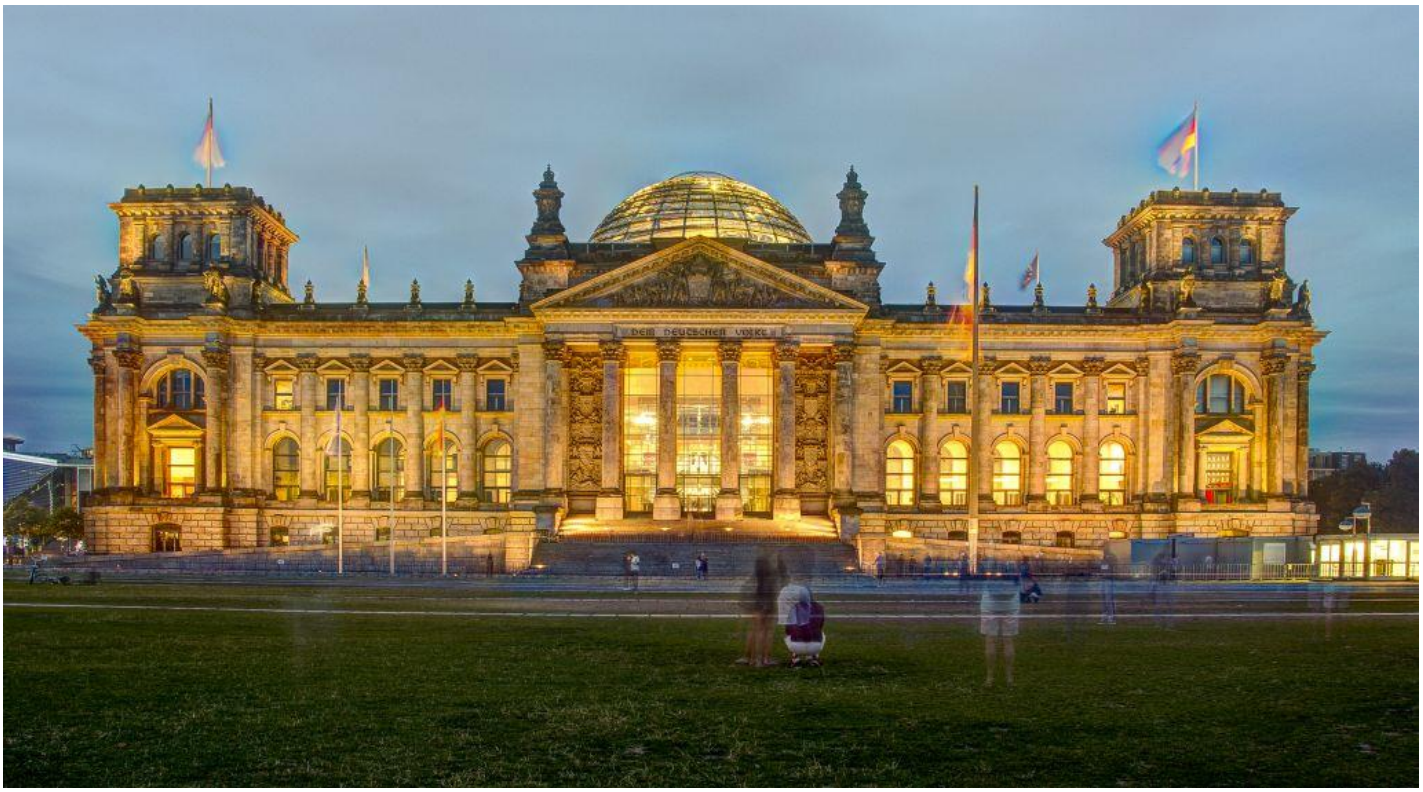
Europe Chapter
Human Factors and Ergonomics Society

Annual Meeting 2018

Technology for an Ageing Society

October 8-10, 2018

BERLIN - GERMANY



BOOK OF ABSTRACTS

Europe Chapter
Human Factors and Ergonomics Society

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MONDAY OCTOBER 8th

SESSION 1: HUMAN MACHINE INTERFACE - 1

Designing for Automated Vehicle and Pedestrian Communication: Perspectives on eHMIs from Older and Younger Persons

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The automation of automobiles requires much theoretical, legal and empirical work in order to define and ultimately resolve the complexities associated with it. One of the many challenges that automotive manufacturers face is how driverless, automated vehicles will communicate to other traffic participants. This issue is especially crucial for vulnerable road users such as pedestrians, where the consequences of miscommunication are particularly critical. One possible way for automated vehicles to communicate to pedestrians is through an external human-machine interface (eHMI), where an explicit, informative message in the form on an icon (static) or dynamic animation, for example, is presented outside the vehicle. In this paper, we report the subjective results of an experiment investigating four different eHMI concepts in two age groups (20-30 and 60-70 years old). The participants were exposed to the concepts in an immersive, virtual environment, consisting of three different traffic scenarios, presented on a head-mounted display. The aim of the subjective inquiry was to understand the participants' preferences regarding the eHMIs experienced as well as their suggestions regarding improvements. Overall participants preferred dynamic messages over static ones. The results provide eHMI designers with concrete user insights for the design of such external systems.

The Possibility of Measuring Affects by Measuring Persons' Body Tilt

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Germany

Typical methods to measure affects during HCI have several disadvantages. Questionnaires, for example, are a cost saving method. However, since it is always retrospective, the moment of survey can influence the subjective evaluation. The common objective of the present studies is to evaluate an alternative method to measure affects by using the Wii Balance Board®. It may offer the possibility to measure affects immediately by recording the participants' body tilt. In our studies, participants had to either stand (N=40) or sit (N=40) on the balance board, looking at a number of pictures from the International Affective Picture System (IAPS). The pictures differed in their level of valence. The participants' task was to evaluate the pictures' valence by tilting back or forward. To indicate a positive valence, they had to bend forward on the board. If they perceived the picture's valence as negative, they had to lean back. The measured participants' body tilt and the evaluation of the pictures correlated on a high level. This leads to the assumption that the balance board has proven its worth as an alternative measurement for valence. We are currently working on connecting the continuous measure with interaction elements of an ongoing HCI.

Cooperation through communication - New light technologies for improved traffic climate

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Technische Universität Braunschweig, Engineering and Traffic Psychology
Germany

In order to promote cooperative interactions and positive encounters in daily road traffic and improve traffic situations which lack communication, a cooperative laser beam based on new light technologies is developed within the research project “KoLa“. Via light projections drivers can get in touch with other road users. In order to identify possible fields of application, relevant traffic situations and the situation-specific needs of diverse road users were investigated in an online survey and a one-week diary study with car drivers, cyclists and pedestrians. From the results, scenarios were derived, which could be improved in their experience by the use of communication technologies (e.g., by giving the right of way, thanking, etc.). Some scenarios were implemented in a driving simulator and according communication concepts were evaluated by experts. Generally, drivers reacted positively to the new communication possibilities, which differed in their understandability and emotional effects. Furthermore, potential distraction and influences on the driving performance due to the projections were regarded. These occurred mainly in the case of a graphical representation of the predicted driving trajectories. Overall, a cooperative laser beam offers great opportunities to improve the traffic climate. However, further applications and safety-critical consequences should be explored in more detail.

Improving cooperation in traffic - Novel HMI approaches to enhance driver-driver interactions

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University of Twente, The Netherlands

The strong increase of traffic within limited infrastructure requires drivers to cooperate in order to arrive safe and on time at their destination. However, 30% of these interactions fail (Benmimoun, Neunzig & Maag, 2014). Recent technological developments provide the opportunity to support these interactions via HMI concepts. Therefore, we evaluated two novel ways to support the driver during lane change manoeuvres. In a simulator study (N = 50) participants drove on a two lane motorway and experienced multiple lane-changes of other cars. During this lane change, participants were supported by a combination of novel HMI concepts. We modified the indicator of the merging car, in order to distinguish between planning and execution of the manoeuvre. In another condition we added a head-up display (HUD) that signalled the upcoming lane-change of the partner car. In a third condition we added the distinction between planning and execution of the manoeuvre to the HUD concept. The results of this study show that the novel indicator concept was not intuitively interpretable by the participants. However the HUD concept did show a strong effect on the cooperatives of the participants. This effect was stronger as the participants could distinguish planning and execution of the manoeuvre.

SESSION 2: AVIATION, COMFORT and SAFETY

The Safety - Productivity Balance and its Association with Human Factors and Safety Awareness and Communication

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The presentation will present the findings of a published research which assessed the degree of balance between safety and productivity, and its relationship with awareness and communication of human factors and safety rules. The study was carried out at two aircraft manufacturing facilities where a questionnaire was administered to a representative sample. The instrument included topics relevant to the safety and human factors training provided to the target workforce. The results showed that workers were sufficiently aware of how human factors and safety rules influenced their performance and acknowledged that supervisors had adequately communicated such topics. Safety and productivity seemed equally balanced across the sample. A preference for the former over the latter was associated with a higher awareness about human factors and safety rules, but not linked with safety communication. The findings also suggested that although human factors training had been provided and sufficient bi-directional communication was present across the sample, quality and complexity factors might have influenced the effects of those safety-related practices on the safety-productivity balance for specific parts of the population studied. Therefore, customization of safety training and communication to specific characteristics of employees may be necessary to achieve the desired outcomes.

Wearable comfort and performance expectancy predict user acceptance of a sensor-based home lighting system

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The aim was to evaluate an early prototype of a personalised home lighting system comprising body-worn loggers, a mobile phone, and LED-based lighting with variable intensity and colour temperature. A convenience sample (N = 28, 50% female) wore the devices for 24 hours in the field and were given a demonstration of the lighting system components in a full-scale model of a studio apartment. Participants then assessed their acceptance of the lighting system using a validated questionnaire. As user comfort and design were expected to influence the outcome, additional questions addressed the physical comfort and visual appearance of the body-worn loggers. To cross-check the quantitative findings and to address issues not included, semi-structured interviews were held in the full-scale model. In a hierarchical linear regression, physical comfort of the loggers explained 35.8% of the variance of 'the behavioural intention to use the system in the future'. Adding 'performance expectancy' to the model accounted for 50.6% more variance in behavioural intention. The thematic analysis of the qualitative data provided more understanding of how physical, psychological and social comfort of wearing the devices and carrying the phone in the home, influenced participants' willingness to use the home lighting system in the future.

Sequential Human Redundancy

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Germany

When critical checks or assessments are conducted, it is often done subsequently by two individuals. This form of sequential human redundancy is implemented under the assumption that four eyes see more than two and thereby the risk of mistakes is reduced. Unfortunately, human redundancy might be compromised by social loafing effects, i.e. the reduction of individual motivation and effort when sharing responsibility for a task. We present one of the first studies investigating the performance effects of sequential human redundancy. In a laboratory experiment, 54 participants performed a simplified simulation of an operator's job in a chemical plant. They were responsible for three concurrent tasks, one of which was a critical quality check of chemicals before dispatch. Here, participants had to sort deficient products either alone or redundantly with another crewmate. In the redundant condition, participants were further split up depending on whether they were first or second in line to check the chemicals. Operators second in line were provided the evaluation results of operators first in line. Analyses of checking behaviour, ratings of responsibility as well as invested effort indicate that especially the second checker is prone to social loafing, which might reduce the gains of redundancy.

Teams Coping with Unknown Failures in Aerospace and Operational Environments

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Operational environments imply to cope with unknown problems (neither expected nor experienced). Apollo 13 is a major example. Thus, it appears crucial to understand the relations between the (quantitative) performance of a team and the (qualitative) parameters of its common experiences. This is the purpose of a PhD study based on the two-year French Air Force Academy's training. Three teams with different levels of shared experiences were submitted to twelve resolutions of unknown problems for twenty months: LETUCA, Longitudinal Evaluation of Teams via Unknown and Collective Activities. Team 1 and 2 are FAFA cadets: one performed all the air force training together and the other one performed the same training separately. Team 3 is built by service women and men without any relationship with one another. The basic conjecture: "mutual experience leads to a better efficiency" is verified. But the main step was to understand the whys and hows. A qualitative analysis revealed that metacognition (i.e. cognition about cognition) was the pivotal point. Thus, a "metacognitive clearness" was defined so as to model an origin of the collective performance's increase. The twenty-month data's final analyses will allow defining recommendations for long-term mission teams, especially for future deep space flights.

SESSION 3: AUTOMATION - TRANSPORT - 1

Should the urgency of visual-tactile takeover requests match the criticality of takeover situations?

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Germany

Highly-automated driving requires drivers to take over the control of their vehicle at any time. In takeover situations with short time budgets, a fast takeover is crucial. Here, drivers could be supported by an appropriate takeover request (TOR). A driving simulator study was conducted investigating whether a match in the urgency of a TOR and the criticality of the takeover situation benefits drivers regarding their takeover performance and subjective experience. Fifty-two participants experienced two takeover situations with varying time budgets (short and long). A low urgent, visual-tactile TOR was presented to half of the participants. The other half experienced a highly urgent, visual-tactile TOR, resulting in congruent and incongruent matchings of time budget and TOR-design. The results showed that a congruent matching neither shortens takeover time nor enhances subjective experience. However, participants generally performed better in low critical takeover situations, but they took over quicker in highly critical situations.

Prediction of Take-Over Performance in Conditionally Automated Driving. Results of a Naturalistic Driving Study

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WIVW GmbH
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Soon, vehicles providing conditional automation functionalities (SAE level 3) will enter the consumer market. In conditional automation, the driver still functions as a fall-back and has to be ready to take back manual vehicle control within a short time frame. It is therefore important to understand all factors that may influence the take-over process. This study focuses on characteristics of the driver that may influence the take-over time in conditionally automated driving. 34 participants (6 females) with a mean age of 54 years (SD = 14 years) took part in a real traffic study relying on a Wizard-of-Oz vehicle that fully simulated conditional automation functionalities. While driving with the active system, users engaged in five different secondary tasks until a Request to Intervene (RtI) was issued. Various driver characteristics were assessed and related to the driver's risk behaviour, which was classified from the recorded gaze patterns. Although the individual risk behaviour was somewhat influenced by the specific secondary task, it was found to be stable over the total drive. Further analysis indicated a non-linear relationship between risk behaviour, reaction times (from a reaction time test) and take-over times. Moreover, and in accordance with previous literature, experience with ACC systems resulted in decreased take-over times.

Drowsiness and fatigue in conditionally automated driving - Towards an integrative framework

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The introduction of conditionally automated driving will change the role of the driver fundamentally. Drivers can be engrossed in non-driving related tasks or fulfil a new role of a passive passenger while the automation executes the dynamic driving task. In both cases, fatigue and/or drowsiness could impair drivers' availability for an upcoming take-over if the automation reaches a functional limit. In that case, conditionally automated driving relies on drivers to act as a fall back ready user to take-over control manually. We propose an addition to the framework proposed by Marberger et. al., (2017) with a more detailed look on the constructs fatigue and drowsiness and their interdependencies within the framework and additional aspects of driver availability. This work also provides a comprehensive overview on relevant literature regarding these constructs in general and the current state of research concerning conditionally automated driving. Furthermore, it includes selected findings and recommendations from the German joint project Cooperative Highly Automated Driving – Ko-HAF. We conducted >10 experiments of prolonged automated driving periods, to reveal effects of fatigue and drowsiness on drivers' availability. This work integrates the lessons-learned and the development of advanced methods and procedures derived from the extensive empirical expert knowledge.

Should I stop or should I go? Evaluating Human Capabilities of Cooperative Manoeuvre Strategies on Automated Driving

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Germany

The cooperative driving framework in combination with adaptive automation provides a suitable solution for overcoming legal and system limitations by sharing responsibilities and tasks between driver and automation. The evaluation of human capabilities of partial take-overs in traffic is required as foundation for this approach. A basic cooperative manoeuvre strategy was tested in a driving simulator using a traffic light scenario. Participants drove on a rural road either with assisted or partial automation while occasionally approaching red or green traffic lights. For half of the trials they received a cue, indicating an upcoming traffic light. Drivers (N=24) had to decide for the appropriate oncoming behaviour of the automation while not or only partly taking operational control of the automated car. Results of behavioural and gaze data showed that attentive drivers were capable to perform cooperative manoeuvres. Due to transparent and distinct system behaviour, drivers were successful in acting cooperatively in low levels of automation. Implications for conditional or high automation, more complex driving tasks and distracted driving are discussed.

SESSION 4: SIMULATORS - SICKNESS

Simulator sickness - On the duration and intensity of occurring symptoms

Melanie Schliebener, Jovic Josip, Liebherr Magnus, Schweig Stephan, Maas Niko, Schramm Dieter, Brand Matthias, Proff Heike
University of Duisburg-Essen, Department of General Psychology: Cognition
Germany

In recent years – since simulators were developed for training and research – a phenomenon similar to motion sickness becomes more and more apparent. In the study at hand we aimed to provide a better understanding of the duration and intensity of simulator sickness symptoms. 312 people with a mean age of 62.74 years (SD = 11.74) completed the present study. Participants were asked to drive in a driving simulator for 25 minutes. A few weeks after completing the simulator driving, participants got a modified version of the simulator sickness questionnaire. During the simulator driving 119 participants failed to complete the task because of the occurrence of simulator sickness. The most frequently reported symptoms are nausea (172) and general discomfort (168), followed by dizziness with eyes open (131), stomach awareness (119), Vertigo (89), sweating (87), and difficulties in concentration (62). The longest mean symptom durations are reported for fatigue (327 minutes), general discomfort (274 minutes), nausea (193) and fullness of the head (192). Significant gender and age-related differences in duration and intensity could not be identified. Along with the different symptoms and related aspects, further variables, such as environmental and technical factors will be discussed.

Occurrence of motion sickness during highway and inner city drives

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BMW Group, research, new technologies and innovations
Germany

Recent concepts for automated vehicles point towards future interior design that allows passengers to consume media on in-vehicle displays during travel. Engagement in non-driving-related tasks which impede a view of the outside world, can lead to conflicting motion information provided by the visual and vestibular system, leading to motion sickness. Two field studies were conducted investigating the occurrence of motion sickness while driving on a highway (n1=285) and in a city (n2=295). Both studies employed a between-subject-design in which the seat direction and non-driving-related task were varied. Seat direction was varied between forward- and backward-facing. The task varied from watching a movie on a handheld tablet, positioned on the passengers' laps, to watching a movie on a tablet mounted at eye-level and a baseline condition in which the passengers did not watch a movie. The effect of seat direction, task and road type on the occurrence of motion sickness was evaluated using subjective misery scale ratings and galvanic skin response of the participants. Results showed that neither seat direction nor task affected motion sickness during both highway and inner city drives. These results indicate that the risk of motion sickness in automated vehicles may be smaller than is often assumed.

Autonomous cars can make you carsick: How to research carsickness (and not simulator sickness) in a driving simulator

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Autonomous vehicles will shift occupants from drivers to passengers, who are at higher risk of experiencing carsickness than drivers of conventional vehicles. This especially holds when utilizing displays. To study the automated driving experience in terms of comfort and carsickness in particular, moving base simulators can offer a highly controlled environment compared to on-road studies. Although the motion frequency range most provocative in terms of motion sickness (around 0.2 Hz) can be recreated by most simulator motion platforms, the required acceleration magnitudes may not be reached. Our study (N=16) showed that a moving base simulator with a 60 cm lateral amplitude can induce carsickness at rate similar to on-road studies. We excluded simulator sickness (i.e., sickness induced by the simulator not occurring in the real simulated condition) by removing the principal component unique in simulator sickness: the artificial visuals. During automated driving, the occupant is engaged in the vehicle interior, e.g. when utilizing a display, thus the (lack of) external view does not essentially change the occupant's experience. We therefore propose that research questions about, e.g., seating arrangements, display placement, and the transfer of control in automated driving can be investigated in a moving base simulator.

TUESDAY OCTOBER 9th

SESSION 5: AGEING and HEALTH

A cognitive aid to support emergency response teams during in-hospital cardiac arrest

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Germany

In fast-paced, time critical, and stressful cardiac arrest situations it can be challenging to precisely remember and carry out all steps of the European Resuscitation Council guidelines. In an iterative user-centered design process, we developed a tablet-based cognitive aid application to support emergency team leaders during resuscitations in relation to reversible causes of cardiac arrest, cardiopulmonary resuscitation, and non-technical performance. Thirty-three emergency teams participated in simulated cardiac arrest scenarios and used either a documentation application or a cognitive aid application. The evaluation in relation to diagnosis (time until diagnosis was said out loud and specific diagnoses related actions were done, number of diagnosis related statements), resuscitation (no-flow fraction, average chest compression depth and rate, time to first heart rhythm analysis, adherence to the timing of reoccurring interventions based on guidelines), and non-technical performance (Team Emergency Assessment Measure) showed clinically relevant but no significant advantages for the cognitive aid application compared with the documentation application. Frequent application use was significantly associated with better non-technical performance and earlier heart rhythm analysis. The results indicate the potential benefits of cognitive aid elements.

Building a tremor compensating mouse driver

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Patients suffering from Parkinson disease do experience tremor – an uncontrollable shaking of extremities. This tremor varies individually but also depends on the situation and daily condition. While interacting with modern information and communication technology (ICT) this tremor represents a major hurdle especially while handling the computer mouse. Until now there are only a few mouse drivers that generally smooth the tremor effect a little. However, we try to develop a mouse driver that responds to the individual and situational differences of the user´s tremor by calibrating the mouse driver at the beginning of a computer session. For this, the user should only move the mouse briefly along a few lines. During development, we have to clarify if and to what extent the tremor also depends on the length and the angle of the target movement with the computer mouse as well as the pressing of a mouse button. First results of studies with Parkinson patients that focus on these aspects will be presented and discussed during the conference. The project is financed by the German Parkinsonhilfe. All results as well as the mouse driver will be made available free of charge and open source.

Considering older adults throughout the development process - The HCD+ approach

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Institute for Multimedia and Interactive Systems (IMIS), University of Luebeck
Germany

With the demographic change, the percentage of older adults increases while information and communication technology (ICT) becomes ubiquitous and often indispensable. However, many older adults using ICT encounter usability problems, particularly if the ICT was not designed with them in mind. If older adults are considered, their participation is often limited to the evaluation of a finished product. Our approach called “human-centered design for aging” (HCD+), considers older adults’ requirements and abilities throughout the development process, adapting established HCD-methods to accommodate the participation of older adults as experts for their own age group. This approach has been tested in a project aiming to link older adults' life stories to historical events and appreciating their life experience. By conducting interviews, focus groups, workshops and evaluations with older adults, meta-guidelines were identified and integrated into the HCD+ approach. Following this approach, older adults can be better served by ICT, fostering their participation in society.

Searching for ways to elicit ‘soft’ user requirements on assistive technology

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The use of assistive technology (AT), such as wheelchairs and hearing aids, is not without its problems. Users sometimes abandon AT-solutions due to their lack to meet their needs, and some users experience stigmatisation. When it comes to user requirements on AT, there have historically been a focus on functionality, performance and safety, which may explain the aforementioned problems. Therefore, it is essential to understand the users’ emotion-related (‘soft’) requirements on AT devices. In a project aimed to design a user-friendly AT-device for short distance individual transfers indoors, 36 contextual user interviews were carried out. In all interviews pictures of AT-devices were used as mediating tools, and 15 of the interviews included questionnaires with semantic differential scales (SDS). The main research aim was to enhance the understanding of how to elicit soft requirements from users. The study showed the importance of actively triggering the users to reflect on issues beyond functionality, and that the use of pictures and SDS had an effect on the character of the elicited data. The implications of the study are that users need support in envisaging both the product to be designed, and its context of use, in order to express soft requirements.

Comparison of a thermo-tactile, vibro-tactile and auditory interface to improve hazard detection of older pedestrians

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Technische Universität Berlin
Germany

Developing an assistance system for older pedestrians, three interfaces of different modalities have been compared within a dual-task laboratory experiment with 30 participants (age: 65+). In the primary hazard detection task, they had to pull a joystick when a car appeared in the periphery of the screen in front of them. Secondary tasks were in turn, a visual search task and a memory task. Response time, errors, subjective workload and acceptance served as dependent measures. Interface modality was varied within subjects and compared to a baseline measure without assistance. The system gave a notification prior to car appearance on the corresponding side (left or right) of the body. Modalities were: thermo-tactile (two Peltier elements placed at the neck, generating cold signals), vibro-tactile (two cuffs with vibration motors placed at the upper arm), and auditory via headphones. All types of interfaces fasten participants' response time. Vibration and audio also reduced the number of errors, when being involved in the visual secondary task. Subjective workload was highest with the auditory and lowest with the thermo interface. Vibration turned out to be most accepted by users. Results will be discussed with regard to the current application and alternative use cases for older people.

SESSION 6: SURFACE TRANSPORTATION

Measures for Improving the Detection of Motorcycles in Student Drivers

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Austria

Research shows that about 60% of motorcycle accidents are caused by a collision with another vehicle. About half of these accidents were caused by the accident opponent, typically a car. This study aimed to improve drivers' detection of motorcycles. For this purpose, a multimodal motorcycle warning as well as a training program with different methods was designed and tested in a driving simulator with 80 student drivers. The simulator training has different effects depending on which training method was used. In the absence of a warning, "variable priority" (VP) training results in significantly earlier detection of motorcycles on country roads with low contrast compared to the methods "equal priority", training with the motorcycle warning and a control group. The VP training resulted in significantly earlier detection of motorcycles on the country roads with high and low contrast even when a motorcycle warning system was used. Most students would use the both the training and the warning in the future and would recommend it to other student drivers, too. Although simulator training cannot replace the practical training in the vehicle on the road, the recommendation is to improve and implement both the VP training and the motorcycle warning system.

Short-term Effects of Unnecessary Collision Alarms on Driver Behaviour

Christina Kaß, Gerald Schmidt, Wilfried Kunde
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Germany

Prior research has shown that warning systems with low perceived reliability have negative long-term effects on users' compliance with alarms in terms of increased reaction times and decreased reaction rates (cry wolf effect). Here, we investigated short-term effects of unnecessary collision alarms on driver behaviour in two driving simulator studies. In both experiments, a hard braking lead vehicle caused time to collision values that fell below usual thresholds for collision alarm activation. However, collision alarms were eventually unnecessary, providing that the own intended driving manoeuvre or that of the leading driver were taken into account. In the first experiment (N = 42), the braking lead vehicle was irrelevant for drivers' own planned trajectory. In the second experiment (N = 40), drivers were able to anticipate that the lead vehicle will leave their lane within a short period of time. Whereas half the participants received (unnecessary) collision alarms, the other half did not. Results revealed that drivers who received unnecessary alarms decelerated more strongly than drivers who showed their natural driving behaviour without receiving alarms. These findings underline the need to reduce the rate of unnecessary alarms in order to avoid driver overreactions as potentially critical short-term effects.

Towards an Error Tolerant HMI Approach for the compensation of Registration Errors in Augmented Reality Applications

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Germany

An Augmented Reality Head-Up Display (AR-HUD) enriches the driver's view by accurately placed virtual content to support the driving task. Frequently addressed problems in the context of AR are discrepancies in the superimposition of virtual objects onto real objects. This is referred to as registration errors (Holloway, 1997) and is leading to a reduction in driving performance and subjective usability assessment (Pfannmüller, Walter, & Bengler, 2014). In this contribution an error-tolerant HMI approach will be described for the compensation of occurring registration errors. The approach was evaluated in a stereoscopic driving simulator with 65 Participants performing a monitoring task by using an adaptive cruise control assistant system (Level 1 automation). The participants had to intervene in critical situations by braking to avoid any collisions. Furthermore they performed a secondary tactile Detection Response Task (tDRT). The subjective perception of augmented reality accuracy was higher, when the vehicle ahead was marked by extended and diffuse visualizations than conventional ones with sharp edges. Meanwhile there were no negative effects observed regarding driver distraction (brake performance) and mental workload (tDRT performance) due to the error-tolerant HMI solutions.

The influence of a passenger and meditation before driving on driving behaviour and emotions – a simulator study

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School of Engineering and Architecture of Fribourg
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More than 90% of road accidents can be tied back to human mistakes, which are often a consequence of distraction or stress. Previous studies have shown that other persons present in the car are potential sources of stress and distraction while driving. This piece of research aims at the replication of findings of a study indicating that presence of a co-pilot is increasing risky driving behaviour. In addition, the role of meditation before driving as source for reduction of stress is addressed. In a 2x2 between-subjects design, 60 participants completed a 10-minutes driving session on a driving simulator either alone or with a co-pilot. Before their driving session, participants spent 10 minutes either with relaxation or listening to an audiobook. In addition to subjective data on mood and emotions, psychophysiological signals such as EDA, ECG and respiration have been recorded. Findings indicate that the presence of a co-pilot did not increase risky driving. Analysis of data revealed however several interesting results with regard to psychophysiological and subjective measures.

SESSION 7: AUTOMATION

Contribution of Industry 4.0 to the emergence of a joint cognitive and physical production system

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France

The digital and technological revolutions of Industry 4.0 aim at increasing the flexibility of companies, the mass customization of products and the improvement of working conditions. Thus, IoT and biofeedback sensors become new sources of information on the production context and the state of resources, big data and cloud computing offer increased processing capacity (for learning and simulation), virtual and augmented realities, as well as vocal or gestural commands, make the interactions more contextual, natural, and customized. The integration of these Industry 4.0 technologies must however reconsider the place of the operator in the production, to tend towards a joint cognitive and physical system. Interference between operators and the cyber-physical production system must be optimized, by fostering the emergence of a real know-how to cooperate on the different production management activities (line operations, supervision, planning). In this perspective, the paper provides an overview on the Industry 4.0 technologies and their impact on the human-systems cooperation. A synthesis model proposes to position these technologies around the processes of building common frame of reference and distributing functions between humans and the cyber-physical system. This model is finally illustrated by a conditioning activity, shared between a human operator and a cobot.

Effects of automation support on prospective monitoring, situation awareness, and operators' role definition in a complex supervisory control task

Linda Onnasch
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Automation support can both hurt and benefit human performance. This is especially true for action support automation and automation that additionally resumes the implementation of actions. However, the reasons for performance consequences are not well understood, nor specified for the two different automation support forms. Previous studies discuss the operators' perceived role as one reason for different performance patterns. When a task is completely automated, operators might feel accountable for the overall task. In contrast, operators interacting with action support automation might define the role limited to the only task not supported by automation. This should be mirrored by different monitoring strategies. Accordingly, the current experiment focusses on the precursors of performance: perceived operators' role, situation awareness, and prospective monitoring. Participants have to supervise a space platform cabin air management system responsible for the survival of inhabitants. After an elaborated training and a first experimental block without automation support, participants perform the different tasks over a prolonged time with two levels of automation support, followed by an automation breakdown. Monitoring is assessed with mouse clicks, situation awareness with the SAGAT, and the perceived operators' role is captured in a semi-structured interview at the end of the experiment. If operators' perceived role is affected by different levels of

automation support, we expect participants supported by full automation to show a prospective monitoring and have a better situation awareness compared to participants who work with action support automation.

Social Metaphors in Human-Automation Interaction Design

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Design metaphors impose a top-down framework for establishing a likeness between a specific design context and a familiar pattern of ideas (e.g., a desktop workspace), and through that likeness highlighting design dimensions associated with effective outcomes in analogous situations (e.g., physical files and folders). However, metaphors also guide thinking away from dimensions deemed less effective or inconsistent with the metaphor. The supervisory control metaphor has dominated human-automation interaction (HAI) literature for four decades. Supervisory control guides designers to think about HAI in terms of transactional relationships - the exchange of information and authority to decide and act - between the human supervisor and machine subordinates. The metaphor allows the designer to extract the principles of management and apply them as a design pattern across situations. As automation functionality progresses, transaction metaphors may not guide designers' attention to the most profitable insights for HAI. Teamwork metaphors employ different situations for comparison, and suggest different design dimensions to foster insight. In this presentation we will introduce prospective new metaphors for HAI and discuss whether they fit into families of transactional and teamwork metaphors. In exploring these metaphors we recognize new dimensions for HAI design that may be applicable across design situations.

Supporting supervisory control of safety-critical systems by optimizing visualizations on monitoring displays for fast and accurate perception

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The amount of automation in technical systems continually increases e.g. autonomous driving or automatic failure detection in control rooms. The monitoring of a high amount of information becomes a major task of the human operator. Due to the rising quantity of information, this task becomes increasingly complex. Especially in safety-critical systems, it has to be ensured that the operator assesses critical system states fast and accurate to initiate countermeasures in time. Therefor the HMI has to be designed carefully. For this, we developed the Konect method that allows systematic derivation of efficient visualizations. The method combines knowledge from the human factors domain (e.g. task analysis, ecological interface design), the information visualization domain and knowledge about human perceptual skills. Konect provides a numeric indicator system that allows the calculation of a value indicating the quality of the HMI directly at design stage. We validated the method in the automotive domain (for truck platooning) and in the maritime domain (with 17 designers creating designs, and 51 participants testing the designs in different laboratory studies).The results revealed that Konect designs performed significantly better than designs constructed with conventional methods ($p<0.001$) which reduced the amount of accidents by 81.8% (tested in driving simulator).

SESSION 8: VULNERABLE ROAD USERS

Should I Stay or Should I Go? Evaluating external HMI Concepts in Virtual Reality

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Higher automation levels will cause new paradigms of vehicle to pedestrian communication: With no driver in the loop or on board, external Human Machine Interfaces (eHMIs) will likely replace the driver to explicitly communicate the automation's intent to vulnerable road users. Recent advancements in display technologies made it possible to evaluate these concepts within a safe, repeatable and controllable environment using pedestrian simulators. New head mounted displays (HMDs) are a cost effective and mobile solution. However, little research has been carried out on applying HMDs for virtual reality (VR) pedestrian simulators. A study was conducted involving 43 participants that were exposed to four different eHMI concepts. To increase realism and reduce predictability of events, the virtual traffic and gap sizes were predefined and pseudo randomized. Widely used metrics in the context of traffic safety research were analysed and proven to be unsuitable to describe the influence of eHMIs on pedestrian crossing behaviour. New dependent variables are introduced to describe the efficiency of AV communication strategies. It could be shown that VR based pedestrian simulators are a suitable tool to evaluate early stages of communication concepts for future automated vehicles and pedestrian encounters.

Evaluation of a Walking Frame Mounted Assistance System Designed to Increase Safety for Older Pedestrians in Road Crossing Tasks

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An assistance system for older pedestrians designed to increase users' safety in road crossing will be evaluated in a field experiment with 30 subjects (65+ years).

The central reason older pedestrians get into accidents is their lack of attention to the traffic, mainly due to the multi-task requirements of the situation. That is being engaged in scanning the ground for obstacles or walking concurrently to the hazard detection. Therefore, the system was developed with the aim of reminding users to stop and to focus their attention to the street. For this purpose, a camera-based algorithm detects curbstones and gives a notification via vibration cuffs worn at the upper arms. In the experiment, subjects will cross the same ten low-traffic streets twice, with and without the assistance system. Gaze frequency and number of stops serve as dependent measures, which will be extrapolated from additionally mounted cameras. Furthermore, mental workload and acceptance will be assessed using questionnaires. Data collection will take place in June/July 2018. We expect higher gaze frequency towards the street and an increased number of stops before road crossing when using the assistance. Results will be presented and implications for road safety of older pedestrians will be discussed.

Preferences of European cyclists towards active systems with audio-visual and with handlebar vibration warnings

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The number of vehicle accidents is rapidly increasing and causing significant losses in many countries. According to the World Health Organization, road accidents will become the fifth major cause of death by the year 2030. In Europe cyclists suffer a disproportionate share of serious injuries and fatalities, and in recent years that disadvantage has been growing. To minimize accidents different types of collision warning systems have been proposed for motor vehicle drivers. These systems can detect early and warn the drivers about the potential danger, up to a certain accuracy. They speed up the drivers' response and can help to minimize the accidents that may occur due to driver's temporary inattention. Few studies are available on on-bike systems. The H2020 EU-project XCYCLE developed systems aimed at improving active and passive detection of cyclists informing both drivers and cyclists of hazards at junctions. We developed on-bike systems warning cyclists about risk of collision and we were interested in understanding preferences for different warning modes. In a review on responses of drivers against different collision warning systems (Muzammel, 2017), tactile early warnings are found more effective as compared to the auditory and visual early warnings. The systems' performance change within different age groups. Age showed to be a moderator between multimodal warnings and reaction times, with older drivers benefiting more from the use of multimodal warning systems than younger drivers. This is of particular interest given the demographic shift towards older society. We investigated the preferences for four different on-bike systems: 1) passive system without warning; 2) active system with audio-visual warning; 3) active system with handlebar vibration warning; 4) active system with both audio-visual and vibration warning. We administered a survey to 2381 European cyclists from six countries with different cycling rates and fatalities (Italy, Spain, Hungary, Netherlands, Sweden, United Kingdom). The passive bike tag was the most preferred among the respondents (67.8% would use), followed by active system with audio-visual warning (65.9%), active system with handlebar vibration warning (65.5%) and active system with combined warning (62.8%). Younger cyclists and cyclists who cycle daily prefer active system regardless of warning mode. Cyclists coming from countries with low cycling rates (e.g., Spain or Italy) tend to prefer on-bike systems than cyclists from countries with high cycling rates (e.g., Netherlands and Sweden). 76% of the respondents reported that their risk would decrease when using both the active and passive systems, while according to 70% and 69% the use of active and passive system, respectively, would decrease their risk when cycling.

The influence of automated vehicles on pedestrian motor behaviour

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In the future, pedestrians are expected to interact with automated vehicles. It has been previously documented that non-verbal communication such as eye contact and hand gestures play an important role in determining both the behaviour of drivers and pedestrians while crossing. In the absence of a driver such communication will cease to exist, thus potentially altering pedestrian behaviour. The aim of this study is to examine differences in pedestrian behaviour while crossing the street in front of a conventional vehicle as compared to crossing in front of a vehicle simulating automated driving by a biomechanical approach. Fifteen pedestrians were asked to perform two use cases: Forward Cross and Turn Right. The results show pedestrians increase walking velocity and leave a larger distance between themselves and vehicles while crossing in front of a vehicle simulating automated driving than a conventional car. Conclusively, when crossing the street pedestrians show stereotypical motor behaviour that could be used to optimize cars' decision making and increase pedestrian safety. External communication is advisable in order to indicate the intent of an automated car to yield.

KEYNOTE

Robots to Support Successful Ageing: Potential and Challenges

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There is much potential for robots to support older adults in their goal of successful aging with high quality of life. However, for human-robot interactions to be successful, the robots must be designed with user needs, preferences, and attitudes in mind. The Human Factors and Aging Laboratory is specifically oriented toward developing a fundamental understanding of aging and bringing that knowledge to bear on design issues important to the enjoyment, quality, and safety of everyday activities of older adults. Our research does not emphasize loss of function associated with aging; rather, we wish to understand how to enhance a person's ability to function well in later life, perhaps through technology. In this presentation, I will describe our research with robots: personal, social, telepresence. We focus on the human side of human-robot interaction, answering questions such as, are older adults willing to interact with a robot? What do they want the robot to do? To look like? How do they want to communicate with a robot? Through research examples, I will illustrate the potential for robots to support successful aging as well as the challenges that remain for the design and widespread deployment of robots in this context.

WEDNESDAY OCTOBER 10th

SESSION 9: HUMAN MACHINE INTERFACE - 2

The role of mental workload in determining the relation between website complexity and usability: an eye-tracking study

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Digital technology is now crucial for carrying out many activities and the drive for innovation in digitization has involved not only private organizations but also public administrations. However, despite a growing awareness of the importance of digitization of public services, usability issues have been addressed only recently. Terms like "Usability", "User Experience", and "Human-Centred Design" are surely becoming part of the vocabulary, but often they are used as empty keywords by policymakers, while there is a scarcity of specific research in this domain. One notable example is the lack of studies on cognitive load imposed by information abundant websites and its influence on both users' performance and perceptions of usability. The main objective of the present study was to evaluate the mental workload of users navigating websites with different levels of complexity in their information architecture. Eye movements of twenty users were recorded during the execution of search tasks carried out on websites of three public agencies previously selected for their complexity level. Mental workload assessment was obtained by analysing subjects' ocular behaviour and results showed that low complexity websites were associated with better performance, lower mental workload, and higher usability rates compared to high complexity websites.

Effects of Traffic Situation on Secondary Task Performance and Workload

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Facing the digital revolution, new and extended functions will be available both on the smartphones and the in-vehicle information systems (IVIS). To investigate the interaction effects of traffic situation and modality of secondary task, a fixed-base simulator study was conducted (N = 42). Traffic situations differed in willingness to engage into a secondary task, and modality of secondary task was visual-manual, Surrogate Reference Task (SuRT), cognitive-auditory, n-back, both in three levels of difficulty versus no secondary task. Task Performance, independent of difficulty, yielded no significant effect between the traffic situations, indicating compensatory behaviour. Subjective workload differed significantly between traffic situations and the secondary task modalities. Meeting the predictions, situations with a lower engagement willingness were perceived higher in workload. Moderate task difficulty provoked the highest perceived workload in the traffic situation of the lowest engagement willingness. In situations of low anticipation and higher driving speeds, the visual-manual task provoked a higher workload than the cognitive-auditory task. Hence, a protective effect of cognitive-auditory tasks can be assumed. Due to these findings, the drivers' compensatory behaviour shall be supported by an IVIS that adapts on the traffic situation and modality of the task-to-be-executed.

How to use AR-information to benefit the driver in a navigation task? Investigation of the acceptance and the effectiveness of AR-information in a navigation task compared to a classic Head-up Display

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With Augmented Reality (AR) additional information directly related to the environment can be presented to the driver. Thus, the driver can understand the information more easily with less cognitive load. Especially in navigation, this visual support can lead to an improved understanding of the route. The aim of the driving simulator study was to examine the acceptance and effectiveness of AR-information in a navigation task compared to a classic Head-up Display (HUD). While driving in an urban area, the driving task was to identify the correct destination street by means of navigation information presented in the display. After deciding for the correct destination street, the task was to switch off the display and navigate to the destination. Additionally, there was a non-driving-related task to raise the drivers' mental load. In total, 61 subjects participated in the study. Results revealed that while driving with the AR-HUD, participants switched off the display significantly earlier than with the HUD. Furthermore, the AR-HUD lead to reduced navigation errors compared to the HUD. The AR-HUD was rated as a relief regarding mental load and as more useful than the HUD. Recommendations for an adequate use of AR-information for navigation can be derived from this study.

Examining perceptual performance on a 3D instrument cluster

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Autostereoscopic displays allow a better user performance in recognizing and classifying on-screen objects. If implemented into Advanced Driver Assistance Systems (ADAS) or In-Vehicle Information Systems (IVIS), they can increase the effectiveness of such systems by providing distinguishable spatial relationships between information elements. The user will have a better understanding of complex user interfaces which reduces the total eyes-off-road time and therefore, benefit towards traffic safety. We present a study with 20 participants to examine the perceptual performance on a 3D instrument cluster using the Lane Change Task (LCT). While driving the LCT, the participants performed a secondary task. The aim of the secondary task was the repeated, controlled visual search of five stimuli within a 5x5 letter matrix. The target stimuli were emphasized either by a perceptible three-dimensional depth effect (autostereoscopic monitor) or by the relative size of the stimuli (conventional monitor). LCT-data, eye-tracking, visual function and fatigue questionnaires as well as socio-demographic data were collected. Results show, that users can acquire and process more information from a stereoscopic view while performing a driving task than in the two-dimensional condition. Also, visual fatigue seems to be unproblematic regarding 3D displays. To conclude, a suitability for ADAS/IVIS applications is demonstrated.

SESSION 10: AUTOMATION - TRANSPORT - 2

Design of a time-to-lane-crossing based haptic steering guidance

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Current haptic control systems provide feedback torques based on a lateral error with respect to a reference trajectory (i.e., centre of the lane), which do not capture the satisficing behaviour human typically adopt during a lane keeping task. As such, a novel time-to-lane-crossing-based controller is proposed, which is expected to provide more human-like guidance. The aim of this study is to describe the novel time-to-lane-crossing-based controller and investigate its potential as an alternative to previous reference-trajectory-based guidance. In a simulator study twenty-four participants drove three trials through a single-lane, 10.8 km long road (width: 3 m), receiving three types of guidance, namely 1) none (manual), 2) reference based controller, 3) TLC-based controller. Results showed that both the reference-based, as well as the TLC-based guidance provided significant safety benefits, in terms of more centered and less varying lane position, and higher safety margins. Moreover, no significant differences were revealed between the two guidance approaches. In conclusion, the TLC-based guidance is a potential alternative to reference trajectory-based guidance. Nevertheless, a more detailed analysis is warranted to investigate the two approaches in different driving conditions, like road width, straights, and curves.

Perceived Safety: A necessary precondition for successful autonomous mobility services

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In order to reach the goal to reduce traffic volume in cities, new smart, sustainable and user-centred mobility alternatives to motorized individual traffic are needed. The progress in vehicle automation holds a great promise for increasing attractiveness of public transport by improving flexibility and availability of service. Besides the expected benefits, autonomous mobility services will open up a range of new challenges. Perceived safety issues of autonomous driving are a recurring theme in the media. In the project HEAT (Hamburg Electric Autonomous Transport), a living lab is set up to operate and evaluate autonomous busses within regular traffic with speeds up to 50 km/h. Besides the technological challenges, the perceived safety of prospective users is taken into account as a necessary precondition for the success of the driverless mobility service from the beginning. Based on the results of a Design Thinking workshop with prospective users of the autonomous transport system, an online survey was developed to analyse fears. The identified fears can be clustered in three groups: (1) Fears of other persons, (2) Fears resulting from intransparency of the system and (3) Fears of technical malfunctions. Countermeasures to cope with those fears were defined and rated by the respondents.

Who is driving whom? Highly automated driving transitions from manual to automation in reality and the impact of situation, personality and the driving experience.

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Highly automated vehicles will soon disseminate in road traffic. Much research is concentrated on the design of highly automated vehicles and the take over request. Few research has focused on the drivers willingness to engage the automation while driving. In the present study 38 drivers were asked to drive a Tesla Model S, equipped with longitudinal and lateral support, in different traffic situations nearby Berlin. They were allowed to enable the automation at any time. We examined under which conditions they used the automation. We also assessed subjective measures and the objective driving performance. The results show that usage behaviour depends on driving situation and we also found effects of driver personality. Finally we obtained that the driving experience affects the assessment of the highly automated vehicle. We conclude that highly automated vehicles still have a long way to go until they will be used in every driving situation on the road.

The influence of drivers' mental models about automated vehicle guidance on transition behaviour in critical situations

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The automation of driving tasks influences the way people interact with the corresponding systems. Research on advanced driver assistance systems has shown that the mental models which are formed by system interaction do not always fit the actual system limits. The aim of this study was to assess whether drivers' mental models of an automated vehicles' performance in a specific situation influence their driving behaviour when this situation occurs. In total, N=53 participants took part in a driving simulator study. The participants' task was to perform an automated drive whereas manual control needed to be regained once the car detected a system limit. To influence mental models, three sub-groups were formed with varying information on system performance: accurate knowledge about the cars' system limit, incorrect knowledge and incomplete knowledge. Results show that mental models about the automated car have an influence on driving behaviour: drivers with incorrect or incomplete knowledge tend to break more strongly and immediately after the transition cue occurred, without thoroughly checking if their surrounding allows such behaviour. This implies that drivers' individual understanding about system limits influences driving behaviour and can cause safety-critical events, and therefore needs to be minimized or eliminated.

POSTERS

Parametric evaluation of sustained light muscular activity in product use

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Usage of a PC mouse is a kind of task where muscle activation levels, while low in general, can indicate potential for musculoskeletal disorders due to prevalence of static muscular activity. This is believed to represent a higher risk for musculoskeletal health than dynamic muscular activity. The study reported in this paper proposes a two-dimension approach to comparative evaluation of muscular activity during mouse use, based on the percentage of Maximum Voluntary Contraction of selected forearm muscles as well as on the dynamics of muscle activation. The latter is computed as a ratio between the difference between APDF90 and APDF10 divided by APDF50 (APDF-Amplitude Probability Distribution Function for the 90th, 50th and 10th percentiles). The paper demonstrates the approach with results of comparative evaluation of a horizontal, a slanted and a vertical PC mouse, through surface EMG monitoring of 20 participants performing standardized graphical task with the devices. The paper, hence, demonstrates a parametric approach to assessing the dynamics of muscular activity. Ergonomic evaluation of PC mice, besides usability, concerns risks for musculoskeletal health, which are assessed from posture and muscular activity. Low levels of activation may be balanced with more dynamic contractions, springing from device geometry features, diminishing risks.

A Tactile Interface for Identification of Hazardous Situations During Operational Movement

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Most of the operational tasks that Infantry commanders do rely heavily on the visual modality. At the same time, use of advanced visual devices has become common. This, together with the need to execute tasks rapidly, may cause overload and decrease commanders' performance. One promising alternative is utilization of the tactile modality via wearables. In the current field experiment, eleven commander participants performed an open terrain navigation mission while accompanied by a team of five subordinates and while identifying stationary targets and responding to tactile/visual alerts. The tactile condition included two separate alerts and each required a different response. Objective and subjective measurements were collected. Results revealed a positive tendency towards the use of tactile cues during operational movement in open terrain. Response time to tactile cues was faster compared to the visual condition. The findings confirmed that participants could distinguish between two types of tactile patterns during movement and identify them correctly. Thus, tactile interfaces are useful under fielded dynamic conditions. Tactile cues can potentially be used for varied information delivery necessary in the field, communicating warnings, increasing awareness, or giving commands.

Wheelchair Motion Control Using Smooth Pursuit Eye Movement

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This paper describes the study of the motion control for a powered wheelchair by using smooth pursuit eye movement. The electric wheelchairs on the market mostly controlled by joystick, which are unusable for the person with a disability of upper body. Eye movement interaction technique can work as a joystick to control the wheelchair. Smooth pursuits, which happen when eyes follow a moving object, is a spontaneous and natural eye movement compared with the fixations and saccades. Smooth pursuits is a calibration-free gaze interaction technique, as it detects which object is being looked at just by correlating the moving object's trajectory with the gazes' trajectory in real time. A Tobii EyeX eye tracker is connected to the wheelchair and a eye-based user interface is developed. The moving targets on the user interface represent different control commands (e.g., move forward, move backward, go left, go right). Smooth pursuits offer a natural selecting method by just using eyes to track one of the moving targets on the screen. The purpose of this study is to provide a natural gaze-based interaction technique for the wheelchair control.

How to achieve applicable user responses? - The design of feedback dialogues in the context of usability engineering

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For software developers user feedback is an essential source of information for improving usability. Therefore, versatile user responses as well as a high substantial quality is crucial. In practice this demand is hardly met as the given user feedback lacks in quantity and quality. Concerning this issue, a booking app of an in-house mobility concept was investigated regarding the feedback behaviour of users on their disposition of the app as well as their preferences respectively methodology, means of transmission and the design of the user interface of feedback features. For the purpose of data acquisition, which involved 200 participants, standardized questionnaires including open, closed and multiple-choice questions were used. Furthermore, the subjective expectations of users were opposed with their objective feedback behaviour. The study shows that requirements on the design of feedback features are context-sensitive. Thus, responses on the software are preferential given by quantitative features whereas qualitative feedback features are used for reporting bugs. Furthermore, a difference in subjective and objective feedback behaviour was found. Hence, indications for user-centred design of feedback systems could be derived.

To change or not to change– that is the question: Detecting lane change signals for anticipatory highly automated driving

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In near future manually driven and highly automated vehicles (HAV) will share roads. Current HAVs are limited in perceiving and understanding signals that manual drivers, consciously or unconsciously, send to other road users, like using the indicator, driving near the lane edge or swerving when they are about to start a lane change manoeuvre (LCM). If the HAV is not able to recognize and anticipate other road users' behaviour, reactions are induced too late and e.g. suddenly occurring brake manoeuvres can be the consequence. Therefore, algorithmic prediction models of traffic behaviour need to be enhanced to develop a safe, smooth and well-accepted driving style of an HAV. The presented work examines lane change manoeuvres in detail. The executed experiment focuses on identifying signals, which experienced drivers would use to predict LCMs. A user study (n=17) was conducted using 21 video sequences (14 with and 7 without a LCM) being paused shortly before a potential lane change of another car. Test subjects had to assess the probability of a lane change and name reasons for their decision. The article gives an overview of the most common signals and their possible usage for improving HAV's anticipation performance.

Positioning of side-view cameras on passenger vehicles to aid rearward perception

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A growing amount of work investigates the advantages of camera-monitor systems (CMS) as replacement for conventional side-mounted rear-view mirrors in passenger vehicles. Research mostly focuses on monitor placement or increased field of view and their effects on perception. Fornell Fagerström and Gardlund (2012) have highlighted technical advantages of altered camera positions, compared to the conventional mirror position. However, no empirical work has investigated perceptual effects of different camera positions so far. Considering this, we investigated how camera position affects drivers' rearward perception. In a first study, 20 participants observed static rearward traffic scenes on a monitor placed on a test vehicle's dashboard. Each scene showed two target vehicles at varying distances between each other and to the test vehicle. Participants verbally estimated egocentric distance between the test car and the first target, as well as exocentric distance between the two targets. We hypothesized that a higher camera position results in reduced visual compression of perceived distance, in particular in exocentric judgments. However, placing the camera further to the front or back of the vehicle should not affect distance estimates. Results show that camera positioning does affect distance estimations differently, with lower camera positions leading to lower estimations of exocentric distance.

Expectations of automatic vehicle guidance in cooperative situation: Modelling with Naturalistic Decision Making

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With the introduction of automatic vehicle guidance (AV) mixed traffic scenarios between automatically and manually guided vehicles are to be expected, at least at the beginning. Thereby, situations which afford a cooperative interaction between human drivers and AV are of particular interest. An approach to understand human decisions in cooperative situations is the Natural Decision Making (NDM). It describes how experts decide in complex and uncertain conditions. An example for the NDM is the “Recognition Primed Decision Model” (RPD) of Klein (2008) which we applied for this study. With the help of a “Recognition Module” it divides the decision into "Actions", "Expectations", "Relevant cues" and "Goals". As a method to investigate expectations, an online questionnaire was used in which the respondents (N = 87) were presented various cooperative situations and asked about expectations of AV. As a result, the relationships between goal and actions as well as actions and expectations could be examined in more detail. Furthermore, the results were compared with an online survey (Imbsweiler et al., 2018) in which the expectations of human road users were examined. In the conclusion a recommendation is given which behaviour should be taken into account in future studies and for AV.

Motion sickness in cars: a holistic approach of a design pattern for constructing in-car motion sickness studies

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Automated driving opens the way for different sideline activities, which have great influences on the passengers considering motion sickness. Critical situations can be provoked by dynamic and visual stimulation, whereas the degree of impact is highly determined by an individual’s susceptibility. To understand these diverse reactions a structured procedure for empirical research is essential. A systematic decision matrix was developed based on literature research and self-conducted real driving studies. The matrix assists the user in the holistic design of an experiment considering the composition of the different stimuli, possible definitions of subject groups, sickness detection methods and ethical validation. This work contributes to the once again growing field of motion sickness research. It is meant to stimulate the debate within the different challenges in the field and across professions. One example would be sickness detection by verbal questioning which is established but offers plenty arguable side effects. Over 35 years of research on motion sickness in cars provide experiences on how to conduct experiments. The now existing research groups should bundle their resources and merge the knowledge to answer the emerging questions. This should happen promptly to solve the issues of motion sickness arising due to highly automated driving.

The effect of time budget and driver assistance on manual takeover performance in a highly automated vehicle

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Due to the development of automated driving, driver performance and decision making during manual takeover is a growing topic of interest. One factor that could substantially influence the security of takeover and that occupies policymakers' agenda is the total time budget granted to the driver. The aim of the current study was to investigate the influence of total time budget on drivers' performance and to test whether driving assistance, namely, a blind spot alert, could improve performance during manual takeover. Seventy drivers completed three scenarios on a driving simulator with a level 3 automated function (SAE, 2014, 2016) while performing non-driving-related tasks and experienced a takeover request caused by an obstacle in the lane. Time budget to takeover manual driving was defined as the time to collision with the obstacle. Depending on the experimental group, it was set to either 4 seconds or 8 seconds. Results showed an influence of time budget on crash rate, takeover strategies, and obstacle-avoidance strategies. Blind spot alert improved driver's performance during manual takeover for an 8 seconds time budget, but had no effect for a 4 seconds time budget. These results could have implication when designing the level 3 automation.

Driver-Initiated Take-Over Behaviour in Highly Automated Driving

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A major topic in highly automated driving is the transition of control between driver and automated vehicle. This transition of control is commonly initiated by the automated system via take-over requests. However, transitions can also be initiated by the driver. These driver-initiated transitions can be reasonable when reliability of the automated system is low and critical driving situations arise. In a simulator study, we examined the impact of reliability of the automated system and criticality of the driving situation on trust in automation and driver-initiated take-over behaviour. Reliability was manipulated by the number of automation failures in the first phase of the experiment. In the second phase, the automated vehicle followed a lead vehicle and was confronted with an obstacle. However, there was no automation failure. Criticality of the driving situation was manipulated by time headway to the lead vehicle. Results indicate that most drivers took over control of the vehicle. Criticality of the driving situation and reliability of the automated system did not impact the number of take-overs. Moreover, reliability did not affect trust in automation. However, when criticality was low, higher trust in automation was associated with fewer take-overs. Implications on the design of vehicle-driver interaction are discussed.

Safe and Seamless Transfer of Control Authority

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According to Sae International, within Level 4, drivers could safely go to sleep or leave the driver's seat as their attention in not ever required for safety. Since the driver won't be asked to monitor the road, the take-over requests could become critical situations to cope with: driver might want to take over and the vehicle must be able of providing the transfer of control in the safest manner possible; on the other hand, it might be even the case in which the vehicle requests the driver to take over within a limited amount of time. Safe accomplishment of these transfers requires monitoring systems capable of detecting drivers' impairment and their situational awareness. Therefore, the aim of this paper is to provide a survey on the existing literature on Take-Over Request (TOR) in SAE Level 3, analysing the experimented methodologies, how their performance are evaluated and the used monitoring systems. Finally, unsolved related issues and a novel way to cope with TORs will be outlined as well as some of the potential benefits that could arise from the application of such new methodology on both safety and performance.

Visual inspection of baggage X-ray images: How do expertise and automation influence detection performance?

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The current study examined the impact of expertise on performance and use of automation in an X-ray baggage screening task. 30 certified airport security officers and 31 novices (students) were asked to indicate the presence of a target object (either a gun or a knife) in a series of X-ray images of cabin baggage. Adaptable automation was provided to half of the participants, whereas the other half worked without support. They could freely selected between three support levels: (1) no assistance, (2) a frame surrounding the whole piece of baggage (indirect cue), or (3) a frame surrounding the potential target (direct cue). Overall, experts performed better than novices. Although both groups used the diagnostic aid in a similar way, results showed that detection performance increased for novices working with the adaptable automation compared to novices without support. No such benefit was observed for experts. Interestingly, more compliance (i.e. following automation suggestions when it indicated the presence of a target) and reliance (i.e. following automation suggestions when it indicated the absence of a target) were observed for experts than for novices. This suggested that novices benefited more from automation than experts.

Problem Solving in the Human-Machine-Interaction: Rethinking the Role of Spatial Working Memory

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Troubleshooting automated production systems poses high demands on the human operator. The analysis of human eye movements has the potential to create insights into problem solving activities such as troubleshooting. Through attention guidance these insights can improve task performance (Jarodzka et al., 2010). At the same time physiological parameters in general show strong inter-individual differences in their reaction to varying demands (Schneider, 2017) while eye movements in specific interact with working memory content (Theeuwes, Belopolsky & Olivers, 2009). Our contribution poses the question to which degree spatial working memory capacity (SWMC) as an intra-individual factor influences eye movements during problem solving. To this end, 34 participants completed two tasks to capture problem solving behaviour ("Tower of London") and SWMC ("Corsi Block Tapping Task") while their eye movements were recorded. Results show weak support for SWMC as sole predictor of eye tracking parameters like fixation duration, saccadic amplitude or dwell time. Further analyses using a linear multilevel approach speak for an intricate interaction with additional factors like task difficulty and stage of the problem solving process though. This stresses the importance of inter-individual differences when analysing eye movements. Implications for interventions to improve troubleshooting performance will be discussed.

Using a Teamwork Metaphor for Operator Interaction with Procedural Automation

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The classical "who does what" transaction metaphor underlying Degree of Automation modelling has been criticized for narrowing the research perspective on Human-Automation Interaction (HAI). A teamwork metaphor focusing on how humans and automation "should get along" has been offered as an alternative or supplement to the transactional thinking that has traditionally dominated HAI research. However, design examples based on this metaphor are not common in the literature. In order to explore the teamwork metaphor as a starting point for HAI design, we developed and tested a wall-sized interactive display in IFE FutureLab to inform operators about on-going automation activities during the startup of a nuclear plant. The prototype allowed flexible HSI interactions with a realistic user experience, but dynamic process simulation was not implemented. We conducted a feasibility study with eight individual participants to assess the usefulness of the collaboration-oriented design concept. The experiences from the iterative prototype design and empirical-inductive testing suggest that teamwork metaphors may facilitate the extraction of under-researched design dimensions that could become important for HAI design in future systems.

Virtual realities, mental abilities and the effect of ageing

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Within a society that is characterized by technical progress, virtual realities are becoming increasingly important. While simulators provide the opportunity to systematically and efficiently investigate innovations, interindividual differences as well as influencing factors, the time of adaptation to the system has been neglected so far. Aiming a better understanding regarding individual differences, the study at hand investigates the effects of aging and mental abilities on the time of adaptation in driving simulators. 366 participants with a mean age of 62.59 ± 12.31 years (ranging from 25 to 89 years) were tested by a neuropsychological test battery (Trail Making Test (B), D2, LPS4) and a 25-minute drive in the driving simulator. Consistent with previous findings, the present results demonstrate a significant relationship between age and mental abilities. In contrast, neither a significant relationship between age and time of adaptation nor between mental abilities and time of adaptation could be identified. Additionally, we found a relation between age and time of cancelation, because of the occurrence of simulator sickness. While technical innovations, such as modern cars, are more and more used by the elderly, future studies in the field of virtual realities should increasingly focus on the effect of ageing.

Impact of Task Complexity on Driving a Gaze-Controlled Telerobot for Social Interaction

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Gaze interaction is a common control mode for individuals with movement disorders. Robotic telepresence systems promote social interaction for geographically dispersed people, which allows people with limited mobility to independently participate in social activities. Telepresence and situation awareness (SA) play an important role regarding how much and what information should be provided in the telepresence robot's user interface. A limited amount of research exists on gaze-controlled, telepresence systems and it is still unclear how task complexity impacts users SA, telepresence, and performance. The telerobot's interface was presented via a virtual-reality, head-mounted display with gaze tracking and the telerobot was equipped with a 360◦ field of view camera that was placed at eye level. The route the telerobot was supposed to follow was manipulated to be either low or high in complexity. Users' eye movements, telerobot's position, and working memory task accuracy revealed significant differences between the two task complexity groups. However, the task complexity manipulation was inadequate, and no validated SA technique was implemented. Thus, experiment 2 included an elaborate task complexity manipulation, a social interaction task, and implemented the situation present assessment method (SPAM). Results from SPAM probes (reaction time & accuracy) differed as a function of task complexity.

The use of 3DSSPP for motor vehicle accidents

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The 3DSSPP software quantifies lumbar compressive loads during activities of daily living (ADLs). In medicolegal circumstances, biomechanics experts commonly utilize this software to relate calculated forces from a motor vehicle collision (MVC) to those experienced in ADLs as a method to deduce potential for lumbar intervertebral disc (IVD) injury or non-injury. The external validity of this methodology, however, is in question. 3DSSPP quantifies loads through the use of a static equilibrium model. Limitations therefore include considering joints as frictionless pin-joints, representing the torso as a single segment, disregarding tissue deformation, assuming the standing position of the individual (feet on the ground). Despite its "dynamic mode" enabling frame by frame interpolation, the program only works for movements with negligible acceleration as it does not take into consideration the loading rate applied to the lumbar human tissues associated with the, therefore ignoring their viscoelastic properties. In addition, the program does not allow experts to take into consideration additional seat belt load or individual's pre-medical condition which may affect the threshold for injury. While the program has been validated for ergonomic study of workplaces, its use for injury potential in MVCs appears invalid and beyond the program's capabilities.

Analysis of drivers' visual behaviour in road curves with different geometry

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This paper analyses the visual behaviour in terms of fixations during negotiation of three different road curves (circular, clothoid and continuous curve). Studies on performance of particular road curves involve complex analytical calculations whose aim is to quantify indices and functions, based on the fundamental hypothesis that a user "follows" the axis of the lane. However, since the acquisition of information from the environmental context takes place almost entirely through vision, it's interesting to see whether drivers realize the different curves geometry and, if so, how they behave on these. An experiment in a driving simulator with controlled road alignment to guarantee similar traffic and weather conditions for all. The experiment resulted in indexes related to the fixation of the tangent point of the curve. The results show that drivers did not perceive the three curves in the same way, reflecting slight differences that characterize them. However, visual behaviour did not always translate into different steering manoeuvres.

Assessment of Scanning Behaviour Characteristic at Unsignalised Intersections for Driving Aptitude Diagnosis of Elderly Drivers

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The aim of this study is to assess scanning behaviour characteristic at unsignalised intersections for future driving-aptitude diagnosis of elderly drivers. In Japan, traffic accidents caused by elderly drivers is a serious problem. However, if driver characteristic leading to unsafe behaviour is identified, driving could be improved by sufficient support considering the characteristic and accidents will be prevented. In this study, we focused on drivers' scanning behaviour, which is a direct causation of crossing accidents, during an unsignalised intersection passing scenario, which is a typical accident scenario. First, to identify an assessment criterion for scanning behaviour, driving data on public roads of elderly drivers and driving instructors, whose behaviour is exemplary and safe, was analysed. We set a criterion by comparing behaviour of the elderly and instructors. Although physical function of the elderly decline due to aging, physical function is a requirement of sufficient scanning. Therefore, we examined the required function based on the scanning criterion and geometry of intersections. Angular velocity of head rotation was extracted as the required function and a criterion was set to judge scanning capability. Finally, we proposed a classification method of scanning behaviour characteristic based on the criteria of scanning behaviour and physical function.

Anticipation of Social Interaction with a Virtual Agent based on Eye Contact Duration

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Both gaze direction and gaze duration convey information about communicative intentions. But, how do they interact to affect an inference about such intentions? In a facial expression identification task, an avatar face was presented with a neutral expression and direct or averted gaze for 1.2, 3.3 or 6 seconds. Then, it produced either a social expression or an arbitrary one. Participants fixated on the avatar's eyes and made speeded judgments. In the 1.2-second direct gaze condition, both expressions were expected to be identified equally fast, since a brief glance should not have generated any anticipation of social interaction. In the 3.3-second direct gaze condition, we expected participants to be faster and more accurate in identifying the social expression, as anticipation should have already arisen. In the 6-second direct gaze condition, both expressions were expected to be identified equally fast, since an expressionless stare should have had a distracting or discomforting effect, causing performance to decline. In the averted gaze condition, both expressions were expected to be identified equally fast, as anticipation of social interaction should have never arisen. Results are discussed in connection with known socio-temporal neurocognitive mechanisms. Implications for designing efficient human-robot interactions are also discussed.

Evaluation of external autonomous vehicle-to-pedestrian communication solutions: A field research

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Due to lack of human drivers, intention communication with other road users through conventional methods, such as eye contact and gesture, will be on longer available for autonomous driving. Aiming at avoiding pedestrians' misunderstanding on intentions of autonomous vehicle in urban traffic, two types of external communication solution for the autonomous vehicle were developed in this study. One is a single-mode solution based on visual display and another is a multi-mode solution by combining visual display with acoustic cue. To study the effect of these communication solutions on pedestrian's road-crossing decision-making, a within-subject field experiment was conducted with 30 participants in two traffic situations (vehicle stop and vehicle go). In addition to the communication solutions, dispositional factors (risk-perception and tendency of trust in autonomous vehicle) and situational state (feeling of safety) were also assumed to have influence on pedestrian's decision-making accuracy. The final analysis results show that the decision-making accuracy can be significantly improved by employing communication solutions. However, in comparison with visual communication, only a slight improvement of accuracy is obtained by introducing acoustic cues. Additionally, feeling of safety has a positive effect on decision accuracy and is found to be an important factor in pedestrians' road-crossing decision-making.

Measuring cognitive load with a low-budget Arduino device

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Considering cognitive load when developing user interfaces is important, especially when tasks are performed in addition to safety-relevant tasks as a driving task. There are various physiological measurements to detect shifts in cognitive load. As researcher, the most important requirement when choosing a method is the validity and reliability of the method. But there are also other important requirements, as availability and the costs of the device. Today there are several approaches, many of them involving Arduino-based devices that promise to fulfil all those requirements. This contribution shows the results of measuring skin conductance with a low-budget Arduino-based device. Participants had to perform a critical tracking task (CTT) as primary task and n-back tasks as second task. Results show, that skin conductance measured by this device could not differentiate between the n-back levels (1-back and 2-back). However, future application with improvements of the hardware should also be discussed and will be pointed out by this poster.

Prediction of recidivism to understand and prevent aberrant driving behaviours

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To better understand these "aberrant driving behaviours", it is necessary to know which behaviours are most significant in the prediction of recidivism. This study aims to contribute to untangling and assessing the potential predictors of reoffender drivers. In this study, 296 drivers: 86 reoffenders (7 women and 79 men) and 206 non-reoffenders (105 women and 101 men) responded to a battery of assessment questionnaires in which they were asked for demographic data (i.e. gender and age), alcohol consumption habits, driving styles, general estimation of risk in everyday life, sensitivity to reward and punishment and anger while driving. The results provided a logistical regression model capable of predicting reoffending and explaining 34% of variability, successfully classifying 77.6% of participants. In this model, the best predictor of reoffending is higher consumption of alcohol (Alcohol Use Disorders, AUD), followed by incautious driving (since cautious driving style correlates negatively with reoffending) and to a lesser extent, infra estimation of recreational risk and a greater sensitivity to reward. Relying on results to predict recidivism could be important to plan better interventions to prevent it.

Influences of system response delay on elderly participants' performance in a virtual memory training

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So far, evidence on influences of system response delay in spoken human-machine dialogues is rather ambiguous and mainly focuses on subjective system evaluations. Studies that systematically inspect effects on performance are still lacking, and influences of individual characteristics like age, gender or affinity for technology are often neglected as well. The current study addresses these issues by testing a sample of 62 elderly participants (M = 69.03 years, SD = 5.48, range: 60-81, 57% female) in a Wizard-of-Oz study with a simulated virtual agent. In three training runs with fading guidance they acquired the method of loci and applied it afterward to memorize and recall lists of German substantives. System response delays varied continuously between 0.5 s and 5.5 s with a fixed length for each participant. Results indicated positive effects on memory recall with higher training performance, female gender and less negative perception of technology. Moderating effects on increasing system response delay were found for retentivity and some facets of affinity for technology. Participants also provided more positive system ratings with higher enthusiasm for technology, but reported increasing frustration with a more positive perception of technology. Taken together, the framework shows potential for investigating effects of adaptive voice-controlled technology on human performance.

Supporting Collaborative Fault Diagnosis: Complete Information Transfer or Strategic Hypothesis Testing?

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Fault diagnosis in the process industries requires close cooperation between control room operators and field operators. Communication problems result from the partners' spatial separation, their reliance on verbal communication, and their access to different types of information. In a previous study using a task that required participants to jointly diagnose five technical faults in a simulated plant, we illustrated a large number of communication problems which occurred regardless of the amount of information participants shared. To address these problems, two sets of instructions were developed to support remote cooperation. One instruction promoted precise and complete transfer of task-relevant information (completeness), while the other promoted strategic planning, execution, and evaluation of all diagnosis activities (strategy). The results revealed no group differences in overall solution times and error rates but specific changes in the problem solving process and communication: While the completeness instruction led participants to communicate more without testing more relevant hypotheses, the strategy instruction resulted in a larger percentage of time spent on planning activities while fewer control actions were performed. These findings suggest that supporting operators in jointly planning, executing and evaluating can reduce the amount of unnecessary interference with plant processes.

From in-cabin driving to remote manual interventions: How task allocation changes with railway automation

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Automated train operation, classified through four distinct grades of automation (GoA), is on the rise in urban as well as long distance operations. An effective allocation of tasks to either the train driver or automated system components lies at the heart of operational safety and each subsequent GoA alters the needed allocation of tasks. The changing tasks of the train driver when stepping from GoA 1 to GoA 2 have been described in terms of levels and stages of automation, but the substantial changes that come with the next step towards GoA 3 need to be considered with care, as GoA 3 is characterized by unmanned train operation. Unmanned operation fundamentally challenges the way railway safety is ensured, as the train driver disappears from the cabin. We present a possible allocation of necessary task between remotely placed train operators and autonomously driving vehicles, which is based on current German operational regulations. The work is set out to contribute to the development to safe GoA 3 mainline operations. The task allocation is discussed in the context of widely acknowledged stages and levels of automation, and it´s prototypical implementation into a simulated remote workplace for experimental research is introduced.

Fidgeting as a sensory reinforcement strategy for overcoming boredom

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A large number of studies on human performance in sustained attention tasks have been conducted since the first half of the last century. Despite results describe boredom as one of the leading causes in depleting attentional resources, the understanding of its relationship with human performance has been limited by the unavailability of observational measure. This study tries to solve this problem by focusing on a behavioural outcome of boredom that is an increase in brief, repetitive and involuntary body movements, named fidgeting. An experimental study has been conducted, and the performance of individuals involved in boring and an engaging version of the same task was compared. Arduino technology was used for detecting movements. Results showed that individuals make more aimless movements in the boring condition, therefore confirming that this strategy may be used to introduce variability where it lacks. Fidgeting seems to be a promising measure for the operator functional state that could be used in many operational settings.

Drive me natural: Design and evaluation of trajectories for highly automated driving manoeuvres on rural roads

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Sensory and algorithmic developments enable an increasing implementation of automation in the automotive sector. Driving-related psychological studies have been rather subordinated issues, but constitute essential aspects for a later acceptance and use of highly automated vehicles. In addition to studies on driving task transfer or out-of-the-loop issues, there is a lack of knowledge on how people want to be driven in a highly automated vehicle. First insights show that preferences regarding the perception and rating of driving styles are widely spread. Many subjects prefer their own or a very similar driving style. Swift, anticipatory, safe and naturally-looking driving styles are prioritized. The paper presents results of a within-subject design driving simulator experiment that investigated varying driving trajectories on rural roads with oncoming traffic. 20 subjects experienced a static (always driving in the centre of the lane) and a reactive (reacts on oncoming traffic by moving to the right edge of the lane) trajectory behaviour. Subjects gave online feedback via a discomfort handset control, questionnaires and interviews. The article gives an overview of the preferred trajectory behaviour, the reasons for subjects' choices and their hints for further development.

How to apply what we know about Human-Computer Trust to System Design: A Framework for Building Trustable Systems

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Human-Computer trust has been investigated over many years by human factors researchers as a major enabler of advanced technologies. However, the gained knowledge can often only be insufficiently applied to traditional technology development processes where technological goals often do not allow viewing the holistic properties of an operational reality. However, such view is needed to make human trust issues visible and derive trust requirements that could help designers develop more trustworthy systems. In this paper, we are presenting a process framework that was developed within an ongoing European research project with the intent enable human factors and engineering practitioners to work together toward developing more trustworthy systems. The framework is based on recent and current theories of human-computer trust from which converging perspectives were extracted. Human factors practitioners are brought into the conceptual design process early on and moderate the envisioning of operational scenarios. With the application of the framework, otherwise hidden trust issues are rendered visible. Thereby trust requirements are formulated and inserted into the overall specification process. We describe the lessons learned, intermediary results, and our approach to validate the framework for several use cases across different domains including automotive, railway, and health care.

Operator strategies in the food processing industry: Individual differences in handling machine faults

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Food processing and packaging plants are highly automated systems. However, complex interactions between the machines, products, packaging materials, and environmental factors result in a high frequency of faults and malfunctions in this domain, which makes human intervention essential. Operators are needed to diagnose and rectify faults and these activities strongly rely on human competencies and experience, but the Human Factors literature in this domain is scarce. To make a first step towards understanding operator strategies and knowledge requirements, explorative observations and interviews were conducted in a factory that produces and packages chocolate products. Six different shifts were observed to investigate the cooperation between operators and machines. This work revealed that operators differed immensely in their general understanding of the machines and processes, in their use of different information sources from the plant and HMIs, as well as in their strategies of handling faults. Specifically, such differences were observed in the activities associated with anticipating, preventing, diagnosing, and removing faults, as well as in the amount and type of communication and cooperation with co-workers. The present work describes these different activities, illustrates them with examples from operators' daily work, and derives implications for future research and the design of assistance systems.

Developing a Pictorial System Usability Scale

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The System Usability Scale (SUS, Brooke, 1986) is a widely used instrument to assess perceived usability of interactive systems. Besides the English version, translations were made into many target languages, but few of them have been validated (e.g. Portuguese version, Martins et al., 2015). We created a first version of a pictorial SUS in order to provide a language-independent alternative to the verbal questionnaire, which eliminates the need of translation. The pictorial items were developed and pretested for comprehension with an iterative approach. The items were afterwards validated conducting a first lab study (N=60) where participants had to interact with a smartphone prototype. After task completion, they filled in a pictorial and a verbal version of the SUS to evaluate the prototype. In addition, we measured questionnaire completion time and motivational aspects such as fun. The results showed that seven out of ten pictorial items obtained medium to high correlations with verbal items. The pictorial scale was also perceived as more interesting to be used. The findings suggest that the use of such a pictorial scale appears to be a promising alternative to verbal scales.

Supporting user interaction with the range of electric buses in local public transport

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Electrification of local public bus transport is a key measure to reduce transport emissions. Yet, to ensure optimal utilization of electric buses, operators' interaction patterns with the range must be identified and considered during interface development. While previous studies on user-range interaction focused on individual car use, the context of electric buses in local public transport entails specific challenges for operators (drivers and dispatchers) and for the design of support systems. The objective of the present research was to examine user-range interaction of electric bus operators and how support systems could facilitate this interaction. We conducted a qualitative interview study with drivers and a survey with dispatchers where we examined the processes of range assessment (i.e., appraisal processes) and range optimization (i.e., coping processes). Results indicate that drivers' time resources for range assessment and optimization are scarce and that driving behaviours of previous and following drivers can further complicate range management. Drivers tend to inform dispatchers in case of criticality and rely on their appraisals and decisions. User-range interaction could be facilitated by specifically addressing the identified challenges, for instance by introducing an action-integrated visualization of range criticality or system elements supporting range communication among operators especially during shift changes.

A Methodology for Redesigning Flight Training Using Augmented Reality

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In this study we propose a methodology for redesigning flight training using augmented reality (AR). In the first phase study pilots' limitations and strengths in basic and advanced flight training are explored through interviews with instructors, flight students and professional pilots. In workshops with experts the data from the preliminary study is used for specifying parts of the syllabi that could benefit from a revision of teaching methods. In addition, the potential of new augmented reality (AR) technologies such as HoloLens will be examined for outlining a research agenda for AR-based teaching methods. Finally, the new training methods will be evaluated in experiments with test persons of both genders and compared in an AR and in a conventional learning environment. The results of this study will be a research and development agenda for future flight training and a proof of concept for the use of AR. The results will be used for designing new teaching concepts for future flight training and to ensure that learning needs and preferences of both genders are considered.

Investigating driver preferences for automation usage in different driving scenarios

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Autonomous driving can potentially increase traffic safety and travel comfort. However, surveys show that only half of the individuals desire to use autonomous driving. In order to establish if this holds true for driver behaviour and to investigate user preferences for autonomous driving (Level 3) on different track types and different situations, a driving simulator study was conducted. The 19 participants drove on three different tracks (highway, rural road, city) with three different driving situations per track (e.g. intersection, traffic jam). They could choose if they wanted to activate the automation in the specific situation or not (three modes of activation). Automation usage, trust in automation, preferences and reasons for automation usage per situation were assessed. Automation usage was generally high in the sample (> 90% of the track) over all track types and situations. Automation usage could be predicted by trust in automation and perceived system usefulness. Comfort was the most frequently named reason (51% of participants) for enabling the automation followed by safety (20%). Results indicate that driver´s readiness to use automated driving seems to be higher than surveys might suggest and that comfort is the primary reason for usage.

Inaccuracies in energy efficiency perception based on instantaneous consumption displays – Implications for interface design

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Instantaneous consumption displays (ICDs) constitute a central and salient information source for drivers to perceive the energy efficiency of their manoeuvre-level driving behaviour. A key question is whether drivers can accurately perceive efficiency differences of driving strategies based on this information. There is reason to assume, that drivers may be biased in their consumption judgements similar to related phenomena like the time-saving bias. The aim of the present research was to examine how accurate drivers can derive the average consumption from dynamic ICD sequences. Videos of a schematic ICD were presented in a controlled experiment where the maximum instantaneous consumption systematically varied over time and participants estimated the average consumption (50 judgements of sequences per participant). Judgements of participants (N = 54) significantly differed from the correct values and also the empirical ranking of the sequences differed significantly from the correct efficiency ranks. Multilevel modelling was used due to the nested structure of the data. Results indicate a peak-bias in form of an increasing difference between judgements and correct values with higher consumption peaks. The results indicate that ICDs can lead to biased perceptions of energy efficiency. Design implications regarding the ideal aggregation of consumption information are discussed.

Investigating the impact of adaptable alarm systems in younger and older adults on the example of a pedestrian assistance system

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Alarm systems (AS) could compensate for age-related deficits regarding perception and attention by notifying pedestrians of approaching cars. People, especially older, often experience problems in adjusting their behaviour to AS. Moreover, dynamic changes in the amount of traffic imply changes in the base rate of critical events. These fluctuations cause changes in the behaviour of the AS and therefore complicate the adjustment of peoples' behaviour even more. Adaptable AS can be an alternative to conventional AS. Instead of adjusting their own behaviour to the system, users can customize the behaviour of the AS and adapt it at any time when the situation changes. Two experimental studies will be conducted to compare an adaptable and three conventional AS within a dual-task paradigm with younger and older users. A pedestrian simulation serves as test environment. In each of the experiments, the base rate will be varied through changes in traffic. Dependent variables are trust, behaviour and performance. It will be answered whether adaptable AS are of greater utility for younger and older users than conventional AS and, whether adaptable AS represent an approach to increase safety. This work will present and discuss the research project and study design.

Social stress in human-machines hybrid teams

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With the continuous development of technology, people are increasingly more likely to be confronted with automated systems, artificial intelligences or complex algorithms, and that as much in their personal as in their professional life. In several professional domains, people are already part of so-called “hybrid teams”: teams where humans and highly automated systems are colleagues working together. Considering the progress in automation, the social interactions between humans and machine in hybrid teams will grow in complexity, and might get closer and more similar to actual human interactions. It thus makes sense to study these processes in hybrid teams and their interplays with social stress, social support and work performance. Social stress at work has already been widely empirically studied, but only in human teams, and often without taking into account the effect of stress on performance. We plan to experimentally study the impact of several factors like Illegitimate Task Assignment or Negative Feedback on participants, comparing whether it comes from a human or a machine.

Human-Machine Interface to Support Speed Regulation

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Traffic management might soon determine optima for speed and safety distances. Broadcast by Car2X communication, the crucial question remains how to present these recommendations to drivers in a way which is easily understandable, supportive and predictable. Since speed is the travelled distance in time (km/h), and the time factor can be externally determined, the distance itself includes the speed’s information. Accordingly, a human-machine interface (HMI) called a “distance-speedometer”, presenting augmented distances derived from speed, was developed and evaluated. In a within-subject design, the distance-speedometer was compared to the standard speedometer (scenarios: car-following and sign-following). As an inverse indicator of visual workload, drivers were encouraged to perform a visual search task to the degree that driving did not suffer. The HMIs showed no significant differences in driving performance when the drivers reacted to speed signs. However, with the distance-speedometer the drivers could complete more secondary tasks. When reacting to speed changes of a preceding car, there was no difference in secondary task engagement between the groups. However, the variance of speed deviations was significantly lower with the distance-speedometer. Usable in various vehicles, the distance-speedometer might enhance traffic safety and efficiency at a larger scale.

Evaluation of biologically effective light in the vehicle interior

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Individually adjustable ambient lighting is getting increasingly popular to enhance the interior design of cars. Research has shown that light entering the human eyes is not only stimulating cones and rods, but also intrinsically photosensitive retinal ganglion cells ("ipRGCs"). These cells regulate the circadian clock and thereby influence a wide array of light-dependent physiological processes, known as non-visual lighting effects. Using such effects in the vehicle interior to increase health and well-being of passengers sounds promising. However, literature does not provide congruent evidence regarding the size of such effects depending on light parameters (illumination intensity, colour temperature) and duration of light-exposure. To evaluate the potential of non-visual light effects in the car interior we conducted a comprehensive field study lasting five months in the wintertime. We chauffeured 29 participants to their worksite in the morning on a daily basis illuminating them with polychromatic cold white light for 45 minutes. We collected subjective, cognitive and physiological data to investigate non-visual lighting effects in an automotive context. On the conference, we want to present the study design and first outcomes of the currently ongoing data analysis.

Motorcycle helmet use – comparing self-reported and observational data

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While motorcycle riders are categorized as vulnerable road users, their vulnerability, i.e. risk of heavy injury in case of a crash, can be decreased through the use of a motorcycle helmet. Despite this, the rate of helmet use among motorcycle riders is only known for 40% of countries in the world, which can in part be attributed to complexities in setting up observational studies on helmet use. In this study, we investigated if self-reported helmet use data collected through a questionnaire can be a valid alternative to behavioural data gathered through observational studies. Fourteen interviewers conducted a survey of 513 motorcycle drivers in the area of Arusha City in Tanzania, collecting data on self-reported helmet use. The questionnaire survey was followed by a naturalistic observation of helmet use of 2922 motorcycle drivers in the same area. Of the 513 motorcycle drivers interviewed, 27.7% report to use a helmet "never", "rarely", or "sometimes", while 71.5% state that they use a motorcycle helmet "often" or "always". The naturalistic observation of 2922 motorcycle drivers revealed a helmet use of 79.9%, indicating that self-reported helmet use can provide a valid estimate of actual helmet use.

Influencing driver´s route choice - how recalling traffic scenarios can shift decisions

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As traffic volume increases, traffic management can distribute traffic in a manner to minimize congestions and ecological harm. To achieve this, influencing drivers' route choice becomes an important option. To better understand drivers' route choice depending on the presentation of the information, an online study was conducted with 136 participants. Drivers were first asked to remember recent traffic congestion, either instructed to remember a negative, a positive, or the last three times standing in traffic congestion. Afterwards, they were asked to rate their potential affective state in oncoming congestion. Further, they made route decisions on navigation-maps, where routes differed in route choice attributes, like congestion or lengths. The results show that drivers with a very negative memory rated the expectation about an oncoming situation very negatively. This influenced their choice to select an alternative route. However, this effect was only seen in situations where the alternative route was quite lengthy and overall very few drivers selected this route. This study shows that the presentation of route information is an important means to influence route choice. Having drivers recollect negative experiences with certain route characteristics makes routes with these characteristics less attractive and shifts the decision towards alternative routes.

The influence of new UX principles for inclusive UI design: How older people perceive Facebook compared to a senior-dedicated social media platform

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Contrary to preconceived ideas, the vast majority of older people have the necessary skills to use digital tools. Although they do not like to rely solely on digital solutions, they are willing to use digital tools to enhance their lives – but have specific needs with regard to the design of such tools. This study examined the effects of the application of specific design-heuristics in the development of a social media platform on several outcome-variables in UX tests. The resulting digital tool — Resoli — helps users create and publicize new events and share memories from past ones. The tool Resoli was compared to Facebook by 26 seniors (55-85 yrs.) who conducted similar tasks on both platforms. The goal was to determine the usefulness of the developed UX design-heuristics and their influence on typical measures of UX such as perceived usability, emotional state, aesthetic, and performance measures. The results showed that participants rated Resoli significantly more positive than Facebook on all UX-indicators and showed better performance. This indicates that the use of our UX design-heuristics is meaningful and useful for this group of users.

The use of telepresence robot to promote the social interaction of older adults: user needs and user experience

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Recent development of mobile robotic telepresence systems may offer the possibility for elderly users to foster their social interaction, which may largely reduce the social isolation and loneliness caused by immobility or distance. However, most of the existing telepresence robot, such as Double, is not specifically designed for older adults. To adopt the technology successfully by the aging population, it is essential to target their user requirements and eliminate barriers to use. The goal of the study is to explore the potential for robotics to assist older adults in social interaction, find out their user needs and evaluate user experience, acceptance and usability problems with the existing telepresence robot. The present work consists of a focus group and a field study, in which elderly users took a virtual tour to the museum with the help of a telepresence robot. Data measurement techniques include: questionnaires, task performance, observations during driving the robot and interviews. Results suggest that the telepresence robot can create opportunities for social connectedness. Participants showed great interest in using the technology, especially in off-site scenarios. However, the system should be improved in terms of functionality and usability to fulfil the user requirements of this age group.

Training for Smooth Pursuit Eye Movements based Text Speller

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Gaze input is an innovative and contactless interaction, which can free hands for other tasks. The objective of this study is to train typing performance using a gaze speller which is based on smooth pursuit eye movement. Typing performance was evaluated in three separate training sessions. Considering individual differences in learning, an adjustable training was designed to meet the needs of different people. In this condition, users could adjust the object movement speed. 20 participants were randomly separated into two groups. One group received training with a fixed object movement speed (300 px/s). The other group was trained with adjustable object movement speed (180 px/s, 220 px/s, 260 px/s, 300 px/s, 340 px/s). Both groups had three training sessions, each consisting of 10 training phrases and five test phrases. Text entry speed increased over three sessions, reaching 3.25 wpm in the third session and there was no significant difference between the group with fixed and that with adjustable speed. The number of discontinuations per sentence and the error rate of keystrokes per character (KSPC) decreased significantly during training.

Eye-tracking as a field research tool during Helicopter Operations

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Purpose of study: Real life settings maybe different from simulator settings. The main purpose of this study is to create a procedure that employs eye tracking in an ecological setting for helicopter operations. While it is assumed that simulators are validated it maybe useful to map real life settings in a helicopter flight deck and compare with existing simulator(s) design. Methods: A mobile eye tracker (mobile glasses) will be used to track visual attention of the pilot during a helicopter operation. At a very basic level this will provide detailed quantitative information about the division of attention between outside and on the instrumentation within the flight deck. The eye tracker also captures other metrics such as pupil dilation, which are validated metrics for mental workload. The study can be characterized as a preliminary study since we will collect data from only one subject (one pilot). Expected Results: A rich dataset of visual attention (although only from one subject) from an ecological setting for helicopter operations that can help us uncover important questions/hypothesis that maybe tested in a simulator (or) other controlled environments.

A regional UK project for implementation of the Human Factors courses for Surgical Specialities trainees

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Objective: There is a recent increase in the reporting of technical and non-technical errors in healthcare within the United Kingdom (UK). Perioperative human factors (HF) is a colloquial term for 'softer' or non-technical skills for surgeons (NOTSS) which, if not applied, contribute to increasing numbers of errors in the UK and are reported as affecting a high number of patients, with the subsequent costs. Interventions to decrease surgical errors caused by failures in HF is crucial to ensure appropriate, safe teamwork and holistic care of the patient. The aim of this project is to facilitate the study of HF in surgery through the planned use of surgical simulation across surgical specialties in one geographical region (Wessex). Methods: Training for surgeons shall focus on the 4 domains of HF: situation awareness, decision making, communication & teamwork and leadership. During October 2017 – October 2018 all three organizations will donate time, resources and facilities. A clinical fellow is appointed to run the project. After assessing the HF teaching need by online questionnaire, the first method chosen is to perform small teaching session on HF locally and regionally, followed by the Wessex NOTSS Masterclass and HF Workshop using the regional simulation facilities and surgical scenarios. Results: Our primary outcome is to measure the interest and knowledge of the regional surgical trainees on the HF and we measured this by using an online questionnaire. Our secondary outcome includes the development of new courses on HF in surgery and we will measure this by collecting feedback at the HF courses taking place in July 2018. The activity of the clinical fellowship was structured in 3 phases: initial preparations; teaching and training on HF by surgical simulation; evaluation and dissemination of the results. Conclusion: The study of HF has a crucial role in developing new surgeons and in improving the quality of teamwork across the surgical specialities whilst addressing the challenges and seeking to reduce errors in surgery. This clinical fellowship project has a high potential to develop the non-technical aspects of the surgical training in the Wessex region and to improve the surgical patients' safety subsequently.

Expert evaluation of automated driving HMI – does a checklist-based method work?

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We tested the usability of a checklist-based procedure of HMI evaluation for L2 automated driving systems in a real-driving study with six Human Factors experts. Three teams of two experts each used a checklist which contained 22 items describing the most relevant HMI recommendations for automated driving (e.g. presence of relevant mode indicators, as demanded by NHTSA (2016, 2017)). Each expert experienced several use cases in a real road environment once as a driver and once as an observer. The use cases to be driven were e.g. activation, deactivation, transitions between automation levels and sensor failures. After the drive the experts separately rated each item on a three-point scale from no concerns to minor concerns up to major concerns depending on the level of fulfilment of the item and gave a global rating of guideline compliance of the HMI. In a final discussion round the experts tried to achieve one common rating for each item. Analysing the outputs of the ratings before and after the discussion revealed that sharing experience of the use cases and understanding of the items is necessary to reach a high interrater reliability. Further explanations and examples of single items (which were part of the checklist) turned out to be useful but not inevitably necessary however, an exhaustive instruction of the use of the checklist is highly recommended. Altogether it turned out that the checklist is able to identify the most relevant HMI problems w.r.t. automated driving.

Using Receiver Operating Characteristic (ROC) Analysis to Measure Human Performance in Detection, Localization and Classification of Sonar Images

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The use of Receiver Operating Characteristic (ROC) analysis is a reliable methodology to account for both objective performance and its variability based on confidence in the fields of radiology and eyewitness memory. ROC analysis plots hit and false alarm rates as a function of confidence. Performance improvement is shown when hit rates for every level of confidence increase while the false alarm rates decrease. Measuring confidence is also a way to overcome criterion variability in human performance. This study will evaluate the use of ROC analysis to measure detection, localization, and classification performance of Unmanned Underwater Vehicles (UUVs) operators on Post Mission Analysis (PMA) tasks. Implementation of ROC analysis will provide a universal quantifier of operator performance, thus making it feasible to compare operator's performance to a baseline (e.g. the average of all other operators) as well as track the differences in one operator's performance across different PMA environments (e.g. clear vs. cluttered bottoms).

Developing an algorithm to incorporate Human Factors and Ergonomics (HFE) findings into public procurement of medical devices in Spain

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Applying HFE methods to inform public procurement can help identify human factors issues related to the context of use, prior to the selection and implementation of the technology. We conducted usability testing (UT) and heuristic evaluation (HE) to inform the procurement of infusion pumps for a public healthcare provider. This was the first time these methods had been included in a Call for Proposals (CFP) in Spain. In order for the results to be used for public procurement, they had to be transformed into a quantitative score. We classified the use issues into four severity levels: functional, minor, moderate and severe; Each use issue was associated with one of 8 characteristics of the pump (e.g. control panel, alarms, etc.). The CFP defined a maximum score for each of the aspects, summing up to 20 points, and a minimum score of 0. Each aspect of the pump initially began with the maximum score, and points were subtracted for each use issue, depending on the severity level: functional (-0.3%), minor (-1.7%), moderate (-25%), critical (-80%). Converting the results of the UT into a quantitative score allowed us to provide results regarding each device's usability into the procurement decision process.

Strategic support in Infusion Pumps' implementation: Improving safety and self-efficacy with Human Factors-based training

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Infusion Pumps (IP) are recognized for their potential to negatively impact patient safety due to use errors (listed as a high-priority device for HFE review by the FDA on 2016). Traditionally, IP implementation is done through training strategies based on the devices' functionalities without consideration as how the IP impacts the workflow. This submission describes 1) a new implementation strategy with "superusers", 2) the creation of a Human Factors (HF) - based training program, and 3) the evaluation of the impact on the clinicians through self-efficacy questionnaires and open-ended feedback. 31 clinicians (from two different hospitals) were selected for a "superuser" group that received targeted training consisting of: an introduction to HF concepts and potential IP use issues (5 hours) as well as hands-on simulation for safety-critical tasks (1.5 hours). Fourteen of 31 clinicians initially reported lack of training. Mean and standard deviation values of "confidence in use" (μ=5.64/9, σ=1.89) were improved with the training (μ=7.77/9, σ=0.96) ($p=<0.05$). There were also statistically significant increases ($p<0.05$) in participants' "perceptions of security and effectiveness of the provided care", "management against adverse events" and "awareness of the risks". This new approach allowed "superusers" to understand and disseminate IP' use issues to additional user-groups.