potential components (mismatch negativity and P3) elicited in both 'real-world' settings differed significantly from those obtained under laboratory conditions. These findings demonstrate the impact of environmental factors on attentional processing during simultaneously-performed motor and cognitive tasks, highlighting the value of incorporating dynamic and unpredictable contexts within naturalistic designs.

## Assessing physical demands using wearable smartwatches among precast concrete construction workers

Oscar Arias, James Groehler, Mike Wolff, Sang D. Choi
*Department of Occupational & Environmental Safety & Health, University of Wisconsin - Whitewater, WI., United States of America*

Construction work is a physically demanding job that exposes workers' musculoskeletal system to high physical loads. Assessing physical activity levels at work as a proxy of the physical demands is essential to implement tailored interventions in physically demanding jobs. Our study aimed to characterize precast concrete workers' physical demands at work and outside of work. Direct heart rate (HR) measurements were used to estimate physical demands. A total of 21 precast concrete workers wore a smartwatch HR monitor for seven consecutive days. HR data was parsed in minutes associated with occupational and non-occupational physical activity. The percentage of HR reserve (%HRR) was used to determine physical intensity levels. Directly measured HR data corresponding to occupational physical activity (OPA) were 177,266 seconds, and the data points of physical activity outside work were 162,694 seconds. Workers accrued a median of 415 minutes of directly measured moderate OPA per week. The results revealed that the sample group of workers was getting a high amount of moderate OPA. This study's findings could help better understand how to design and implement interventions as part of an integrated human factors and ergonomic approach in the construction industry.

# SESSION 7: MARITIME HUMAN FACTORS

## Sharing Periscope Imagery and Analysis Tools in a Simulated Submarine Control Room

Shayne Loft, Steph Michailovs, Zachary Howard, Stephen Pond, Madison Fitzgerald, Troy Visser, Jason Bell, Gavin Pinniger, Jessica Irons, Megan Schmitt, Matthew Stoker, Sam Huf
*The University of Western Australia, Australia*

Submarine periscope operators analyse visual imagery and share outcomes (e.g., contact classification, range) to the submarine control room team to allow tactical picture compilation (contact localisation). This work design creates an information-processing bottleneck, which may be alleviated by digital technology that allows periscope imagery and imagery analysis tools to be made available across the submarine control room. We examined the impact of sharing periscope-operator visual imagery and analysis tools in eighteen five-member teams (Sonar, Periscope, 2xTrack Motion Analysts, Track Manager) who undertook simulated submarine patrol. Compared to an unshared baseline condition, sharing periscope imagery increased perceived workload, with no improvement to team performance (tactical picture compilation). When both periscope imagery and the tools to analyse that imagery were shared, perceived workload increased and tactical picture compilation was more accurate. In contrast to the increased perceived workload, individuals in teams provided imagery (with or without tools) had a lower physiological response (heart rate variability, electrodermal activity) to task demands compared to baseline. Sharing imagery and analysis tools benefited performance by enabling dynamic task redistribution and multiple streams of concurrent data analysis. These findings have implications for other work domains that require teams to integrate information to develop a tactical picture.

## Augmented Reality for Situation Awareness in Ship Navigation

Floris van den Oever, Anna Kartnes Andersson, Morten Fjeld, Kjetil Nordby, Joakim Vindenes, Bjørn Sætrevik
*University of Bergen, Norway*

High-quality collaboration between ship bridge crew members is crucial for safe ship navigation. The key collaboration components of shared situation awareness and communication may be improved through augmented reality (AR). Implementing AR for ship navigation requires an understanding of how it influences situation awareness and communication, as well as an understanding of its usability and potential risks and advantages. We studied these factors in a preregistered experiment with a between-subject design (see https://osf.io/ackt3). Forty participants performed the role of ship bridge lookout on two virtual reality (VR) simulations of arctic ship navigation scenarios. One scenario had VR simulation of conventional ship navigation equipment, and the other scenario had VR simulation where the navigation equipment was enhanced with AR components. Situation awareness was measured with a modified SAGAT, the communication was analysed in terms of situation awareness level themes, usability was measured with the System Usability Scale, and perceived risks and advantages were measured with a structured interview. We will present and compare the safety implications of ship navigation with and without AR elements. Findings may inform the development and research of AR applications for collaboration in safety-critical operations such as ship navigation.

## Room to Manoeuvre - Exploring Seafarer's Expectancy-Value, Motivation and Preference for Automation in Route Planning

Mourad Zoubir, M. Gruner, & Thomas Franke
*University of Lübeck, Germany*

To close energy efficiency gaps in shipping and thereby support climate goals, a clear understanding of what motivates seafarers to engage in energy-efficient behaviour at sea, as well as their preferences for automation in this regard, is needed. The objectives of this study were the development of a hierarchical task analysis (HTA) of route planning, an expectancy-value-cost evaluation of these tasks, and an examination of factors possibly affecting seafarers' motivation to complete these tasks. To this end, we developed a comprehensive HTA based on domain-specific requisite guidelines and further iterated upon by subject experts. Based on the task analysis results, we conducted an online survey of nautical officers who rated success expectancy, subjective value and perceived cost of these tasks, as well as self-ratings of psychological need fulfilment and locus of control. Additionally, participants rated preference for manual control or automated systems in four automation types (acquisition, analysis, decision, action) in route planning. Drawing upon results, we discuss how to inform development of automated, human-centric decision support systems that assist energy-efficient operations on board. More precisely, we elaborate how such systems can support routing tasks with higher value but lower expectations of success or higher cost.

## A simulator-based investigation of workplace stressors on human performance: An fNIRS study

Steve Symes, Steve Fairclough, Jin Wang, Zaili Yang, Eddie Blanco-Davis
*The faculty of maritime engineering and technology, Liverpool John Moores University, United Kingdom*

80% of incidents in the maritime sector are linked to human error. These errors could be the result of increased mental workload in operators due to the addition of various workplace stressors. This study's aim is to evaluate the effect of workplace stressors on human performance. To achieve this aim, a simulator study was conducted to investigate workplace stressors influence on human performance in a ship engine room. 20 participants were recruited for each investigation. The participants interacted with a TRANSAS simulator series 5000. The participants took part in a 30-65minute scenario where they had to correct a fault with the ballasting system. During this interaction, half of the participants experienced adverse workplace stressors (distraction, fatigue and an increased workload). The other half were given a standard task. Functional near-infrared spectroscopy (fNIRS) was utilised to measure neurophysiological activation from the dorsolateral prefrontal cortex (DLPFC). The results indicated increased activation of lateral regions of the DLPFC, this trend was enhanced due to workplace stressors. From the results of this study a scientific human error model was developed and can be used by the maritime industry to better evaluate and understand human error causation and the effect of workplace stressors on seafarers.

# SESSION 8: HIGHLY AUTOMATED VEHICLES

## Sound and Vision: Can auditory displays support a visual HMI in maintaining vehicle automation mode awareness?

Canmanie Teresa Ponnambalam, Rins de Zwart, Reinier Jansen
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Higher levels of vehicle automation allow for less constant attention on the driving task, enabling drivers to engage in non-driving related activities (NDRAs). Shifts between levels of automation require self-regulation of NDRA engagement in order to remain sufficiently attentive for future changes in automation level. A visual HMI can provide information about current and upcoming changes in automation level but requires visual attention, compromising the convenience of automation. Auditory displays have been used to provide continuous information during monitoring tasks, but there has been little research into how sound can aid automation supervision in the driving context. An online video study explored how auditory displays can augment a visual HMI of a self-driving vehicle while participants were engaged in an NDRA, comparing sounds that convey information about current and (time to) future system states through changes in volume, inter-pulse interval, harmonic series, and pitch. Adding sound improved perceived direction of change and remaining time until changes in automation level. Despite best efforts in sound design, sounds in the vehicle were initially perceived as bad even when they indicated something positive such as an upcoming increase in automation level. This and other implications for HMI research and design are discussed further.

## Conceptualization and evaluation of adaptive driver tutoring for conditional driving automation

Nikolai Ebinger, Sandra Troesterer, Norah Neuhuber, Peter Moertl
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Drivers of automated vehicles are often overstrained by the complexity of driving automation resulting in difficulties in using automation. Recent research shows that driver tutoring is a promising approach to improve drivers' understanding and use of driving automation (e.g., Boelhouwer et al., 2020; Forster et al., 2019). We propose that presenting information in an adaptive and context-sensitive way can help drivers to use vehicles with conditional automation (SAE level 3) safely. Thereby, a special focus of our tutoring approach is improving the transition of control from automation to the driver. In our approach, drivers are provided with an initial tutoring video before driving and receive auditive explanations and adaptive instructions based on their take-over performance during the drive. In a simulator study (N = 20), we compared a group with tutoring to a baseline group that only received written instructions. Our results show that drivers with tutoring had a better mental model of the driving automation and gazed less at a non-driving-related activity while taking manual control. In line with these results, drivers stated that they changed their behaviour toward the adaptive feedback. Our research confirms that adaptive and context-sensitive tutoring helps drivers to use and understand conditional driving automation.

## Comparing accepted gaps in traffic flow for initiating left-turn actions in different intersection scenarios – A driving simulator study

Ann-Christin Hensch, Matthias Beggiato, Josef F. Krems
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Traffic as a social system requires the coordination of different road users, particularly during turning actions at intersections. Due to anticipating the development of driving scenes and adapting own manoeuvres, drivers maintain individual safety margins (accepted gaps, GA) in traffic flow. However, accepted gaps are influenced by various factors. Therefore, to provide user acceptance and intuitive interactions in mixed traffic, involving manual and automated vehicles (AVs), appropriate gaps according to influencing factors need to be selected by AVs when initiating turning manoeuvres (i.e., supporting road safety but also traffic flow). In the current driving simulator study, GA parameters during left-turn actions in two different intersection scenarios (i.e., including oncoming traffic vs. crossing traffic at the intersections) were investigated and compared by a within-subject approach with N = 29 participants contributing. The results of the study provide further insights into drivers' interaction behaviour. Moreover, the results show the influence of varying scenarios on driving parameters (i.e., GA), despite requiring comparable manoeuvres of left-turns. The findings could provide a basis for intuitive driving parameters in AVs and further insights to influencing factors on driving behaviour. The results should be considered for integration into AVs as it enables adapting driving actions accordingly.

## Behavioural Communication on the Motorway Slip Road: A Driving Simulator Study

Sofie Ehrhardt, Raphael Roß, Barbara Deml
*Karlsruhe Institute of Technology, Germany*

The mutual use of infrastructure by (partially) automated and manually driven vehicles requires an understanding of human communication in road traffic. This paper investigates the situation of the motorway slip road. In a driving simulator study (N=32), subjects evaluate the behaviour of an interaction partner regarding cooperativity and criticality. The interaction partner was either a regular car or marked as automated by an external Human-Machine-Interface (eHMI). Three behavioural communication means were tested: Accelerating, decelerating, and maintaining speed. Subjects experienced this both from the perspective of the slip road and the right lane while the interaction partner merged (2x3x2 design). Subjects on the slip road evaluate the behaviour of partners with eHMI significantly less critical. If they are already on the motorway themselves, an eHMI on an oncoming vehicle has no influence on the evaluation. However, subjects maintain a significantly greater distance from oncoming vehicles with eHMI. When entering the motorway, deceleration of the cooperation partner in the right lane is perceived as less critical and more cooperative than acceleration. Maintaining speed is rated even more cooperative. If the cooperating vehicle is on the slip road, deceleration by it is assessed as less critical and more cooperative than acceleration.

# KEYNOTE

## Human Factors, Ergonomics and Human Systems Integration for biological and artificial intelligence

Frank Flemish
*RWTH Aachen University*

Both Human Factors & Ergonomics as the meanwhile classical discipline to address human issues with technology, and it's younger sister discipline human systems integration, addressing the systemic integration of human, technology, organization and the environment, started in the last millennium where the human was thought to be the only source of intelligence in a system.
At the end of the last millennium, with the conception of cybernetics and AI in the 1950ties, more and more researcher started to dream that machines might become intelligent as well. Now, still at the beginning of a new millennium, humans develop machines with cognitive capabilities, which surpasses human capabilities in more and more domains. While one part of the scientific community and of the public still thinks that machines will never outsmart the human, another part of the community is already developing autonomous systems which replace humans, and intelligent chat programs, which becomes virtually undistinguishable from humans.
I will at first try to shake up the sleeping part of the community with a couple of striking recent examples. Bypassing the discussion on whether machines can really have human intelligence, it will base the discussion on the scientifically more grounded concept of cognition and its role in cybernetic feedback loops. Inspired by Wieners book on cybernetics as the control in animals and machines, a model is introduced, which originally started in the military domain and its discussion about the control of AI, and generalize this into a holistic model of biological and artificial cognition.
Instead of talking about an unavoidable fate of technology, e.g. in form of a singularity (Kurzweil) or Superintelligence (Transhumanism/Nick Bostrom), I will develop a perspective of critical optimism that we humans still have an influence on how non-biological cognition is used. A couple of key challenges and potential solutions like joint and cooperative cognition and its technical and ergonomics counterparts cooperative automation, cooperative AI and reversible symbiotic systems are sketched. Not surprisingly, Human Factors & Ergonomics and Human Systems Integration can contribute significantly to balance human, technical, organizational and environmental cognition in a way that we can assert our role as homo sapiens but only if we wake up. It is not too late, but time is up.

Human Factors and Ergonomics Society
EUROPE CHAPTER

# FRIDAY APRIL 28th

# SESSION 9: AVIATION

## Training media allocation: Simulator vs actual flying

Dimitrios Ziakkas, Konstantinos Pechlivanis, Anastasios Plioutsias, Hans Cornelius Natakusuma
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(a) Concise statement of the thesis: This review examines the targeted allocation of training media in pilot licensing allocation: Simulator through human factors science research to determine the effective value of on - aircraft flight training considering the evolution of training media and the pedagogical development of flight training. (b) Brief discussion of the sources: A review of the existing literature on the existing simulator devices structured the proposed research in flight training design and potential user reactions. Interviews with Subject Matter Experts and questionnaires (disseminated to a group of professional pilots) examined different training methods and media implementation. Results were analysed, and the suitability and significant differences of simulator vs. actual flying training were evaluated. (c) A summary of major conclusions: Results indicate the AI implementation challenges – limitations and resistance of users in transitioning from actual and traditional flight simulators to AI training. 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), simulator training, human factors, ergonomy, decision-making.

## What would you expect? Insights from a customer journey analysis of passenger drone flights

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*Johannes Kepler Universität Linz (JKU), Germany*

Urban Air Mobility (UAM) includes, among others, passenger drones that transport passengers from A to B along fixed routes and predefined stops (vertiports). As with any future technology, there are various issues to be resolved before widespread use by potential customers can be expected. Among the main factors, high user acceptance and customer experience are responsible for the success of this technology. To better understand what customers expect from a passenger drone flight along the entire journey (including booking, check-in, security control, boarding, actual flight, …), several user workshops with a total of N = 21 participants were conducted. The results are presented in an attempt to help other researchers in the field of UAM to get started. The findings include the need for safety briefings, the display of information about flight status and weather, as well as flexible luggage options. In addition, future passengers expressed a desire for a clean environment, clear security measures, time-saving processes, and good accessibility. The greatest emphasis was placed on qualified personnel at every single stage of the customer journey. In summary, for a successful start of UAM, user requirements must be considered to create an inclusive and accepted future mobility solution.

## A new experimental method to investigate multitasking strategies in flight environments via the use of gamification

Sophie-Marie Stasch, Sophie-Marie Stasch
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Aviate, navigate, communicate: this approved axiom for pilots demonstrates that the use of an appropriate multitasking strategy is essential to operate an aircraft safely. Different multitasking strategies have been identified recently in basic research studies. However, they have not been experimentally manipulated in a flight environment. Therefore, a suitable experimental method is required to establish a precise connection between a multitasking strategy and the related performance outcomes. The present approach manipulates the stability-flexibility-dilemma of cognitive control as a multitasking strategy using the Multi-Attribute Task Battery (MATB). The MATB simulates four flight tasks that must be completed simultaneously. By the use of a novel gamification method, participants had to either complete the flight tasks in a more stable or more flexible control state. Results indicate the successful manipulation of the multitasking strategy by differences in the task performance and the distribution of visual attention. Future studies may adopt the described method to investigate other multitasking strategies in the cockpit. The presented method is not limited to the field of aviation, but can also be used to examine multitasking strategies in other domains such as air traffic control or driving.

## Assessment Of A Hybrid Cursor Control Device (CCD) For Highly Dynamic Cockpit Environments

Engelbert Hartmann
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In today's fifth generation fighter aircraft, the human-machine interface is relying largely on display interaction, which is physically enabled by cursor control devices (CCD). The challenges of increased mission complexity and operational tempo in future multi-domain environments, suggest the need to further increase the efficiency of interaction modalities. This work proposes a hybrid CCD, where head-control is used for long distance coarse aiming, followed by fine control of the cursor with a trackball in the terminal phase of the approach. A research prototype is evaluated to answer the principal question, whether the hybrid concept could provide performance advantages over the respective single modalities in a dynamic cockpit environment. The experimental study exploited a within-subjects design with 12 fighter pilots in a laboratory setup, using a motion platform to simulate various flight dynamic conditions. Throughput was used as a single measure for performance, while the variation of pointing distance refined the results. Furthermore, user behaviour, workload and subjective attitudes towards the use of the modalities were captured to supplement the comparative evaluation. Overall it is concluded, that the hybrid CCD modality can provide significant advantages for long distance point and select tasks under light atmospheric turbulences.

# AGEING, ATTENTION AND... THE DARKNET!

## Improving Voice Interface Design for Older Adults

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For many older adults, voice interaction – such as with smart speakers or virtual assistants - can be a bridge to computing that has less friction than using a computer or a smartphone. However, despite the possibilities these interfaces offer, there are some challenges when using voice interfaces, including difficulty hearing the speech challenges with speaking clearly or loudly enough for the device, and/or memory issues recalling instructions and issuing commands. Making voice interfaces more useful and usable to older adults would positively impact adoption and unlock the benefits of digital interaction. On the input side, first, there is the obvious and easy to implement: provide clear written instructions for use designed with the older adult population in mind (e.g., large fonts). Second, improve the speech recognition algorithms to account for age-related changes in speech patterns (e.g., prosody, slower, halting, tremors, fillers, etc.). On the output side, voice designers should focus on: pacing, enhancing dialogue (e.g., more giving turn-taking), and physical factors such as volume adjustment. Overall, by focusing on improving the dialogue design, voice recognition technology, and instructional support of voice interfaces, technology companies can make these devices more accessible, useful and usable for older adults.

## VRalive: A virtual reality project in nursing homes with the purpose of improving activity, well-being and social communication for seniors

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*VirtuaLounge, Braunschweig, Germany*

In geriatric mental health rehabilitation, the objective is to restore function and improve the quality of life for the elderly. VR-based intervention is a new field in geriatric rehabilitation that has grown rapidly over the last few years. There are two main applications of this technology: training in function with specific tasks on the one hand, and entertainment to improve well-being on the other hand. Additionally, supporting social interaction is also essential to prevent loneliness as a result of aging. In order to combine these three components, we designed a virtual reality intervention (Project VRalive) for elderly people in nursing homes. The virtual reality story is to build a cottage in a VR environment. Seniors can participate in activities they are no longer able to do in reality, such as gardening and making pizza, with head-mounted displays and consoles during four group sessions. Before, during, and after the intervention series, two psychologists measured the activity, abilities, well-being, and user feedback of the participants. The preliminary data of 49 participants show slight improves of abilities in adjustment, flexibility, group integration and endurance from before to after 4 VR-interventions. Usability of the application as well as feedback from nurses are presently assessed.

## Effects of attention manipulations on passive risks estimation and mitigation

Yoella Bereby- Meyer, Lidor Krava, Ron Carmeli
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Global warming, pandemics, and cyber security are all risks that can be reduced, but people tend to ignore them. These behaviours reflect people's tendency to take passive risks, namely inaction-based risks. We demonstrate that passive risks are perceived as less risky than equivalent active risks. As many of these risks will materialize in the distant future, they draw less attention and emotional reaction than active risks. Therefore, they are underestimated and less mitigated. In 3 experiments (N= 353) we manipulated attention toward different passive risks using an attentional search procedure. In Experiments 1 and 2, participants searched for a designated target risk in a set of 10 sequentially presented risks. Then they assessed each risk's severity and level of fear. Target risks were seen as more severe than others. This effect was mediated by reported fear. In Experiment 3 participants in the experimental condition had a cyber security risk as the target risk, while in the control condition it was a non-cyber security risk. Consequently, the two conditions differed in cyber security behaviour, as reflected in an increased rate of password strengthening. These experiments show that devoting attention to passive risks may raise fear and the tendency to mitigate them.

## Disrupting the trade of illicit goods in the darknet: does information manipulation influence buyer decision making in darknet marketplaces?

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The darknet is a layer of the Internet that enables anonymous communication and the trading of illicit goods. Recent Human Factors research has suggested that information manipulation could be used to influence buyer decision-making, enabling law enforcement to steer buyers toward controlled vendors (Lane et al., 2021). This paper describes the findings from two studies undertaken to test the effect of information manipulation on buyer decision-making. Both used a simulated darknet, with participants being asked to choose to purchase a quantity of MDMA/Ecstasy from one of 16 vendors. Study 1 was undertaken on-line, with participants (n=47) completing a post-hoc questionnaire regarding the factors influencing their decision-making. Study 2 was undertaken in person, with participants (n=22) completing a post-hoc Critical Decision Method interview (CDM; Klien et al., 1989). In both studies the majority of participants chose not to purchase drugs from 'hostile' vendors negatively portrayed via the information manipulation (77% in study 1, 68% in study 2). Questionnaire and CDM responses showed that vendor reputation, forums, and product descriptions had the most influence on buyer decision-making. It is concluded that information manipulation provides a useful tool for law enforcement agencies wishing to disrupt the trade of illicit goods in the darknet.

# POSTERS

## Investigating trust attitude as a mediator and the moderating effect of risk in human-automation interaction

Steffen Hoesterey, Linda Onnasch
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In many models of trust in automation attitudinal trust serves as a mediator between the perceived system properties (e.g., reliability) and the behavioural trust (e.g., reliance, compliance). However, there is evidence questioning this mediation, especially in studies not incorporating risk as a key contextual factor. In a two-factorial between-subject design study this relationship was investigated using moderated mediation analysis. In a virtual reality multi-task paradigm 80 participants had to conduct their task while being supported by one of two decision automations differing in their reliability (60% vs. 90%). Risk was also varied between subjects. Mistakes in the primary task could either result in a purported waste of resources (no personal risk) or the possibility of virtually falling from 70m above the ground (personal risk present). Results show that the relationship of reliability and trust behaviour is not mediated by trust attitude. This is striking as several important models (e.g., Lee & See, 2004) predict this relationship as a given. Moreover, risk is a significant moderator of the relationship between reliability and trust attitude as well as reliability and trust behaviour. The relationship is stronger the higher participants rate their perceived risk.

## Rethinking Public Transportation: Why do commuters intent to adapt?

Eva Gößwein, Magnus Liebherr
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Technical progress in highly automated vehicles inspires researchers and experts to reinvent established public transportation, augmenting the existing infrastructure with innovative on-demand solutions. The availability of affordable, sustainable, and highly automated transportation in turn could inspire commuters to rethink their everyday mobility behaviour. This study will therefore explore the human factors influencing the intention to adapt a new form of public transportation: the Fast-Lane Artificial-Intelligence Transportation System (FLAIT). Interindividual variability of mobility behaviour has been explained applying the theory of planned behavior (TPB). We extend these insights by considering additional person factors related to technology. Using a German panel, we will conduct a pre-registered online study introducing FLAIT via a video simulation. The measured variables include the classical TPB constructs fitted for the transportation context (attitude, subjective norm, perceived behavioural control), environmental drive, and technology readiness, all of which we assume have an influence on the intention to adapt to FLAIT, supposedly moderated by the perceived risk of climate change. As the survey is going to be carried out in the beginning of 2023, we will present our results at the Annual Meeting of the HFES, Europe Chapter.

## Does subjective knowledge predict acceptance of automated technologies?

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Automated technologies are developing rapidly and attracting increasing attention in our society. However, the numerous advantages are offset by a lack of acceptance. In order to get a better understanding of potential influencing factors, the present study aimed at focusing on the effects of subjective knowledge on the perception and acceptance of autonomous vehicles. Within an online study, N = 435 participants (M = 28.59; SD = 10.04 years; 291 female) received a four-minute explanatory video on autonomous driving. Before and after the video, subjective knowledge was surveyed. Furthermore, variables on perception and acceptance of autonomous vehicles were examined. Within a structural equation analysis, subjective knowledge was shown to directly influence perception (perceived risk and perceived ease of use). In addition, indirect effects via the perception factors on acceptance could be determined. Furthermore, participants showed a higher subjective knowledge after the explanatory video than before. Participants with previously below-average knowledge indicated a higher increase in knowledge than participants with above-average subjective knowledge. The results indicate that subjective knowledge is a determinant for improving perception and subsequent acceptance. In this regard, individuals should be informed about automated technologies at an early stage before misconceptions and expectations become established.

## Developing Self-Standing Robot Systems for Safe Human-Robot Collaboration in Dynamic Environments: The SESTOSENSO Project

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There is a growing need for robotic systems that can safely act and interact in dynamic environments and increase the flexibility of shop floor configurations in production and service facilities. The Horizon Europe Project SESTOSENSO project aims to develop autonomous robotic systems that can safely operate and interact with human workers in dynamic environments. The project takes a transdisciplinary approach, combining technology with human factors, cognitive ergonomics, and organisational psychology expertise to develop technologies that support human operators and improve their safety and well-being. The project also focuses on developing fluid and intuitive interfaces and interaction patterns that address human factors such as usability, trust, acceptability, and mental models. By designing robots that understand the intentions of human workers and meet their innate expectations, the project aims to increase productivity and make companies more flexible. The project includes actions led by human factors experts and organisational psychologists to ensure that the planned robotic solutions are safe, efficient, intuitive and enhance the robots' cognitive and social capabilities.

## Driver Monitoring state: Procedure and methodologies to monitor the driver distraction in the driving simulator

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The main characteristics of a driving simulator are the highly realistic vehicle dynamic models and a configurable vehicular traffic model. It allows to study driver behaviour by exposing users to dangerous driving tasks without physically risk. In the NextPerception project, the driving simulator has been used to validate a driver monitoring system (DMS) capable of detecting the driver distraction (emotion, cognitive and visual distraction, arousal). Moreover, a dashboard on the cluster has been developed to provide indications of the output of the DMS. For the tests, three user stories have been created. User stories are those of Julie, Peter and Michael, three ordinary people who use vehicles for everyday journeys, but who find themselves in unsuitable driving conditions for different reasons. Details about the procedures and methodologies followed to test the system will be presented. A first test has been run with the aim to validate the DMS. Participants have performed various secondary tasks while driving to simulate the distractions and different kinds of emotional activations. A second test has been executed to assess the effectiveness of the recovery strategies. Participants were asked to emphasize with the user of the user stories by imagining themselves within specific driving context.

## How crowded is the train? Investigation of the optimal conditions for providing capacity information for public transport

Malte Petersen, Mandy Dotzauer
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Crowding in public transportation (PT) is a major challenge that has both negative economic consequences for providers and negative psychological consequences for passengers. The increasing availability of precise information on capacity rates of PT brings the possibility of providing information on alternative, less crowded route options to passengers. In order to determine when, how and where the information on capacities needs to be displayed to be effective for planning a trip, an online study was administered. The goal of the study was to investigate the effects of socio demographic features of passengers, PT-use, certain trip characteristics, use of journey planner apps and the perceived usefulness of capacity information (PUC) for passengers. Data was collected via an online questionnaire. Results show that older persons are more interested in information on capacity rates but use journey planner apps less often. While frequency of PT-use had a significant negative effect on use of journey planner apps, no effect on PUC was found. Regarding trip characteristics, PT-service frequency and trip duration had a significant effect on PUC. Strategies and requirements for providing capacity information effectively will be derived.

## Identifying requirements for a novel gig economy incident reporting tool with Cognitive Work Analysis

Gemma Read, Grant Butler, Paul Salmon
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The so-called 'gig economy', whereby 'gig workers' utilise the road system to provide on-demand services (e.g., ride-hailing, food/goods delivery) via intermediary online platforms, is expanding. Gig workers are usually independent contractors and do not fall under the protection of standard organisational safety legislative requirements. However, they are likely influenced by various work pressures, for example, consumer and platform expectations of on-time delivery under time pressure and optimising earnings given they payment per 'gig'. The vulnerability of gig workers is evident, with a number of serious incidents, especially involving cyclists, being reported internationally. However, limited availability of safety data means that the frequency of incidents, near misses, and factors influencing gig worker safety remains unknown. This study aimed to use a Cognitive Systems Engineering approach to support the design of an app-based incident reporting tool for gig workers in Australia. Specifically, the abstraction hierarchy from Cognitive Work Analysis was applied to identify design requirements for the incident reporting tool. A draft abstraction hierarchy of the tool was developed and validated via a workshop with 13 stakeholders from government, unions, gig platforms and industry associations. The presentation will outline the abstraction hierarchy and how design requirements were identified.

## Studying cyclist-vehicle interaction on a bicycle street: comparing results from a driving simulator and online study

Arjan Stuiver, Dick de Waard
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The interaction with vulnerable road users, such as cyclists and pedestrians, is often difficult for drivers. One reason is that pedestrian and cyclist behaviour can be very diverse and unpredictable especially when they interact with vehicles in urban areas. Since the consequences of errors in this interaction can be very serious, solutions are developed in different areas. Infrastructure can for example increase safety, just as the introduction of intelligent safety systems in vehicles. For these developments it is important to understand pedestrian and cyclist behaviour. We therefore created scenarios in which drivers (usually) interact with cyclists on bicycle street, an infrastructural design solution for safer interaction. We studied the effects of bicycle street design both in a driving simulator and an online questionnaire. In this work we report the results on design choices and the possibilities to study vehicle-cyclist interaction with these two tools.

## The autonomous family vehicle autoELF - Results from a usability study with parents and their minor children using a high-fidelity prototype

Vanessa Stange, Kerstin Kuhlmann, Tobias Schräder, Leon Brettin, Markus Maurer
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In the project unicaragil (funded by the German Ministry of Education and Research), the autonomous family vehicle ("autoELF") is being developed for the use in a multigenerational family. The vehicle concept is intended to provide a new, more independent means of transport for minor children who have not yet reached the legal minimum age to drive a car and for older persons who are no longer able or allowed to drive themselves. In a usability and UX study with the high-fidelity autoELF protoype, we examine the behaviours and opinions of parents and their minor children when using all of the vehicle features required to operate the vehicle. We include the trip planning app, safety features that children should be able to use independently while driving, and the infotainment system. For each vehicle feature, we have developed usability tasks that can be solved either by the child or by the parents. The aim of the study is to gain insights into the needs of parents and children and to promote user-centred development for the next generation of autonomous family vehicle prototypes. Data collection is currently underway. In total, we plan a sample of 15 teams of parents and children.

## Aircraft design requirements against known security threats and detection capabilities in service

Kristoffer Birger Borgen, Dimitrios Ziakkas, Hans Cornelius Natakusuma
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(a) Concise statement of the thesis: This review assesses aircraft design requirements against known security threats, detection capabilities, and the role of human factors in aviation safety. (b) Brief discussion of the sources: A review of the existing literature also considers the technical capabilities and requirements of cyber-attacks on various aircraft systems. In contrast, minimal emphasis has been placed on the pilot's decision-making process during and after a cyber-attack on aircraft systems. Multiple potential attack scenarios were investigated at the Purdue University A-320 MPS simulator. Each simulated attack was a repeat situation of the previously established landing scenario focusing on aircraft design requirements against known security threats and detection capabilities in service. (c) A summary of major conclusions. Results were analysed, and the pilots' decision differences were evaluated. Most of the pilots chose to initiate a go-around during the simulated cyber-attack. However, the decision was not unanimous among all the pilots. Some decided to continue with the landing sequence due to familiarity with the airport, confidence in the aircraft system, and the current location and velocity. The process was also triggered over 30 seconds, with the earliest decision occurring 5 seconds after the attack was initiated and the longest around 25 seconds. (d) Keywords: Human Factors, security threats, aircraft design, ergonomy, decision making.

## Assessing the physiological effect of non-driving-related task performance in conditionally automated driving systems: A systematic review and meta-analysis

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Background: Conditionally automated driving requires the driver to remain ready to resume control of the vehicle in response to takeover requests, which are issued when the system encounters a scenario outside of its operational design domain. With increasing vehicle automation, drivers often engage in non-driving-related tasks (NDRTs) which have been shown to increase cognitive load, thus hampering the driver's ability to fulfil takeover requests. The present systematic review and meta-analysis therefore sought to understand the physiological effect of NDRT engagement during conditionally automated driving. Methods: Five electronic databases were searched for records published since 2012. These records were screened for eligibility, and relevant data was extracted from a final sample of 32 studies. Analysis was conducted using a narrative synthesis and a meta-analysis. Results: There was strong evidence that NDRT engagement led to an increase in heart rate, modest evidence for an increase in electrodermal activity and a decrease in heart rate variability, and mixed evidence for an effect on eye movements and respiration. Conclusion: Understanding psychological factors such as cognitive load and fatigue are of critical importance to the development of driver monitoring systems which can track driver state changes – physiological parameters can help to reach this goal.

## The Driving Style as Cooping Skill: strategies to mitigate Electric Vehicle Range Anxiety

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Battery Electric Vehicles (BEVs) offer the opportunity to face many sustainability challenges. Range Anxiety (RA), defined as the driver's fear of running out of electricity before reaching another available charging station, is one of the main barriers to the BEVs' spread. RA involves many factors, such as psychological characteristics of the driver, algorithms, interface features, BEV technical aspects, infrastructure configurations and policies. Following a Systematic Review, drivers' Coping Skills and Driving Style (DS) emerged as possible factors affecting RA. In an experimental procedure, 51 participants drove a BEV in a real traffic field. The State of Charge (SoC) level and the task instructions were manipulated. The RA level was measured by the "Primary Appraisal and Secondary Appraisal" questionnaire, while the Driving Style was assessed by the "Multidimensional Driving Style Inventory". The physiological activation (EDA) was measured as well. The results show that, in high SoC condition, participants felt less RA when their DS was "patient", while in low SoC condition, participants felt to be in control of the situation when their DS was "risky". The collected data would be beneficial for designing an adaptive HMI, which considers drivers' preferences and SoC condition, reducing RA and improving BEVs acceptability.

## I also care in manual driving - Influence of type, position and quantity of oncoming vehicles on manual driving behaviour on straights 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 behaviour. Trucks and vehicles with lateral offset to the road centre lead 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 on-coming vehicles. Thus, our results help to design an accepted and trusted trajectory behaviour for highly automated vehicles.

## Modelling human behaviours in urban driving scenarios: A computational rationality approach

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Vehicles are having increased autonomous driving capabilities and to ensure safe interactions with humans it is important to understand how humans behave in everyday traffic situations. An urban T-junction provides a microcosm of the rich interactions and social norms in everyday driving. Thus, we selected data collection areas to include T-junctions, with frequent interaction and communication between drivers. Next, we define different behaviours such as gap acceptance hesitation by vehicles, headlight flashing (social norm) to encourage a vehicle to merge or turn, exaggerated acceleration or deceleration to emphasise right of way or giving way to detect and analyse in the naturalistic driving data. Lastly, we develop and test a computationally bounded reinforcement learning (RL) agent with respect to the defined and observed behaviours in the naturalistic driving. The computational rationality framework models the human behaviour with the computational bounds on the RL agent, considering human limitations, in our case, sensory limitations. The computational bounds imposed on the RL agent should enable it to naturally behave more human-like. This model thus can be used to build a realistic simulation framework for testing the safety and performances of automated vehicles in an environment with human-like behaviours for interaction with the surrounding vehicles.

## Effects of additional traffic in a deadlock-situation on drivers' cooperation behaviour at an equal narrow passage

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An equal narrow passage is one situation in urban traffic where the right of way is not clearly regulated and drivers have to cooperate. To investigate how additional traffic affects cooperation behaviour in this situation, an online study was conducted. Subjects (N = 32) were shown videos of simulated approaches to a narrow passage. These varied in whether another vehicle drove through the narrow passage in front of the ego vehicle or the oncoming vehicle, and behind the cooperation vehicle. Subjects indicated the anticipated behaviour of the cooperation vehicle and how they would behave themselves. Additionally, they rated the difficulty and visual clutter of the situation. When participants expected the cooperation vehicle to stop, probability to drive first increases. A vehicle in front of the own vehicle increases the probability to drive first, whereas a vehicle in front of the cooperation vehicle decreases the probability to drive first. A vehicle behind the cooperation vehicle does not have an effect on cooperation behaviour. Findings showed no consistent influence of additional traffic on perceived visual clutter and difficulty. These two constructs do not seem suitable to explain cooperation behaviour. Recommendations for the behaviour of automated vehicles are derived from the findings.

## Compliance monitoring effectiveness

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(a) Concise statement of the thesis: This review measures the performance of a compliant system in the context of aviation regulations in terms of qualitative and quantitative methods/tools for use in continuous monitoring. Moreover, it focus how human factors affect compliance, (b) Brief discussion of the sources: A review of the literature (vertical reading of related journals) and interviews with Subject Matter Experts were conducted. Findings were incorporated into developing a questionnaire that includes the performance of a compliant system in the context of aviation regulations in terms of qualitative and quantitative methods/tools for continuous monitoring. The instrument was disseminated to a group of professional pilots. Results were analysed, and the suitability and significant differences of proposed methods/tools were evaluated. (c) A summary of major conclusions: Results indicate that current reporting and survey instruments, while suitable for identifying compliance, are insufficient for monitoring effectiveness. This can lead to misidentifications of compliance levels experienced by crews, especially in cases when psychological fatigue is prevalent. Potential improvements to these instruments are discussed. (d) Keywords: Human Factors, compliance, monitoring methods.

## The role of Human Factors in Aviation Regulatory Framework

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(a) Concise statement of the thesis: This review analyses the role of human factors in regulatory barriers and the associated social implications to establish an adequate regulatory framework for multi-national group operations. (b) Brief discussion of the sources: A literature review assesses the impact of airlines' group operations for regulatory and safety oversight. Operators consolidate their business at the level of multi-national airline groups, which is essential for their commercial viability internationally and in a fully liberalized market. However, most existing rules, including ICAO SARPs, are State-centric. (c) A summary of major conclusions. Results indicate that Human factors barriers within the existing regulatory framework lead to inefficient redundancies and generate unnecessary complexity. Potential improvements to these instruments are discussed under the EASA -FAA organizational culture. (d) Keywords: Human Factors, aviation regulatory framework, ICAO, EASA, FAA.

## How meaningful is a drone? Public acceptance of civil drones in light of their purpose

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Recent literature portrays the public not to be all too negative towards the use of drones, especially if the purpose for the usage is agreeable. In our paper as part of the EU project ADACORSA, we attempt to investigate this notion further. For this, we developed a theoretical acceptance model for drone use, specifically to understand public's acceptance towards drones. A total of 600 participants participated in an online survey to expressed their individual opinion on the use of drones mainly for civil and industrial purposes. To make it as accessible as possible, participants could take the survey in 16 different languages. The model is based on the theory of planned behaviour, but includes relevant inputs from other drone-specific acceptance theories and interview and workshops conducted with experts within the drone industry. The proposed model consists of various determinants: external variables primarily personal experience and familiarity with drones, individual characteristics, and socio-demographic characteristics, and core beliefs principally perceived meaningfulness of purpose, perceived concerns/benefits, social influence and control opportunities each of which are hypothesized to have an effect on drone-acceptance. The aim of this paper is both to validate our developed drone acceptance model and to provide a nuanced overview to drone operators of which purposes are perceived as reasonable and are accepted by the general public.

## Investigating the acceptance of AI-based psychotherapy Apps

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According to the World Health Organization (WHO), 12% of the world's population suffered from a mental disorder in 2019. That number even increased during the COVID-19 pandemic [1,2,3]. Considering this development, the WHO has recently criticized the lack of resources in the mental health infrastructure, preventing patients from getting the help they need [1]. Artificial Intelligence (AI) based applications may increase efficiency in using these resources by matching patients and therapists and providing individual support between therapy sessions. Yet, it is unclear whether patients and psychotherapists accept these tools in the sensitive mental health care area. To investigate this question, we conducted an online questionnaire study, asking 50 psychotherapists and (potential) patients about an app's perceived utility and usage intention using selected items from the meCUE questionnaire. The results show that both groups rated the app functions as highly useful. Also, they wanted to use it regularly, with more frequent use on the therapist's side. The potential patients stated that they would agree to a small monthly service fee, further indicating the personal relevance they see in this psychological support. Implications of the results and limitations are discussed. These results indicate a first step towards an optimized patient care.

[1] World Health Organization. Newsroom, (https://www.who.int/news-room/fact-sheets/detail/mental-disorders, accessed 14 November 2022).
[2] Institute of Health Metrics and Evaluation. Global Health Data Exchange (GHDx), (https://vizhub.healthdata.org/gbd-results/, accessed 14 May 2022).
[3] Mental Health and COVID-19: Early evidence of the pandemic's impact. Geneva: World Health Organization; 2022

## BD Libertas™ Wearable Injector Human Factors development and testing

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The continued aging of the world's population, along with the rise in chronic diseases, and global events such as the COVID-19 pandemic, are putting increasing pressure on the healthcare system to develop new solutions to facilitate more effective patient care delivery in and outside of clinical settings. To enable this shift, BD is developing new drug delivery device platforms that allow transition from intravenous infusion to subcutaneous injection in clinical and new care settings. Such device platforms should be designed with consideration of patient and caregiver usability to reduce the opportunities for use error and delayed or missed treatment. We will present the Human Factors and clinical work conducted on the BD Libertas™ Wearable Injector. We will demonstrate the evolution of device design in response to feedback from experts and users. Usability and clinical considerations that contributed to device platform development will be highlighted, including dose delivery progression, adhesive pad design to accommodate wheal formation in the tissue, the reduced number of use steps compared to other devices, and the ability for the user to detect an injection stall. This poster will highlight usability considerations to develop effective, safe wearable drug delivery device in clinical and new care settings.

## HMI design for a stress and time critical pediatric emergency scenario: PediAppRREST

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Medical support apps can be helpful training tools to minimize deviations from international guidelines in time-critical emergency scenarios. However, not all apps have been tested for usability and workload, and a lack of proper HMI design guidelines has been a significant limitation. To address these issues, an interactive support app, called PediAppRREST, was developed for the management of pediatric cardiac arrest (PCA) using an iterative approach. After the first design stage, the app was tested in a previously published study and found to have good usability evaluation and ease on mental workload. Participants provided qualitative feedback and the results guided the second design stage. Following the refinement, the app is currently undergoing further testing to measure its effectiveness. The objective of this paper is to report the Human-Machine Interaction (HMI) principles derived during the design and testing stages and to collect them as a step toward systemized HMI guidelines for medical cognitive support apps. From an HMI perspective, timely and precise information, effective interaction flows and correct interaction modalities, as well as providing effective feedback were found to be essential. Considerations also addressed User Interface (UI) layout, shapes and buttons, language and readability, and colour selection.

## Which is better, 8-hour work or 12-hour work? - A survey on work-related fatigue of forklift drivers

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In China, some large factories have try to run 12-hour work shifts instead of 8-hour for saving commuting time. However, extended working hours would probably cause employees' fatigue and occupational health problems. Therefore, work-related fatigue of 12-hour shift workers in China were studied. 30 forklift-truck drivers working in a large manufacturing company were enrolled. They were working in a 12-hour shift system and asked to complete a shift rotation including a 12-hour day-shift (7:00am–7:00pm) followed by a 12-hour night-shift (7:00pm–7:00am). During their work, fatigue status including subjective feelings, EMG and EEG were recorded. Changes of fatigue were recorded and analysed. The results showed that the drivers' fatigue appeared after 8 hours work. The night-shift drivers felt more fatigue than day. The drivers felt fatigue especially during 2:30pm-4:00pm and 2:30am-4:00am. Moreover, women felt more fatigue and drowsy at night than men. However, the effects of gender on fatigue were not significant at daytime. It was found that the drivers felt both physical and mental fatigue in 12-hour shift-work and could not recover rapidly. The extended working hours can affect both the performance and health of the people, and it may make human errors occur and cause accidents.

## Hear About It: Case Study on Designing for Pixel Buds Pro Earbud Comfort

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Designing wearable devices that accommodate diverse user anthropometrics and lifestyles is a challenge in Human Computer Interaction. This is particularly true for earbuds. In this case study, we discuss earbud design factors and our approach to prioritize comfort in creating Pixel Buds Pro, launched in July 2022. We contrast form factor differences with previous generation earbuds, Pixel Buds A-Series, released in June 2021. Measuring user comfort is tricky as ear geometry varies by gender, age, and ethnicity, and results in individual differences in fit. Because comfort is subjective, self-reported comfort ratings can differ based on activities when earbuds are worn and duration of wear. Ratings can also be biased by prior earbud ownership. To optimize design of the Pixel Buds Pro for physical comfort, our research considers comfort during a range of initial, active, and prolonged wear activities and contrasts design choices to accommodate functionality and comfort. As part of this study, we look at distinctions in marketing and consumer reviews that reflect design choice differences. While this study focuses on earbud design we propose that our approach might be generalized to wearable and other areas for researchers who are challenged with adapting product design based on evolving user and technology needs.

## The effect of cognitive load and the detection response task on steering behaviour during day and night-time driving

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Previous studies have shown that visually distracting activities that take drivers' eyes-off-road result in a higher number of large steering wheel corrections (revealed by reversal rates) compared to small "micro-corrections", which are normally associated with cognitively demanding, non-visual tasks (Kountouriotis et al., 2016). This study investigated the effect of a visual Detection Response Task (DRT) and non-visual versions of the n-back task (1-back, 2-back) on the driving behaviour of two groups of drivers (Young: Average age 22.30, and Older: Average age 65.82), who completed a driving simulator study during the day and night-time conditions. Results showed that whilst the number of small reversals (0.5°) increased with the n-back task in the absence of the DRT, adding DRT reduced the effect of the n-back, increasing the number of large reversal rates (2.5°). The effect of day and night-time conditions on driving behaviour, and the implication of these findings on road safety will be discussed.

## Improving and Extending Design Guidelines for Human-Robot Collaboration in the Workplace

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Progressive automation and digital transformation in the wake of the fourth Industrial Revolution have led to companies increasingly integrating industrial robots into their workplaces. As a result, interactions between workers and robots have increased in the form of Human-Robot Collaboration (HRC), bringing about a change in work characteristics. Current research on HRC focuses primarily on technical aspects and often neglects the importance of cognitive ergonomics in improving worker well-being and production performance. The present work aims to improve and extend the design guidelines proposed and evaluated by Gualtieri et al. (2022) to improve workstation features and HRC patterns that have been shown to have a positive impact on workers' cognitive responses and assembly tasks. To improve the guidelines in terms of clarity and relevance, a total of 93 papers published between 2020 and 2022 were selected through systematic screening to identify features and interaction patterns that could impact cognitive ergonomic variables. An online questionnaire will then be conducted with experts in the field, asking them to comment on the guidelines in terms of their expertise, to assess their clarity and relevance, and to propose practical solutions for implementing the guidelines and KPIs for evaluating their effectiveness.

## Crease height and width effects on perceived visibility and annoyance of foldable smartphone display crease

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Foldable smartphones have gained much popularity in recent years. One of the factors that impact the user experience of a foldable smartphone is the crease, the line/mark on the display surface that occurs due to the folding/unfolding of the device. A noticeable crease is considered a nuisance, but, eliminating it completely is known to be extremely difficult. The manufacturers are currently making efforts to reduce its visibility as much as possible, making only incremental progress. A crucial piece of information related to this is the relationship between physical features characterizing a crease and its perception. The relationship, if available, can guide the efforts for design improvement by helping to avoid under- and over-design. However, the relationship is currently unavailable, due to lack of research. To address the research need, this experimental study investigated the effects of two crease features, that is, crease height and width, on the perceived visibility and annoyance of a crease. The study participants subjectively evaluated a set of foldable smartphone display prototypes with creases that vary in crease height and width. Statistical models were developed to describe the relationship between each subjective measure and the crease features. Practical design implications of the quantitative models are provided.

## Exploring HMI concepts for human-line interaction design: the ceramics case study

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Industrial production of ceramics is increasingly changing with the introduction of large slabs providing the resize in volumes and manufacturing features, and adding value to furnishings and interior design markets by fostering the production of kitchen tops, walls and table decoration, and home aesthetics at large. The through-body veining allows products ever closer to natural stone, meaning not only on the top surface but in the slab's profile as well. This line is an example of highly-integrated manufacturing synchronization of a unique process bringing the material from pre-forming to decoration printing, with the engagement of the operator through a variety of interconnected machines that work for a single final aesthetics of the product. As a consequence, industrial machine interfaces are evolving into whole-line interfaces able to accompany, guide, and promote the operators' daily routines. In this research, we explore how participatory design methods can support the design of novel concepts of human-line interaction (HLI) on the requirements coming from step-through process analysis of both creative and machine work operators. The HLI interaction design required the combination of task-based analysis and UX design methods to tackle interface challenges such as the complex line-through process control and the coordination with production queues.

## The Effect of Bottom-Up Resource Management on Resilience of Self-Synchronizing Troops: Results from a Constructive Simulator Study

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Background: Self-Synchronization is supposed to be one of the key elements of resilience by keeping up performance in overstrained and degrading systems where teams and units are constantly breaking up and reconfiguring to keep up a functional output. In a military context, self-synchronization refers to the ability of a force to organize and synchronize warfare activities bottom up. Methods: We set up a defence scenario in a constructive simulation (VR Forces) where defending forces applied three levels of self-synchronization to fight attacking forces that imposed three levels of strain. Self-synchronization was controlled by an algorithm based on the forces capability to provide, or their need to receive support. Results: Our quantitative results indicate that self-synchronization significantly enhances performance of the defending troops in the state of overstrain where they are outnumbered by the attacking forces but not so, when the strength of the two forces was equal or when the defending forces were outnumbering the attackers. Conclusions: It seems, that self-synchronization enabling bottom-up resource management is effective within overstrained systems where the requirements imposed on a system or organization are higher than its capacity and degradation begins while the benefit during normal operation seems to be limited or even inexistent.

## Blended learning in human factors engineering education – a case study

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This paper describes a case of teaching Human Factors Engineering to engineering undergraduates using blended learning in accordance with Bloom's taxonomy. A model developed for lifelong learning was adapted and transposed to undergraduate education.
The course covered 6 modules including work physiology, biomechanics and physical loading; anthropometrics, DHM, manual material handling, musculoskeletal disorders; sociotechnical systems and work organization; cognition and automation; legislation, economics and management systems; psychosocial factors and social sustainability. Textbook is an anchor, but not all content is available on textbook and, therefore, flipped classroom methodology was used, with lectures pre-recorded and on-demand combined with exercises, group work, quizzes and an optional final exam.
Bloom's cognitive taxonomy of learning activities was used to structure the description of the blended learning intended with the course design. This included the six parts understanding and applying through reflection and seminar discussion, exercises and assignments, creating, evaluating and analysing through project group work. In this course design great importance was given to the project work, including company representation, as a way to integrate information and to generate new solutions, as well as production of relevant solutions.

## An AV-MV Negotiation Method Based on Synchronous Prompt Information on a Multi-Vehicle Bottleneck Road

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This study proposed a novel human-machine interface (HMI) for communications between human drivers in manually driven vehicles (MVs) and automated vehicles (AVs) on a bottleneck road with multi-vehicles. eHMIs were reported as communication strategies between human road users and AVs. However, road users can fail to perceive the eHMI information on AVs when their visibility is blocked by other vehicles. Compared to external human-machine interfaces (eHMIs) on AVs, internal human-machine interfaces (iHMIs) are displayed on the devices in MVs. iHMIs can be seen in situations where MV driver's view is blocked by other vehicles in the environment. However, the conveyed information on iHMIs might be unintuitive because it requires identifying which vehicle the information is from rather than seeing it directly from eHMIs on AVs. Considering the (dis)advantages of eHMIs and iHMIs, we designed the novel HMI: synchronous iHMI+eHMI. iHMI+eHMI was compared with iHMI, eHMI, and the baseline without HMI in an online survey with driving simulation videos by subjective evaluations (comprehensibility, perceived safety, trust, and acceptability). The results (N=24) indicate that participants preferred using HMIs to communicate with AVs. Among all HMIs, subjective responses for iHMI+eHMI achieved the best evaluation scores when the views of MV drivers were obscured.

## Measuring proneness to distraction and inattention in motorcyclists

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The research on distraction and inattention in motorcyclists is limited, especially when compared to that in automobile drivers. This study adapted and evaluated the psychometric properties of the ARDES M (The Attention Related Driving Errors Scale for Motorcyclists) for motorcyclists in Spain. ARDES-M is a scale that measures unintentional driving errors associated primarily or secondarily with inattention. A group of experts evaluated the linguistic and cultural adequacy of the ARDES-M to the Spanish context. Afterwards, a sample of 418 motorcyclists responded to the ARDES-M as well as to a scale that measures inattention in everyday life (ARCES, Attention Related Cognitive Errors Scale) and a questionnaire on involvement in distracting activities. Sociodemographic and driving data were also collected. The results indicated a satisfactory overall performance for the instrument. A one factor solution emerged from Exploratory Factor Analysis. ARDES-M showed an adequate level of internal consistency. Correlations with external criteria were theoretically consistent. ARDES-M was associated with self-reported traffic crashes and near-crashes. The study provides evidence of validity for the ARDES-M and contributes to the development of specific instruments for populations of motorcyclists.

## Information SECURITY: Developing a contextually rich procedural task for investigating action slips in the handling of sensitive data

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Interruptions cause a lapse in attention, leading to omissions/inaccuracies in even simple procedures. Office workers are prone to interruption, and action slips in the handling of sensitive data may have serious consequences for information security. Empirical work investigating interruption effects on procedural error has used a focal task requiring a series of operations in response to multi-attribute stimuli, tied to the acronym UNRAVEL (Altmann, Trafton, & Hambrick, 2014). Each stimulus comprises abstract numbers/letters and changes after every step in the sequence; as such, there are few contextual cues to guide interruption resumption. We develop a more ecologically-appealing and semantically-rich SECURITY task, whereby participants complete a series of eight acronym-based 'checks' on an email that contains potentially sensitive information. This retains the same underlying cognitive processes, but shares more surface similarities with an office-based task. Using interruption complexity effects to benchmark SECURITY against UNRAVEL, we find that participants make fewer errors in the semantically-rich email task, but resumption times show similar effects to those in UNRAVEL (slower for more complex interruptions). Establishing a procedural task with an authentic context will allow future research into how to minimise action slips that may pose a risk to information security.

## User requirements for advanced driver assistance systems in rail operations

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Advanced Driver Assistance systems (ADAS) for rail operations aim to reduce energy usage by giving train drivers recommendations on energy-efficient driving based on operational information. Until now, very little is known about train drivers' attitudes towards ADAS, what they require from them, and what is needed for train drivers to comply with the driving recommendations given by the systems. Six in-depth interviews (two female) show that although drivers believe that the system can support more inexperienced drivers in eco-friendly driving, they estimate its overall usefulness to be low. The interviewed drivers rather wish for an ADAS that allows them to adapt their driving to the current situation and upcoming events by providing necessary information (e.g. type and speed of preceding vehicles, the status of signals ahead, estimated passenger boarding and alighting times, feedback on energy consumption), then for a system that "patronizes" them by "telling them how to drive". Measures to meet the train drivers' requirements and potentially lead to comply with the driving recommendations through system design and operative measures are discussed.

## On the use of bicycle simulators

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Virtual reality bicycle simulators (BS) are being used for a wide variety of applications. Their use can be found in the fields of rehabilitation, sports, traffic safety research, and in the study of bicycle dynamics. Each of these fields has different design requirements for the simulators and their associated virtual environments. This poster provides an overview of the different designs of BS and the use of these system in their respective fields. Additional attention is given to the use of BS in the field of traffic safety research, where BS are being used to examine how people experience different infrastructure layouts or how people react to specific traffic situations. Several literature gaps are discussed, as well as some limitations of current designs. This paper argues that more attention should be given to the behavioural validity of BS, since behavioural responses are the primary outcome measure in most studies, and reports on this subject are scarce. Furthermore, an improvement to current designs is proposed by including a balance component to the control of the BS, as balance is necessary for the control of a regular bicycle, but lacking in current BS systems.

## Do I really have to know everything? – iHMI communication strategies in complex situations for a HAV

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Automated driving functionalities in vehicles are increasing year by year. A major challenge for highly automated vehicles (HAV; SAE 4) is the detection of relevant objects in a driving situation which sets the basis for suitable driving manoeuvres. However, this information can also be used to design the interaction between the HAV and its user. Communicating the automation's awareness is crucial for creating understanding of the current situation, establishing transparency, and ensuring both trust and user acceptance. Research suggested a LED light-band as suitable internal Human-Machine Interface (iHMI) communicating this information. The current study investigated iHMI communication concepts for complex driving scenarios displaying multiple road users to reduce the user's subjective uncertainty. In an online study (N=154) participants experienced drives in a HAV that had to consider three other interacting road users (two closer and a third, more distant road user). It was investigated, if all present road users need to be addressed on the iHMI to reduce subjective uncertainty of the user. Results showed that a perception-based communication concept leads to lower uncertainty ratings compared to a static one or no iHMI. No difference was found for displaying all vs. only the two road users near to the HAV.

## Conceptualising user comfort in automated driving: Findings from an expert group workshop

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Comfortable experiences are needed to encourage the broad acceptance and usage of automated vehicles (AVs). However, current knowledge on the descriptions and influencing factors of user comfort in automated driving is limited, especially from the perspective of an AV's driving styles. We conducted an online workshop in which nine experts discussed a series of relevant topics. We found that all of the terms used to describe user comfort and discomfort for currently available vehicles (e.g., taxi/bus/train) apply to higher-level AVs, but additional aspects of comfort/discomfort were revealed for AVs. Thus, although neither of these transport modes require users to control the vehicle, what makes existing transport modes comfortable is not the same as that for higher-level AVs. For AVs, both the number and the nature of categories of terms differed across comfort and discomfort, suggesting additional factors that affect comfort must be considered in automated driving, rather than solely mitigating discomfort. A conceptual framework was developed based on the workshop, to explain how AV driving styles, as well as other, non-driving-related factors, affect user comfort. This work will facilitate a more comprehensive definition, and more accurate measurement, of user comfort, facilitating the design of comfortable and acceptable future vehicles.

## Does Social Loafing Occur in Human-Robot Teams?

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Thanks to technological progress, today robots are used for a variety of tasks in the workplace. Often, they are introduced as team partners to assist employees. This team formation is typically associated with positive effects on work execution and results. However, little is known about whether typical performance-reducing effects that occur in human-only teams also arise in human-robot teams. For example, it is not clear whether social loafing, which is defined by lower individual effort in a task performed in a team compared to a task performed alone, can also occur in human-robot teams. We explore this question in an experimental study, in which participants work on an industrial error-inspection task that requires them to look for production defects on circuit boards. One group of participants works on the task with a robotic team partner and receives boards that have already been inspected by the robot, while the other group works alone. The dependent behavioural measures of interest are effort invested, operationalized as inspection time and area inspected on the circuit board, and error detection performance. In addition, subjects are asked to subjectively rate their effort, performance, and perceived responsibility for the task. Results will be presented at the conference.

## The role of anthropomorphic framing and failure comprehensibility for industrial human-robot trust dynamics

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Applying anthropomorphic framing to industrial robots is a widely spread approach to facilitate trust formation and the robot's perception as a team partner. However, current research indicates possible pitfalls of this approach in task-related settings. This between-subject study examined the impact of anthropomorphic framing of a collaborative industrial robot on the dynamics of trust. Fifty-two Participants interacted with a robot, which was either anthropomorphically or technically framed. In addition, the respective robots conducted either a comprehensible or an incomprehensible failure during the interaction. The analysis revealed that participants tended to trust the technically framed robot more than the anthropomorphically framed one after a failure experience. This result contributes to a growing body of research illustrating the possible negative effects of implementing decorative anthropomorphism on industrial robots. Nonetheless, this trend was surprising, as the anthropomorphic robot was perceived as significantly more transparent than the technical one. Moreover, the robot's intention was perceived as more positive after the experience of a comprehensible failure compared to a non-comprehensible one. This result shows that it is essential to consider not only the quantity but also the quality of failures during human-robot interaction.

## HADRIAN'S EYE: a video analysis tool to coding drivers' mannerisms and behaviours in simulated settings

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Driver monitoring systems (DMS) should issue warnings when drivers show signs of unsafe behaviours or unfitness-to-drive. Advanced (A)DMS try to increase their robustness by fusing multiple sources of neurobehavioral and environmental indices (often) in an unsupervised fashion. However, when testing ADMS in real-world settings, their overall performance remains sub-optimal. The intrinsic complexity of the states being monitored (e.g., overload) and the variability of the indices, might in part explain the weaknesses of the unsupervised approaches. An alternative approach is to provide informative inputs, based on the knowledge of human experts, to the ADMS models. Here, we present a customized software –developed within the EU-project HADRIAN– which allows trained observers to code idiosyncratic behaviours/events known to be related to driver's states (of interest for ADMS) during complex simulated human-vehicle interactions. The inter-rater agreement between observers can be periodically checked. To help develop HADRIAN-ADMS, three couples of observers coded more than 150 driving sessions [1- to 3-hour-long]. They monitored each session throughout multiple videos, which integrated information of >8 neurobehavioral indices, coding predetermined selected indicators. The key idea is to include the ability of humans to detect mannerisms and other elements, not easily observable in the data streaming, into the ADMS models.

## Comparing Driver's Expectation on Automated Vehicles with Manual Vehicles

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With the rapid development of sensor technology and automated functions, automated vehicles are possible to be realized in the future. It means that human drivers have not only conventional vehicles as their interaction partners, but also automated vehicles that will share the roads with conventional vehicles in mixed traffic. Therefore, it is essential to investigate if human drivers have different expectations of automated vehicles compared to manual vehicles, which has been investigated using an online survey in this paper. Forty participants took part in the online survey consisting of 48 video clips. The participant first interacted with an automated or a manual vehicle in a car following or lane change scenarios, and then they should give their expectations of the interaction partners' cooperative behaviours. It was found that participants had more positive expectations and expected more cooperative behaviours of automated vehicles than manually controlled vehicles. Moreover, male participants expected more positive behaviours on automated vehicles than female participants. It was also found that participants with high propensity to trust tended to expect automated vehicles to behave more cooperatively than participants with low propensity to trust.

## Assessing the vigilance of truck drivers during a normal working day using Electroencephalography

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Road accidents are caused mainly by human error, for example through distraction of the driver. Monitoring a driver's vigilance level is therefore highly valuable to improve driving safety. Previous studies have found correlations between a driver's mental states (such as vigilance) and electroencephalogram (EEG) spectrum power, thereby providing an objective measure of vigilance. However, a majority of these studies investigated vigilance under highly controlled driving conditions, either in a driving simulator or in vehicles with specialized equipment. Additionally, most studies employed secondary tasks. On the one hand, such experimental designs increase control, on the other hand decrease generalizability to realistic driving scenarios. If the goal is a real-life application, we must work towards EEG that reliably monitors brain states while minimizing interference with the driver's actions or safety. In this ongoing study, we are equipping professional drivers from four forwarding companies with mobile, unobtrusive ear-EEG. We record during their normal working days, without secondary task or further instructions. We correlate the resulting EEG data with information about the tour, including traffic and driving behaviour. First analysis shows promising results regarding the tracking of vigilance through changes in the spectrum power. We present opportunities and pitfalls of highly realistic EEG data.

## Less is more: Does information removal in the rear-view mirror improve time-to-contact-estimation?

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Camera-monitor systems (CMS) increasingly replace old-fashioned rear-view mirrors. They provide the unique opportunity to remove irrelevant cues from the mirror image. Could this improve the driver's ability to make time-to-contact (TTC) estimations of approaching vehicles? We alter the mirror images provided by a CMS. Three different rendering styles are investigated in a laboratory experiment. These differ in whether specific environmental information is shown in full and natural, only schematic or not at all. Using a prediction motion paradigm, in which a target vehicle approaches from behind on a screen in the different rendering styles and disappears at a defined point in time, the participant's task is to estimate when the vehicle would have arrived at his or her own position. We discuss the circumstances under which reduced information in CMS can improve TTC estimates.

## Understanding contextual cues in anticipating lane change behaviour – insights from a Naturalistic Driving Study

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Human drivers use so-called implicit (e.g. vehicle dynamics) and explicit cues (e.g. turn signals) to anticipate lane changes by another road user. However, it is still unknown whether contextual cues are also used for anticipation. To better understand the potential use of contextual cues, a Naturalistic Driving Study (N = 30) was conducted in which participants drove their typical routes for one week. A (provided) smartphone installed in the participants' cars, functioned as a voice and video recorder. While driving, participants were asked to name cues they used to anticipate a lane change to the left. The voice records were annotated to create a set of predominant contextual cues. Results suggest that in addition to implicit and explicit cues drivers use contextual cues for anticipation. For example, a motorway on-ramp or a convoy of trucks on an uphill road indicates an imminent lane change. In contrast, a dense flow of vehicles on the left lane or an upcoming highway exit indicates against imminent lane changes. Besides these expected contextual cues, other unexpected contextual cues were found, e.g. speed limit. Result of this study is a list of contextual cues used for anticipation of lane changes.

## Blockchain: Do people really need to understand it in order to use it?

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Due to its characteristics, distributed ledger technology or blockchain offers high potential in numerous applications. However, according to previous studies, the main adoption barrier is the lack of knowledge and understanding in the general population. Thus, in an online study (N = 90), different learning materials (with vs. without chunking and cueing, between-subjects) were used to introduce blockchain to novices. We investigated whether the materials, the affinity for technology, gender or age (quasi-experimental) affect the performance in a knowledge test, the subjective understanding, and the intention to use. Only two of these calculations showed significant differences: Participants with a high affinity for technology performed better than those with lower scores, and younger participants rated their performance better than older ones. Furthermore, a significant correlation (r = .34) was found between objective performance and intention to use. However, objective performance was relatively high, while intention to use was rather low. In summary, novices are capable of understanding important characteristics of blockchain and a lacking objective knowledge can be a barrier, but seems to be less important than assumed. This raises the question of whether the understanding of blockchain can be neglected against other aspects such as applications' needs or user experience.

## Do you plan virtually safe? Recommendations for a VR application that rates the perceived safety of bicycle infrastructure for urban planners

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Driven by the mobility shift towards a more ecological modal split, bicycles are becoming increasingly popular as a means of transport in cities. This increases the demands on cycling infrastructure and its planners. When designing infrastructure measures for cyclists, user acceptance, especially perceived safety and experienced comfort, are important reasons for use. However, these factors are rarely considered in infrastructure planning. In order to evaluate such factors in advance and to derive corresponding design requirements for urban planners at an early stage, the use of virtual reality (VR) can help to evaluate planned infrastructure measures. This poster presents an overview of design recommendations for a VR application that enables city planners to evaluate the perceived safety of cycling infrastructure using stereoscopic, static 360° images. In addition to technical recommendations, implementation guidance, and methodological procedures, a technology-centred workshop concept will also be presented to identify the needs of urban planners and government agencies regarding the evaluation of perceived safety. In addition, other possible uses of the presented application in the field of surface transportation are discussed. The poster will conclude with a methodological discussion regarding infrastructure assessment via VR to aid urban planners and authorities.

## Do drivers have preconceived ideas about an automated vehicle's driving behaviour? Results from a coupled driving simulator study using a bottleneck scenario

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This study examined whether drivers have preconceived ideas about an Automated Vehicle's (AV) manoeuvres, when compared to manually driven vehicles (MVs). A pseudo coupled (linked) driving simulator set-up was used to study response to approaching vehicles in a bottleneck scenario. A message displayed the state of the approaching car (AV/MV). Participants were told that the experimenter (hidden behind a curtain) would drive the MV using the other simulator, but exactly the same (preprogrammed) behaviour was displayed in all trials. The AV/MV yielded on 50% of the trials, with 50% of these including lateral offset, and an external Human Machine Interface (blue light band) included in 25% of the yielding trials. Subjective responses (perceived safety, comprehensibility and trust) for the AV/MV were not significantly different. In line with previous studies, kinematic cues were effective forms of communication, with a shorter passing time seen after the yielding trials with lateral deviation. However, when approaching vehicles did not yield, the trials with a more apparent offset had a longer passing time than those with a slight offset. The signposted AV/MV had no impact on participants' passing time, but the eHMI reduced passing time, and participants preferred seeing this interface on the approaching vehicle.

## Evaluation of Crewmembers' User States in Armoured Vehicles

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Crewmembers of armoured vehicles are exposed to high-risk tasks in operational conditions. Despite manoeuvring in uncertain terrain under restricted viewing conditions, hostile threats can cause stressful situations with high time pressure and potentially lethal outcomes of decision-making. To reduce human failure, it is important that the human-machine interface of armoured vehicles is tailored to the specific impact factors of this work domain. In this respect, evaluations of various interaction design concepts are necessary to decide which concept fits better to the specific requirements of the identified use cases. We developed a multi-modal approach called AMbER (Analysis of Mobile Ergonomic Records) to facilitate these evaluations and support design decisions for such safety critical work domains. The human factors analysis Platform AMbER gathers manifold information on the crewmembers' mental states and their interaction with the user interfaces. As an assessment support system, AMbER incorporates a modular dashboard for data collection and visualization that serves as a basis to create purpose fitted experimentation and evaluation tools. The evaluation of crewmembers' user states in armoured vehicles is a use case to show the versatility and adaptability of the platform. Further, it highlights the requirements of an evaluation tool for armoured vehicles.

## Got it? Usability of robotic handovers with visually impaired and sighted users

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Assisted living technologies like robots will play a key part in aging societies, especially with their ability to hand over objects. While this process has been widely researched, literature addressing the special needs of blind or visually impaired (BVI) users is rare. Robots assisting BVI users should be able to coordinate handovers without eye contact. To close this gap, this study gathered first insights on the usability of human-robot handovers including 20 BVI and 20 sighted participants. In a standardized experiment with mixed design, a handover robot prototype equipped with a voice user interface and haptic feedback was evaluated. The robot handed over everyday objects to the participants, i) by placing them on a table and ii) by allowing for midair grasping. Results show high usability and user experience of the handovers across all user groups. In total, 96% of all handovers were successful. Qualitative feedback was positive. However, time required for handover was regarded critically. Feedback of BVI participants was more heterogenous in all subjective criteria compared to sighted participants. Findings are discussed, detailing the differences between the groups. Chances as well as risks of speeding up some processes are considered for making assistive robots more inclusive and cross-applicable.

## Humanizing AI

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This position paper describes how Artificial Intelligence should be and can be effectively personalized for improved Command & Control of automation, more explainable AI, improved Human-System Interaction and more human-like situational awareness. In recent years, AI has had a resurgence in specific narrow areas (e.g. image classification, speech recognition), but more general human-like AI remains a research challenge. AI can provide great benefits for improved automation, but AI faces legitimate challenges. How will operators maintain control of disconnected AI-driven systems? Will the decisions made by AI-driven systems be ethical? Will the reasons for the decisions be understandable to a human operator? How will the operator and AI-driven system interact and understand each other? Although the idealized version of a specific human AI is beyond the immediate capability of current technology, the Navy and DoD have an interim need for AI that can act in certain constrained domains in a manner that is similar to a human and, ideally, a specific human, e.g. the operator or commander. The authors suggest that a combination of knowledge representation of human characteristics, background and behaviour models can cause operators to attribute specific human-like beneficial characteristics to the behaviour, explanation, interaction and situational awareness of an artificial system. Specifically, the authors propose a series of six component models and a method for employing the models to achieve the goals: 1) a 5-concentric circle model of situation awareness; 2) an educational/experience/training model for more effective and rapid communication; 3) a value model for general and specific ethical/principled behaviour; 4) a personality model for specific values/principles/risk tolerance; 5) a mission model for representing the current mission goals, tasks and milestones; and 6) and a role model to avoid misunderstandings during communication. Each model is relatively simple and therefore technologically feasible, but the hypothesis is that the combination is sufficient to achieve a human-like reaction and will improve operator control, understandability, interaction and ultimately trust in AI-driven automated systems. For example, the models could be contained on each operator's identification card and loaded when the operators inserts the card into a system. This paper provides definitions, outlines the basic concepts and principles, recommends initial models, and suggests how the models can support appropriate human-like assessment, decision-making and explainability of smart AI systems.

## Exploration of a Tangible XR Prototype for Agile Product Development – Results of an Expert Study with Product Designers

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Agile prototyping allows a flexible reaction to changing customer requirements in dynamic market environments. However, due to complex development processes, prototyping is often time-consuming and expensive. This paper presents an agile exploration method using a tangible extended reality (Tangible XR) to allow different stakeholders, such as users and experts, to explore and design product functionalities very early in the development process. Based on the findings of multiple resources theory, Tangible XR allows part of the haptic experience to be explored within virtual environments. To test this new method we conducted an exploratory design workshop with a class of product designers. The workshop focused on designing an assistance system that warns drivers of obstacles, e.g. cyclists in their blind spot, via visual, acoustic and tactile signals. Within the study, the participants co-created interaction

concepts for the assistance system. After the design process, they rated the Tangible XR environment in terms of system qualities, such as usability or its immersion. The results allow a first estimation of the acceptance and future usage behaviour of Tangible XR prototyping.

## Using technology to avoid the police on the road: The missing link between enforcement and deterrence?

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Road rules are the behavioural standards that road users need to follow, while police enforcement encourages compliance with the rules in the transport network by applying penalties to offenders. Enforcement involves roadside police checkpoints and automated technology such as detection cameras. The combination of evidence-based road rules and police enforcement, along with supporting public education, has been shown to prevent risky driving behaviours such as speeding, drink driving and distracted driving. While effective, legislation and related enforcement are not guaranteed solutions. An emerging challenge is the use of navigation apps that allow drivers to view and share information showing the location of enforcement activities. Arguably, knowledge of enforcement locations reduces drivers' perceived risk of apprehension, thereby increasing engagement in risky driving behaviours. To investigate this, 450 drivers participated in a cross-sectional study in Australia. The results showed that nearly half of the drivers use Google Maps (48.8%) and Waze (18.7%), which show the location of enforcement operations. Participants who have been using these apps reported more speeding (low range 1-10 kph above the speed limit and high range 10+ kph over the speed limit), substance-impaired driving, and anti-social behaviours such as hooning.

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