Europe Chapter
Human Factors and Ergonomics Society

Annual Meeting 2017

Varieties of interaction: from User Experience to neuroergonomics

September 28-30, 2017

ROME - ITALY

BOOK OF ABSTRACTS

Europe Chapter
Human Factors and Ergonomics Society

Organization Committee 2017

FRANCESCO DI NOCERA

Sapienza University of Rome

FABIO FERLAZZO

Sapienza University of Rome

SIMON MASTRANGELO

Ergoproject

KAREL BROOKHUIS

University of Groningen

ANTONELLA TOFFETTI

CRF

DICK DE WAARD

University of Groningen

THURSDAY SEPTEMBER 28th

SESSION 1: HMI - 1

Persuasive Assistance for Safe Behaviour in Human-Robot Collaboration

Matthias Hartwig, Vanessa Budde, Alissa Platte, Sascha Wischniewski
Federal Institute for Occupational Safety and Health
Dortmund
Germany

In working context, conflicts between working safe and working fast can lead to deliberate violations against safety rules. Modern computer-human interfaces can create new opportunities to reduce these violations by influencing the user. Technologies deliberately used to influence attitudes and/or behaviour of users are called persuasive technologies (Fogg, 1998) and often using nudging strategies (Thaler and Sunstein, 2009) to do so. In a randomized experiment, 90 test persons had the task to collaborate with an industrial robot in a conflict between meeting the safety instructions and monetary incentives for working fast. An intervention group received emotional computer generated feedback on their safety behaviour, while a control group did not. We measured violations committed by the participant during and after the intervention as well as intention towards the safety behaviour. Results show that participants receiving feedback on their behaviour committed only half as many violations as participants in the control group, a tendency that is also visible after the intervention ceased. Interestingly, subjective behaviour intention was nearly identical between the groups, which hint to a less deliberate form of behaviour impact of the feedback. Results suggest considering nudges as complementary action to promote safe behaviour at work besides information and sanctioning.

An Approach to Objectively Measure the Learnability of Interactive Systems

Andrea Marrella, Tiziana Catarci
Sapienza University of Rome
Italy

Learnability is recognized as one of the most relevant components of usability. A learnable system allows a user to know how to perform correctly any task of the system after having executed it a few times in the past. In the HMI literature, there are several accepted metrics for measuring learnability, but they are limited to measure specific aspects of the interaction in (controlled) lab environments. In this paper, we propose a technique to objectively measure the learnability of an interactive system during its daily use. We rely on recording in a specific user log all the user actions that take place during a single run of the system and on replaying them over the system interaction models, which describe the expected ways of executing system tasks. Our technique identifies deviations between the interaction models and the user log and assesses the weight of such deviations through a fitness value. By measuring the rate of the fitness value for subsequent executions of the system we are able not only to understand if the system is learnable with respect to its tasks, but also to quantify its degree of learnability over time and to identify potential learning issues.

Designing an interface to support eco-driving by the combination of Ecological Interface Design with User-Centred Design

Antonella Toffetti, Oliver Carsten, Rino Brouwer, Pablo Mejuto, Samantha Jamson, Johan Olstam, Katja Kircher, Guillaume Saint-Pierre
CRF
Orbassano (Torino)
Italy

The paper describes some of the major results of the European Project ecoDriver. This five-year project aimed to deliver to drivers the most effective support and feedback on green driving by optimising the driver-powertrain-environment feedback loop. To reach the goal, a set of activities, from the design to development of demonstrable eco-driving systems, was carried out. Twelve European partners were involved, fulfilling one of the ideologies of User-Centred Design (UCD) by having complementary skills (system design, automotive engineering, human factors and behavioural economics). The starting point was a set of overall principles and concepts derived from the Ecological Interface Design (EID) approach. Those top-down principles and concepts were then developed and tested, based on the appreciation that drivers play a crucial role in influencing their vehicle's energy consumption and resulting emissions, and therefore needed to be involved as the detailed design was developed. Following a suite of driving simulator experiments and qualitative research, the project partners designed three types of eco-driving systems. A common Human Machine Interface (HMI) was defined and a range of systems tested on-real roads with naïve users. The results showed positive effects on energy-saving and safety, high acceptability and no demonstrable impact on workload. Additionally, the cost benefit analysis results provided a complete picture for stakeholders. As long as the human driver continues to be in the loop, eco-driving systems are very promising means to provide energy savings and reduce emissions. A combined EID and UCD methodology should be adopted from the outset of the design phase, covering both technical and HMI aspects in order to maximize user and societal benefits.

Traffic signs just locating events: the interplay of semantic, embodied and situated parameters

Antonio Lucas-Alba, Óscar Melchor, Ana Hernando, Andrés Fernández, Mª Teresa Blanch
Psychology and Sociology Department,University of Zaragoza
Spain

The 1980s promised safe and efficient traffic flows by means of ITS (COST30, 1982). But ubiquitous information displays are only materializing now. Traffic flow optimisation depends on locating complex events and rerouting traffic flows. In-vehicle full-matrix displays may adopt a number of formal design strategies (e.g., stacking vs diagramming; Lay, 2004). But real-time complex actions call for apprehending messages on the fly, relying not only on long-term memory, but also on driver's inferential capabilities. This paper confronts this issue with 64 drivers by means of a mixed experimental design. We manipulated four factors: presence/absence of a visuospatial route reference (video), presence/absence of trip goals (e.g., 'if there is congestion before next city I will divert'), event location (before, after city) and reading strategy (top-down, bottom-up). All designs displayed familiar sets of arrow-location-event in a vertical fashion but in differing orders and positions. Results showed that in the absence of goal/route manipulation the default reading strategy is top-down and the comprehension was high for messages locating events before city (but not after). However, top-down comprehension worsened when goals and route schemes were introduced. The efficiency of externalized representations and the role of complex embodied and situated knowledge are discussed.

SESSION 2: VULNERABLE ROAD USERS

Cyclists' Anger Experience in Road Traffic: From Anger Provoking Incidents to Developing a Cycling Anger Experience Measure

Anja Katharina Huemer, Michael Oehl, Stefan Brandenburg
Technische Universität Braunschweig
Germany

Cycling anger defined as the propensity of cyclists to become angry in traffic is a concept so far neglected in research. Research on emotions in traffic has been focusing rather only on car drivers. However, as the popularity and use of bicycles is growing, cyclists are increasingly involved in accidents. At the same time the number of reports of driving anger among cyclists are increasing, e.g., in bigger German cities. Traffic research shows that especially anger and aggression among road users lead to maladjusted driving and thereby to a higher accident risk. Therefore, our contribution focuses on cyclists' traffic related anger. To ensure a huge range of anger provoking incidents we conducted two studies. Firstly, cyclists discussed anger provoking events they have experienced in daily traffic in focus groups. Secondly, we asked participants to keep a bicycle riding diary registering all anger provoking events they had experienced during one week. Results of both studies showed that most anger provoking incidents that occurred are conflicts between car drivers and cyclists. Conflicts with car drivers caused more anger than conflicts with other cyclists or pedestrians. On the basis of these qualitative studies a questionnaire was developed as a measure assessing cyclists' anger experience in interaction with their cycling environment. Factor analyses proposed four subscales, i.e., police interaction, car interaction, cyclist interaction, and pedestrian interaction. Confirmatory cross-validations with different samples of cyclists supported these results. Alpha reliabilities were acceptable to good. Significant correlations with the Driving Anger Scale for car drivers and with the general State-Trait Anger Expression Inventory suggested convergent validity and providing a complementary instrument for measuring cycling anger in traffic. Furthermore, significant correlations between cycling anger and self-reported risky cycling behaviours were observed.

Cyclist's riding behaviour at low and high speed

Orazio Pellegrino, Nicola Bongiorno, Gaetano Bosurgi, Giuseppe Sollazzo
Department of Engineering, University of Messina
Italy

The cyclist's riding style is deeply different depending on the adopted speed. This can easily be deduced when examining its ascending behaviour, where the position within the road cross section is located near the right margin. Conversely, in descent at concomitant higher speeds, the trajectory is similar to that of motorcycles, with greater change of his position. Thus, at the same conditions, the only discriminating element between the two types of behaviour is the longitudinal slope of the road. The purpose of this paper is, therefore, to investigate whether there is a threshold value (uphill or downhill) over which one of these mechanisms is activated and whether this entails different consequences for the cyclists' safety. The use of appropriate sensors such as eye trackers for visual behaviour assessment and GPS for position and speed determination have produced interesting results that can be transferred to the road agency to mitigate weak users' danger.

Predicting Cycling Near Misses: How is Behavioural Adaptation Involved?

Víctor Marín Puchades, Marco de Angelis, Federico Fraboni, Filippo Fassina, Gabriele Prati, Luca Pietrantoni
University of Bologna, Department of Psychology
Italy

Cyclists are regarded as vulnerable road users due to their relative no protection and smaller mass in contrast to that of users of bigger vehicles (i.e., cars or lorries). Studying cycling safety becomes crucial for both cyclists' protection and well-being. Near misses have been used as surrogate measures of crashes in surface transportation due to the relatively lower occurrence of the latter and the common causality shared by both near misses and crashes. This study investigates cycling near misses in Spain using a one-day diary questionnaire asking participants about their experiences that very same day. We administered such questionnaire to 270 participants measuring the number of trips done by bicycle, near misses experienced, bicycle use, smartphone use while cycling, hours slept the previous night, and ownership of a car. Poisson regression was applied to model the relationship between the predictors of near miss and the number of occurrences. Not owning a car predicted a tenfold increase in the probability of suffering a near miss, whereas hours slept, and bicycle and smartphone use also predicted near misses. These findings provide insight into how certain behaviours affect the probability of suffering a cycling near miss, and suggest explanations regarding the underlying behavioural adaptation.

Affecting the position of a cyclist on a cycle path

Frank Westerhuis, Bart Jelijs, Anselm Fuermaier, Karel Brookhuis, Dick de Waard
Traffic Psychology Group, Clinical and Developmental Neuropsychology, University of Groningen
The Netherlands

In The Netherlands, single-sided bicycle accidents are an increasing problem, particularly for older cyclists. As an earlier study found that older cyclists enter the verge occasionally, several experiments were conducted in which a number of cycle path shoulders in The Netherlands were customized. The aim of these customizations was to influence cyclists to move away from the edge of the path while being 'forgiving' when cyclists do enter the verge. First, the use of optical illusions was assessed by creating images of virtual 3D objects on the right-hand side of a cycle path. Other measures included additional strips surrounding an existing cycle path. These strips differed in colour and surface conditions in order to increase the width and contrast of the cycle path's edges while also causing noticeable vibrations in a bicycle while riding over these (i.e. a warning signal). Participants' own bicycles were equipped with small action cameras with GPS to assess the effects of the conditions on cycling speed, lateral position, and swerving. Subjective experiences were also gathered during an interview. The results indicate that the effects of the 3D objects and the shoulder strips were different.

SESSION 3: AUTOMATION

Increasing operator flexibility in luggage screening: the impact of spontaneous breaks and adaptable automation on performance

Alain Chavaillaz, Adrian Schwaninger, Stefan Michel, Juergen Sauer
Department of Psychology, University of Fribourg
Switzerland

The current study investigated the impact of more flexible working conditions (i.e. work-rest schedule and automated support) on performance in baggage screening. 72 participants were asked to indicate the presence (or absence) of a threat item (knife/gun) in a series of grey-scaled X-ray images of cabin baggage. Three work-rest schedules were examined: spontaneous break (participants decided when to take a break and how long), 5-minute breaks, and 10-minute breaks. Furthermore, an adaptable automated support system was provided to half of the participants. It had three levels of automation: no cue, a cue surrounding the whole piece of baggage, and a cue surrounding the suspicious object. The results showed no difference between different work-rest schedules. This suggests that spontaneous breaks can be envisaged as a suitable alternative to scheduled work-rest periods. Moreover, participants working without automation indicated more often that there was a target than participants supported by adaptable automation. Providing an automatic support might reduce participants' tendency to report the presence of a target without deteriorating performance.

Automated driving: subjective assessment of different strategies to manage drowsiness

Veronika Weinbeer, Julian Bill, Christoph Baur, Klaus Bengler
AUDI AG
Germany

It is likely that driver drowsiness gains in significance with an increase of automation. As long as the automation system is unable to deal with all kinds of traffic situations, there is still a need to get the driver back into the loop or to initiate strategies like a minimum risk manoeuvre if the transition of the driving task to the driver fails. This article assumes that drivers are not yet allowed to sleep during an automated drive (AD). To date, it is unknown how the system should react in case of elevated drowsiness. To evaluate this, participants (N = 31) subjectively assessed driver-state-related strategies and system-based strategies before and after a tiring simulated automated drive. Assessments revealed that reducing the maximum speed was the best-rated system-based strategy and that a targeted-use of non-driving-related tasks was the most preferred driver-state-related strategy. This article provides first insights into the acceptance of various strategies to manage drowsiness during an AD. Further research is needed to evaluate efficacy and safety outcomes for different strategies.

Eye movements and verbal communication as indicators for the detection of system failures in a control room task

Carmen Bruder, Carolina Barzantny, Dirk Schulze-Kissing
DLR - Department of Aviation and Space Psychology
Germany

In modern control rooms, operators need to monitor visual information representing large technical systems. Due to the complexity of control room tasks, operators usually work together in teams. These teams of operators are required to monitor together in order to detect abnormal system behaviour in time. However, which performance indicators are valuable for assessing a team member's capabilities of detecting abnormal system behaviour? The present study investigates the value of monitoring behaviour and communication behaviour for predicting the performance results of operators attempting to detect system failures while executing a control room task. A simulation of a generic control room was implemented in order to enable synchronized measurement of monitoring processes in teams. The monitoring behaviour was measured by tracking the eye movements of the team members while they were monitoring for system failures. Simultaneously, the communication behaviour between team members was recorded. Eye-tracking data and communication data were used as indicators whether or not a team member would detect a system failure in time. Data from 21 three-member teams imply that operators who detect system failures in time and those who do not differ significantly with regards to their eye movements and communication content. The findings are discussed in the context of personnel selection and training team members in control rooms.

A method to improve driver's situation awareness in automated driving

Yucheng Yang, Martin Götze, Annika Laqua, Giancarlo Caccia Dominioni, Kyosuke Kawabe, Klaus Bengler
Chair of Ergonomics, Technical University of Munich
Germany

In the future, raising automation levels in vehicles is an imaginable scenario. However, there will be situations which cannot be handled by the automation and the driver should take-over the driving task within a specific time budget. With a level 3 system (according to SAE), the driver has no longer to monitor the driving environment and, therefore, could perform other non-driving related tasks; consequently leading to lower situation awareness (SA) and possibly worse take-over performance. In this paper, two versions of new visual advanced driving assistance systems are presented, which display subliminal information about the system states and confidence levels of the automation system. The goal is to increase the SA during automation and improve the take-over quality while allowing the driver to perform secondary tasks without distraction and annoyance. In this mixed design experiment, 32 participants performed a visual-motor task on a smartphone under 20 min automated driving with either one or another version of the new ADAS. Relative to baseline, the results showed some significant improvements in the take-over quality (reaction time and minimal TTC) and eyes on road time, especially for young or inexperienced drivers. The reported systems are currently in process of being patented.

SESSION 4: AVIATION

User performance for vehicle recognition in 3D point clouds

Patrik Lif, Gustav Tolt, Fredrik Bissmarck, Per Jonsson
Swedish Defence Research Agency, Department of C4ISR
Linköping
Sweden

Unmanned Aerial Vehicles (UAVs) equipped with electro-optical sensors, e.g. visual and infrared cameras, are increasingly used in military, security and search and rescue contexts. Lately, active (laser) sensors have emerged as powerful imaging devices, combining accurate and high-resolution 3D measurement with night-time capabilities. The increasing availability of active sensors raise important human factors questions regarding what spatial resolution is required for users to recognize objects. We designed an experiment, where the subjects watched video sequences from a simulated UAV-mounted laser-based 3D sensor. The subject had to recognize vehicles of different type and point resolution, and report their confidence level. The main conclusion is that about 100 points on the vehicles are required for users recognizing vehicles with a distinct shape or with no other vehicles of the same type. For users to recognize a vehicle among others of similar appearance and size required about 1000 points. The results show that the recognition ability deteriorates with lower number of points but that the variations between different vehicles are large. The results also show that at low resolutions participants become more precarious (lower confidence estimations) and take longer time to respond.

Investigating airline pilots' gaze behaviour - recurring problem, new approach

Daniel Weich, Patrick Gontar, Klaus Bengler
Chair of Ergonomics, Technical University of Munich
Germany

In this paper we present our results on recurrence quantification analysis (RQA) on pilots' gaze patterns. This analysis shall answer the question how the level of daily practice as well as different tasks influence the structure of pilots' visual behaviour. RQA presents an approach that is able to identify and quantify visual strategies and behavioural patterns in reaction to external events. To our knowledge no study is published using RQA to analyse pilots' gaze behaviour. We fill this gap by using data from an experiment where 120 airline pilots performed a critical flight simulator scenario. Gazes were assigned to areas of interest and a windowed RQA was conducted. We analysed the influence of recent flight practice and different tasks on four metrics (recurrence rate, determinism, laminarity, diagonal length) using inferential statistics. Although we did not find significant effects for the independent variable of recent practice, we discovered medium to large effects evoked by pilots' tasks. Pilot role (pilot flying vs. pilot monitoring), automation (manual flight vs. automatic flight), and cognitive involvement (decision phases vs. non-decision phases) were found to significantly affect pilots' gaze behaviour. Our results suggest that RQA is a powerful method to examine and describe operators' scanning behaviour.

Innovative cockpit touch screen HMI design using Direct Manipulation

Marieke Suijkerbuijk, Wilfred Rouwhorst, Ronald Verhoeven, Roy Arents
Netherlands Aerospace Centre, NLR
The Netherlands

As a widely-used and proven technology, touchscreens are entering the cockpits of civil aircraft. As part of the EU co-funded project ACROSS (Advanced Cockpit for Reduction Of StreSs and workload), NLR designed an innovative cockpit display with touch interaction, thereby focusing on using Direct Manipulation (DM) as an interaction style. DM is characterized by manipulating UI elements directly on the position where they are visualized and has the potential to be highly intuitive, and less prone to error. Therefore, the HMI design was hypothesized to reduce pilot's workload. The designed HMI comprises the so-called tactical flight control (TFC) operations of an aircraft; changing the aircraft's (vertical) speed, heading and/or altitude. In current cockpit configurations, the controls for this auto-pilot functionality are physically separated from the visualization of the parameters they adjust. In this paper, the HMI design process of eliminating this physical gap and creating an intuitive interaction by means of DM is described. The concept is evaluated in two phases, using NLR's fixed based APERO simulator and NLR's motion based GRACE simulator. Experiment results showed that the TFC design concept has great potential, but needs further improvement, since the touch interaction increased the pilot's workload, especially under turbulent conditions.

FRIDAY SEPTEMBER 29th

SESSION 5: HEALTH & VISION

Assessment of stress sources and moderators among analysts in a cyber-attacks simulation context

Stéphane Deline, Laurent Guillet, Clément Guérin, Philippe Rauffet
Lab-STICC UMR CNRS 6285
France

With the prominence of cybersecurity questions, the role of analysts in managing cyber-attacks is central. Studies which investigated human factors in cyber defence context generally focused on analysts training, situation awareness or cognitive biases (e.g. Gutzwiller et al., 2015) in order to reduce analyst errors. Champion and collaborators (2012) showed that social factors such as team communication influence the cyber team performance. In this present study, we examined elements contributing to the analyst's stress level. More precisely, we studied the effects of cyber events and the moderator effects of affects and social support on analyst stress. We hypothesis that 1) cyber-attacks have an impact on stress levels so that the more the attack is critical, the more the analyst's stress level will increase, and that 2) quantity and quality of social support reduce individual stress levels. This study takes place in a Cyber Security Center where cyber-attacks on an Operator of Vital Importance were simulated with engineer-students as cyber-defenders. Stress levels were measured according to their heart rate, and affects and social interactions were coded from the exercise video. After presenting the methodology, the first results on effects of cyber events and social support on stress will be discussed.

The effect of musical training on the identification of absolute SpO2 values using varying pitch-only and enhanced sonifications: A laboratory experiment

Estrella Paterson, Penelope Sanderson, Neil Paterson, Robert Loeb
School of Psychology, The University of Queensland
Australia

The ability to perceive pitch varies from individuals with absolute pitch to those with amusia. This has implications for the design of the auditory display of the pulse oximeter (heart monitor), which is based on varying pitch. Clinicians sometimes have difficulty distinguishing oxygen saturation (SpO2) values using the pitch of the pulse oximeter. We compared participants' ability to identify absolute SpO2 using (1) varying pitch-only sonification plus an alarm and (2) an enhanced sonification with additional acoustic dimensions of tremolo and brightness. Participants identified absolute SpO2 while performing a distractor task in the presence of background operating theatre noise. 'Music experience' was classified as a participant having more than one year of formal musical training. Participants using the enhanced sonification (65%) were more accurate at identifying absolute SpO2 compared to those using the varying pitch-only sonification plus alarm (48%) (Paterson et al., 2017) However, there was no difference in participants' ability to identify absolute SpO2 in the varying pitch-only condition or the enhanced sonification, whether they had musical training or not ($p = .412$ and $p = .552$, respectively). Participants' perception and interpretation of the auditory display is not effected by their musical training--a positive factor for designing auditory displays.

Potential of wearable devices for mental workload detection in different physiological activity conditions

Franziska Schmalfuß, Sebastian Mach, Kim Klüber, Bettina Habelt, Matthias Beggiato, André Körner, & Josef F. Krems
Cognitive and Engineering Psychology, Chemnitz University of Technology
Germany

Wearable devices gained high popularity in the last years. Their potential for health monitoring and health support has been intensively investigated and discussed. Some devices even aim on identifying mental states, stress or emotions, but scientific studies on the potential of wearable devices for identifying different mental states are rather sparse. Heart rate variability (HRV) proved to be a valuable indicator for both, increasing mental workload, and growing levels of physical activity. The question arises, if wearable devices can be used to identify high mental workload in different physiological activity conditions using the HRV. We expected that initiated additional mental workload would lead to a higher HRV independent from participant's activity level. Twenty participants (male, female) participated in an experiment with a 2 (mental workload) x 4 (physiological activity) factorial within-subjects design. Participants sat, stood, stepped on/off a stepping board or cycled while they fulfilled either no secondary task (5 min) or a counting backwards task (5 min). Heart rate frequency was measured via a wrist-worn mobile device, and a stationary device. As a manipulation control, participants filled out a questionnaire assessing subjective workload after each condition. Results will be presented, discussed and implications will be drawn.

Ocular-based automatic summarization of documents: is re-reading informative about the importance of a sentence?

Orlando Ricciardi, Giovanni Serra, Federica De Falco, Piero Maggi, Francesco Di Nocera
Department of Psychology, Sapienza University of Rome
Italy

In a context characterized by fast growth and dissemination of information, automatic summarization has become important for reducing the time and mental effort involved in reading. Despite the advancements in this field, many summarization techniques do not yet consider the different readers' goals. The objective of the present study was to use eye-tracking for increasing the quality of automatic summaries by examining the ocular behaviour during reading. Eye movements are not linear across the page and the reader usually skips or re-reads parts of the text. Differences between the time of re-reading and time of the first reading may reflect the issues in understanding the phrase or rather the subjective importance of the phrase. To test this hypothesis, we collected eye movements of 30 subjects during reading and compared the ocular pattern with the text underlined afterward in a separate session. Results showed that sentences perceived as more important were re-read longer than sentences perceived as less important, suggesting that eye movements may be used for improving the quality of automatic summaries.

Aesthetic appeal influences visual search slopes

Irene Reppa, Siné McDougall, Andreas Sonderegger
Department of Psychology, Swansea University
United kingdom

Previous work has shown that aesthetically appealing icons are localized faster relative to their unappealing counterparts, especially under duress, i.e., when the target icon is unfamiliar or abstract. The current study employed a classic visual search task (e.g. Quinlan, 2003; Wolfe, 2015) to examine whether visual appeal can cause a target icon to 'pop out' of an array of icons. Eighty participants each completed 480 visual search trials. Participants searched for target icons varying in rated aesthetic appeal (appealing vs. non-appealing). The target icons would appear among randomly varying numbers of distractors (i.e., 3, 6, 9, or 12 distractor icons). Aesthetic appeal of the target icon boosted the efficiency of visual search when set size was large (i.e., when searching for the target among 9 or 12 icons) but had no significant effect of search with small set sizes (i.e., when searching for the target icon among 3 or 6 icons). These findings demonstrate that aesthetic appeal can affect visual search performance. The form that the effect takes (i.e. universally enhancing or decrementing task performance, or only affecting certain parts of the task) may be facilitated by certain factors, which future research needs to explore.

SESSION 6: AUDIBLE ALARMS - SPECIAL SESSION

Introduction - Sound and the Somatic Order: Designing Elocutionary Power for Audible Alarms

Michael Sonne Kristensen
Plymouth University
United Kingdom

What about alarm sound is alarming? In a series of four papers we investigate what Vannini et al. [2010] refer to as the 'elocutionary power' of sound; that is, the potential of sound to be experienced as 'particularly vivid, striking, evocative, and attention-grabbing'. This potential depends not only on acoustic properties but also on the 'somatic order' of a given environment, i.e. the expected baseline soundscape. For many years audible alarms have been designed to breach the somatic order within a paradigm of competitive sound, i.e. by adding more and louder alarm sounds. The negative consequences of this approach include alarm noncompliance and fatigue. Understanding alternative non-competitive routes to breaching the somatic order is key to improve alarm efficiency. On the basis of theoretical and empirical work we demonstrate ways of optimising the elocutionary power of alarm sounds with ergonomic consideration for the alarm user.

Reference: P. Vannini, D. Waskul, S. Gottschalk, and C. Rambo, "Sound Acts: Elocution, Somatic Work, and the Performance of Sonic Alignment," Journal of Contemporary Ethnography, vol. 39, no. 3, pp. 328–353, Jun. 2010.

In-vehicle Auditory Forward Collision Warning Design

Carryl Baldwin, Bridget Lewis
GMU
USA

We sought to determine the acoustic parameters that would facilitate unambiguous recognition of time critical, highly urgent warnings and appropriate collision avoidance response upon first exposure. In the first studies of the series, psychophysical and usability methods were combined to create a paradigm in which perceptions of category membership for in-vehicle alerts could be predicted by their acoustical properties. In particular, it was found that 5 key criteria could reliably predict categorization of a sound as an "alarm": peak to total time ratio (≥ .70), interbust interval (≤ 125 ms), number of harmonics (≥ 3), base frequency (≥ 1000 Hz), and pulse duration (≥ 200 ms). Based on these parameters we created a sound, the GMU Prime, which contained all five characteristics. We next examined collision avoidance responses when presented with the GMU Prime relative to warnings containing only 3 or 4 of the key parameters just prior to simulated high crash risk driving situations. Even on the first exposure the GMU Prime, relative to the other warnings, resulted in greater collision risk reduction. Specifically, across studies participants who received GMU Prime tended to collide less frequently and to do so at significantly reduced speed when they did collide.

Searching for meaning in sound: How alarm sounds are learned and interpreted in visual environments

Sine McDougall, Deili Sinimeri, Judy Edworthy, Jamie Goodliffe, Daniel Bradley
Psychology Department, Bournemouth University
United Kingdom

Auditory alarms are commonly used to provide information and warnings in hospitals, cockpits, cars, and in the nuclear and chemical industries. However, recent research suggests that current standards may be less than optimal. The use of combinations of tones in current alarm standards can make them difficult to discriminate leading to confusion and errors. Moreover, the combinations of tones are not related in any systematic way to the meaning that they are meant to represent. Alarms from a global medical device standard (IEC 60601-1, 2012) were compared with alternative alarm sets which differed systematically in their auditory discriminability and the extent to which the sounds were abstract tones or metaphorical in nature, related to real world sounds (e.g. the sound of a heartbeat to indicate 'check cardiovascular function'). Participants learned one of the alarm sets while viewing an operating theatre scene and clicked with a mouse on the appropriate equipment when an alarm sounded. A combination of accuracy, response times, eye tracking and cognitive modelling was used to examine the relative efficacy of the alarm sets. The usefulness of each of these convergent measures will be discussed along with the implications of the large systematic differences found between alarm sets.

Integrated Operating Room Music - Alerting Through Volume Reduction

Joseph Schlesinger, Judy Edworthy, Carryl Baldwin, Michael Kristensen, Elif Ozcan, Sine McDougall
Vanderbilt University Medical Center
USA

Music is an integral and omnipresent component of surgery. While studies have demonstrated that music reduces surgeon stress and improves the efficiency of surgery, there is evidence that music poses a distraction hazard and contributes to intraoperative noise pollution which has led to deleterious patient outcomes. The acoustics in the operating room are poor and noise levels frequently exceed Occupational Safety and Health Administration (OSHA) safe exposure standards. We have developed a music volume controller device that integrates operating room music with vital sign data from the patient monitor and tested it in a clinical environment with twenty-one anaesthesiologists and nine operating room personnel. Background music volumes were reduced or silenced based on flexible algorithms for heart rate, oxygen saturation and blood pressure. Analogous to an automobile front-collision-warning system that warns the driver of an impending collision, this approach to modulating the acoustic environment before a threshold crisis alarm allows the anaesthesia provider to provide proactive care and prevent an impending emergency. Initial qualitative results show satisfaction with the design and user interface, and have prevented near-miss emergencies. Automatically decreasing music volume during an emergency serves as an alert that diminishes the overall sound exposure level and improves patient safety.

Experience-driven design for audible alarms: An introduction

Elif Özcan, Judy Edworthy, Michael Kristensen, Joseph Schlesinger
Delft University of Technology, Faculty of Industrial Design Engineering
The Netherlands

This talk will be about re-positioning the methods used for audible alarm design and will introduce experience-driven design as a viable method for creating more satisfactory and positive experiences for the users of audible alarms. Experience-driven product design has its roots in three complementary psychological processes (aesthetic pleasure, meaning attribution and emotional response) that all together result in desired user behaviour. Products are designed i. to be pleasurable with their sensory properties (sensory liking); ii. to be easily identified (recognized and categorized) and associated to certain relevant concepts; and iii. to evoke emotional response (valenced feelings and bodily responses such as desire or confidence). Consequently, a user's behaviour can be influenced in certain situations or the way users interact with their environment can be facilitated with a design intervention that simultaneously considers all these three factors. Furthermore, contextual factors are as important as users' needs and concerns to be able make the design fit for the user. Ultimately, this talk will exemplify with previously conducted (commercial) sound design projects how the key elements of experience-driven design are operationalized in both sound creation as well as the measurement of users' responses towards audible alarms.

SESSION 7: SURFACE TRANSPORTATION - 1

Reducing risky driving using behavioural science and in-vehicle data recorders

Mark Sullman
Cranfield University
United Kingdom

Driving is the riskiest work-related activity in most developed countries. In-Vehicle Data Recorders (IVDR) are an important tool for improving driver safety. The information collected by IVDRs can be used to generate driver feedback (directly or indirectly) and real time feedback can be delivered via an in-vehicle warning device. A number of studies have reported that IVDRs reduce both risky driving behaviour and collisions, but these studies all have substantial methodological short comings (e.g. no control group, very short unstable baselines, relying solely on volunteers and non-random selection). In a recent randomised controlled study involving 39 sales representatives no significant reduction in risky driving behaviour was observed following the installation of IVDR and their associated interventions (weekly feedback and in-vehicle warning devices). One of the short comings identified during the RCT was that the interventions did not appear to use principles of behavioural change. Therefore, the present study used a randomised controlled trial to investigate whether including principles from behavioural science would lead to a reduction in risky driving behaviours among 50 sales representatives over a 6 month period. The presentation will describe the results of the full trial and implications for industry practice.

Implementing manoeuvre control in automated driving - effects on trust and comfort

Felix Wilhelm Siebert, Fabian Radtke, Erin Kiyonaga, Rainer Höger
Institute of Experimental Industrial Psychology, Leuphana University Lüneburg
Germany

In this experimental study we investigated how the ability to give manoeuvre commands to an automated car influences the driver's levels of trust and comfort when compared to driving without such a possibility. In a driving simulator, participants drove in 18 traffic situations on city, country, and highway roads. Situations differed widely in the number of other vehicles on the road and the general traffic environment. The level of control participants had over the simulated vehicle was varied three-fold in a within-subject design. In one condition, participants drove by themselves with complete control over the vehicle. In a second condition, the car drove completely autonomous, and participants could not influence the car's movement. In a third condition, participants could initiate driving manoeuvres by using a joystick built into the centre console of the simulator. Each control condition was presented as a block to participants, who then rated the driving experience of each block on the discomfort scale for automated driving. Results show that the ability to give manoeuvre commands to the autonomous vehicle positively influences the levels of trust and comfort in the vehicle, and participants report feeling more responsible for potential accidents when they have manoeuvre control.

Relevant eye-tracking parameters within cooperative traffic situations

Jonas Imbsweiler, Elena Wolf, Katrin Linstedt, Johanna Hess, Barbara Deml
Karlsruhe Institute of technology (KIT)
Institute of Human and Industrial Engineering (ifab)
Germany

In everyday road traffic, communication between road users plays an important role – especially in traffic situations where cooperation is necessary. In order to ensure successful future communication between human road users and autonomous vehicles, the communication between human road users must be investigated and modelled for the context of automatic traffic. A relevant parameter in the analysis of cooperative scenarios is gaze behaviour. But in contrast to e.g. mental workload, no specific parameters have been identified for analysing cooperative scenarios so far. The aim of the analysis was to identify relevant gaze parameters for cooperative scenarios. For this purpose, two experiments were conducted for cooperative situations implementing a narrow passage (N = 21) and a specific t-intersection scenario with three road users (N = 20). In both experimental settings, subjects were confronted with offensive or defensive approaching behaviour and decision-making behaviour was measured. The results show significant differences for the Nearest-Neighbour-Index (NNI) and saccades but no significance for other gaze parameters. Overall areas of interests (AOIs) are the most informative parameters. Finally, a recommendation is given regarding which gaze parameters should be considered in future studies.

The Concept of Trust of Automation in Unmanned Autonomous Vessels

Scott MacKinnon, Yemao Man, Monica Lundh
Maritime Human Factors Group, Chalmers University of Technology
Sweden

The shipping industry has been moving towards unmanned, autonomous vessels at a rapid pace. Over the past several years initiatives, including a project called Maritime Unmanned Navigation through Intelligence in Networks (MUNIN), examined how autonomous shipping might emerge. The project considered vessels primarily guided by automated on-board decision systems but controlled by a remote operator in a shore control centre (SCC). A series of experiments examined how a SCC might evolve. This was done through the interactions of bridge, engine control room and SCC simulators. SCC operators acted in a monitoring capacity, intervening when it was assumed that the autonomous vessel could not resolve a safety threat integrated into the scenarios. The main goal was to examine how SCC operators could obtain and maintain situation awareness while monitoring 6 vessels in remote geographical regions. But it was clear that there was little trust in the automation of the unmanned vessels, as the SCC operators (typically bridge officers) continually took over manual control of the vessels even when the alarm systems did not indicate that safety parameters, pre-programmed into the system, had not been violated. This paper will examine the factors that influence automation trust in this experimental context.

SESSION 8: HMI - 2

Comparing the effects of space flight and water immersion on sensorimotor performance

Bernhard Weber, Simon Schätzle, Cornelia Riecke
German Aerospace Center, Institute of Robotics and Mechatronics, Cognitive Robotics/Human Factors
Germany

Several studies documented the detrimental effects of microgravity during spaceflight on human motor control e.g. during aiming tasks. Besides parabolic flight, water immersion has been used for simulating microgravity effects on earth. Until now, however, the validity of partial or full water immersion setups as analogue environments to explore effects on sensorimotor performance has not been tested. In the present paper, the results of three empirical studies are compared using the identical aiming task paradigm during 1) forearm water immersion (N = 19), 2) full body water immersion (N=22) and 3) during spaceflight (N = 3 astronauts). In line with prior research, we found slower and more sluggish aiming motion profiles during spaceflight (after 2 weeks in space) compared to the terrestrial experiments. During spaceflight astronauts needed substantially longer to approach target areas and for finely matching the targets. Average motion speed and speed variance decreased significantly. Intriguingly, the very same overall effect pattern was evident in both partial and full water immersion, although the effect sizes tended to be smaller. Altogether, results indicate that water immersion is valid in term of weightlessness simulation. However, effects solely present during spaceflight (like vestibular dysfunction) additionally contribute to performance losses.

Affinity for technology interaction - a personal-resource perspective

Thomas Franke, Christiane Attig, Daniel Wessel
Engineering Psychology and Cognitive Ergonomics, IMIS, Universität zu Lübeck
Germany

In a world that is increasingly pervaded by technology, addressing issues of user diversity becomes crucial. Consequently, it is key to advance understanding of personality variables that enable users to successfully cope with new technical systems and therefore constitute a personal resource for technology interaction. The objective of the present research was to advance the concept affinity for technology from this perspective. We present a new questionnaire scale (affinity for technology interaction, ATI) and its psychometric evaluation over three studies (N>350). The ATI scale is an economic 9-item scale. It integrates earlier conceptualizations of affinity for technology while focusing on the actual interaction process (i.e., interaction with instead of attitude towards technology). To ground the scale in fundamental psychological constructs, the scale draws from the construct need for cognition and items are formulated accordingly. The results show good to excellent scale reliability over the studies (Cronbach's alpha .87-.94) and a clear single-factor solution. Further, results demonstrate construct and criterion validity of the scale. The ATI scale is relevant as control variable in usability evaluation as well as for advancing models that explain aspects of successful interaction with new technical systems.

The usefulness of Virtual Reality for learning - why students learn better on a computer screen

Carli Ochs, Nicolas Henchoz, Andreas Sonderegger
University of Fribourg & EPFL-ECAL LAB
Lausanne
Switzerland

Together with considerable advancements in the development of technological devices, virtual reality (VR) is becoming increasingly popular in various application domains. VR is considered to be useful not only for amusement and gaming, but also in other domains such as psychotherapy and education. VR might benefit education by increasing presence and attention, which are both believed to be important factors for learning. This piece of research addresses the usefulness of VR for learning in different learning environments. Using a 2 (learning location) x 2 (learning tool) between-subjects design, participants (N = 63) interacted with an electronic archive in a calm or noisy location either in VR or on a computer screen. Although participants indicated to feel more present in VR than on screen, this did not increase their learning performance. On the contrary, they performed better in the learning test when interacting with the screen compared to VR. This was the case for both learning locations. Interestingly, participants subjectively evaluated the usefulness of the learning tool higher for VR than for the screen. Attention distraction and context-dependent learning are evaluated as explanations for the unexpected results, whilst implications for practice and future research are discussed.

How different input modalities affect users performance and experience of information seeking tasks

Patrik Pluchino, Luciano Gamberini
Department of General Psychology, University of Padova
Italy

The current study aimed to investigate users' preferences regarding two different input modalities, i.e. mouse or gaze. Participants were involved in three different scientific information seeking tasks, i.e., abstract opening, gaze bookmarking, or keywords highlighting. Each participant was asked to perform one task using either the mouse and the gaze input mode (mixed-experimental design). Input modalities were counterbalanced across participants. Findings showed that the gaze input mode outperformed the mouse in terms of execution time and it was also praised as more pleasant to use. However, the mouse input mode was considered more accurate, easy to use and efficient, possibly because of the greater familiarity. Future studies will assess whether an increased familiarity with innovative input modalities (i.e. gaze) can positively affect users' perception of accuracy, easiness, and efficiency of an interface.

KEYNOTE

Physiological Computing as User-Centred Design for the 21st Century

Prof. Dr. Stephen H. Fairclough
Liverpool John Moores University
United Kingdom

The purpose of user-centred design is the creation of technology that reflects human capabilities and values. As we move into a 21st century populated by autonomous technology and artificial intelligence, the need for user-centred approaches is perhaps more urgent than ever before. Physiological computing systems enable closed-loop control by monitoring signals from brain and body during human-computer interaction. These data provide a statistical model of the user state, which informs a process of implicit adaptation at the interface. The current paper will present the biocybernetic model of physiological computing as a nascent form of user-centred control, where technologies adapt in real-time to dynamic fluctuations in user state. These closed-loops can be created in a variety of settings, from brain-computer interfaces to adaptive automation and robotics. By measuring and modelling the state of the user in real-time and using these data as the engine for implicit adaptation, physiological computing may represent the logical conclusion of the user-centred design method over the coming decades. The presentation will examine this idea by describing past research on physiological computing in the context of neurogaming and recommender systems. The potential benefits and pitfalls of this highly personalised form of interaction will be explored with particular emphases on: autonomous technology, machine learning, adaptive interfaces and data privacy.

SATURDAY SEPTEMBER 30th

SESSION 9: HMI - 3

Examining how driver steering behaviour is affected by optic flow after resuming control from a highly automated vehicle

Yuki Okafuji, Callum Mole, Richard Wilkie, Natasha Merat
Department of Mechanical Engineering, Graduate School of Engineering, Kobe University
Japan

Results from studies on steering control during manual driving suggest that drivers combine multiple sources of visual information through active gaze to enable effective path following (Wilkie & Wann, 2003). However, it is unknown whether drivers rely on the same perceptual cues during periods of automated driving, where drivers often adopt different gaze strategies. This is an important road safety issue, as the extent to which drivers can remain well calibrated to their environment during automation will influence how rapidly they resume control during transitions. We considered these questions by manipulating optical flow (the rotation and translation of the visual scene) and gaze direction during a driving simulator lane-keeping task where a transition took place between automated and manual control. 'Flow' was manipulated by artificially increasing or decreasing optical flow speed during three phases: vehicle automation only, manual control only, or both manual and automated control. Gaze direction during automation was fixed to be either congruent or incongruent with manual control. We examine the relative influence of these factors on steering control during the initial seconds of resumption of manual control.

Is improved lane keeping during cognitive distraction mediated by increased physical arousal or higher gaze concentration towards the road centre?

Penghui Li, Gustav Markkula, Natasha Merat, Yibing Li
Department of Automotive Engineering, Tsinghua University
China
Institute for Transport Studies, University of Leeds
United Kingdom

Previous driving studies have shown that cognitively loading (non-visual) tasks lead to improved lane keeping performance, as shown by reductions in the standard deviation of lateral position (SDLP), when compared to baseline conditions. However, the underlying reasons for this are not currently clear. The main competing hypotheses supported by the empirical evidence suggest that cognitive load improves lane keeping due to either increased physical arousal, or concentrated gaze towards the road centre. We report on results of a simulator study involving the completion of different levels of the n-back task during driving. Similar to previous studies, cognitive distraction led to increased physical arousal, gaze concentration, micro-steering activity and decreased SDLP. More importantly, both physical arousal and gaze concentration changed earlier than micro-steering activity, which in turn changed earlier than SDLP during the cognitive task. Based on this finding, multilevel regression analyses were performed. The results suggest that both of the two hypothesised phenomena were independently involved, with cognitive load leading to: (i) An increase in arousal, causing increased micro-steering, which in turn reduces SDLP. (ii) An increase in gaze concentration, causing reduced SDLP both through increased micro-steering and due to a tendency to steer towards the gaze target.

Analysis of potentials of an HMI-concept concerning highly automated driving for system-inexperienced vs. system-experienced users

Kassandra Bauerfeind, Amelie Stephan, Ina Othersen, Sebastian Hinzmann, Lennart Bendewald, Franziska Hartwich
(Chemnitz University of Technology)
Volkswagen AG, Group Research, HMI for augmented reality & driving
Wolfsburg
Germany

Highly Automated driving functions will be the key technology for more comfort and efficiency in personal transportation. This work addresses the importance of an user-centred and variable Human-Machine-Interface (HMI) for highly automated driving in consideration of different levels of trust. The question arises as to how the level of trust, presumably caused by system-experience with a highly automated system, modulates information needs to ensure the highest possible comfort and acceptance. The variable HMI-concept has been tested with a panel of 47 subjects in a static driving simulator. Effects of experience with a highly automated system (between; system-inexperienced vs. system-experienced users) and the HMI (within; maximal-HMI vs. minimal-HMI) on system evaluation were examined. The user groups' gaze behaviour showed that the system-experienced users trusted the system more and monitored the system less frequently than the system-inexperienced users. System-experienced users focused on a side task more often than the system-inexperienced users. The system with the maximal-HMI resulted in higher trust and higher mode awareness than with the minimal-HMI for both user groups. Beyond that further results will be presented. This study supports the idea of adaptability of the HMI depending on the level of trust and the need for Information.

Beyond simplicity: Predicting mental load with cumulated information from cardiac activity

Elena Wolf, Fabian Ries, Jonas Imbsweiler, Barbara Deml
ifab - Institute of Human and Industrial Engineering
Karlsruhe Institute of Technology (KIT)
Germany

Physiological methods like the electrocardiogram (ECG) provide a not invasive technique to measure mental workload in human-machine-interfaces. A variety of cardiac parameters have already been explored regarding their diagnosticity and sensitivity to mental workload. The usual approach in former and current research is to investigate every cardiac parameter separately in order to find a superior indicator. However, this approach leads to moderate success as it cannot handle interindividual differences, simultaneous parasympathetic and sympathetic influences and intercorrelations of cardiac parameters. On this account, our aim was to compress redundant information from different parameters by following the approach from Lenneman and Backs (2000) where cardiac parameters were combined by principle component analysis (PCA) to distinguish between sympathetic and parasympathetic activity. For this purpose we conducted two experiments: In the first experiment 50 participants performed a ball-tracking task while watching stimuli of the International Affective Picture System. In the second experiment different arithmetic tasks were used to induce mental workload on 50 subjects. Throughout the experiment physiological and subjective data was measured with the ECG and the NASA-Task-Load-Index. For both experiments the PCA indicated identical components and loading patterns for the cardiac parameters. Advantages of predicting subjective workload with cardiac components will be discussed.

SESSION 10: SURFACE TRANSPORTATION - 2

Key Performance Indicators to measure the quality of multimodal travel

Andree Woodcock, M.Diana, Y. Susilo, J.Osmond
CMT, Coventry University
United Kingdom

Public transport is key to access social, economic, civic and cultural life. However, there is still a need to better understand 1) the needs of all transport users and 2) transport provision in cities and regions. The development of an inclusive, validated, passenger experience measurement instrument is the first step in under-standing the whole journey, multi-modal journeys. Such a validated tool would enable resources to be focused on areas which travellers felt most important. Such information could be used to create high quality, user centred, integrated, accessible public transport services, capable of attracting and retaining public transport users whilst meeting sustainability targets. This paper describes the FP7 funded, METPEX project, the derivation of a set of Key Performance Indicators and gaps in EU research relating to accessibility.

If Nostradamus was an Ergonomist: a review of ergonomics methods for their ability to predict accidents

Eryn Grant, Paul M. Salmon, Nicholas J. Stevens
Centre of Human Factors and Sociotechnical Systems, University of the Sunshine Coast
Australia

Forecasting loss events before they occur is the biggest challenge facing safety science. A particular challenge for prediction is the accident-causing interactions between components across overall systems of work. Typically, the approach to improving safety has been underpinned by retrospective accident analysis. While this approach has been valuable, many domains applying these analyses have reached a safety plateau where incident rates are not decreasing as they once were (indeed in some areas they are increasing). A proactive strategy for monitoring system performance with the aim of predicting adverse events is the next logical step. This article describes the first step in the development of a new accident prediction method, which included a review and evaluation of ergonomics methods for their ability to be used in a predictive manner. The review covered six candidate methods: AcciMap, STAMP, FRAM, EAST, CWA, HTA and examined the extent to which each could identify a series of core accident causation tenets derived from integrating contemporary accident causation models. The findings suggest that CWA and EAST are the most suited for development into a formal accident prediction methodology. Implications for practice and future research steps are discussed.

Modelling Driver States Based on Specific Driving Style Data

Peter Moertl, Andreas Festl, Christian Kaiser, Alexander Stocker
VIRTUAL VEHICLE
Austria

Driving styles are habitual ways of driving that are characteristic for groups of drivers (Sagberg, Selpi, Piccinini, & Engström, 2015) and represent an important area of research for advanced automation in the vehicle. Especially interesting is the utilization of vehicle movement and engine characteristics such as speed, accelerations, steering control, and fuel-burn to infer driving style characteristics and underlying driver state information. Advanced automation or assistance systems could utilize such driver state information to derive appropriate real-time interventions to improve human driving. However, little knowledge is available that directly links driving indicators and the underlying cognitive-psychological state of the driver. For this purpose, we investigate common driving style indicators and compare them by utilizing driving data that are collected in a driving simulator as well as from real-world driving studies. We describe and compare the statistical characteristics of these metrics and propose a modelling architecture to represent the underlying cognitive-psychological aspects that is derived from related existing models in ACT-R (Anderson et al., 2004) and MHP models (e.g. Card, Moran, & Newell, 1986). We adapt these approaches to create online representations of human characteristics to enable technologies that automatically derive assistance interventions in vehicles such as nudging, assisting, or automated control.

Real-time auditory feedback systems based on headway

Pavlo Bazilinskyy, Jork Stapel, Coert de Koning, Hidde Lingmont, Tjebbe de Lint, Twan van der Sijs, Florian van den Ouden, Frank Anema, Joost de Winter
Delft University of Technology
Delft
The Netherlands

Auditory feedback provided by advanced driver assistance systems is often regarded as annoying, which in turn may result in disuse. We developed and investigated the effectiveness of adaptive headway-based auditory feedback on self-reported acceptance and on car following behaviour. In an attempt to reduce false alarms, our system intelligently adapts to whether the driver remains in a dangerous headway zone or already increases time headway. Twenty participants drove a test vehicle during two trials on the highway, one trial with our adaptive system and one trial with a system that reproduces auditory feedback provided by MobilEye. After the experiment the participants completed a questionnaire assessing their usefulness satisfaction with the system. Sensory data was collected from the vehicle.

POSTERS

Rethinking the Interface for Driverless Last Mile Mobility Solutions

Joscha Wasser, Cyriel Diels, Mike Tovey, Anthony Baxendale
Centre for Mobility and Transport, Coventry University & HORIBA MIRA Ltd.
United Kingdom

The recent arrival of driverless last mile transport solutions (driverless pods) demonstrates that urban mobility is undergoing a radical change. Prototype vehicles by companies such as EasyMile and Navya are the first to demonstrate the driverless technology to a wider audience and allow the public to experience it for the first time. However, due to the complexity of the driverless technology itself, these prototypes are technical demonstrators rather than refined consumer products focusing on the end user, the passenger. This becomes particularly apparent in the vehicle HMI; in most cases the vehicles are still controlled and monitored by a human attendant or rely on basic map based booking systems. But as the technology advances, the passengers will expect a more refined interface. We therefore designed an interface specifically for driverless pods. It is aimed at providing the passenger with easily accessible information, additional functionality such as entertainment as well as increasing trust in the vehicle. All considered essential for the public acceptance of driverless pods. We evaluated the interface on hand held screens with the help of focus groups, with the plan for a final integrated version being tested as part of an immersive vehicle evaluation in a prototype.

Assessment of Registration Errors in Augmented Reality Head-Up Displays

Vitalij Sadovitch, Michael Wittkämper, Fares Wallis
Volkswagen AG Group Research
Germany

An Augmented Reality Head-Up Display (AR-HUD) enriches the driver's view by accurately placed virtual content to support the driving task (Ablaßmeier, 2009). Frequently addressed problems in the context of AR are discrepancies occurring during the superimposition of virtual objects onto real objects. This is referred to as registration error (Holloway, 1997) and is leading to a reduction in driving performance and subjective usability assessment (Pfannmüller, Walter, & Bengler, 2014). Different classification systems for registration errors are available. They are varying in the perspective on the topic, from a technical point of view regarding the incurrence of errors (Holloway, 1997), to an inspection of the geometric characteristics of an erroneous registration (Livingston, & Ai 2008). In this contribution a novel taxonomy will be introduced seizing existing classification systems and consolidate them, considering their coherencies. Main types of errors in real driving applications will be derived from this taxonomy and their impact on subjective system acceptance will be investigated in an empirical simulator study. Fifty-five participants subjectively assessed video material with erroneous virtual projections using a standardised questionnaire (Van der Laan, Heino, & Waard, 1997). Registration errors with critical impact on the subjective system-assessment and acceptance thresholds will be identified and discussed.

Effects of a smartphone collision warning application on drivers' behaviour - A field study

Assaf Botzer, Oren Musicant, Amir Perry
Department of Industrial Engineering and Management, Ariel University
Israel

Rear end collisions account for more than 30% of accidents with another vehicle. Collision warning systems can assist drivers to avoid such accidents, yet their price may cause drivers to refrain from installing them. In this study, we tested drivers' behaviour with a smartphone collision warning application that users can download to their smartphones for relatively small amounts of money. Twenty-six drivers used the application during their daily on-road trips for a period of one to two weeks. Their time-stamped acceleration and warnings were recorded for analyses. We found that drivers decelerated in response to warnings and that they received fewer collision warnings overtime. Nevertheless, twenty-one drivers reported that they no longer used the application after the experiment ended. In view of the potential of collision warning applications to generate safer driving behaviours we recommend developing incentive programs to encourage drivers to use them.

Safety, Ergonomics and Future Challenges for Electric Self-Balancing Scooters

Martin Westhoven, Lisa Fromm, Thomas Alexander
Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE
Germany

Electric self-balancing scooters (ESS), popularly known as "Hoverboards", have a high potential as "last mile" personal transportation devices in urban areas. With the aim of drafting guidelines for a safe usage of ESS, we assess safety and usability aspects of current ESS. Popular discussion of safety aspects focused mainly on fire hazards due to battery problems. This in turn influenced regulatory action. More comprehensive research in this area still remains open. Further relevant safety aspects include braking behaviour, evasion manoeuvres, protective gear and legal issues. The learning curve of handling Hoverboards also plays an important role. We present the results of a literature review of studies about the safety of similar personal transport devices, since literature limited to Hoverboards is sparse. The review provides a definition of Hoverboards in the sense of the ESS-type vehicle, relevant research on further device groups and experimental reports, development of smart capabilities, interaction with other road users, as well as accident risk, accident simulation, typical injuries and safeguards. Subsequently, we present a concept for several experiments further exploring the potentials and limits of the technology. Finally, we provide an overview of potential application fields for Hoverboards in professional and non-professional fields.

Augmented indication of lane change intention - Creating an assistive HMI using design thinking

Adrian Haar, Frederik Schewe, Andro Kleen, Martin Schmettow, Willem Verwey
Volkswagen AG Group Research
Germany
University of Twente
The Netherlands

Traffic becomes denser, space is limited and drivers interact more frequently. This raises the need for cooperation to ensure smooth traffic flow. The application of modern head-up displays (HUD) offers a possibility to support cooperative interactions. We evaluated the opportunity to provide indication of someone's lane change intention via an HUD based human-machine interface (HMI). This paper describes the development of design elements used by the HMI concept. Following the design thinking process four different design variations were developed by understanding, observing, defining and brainstorming. Using a low fidelity simulation, these designs were prototyped and evaluated with naive participants (n=8). To create deeper insight about the driver needs, we used a combination of thinking aloud, interview, sketching and questionnaire. Using the result we developed design features of an HMI supporting the perception of others intention. Based on that knowledge an optimized design was developed. In a second study with additional participants (n=8), this optimized design was tested and compared to previous design alternatives. The ratings regarding usefulness and satisfaction showed substantial improvements achieved by the optimized design. Achieving these results within a short period of time proved the value of design thinking during the HMI development process.

Rear Seat belts Comfort

Gabriella Bisci
Ergonomics PCC, FCA
Italy

Rear seat belts generate comfort issues in many programs, even if customers complaints are not so frequent within European market, due to the rear row seat and seat-belts frequency-of-use. Nevertheless, guaranteeing the rear seat belt comfort requires a significant effort for car makers, in terms of design and validation activities. DFSS method provides a possible approach to this highly subjective vehicle performance, consisting in: - Identify opportunities to carry-out a DFSS projects on this topic - Define technical requirements in order to manage the performance, working on the most impacting components design - Developing concepts among which the best one in terms of performance and other design parameters should be selected. An IDD project has been carried out in order to collect data directly from customers and to focus on the main engineering measurements strictly connected with the customers' needs. In this way, it has been possible to select the best concept, through iterative, comparative assessment based on design parameters such as comfort, quality, technology availability and maturity, reliability, packaging, safety, weight, costs. An hybrid concept has been developed, including new components for which a patent request is still pending. A vehicle installation and full validation is currently under investigation.

The Driving Anger Expression Inventory – Validation of a German (Short) Version

Stefan Brandenburg, Michael Oehl, Christian Hartwig
Technische Universität Berlin
Germany

Driving anger is related to aggressive driving behaviour and a higher rate of traffic accidents. The expression of driving anger mediates the relationship between driving anger and maladaptive and dangerous driving. It is therefore important to assess the driver's driving anger expression. The study tested whether the original American structure of the Driving Anger Expression Inventory (DAX) can be applied to a sample of N = 501 German drivers. A confirmatory factor analysis revealed a poor model fit for the original four factor solution. We excluded items that showed no variance at all; German drivers express their anger adaptively, verbally and by using their vehicle. They do not use personal physical aggression. Instead they show proactive anger management. The short version of the DAX (DAX-s) for German drivers was related to their driving anger experience and their general anger propensity. Results of this study were cross-culturally compared with DAX versions of other countries which partially reported similar findings. The original American structure of the DAX cannot be applied to German drivers. Implications for further research as well as for the application of the DAX in Germany will be discussed.

Ingress strategies of truck drivers

Jennifer Hebe, Tyron Najgeboren, Felix Grobner
Chair of Ergonomics, TU München
Germany

Simulating human motions plays an important role in shortening the product development process. Before being able to predict a human motion, the impact of different motion characteristics has to be understood. One of the characteristics influencing movement is the body height, another characteristic is the environment, like the number of access steps during the truck ingress procedure. The present study investigated the truck ingress motion of individual drivers to determine general motion patterns. The experiment conducted took place on real vehicles, one with three steps, representing the long haul sector, and one with two steps, representing the distribution vehicle sector. The participating subjects, all having a truck driving license, were divided into three groups according to their body height. In sum, 45 subjects entered both trucks 6 times to become familiar with the geometry but not get exhausted. The experimental data were analysed in two ways: qualitative on basis of the video data and quantitative on basis of the joint contribution vector (JCV) index (Park, Martin, Choe, Chaffin, & Reed, 2005). As a result, ingress strategies of truck drivers of different body heights are determined, and changes in strategies regarding the different number of steps are presented.

Designing a Framework for Human Factors Integration in Railway Systems

Roberta Presta, Andrea Castellano, Margherita Vestoso, Roberto Montanari
Scienza Nuova Research Centre, Suor Orsola Benincasa University
Italy

The integration of human factors in the design process of railway systems is playing an increasingly significant role, because of both the intervention of standardization bodies and of the growing awareness about the connection between human performance and safety risks. These aspects are even more important since the railway environment is nowadays ever more oriented towards the automation of control and protection systems, with a consequent urgency for the verification of the human-automation interaction quality. This work focuses on the design of a holistic plan acting as a reference methodological framework for designers and system evaluators to implement human factors assessment at various levels. Starting from the areas in which the rail system may be divided (train cab, control room, infrastructure and station) and from the best practices at the state of the art, methodologies and techniques suitable for the railway domain are considered to measure the quality of the human performance and to design strategies for prevention and mitigation of human errors. As examples of application of the framework, different approaches are presented, from heuristic analysis for high-level evaluations to the predictive analysis to weight human factors in the risk assessment process.

Comparison of HMI-Variants in Highly Automated Driving to Facilitate Driver Reactions in Urgent Take-Over Situations

Christian Purucker, Frederik Naujoks, Andy Prill, Alexandra Neukum
WIVW GmbH
Germany

Automobile manufacturers and suppliers currently expect highly automated vehicles to hit the markets as early as 2020. In order to guarantee safety of use for highly automated vehicles, various functional safety aspects have to be considered; the transition from automated driving back to manual driving is a central topic for human factors research within this realm. A growing number of studies have addressed driver reactions in take-over situations in the past, but empirical studies that compare different human-machine interface (HMI) design variants in these situations are still largely missing to date. Furthermore, more research is needed with regard to the parametrization of take-over situations; often, an available 10 s time budget for manual take-over was assumed, but situations may exist, where the available time budget might be even shorter. The current driving simulator study with N = 24 participants aimed at comparing different HMI variants in urgent take-over situations. A novel concept for the visualization of driving modes in the vehicle interior was compared to a conventional concept relying solely on head-up and cluster display visualizations. Moreover, speech output was used or not. Results showed the effectiveness of the novel concept with regard to several metrics in the study. Implications for future research are discussed.

Motion sickness in cars: Influencing human factors as an outlook to highly automated driving

Adrian Brietzke, Klamroth *(TU Chemnitz)*, **Dettmann** *(TU Chemnitz)*
Volkswagen Group Research
Germany

Motion sickness (MS) in cars will have significant importance for fully automated driving. The individual resilience to MS varies extremely to partly known reasons. To generate a model of individual traits describing the affected person it is important to identify the influencing factors. The study examines the occurring symptoms, coping strategies as well as individual factors like personality, demographics and driving statistics. In detail, the questionnaire (408 participants) showed that nausea, dizziness and headaches depict the most common symptoms. The three common coping strategies were looking straight ahead, avoidance of side lining, and taking medicine. Concerning the self-reported frequency of MS as well as the MSSQ-short-score, women displayed a significantly higher mean value than men. Moreover, significantly positive correlations between MS frequency, MSSQ-short-score, and the personality dimensions neuroticism, openness for experiences and conscientiousness could be proven. A multiple linear regression analysis showed that gender and MSSQ-Short-score are very good predictors for the self-reported frequency of MS. In summary, measurements of personality and factors as sex and age seem to be important for the individual sensitivity to MS. As a conclusion, a recommendation for major risk groups for MS and HAD related driving studies will conclude the paper.

Behaviour change in electric vehicles use: Study of a mobile app interface

Serena Fruttaldo, Roberto Montanari, Tracy Ross, Andrew Morris
Loughborough University, Design school
United Kingdom

This paper is based on a study aimed at examining how historical data on energy consumptions in electric vehicles could be (re)designed by taking into account Kahneman's theories (in particular "Fast and Slow thinking", Kahneman, 2011 and "Prospect Theory", Kahneman & Tversky, 1979): they should be applied support driver's behaviour changing, in particular eco-driving, by focusing on loss rather than gain. This paper describes results from a study based on i) a literature analysis on energy use behaviour and eco-driving and an analysis of information systems for home energy use and instrument clusters already in use in electric vehicles (Fully Electric - FEV and Hybrid - HEV); based on such results, ii) the design of a HMI concept as part of a mobile app, providing information on energy consumption in two versions (loss/gain of recovered km); iii) a heuristic evaluation of the HMI concept; iv) outcomes from a co-design session.

Cycling with low vision

Bart Jelijs, Bart Melis-Dankers, Dick de Waard, Joost Heutink
Traffic Psychology Group, Clinical and Developmental Neuropsychology, University of Groningen
Royal Dutch Visio: Centre of Expertise for Blind and Partially Sighted People
The Netherlands

In the Netherlands, independent cycling belongs to the main modes of transport and contributes to social participation. However, little is known about cycling with permanently reduced vision that cannot be corrected with regular glasses or contact lenses. Consequently, partially sighted people may be unnecessarily discouraged from cycling. More evidence-based knowledge of cycling with low vision is needed to optimize the mobility of partially sighted people. In this experiment, comparisons of the cycling behaviour were made between the following groups: persons without visual impairments (n=10), persons with a reduced visual acuity (n=12), and persons who experience both visual acuity and visual field problems (n=9). The participants independently cycled a fixed route (8 km) in regular traffic twice: once on an E-bike and once on a similar conventional bicycle. The route contained simple situations (e.g., one-way cycle lanes; right turns) as well as complex situations (e.g., shared space zones; a traffic light intersection; lane changes). Data were registered by GPS action cameras mounted on the bicycles. The results indicate that partially sighted cyclists more frequently missed a lane change at the first encounter than cyclists without visual impairments. Notably, only cyclists in the reduced visual acuity group missed this lane change.

Office Tasks in Highly Automated Vehicles

Tobias Vogelpohl, Franziska Gehlmann, Matthias Kühn, Mark Vollrath
Technische Universität Braunschweig, Institute of Psychology, Department of Traffic and Engineering Psychology
Germany

Highly automated vehicles will likely be popular for commutes to the work place, during which drivers may want to get started on office tasks. Car manufacturers are already designing car interiors to provide a work space in the car. However, it is not yet clear if drivers can safely switch from an immersive office task back to manual driving if required by the automation. We analysed reactions of 51 participants to take-over requests in a driving simulator study. During automated driving participants either performed one of two standardized office tasks used in personnel selection procedures or no task. After the office tasks 90% of the drivers deactivated the automation after 7 to 8 seconds. However, 90% of the drivers looked at the side mirror for the first time only after 11 to 14 seconds. This first gaze to the side mirror after the take-over request could be an indicator for the time needed to understand surrounding traffic. Office tasks during automated driving should therefore only be performed if the car is able to safely predict take-over situations, to provide an appropriate time frame for the take-over and to support transitions from office tasks back to safe manual driving.

Case-based decision support for fault diagnosis: Salient outcome ratings do not discourage thorough situation analysis

Romy Müller, Ann-Kathrin Dessel, Amelie Bengsch, Sebastian Heinze, Lukas Oehm
Technische Universität Dresden, Chair of Engineering Psychology and Applied Cognitive Research
Dresden
Germany

In case-based decision support, solutions applied by other operators in the past are presented as cases, and can include ratings of the solution's outcome. However, applying a case because of its positive rating only leads to correct solutions when the present and past situations match. Salient ratings might encourage a quick application of solutions at the cost of thorough situation analysis. However, in a previous study on fault diagnosis for deep-drawing paperboard, we found no evidence for such reduced thoroughness. To investigate the boundary conditions, the present study maximally encouraged subjects to base their decisions on outcome ratings: The solution with the highest rating was correct for more than the first half of the experiment, feedback allowed subjects to learn this, a resource-demanding secondary task required monitoring and interruptions, and time constraints forced subjects to decide quickly. In two out of twenty trials, a counter indication made it necessary to select a case with a low rating. We compared three groups who either used salient graphic ratings, lengthy text ratings, or no ratings. Again, performance and situation analysis were not impaired by salient ratings. This suggests that in case-based fault diagnosis, people are not easily misguided into over trusting an assistance system.

Trust and Beliefs about Autonomous Vehicles: Can They Be Leveraged to Enhance Intention to Use?

Gabriele Prati, Filippo Fassina, Federico Fraboni, Marco de Angelis, Víctor Marín Puchades, Luca Pietrantoni
University of Bologna, Department of Psychology
Italy

Autonomous Vehicles (AVs) are an emergent technology that is not only bound to change how we experience mobility, but also manifold aspects of people's lives, such as the way cities are built or the inclusion of collectives unable to use a car on their own. Nonetheless, different levels of automation are thought to be adopted prior to the final deployment of AVs. This study examines the role of trust and beliefs in the intention to use AVs, as well as the differences in trust and intention to use between different levels of automation (i.e., SAE International Standard). We administered a questionnaire to 250 participants measuring the main beliefs identified in the literature regarding the benefits of AVs, as well as the participants' intention to use and trust in conditionally, highly and fully automated vehicles. Conditions were randomised using Latin square to supress the effect of the order. Regression methods were applied to model the relationship between believed benefits, trust and the intention to use AVs. Trust and certain beliefs were related to intention to use. These findings have implications for AVs design, and provide guidelines to enhance intention to use and trust in AVs by emphasising information on certain benefits.

From distraction to controlled engagement: How secondary tasks affect drivers' supervisory and fall-back performance of the driving task while using SAE level 2 driving automation

Anna Pätzold, Cornelia Schmidt, Nadine Rauh, Peter Cocron, Sebastian Hergeth, Andreas Keinath, & Josef F. Krems
Technische Universität Chemnitz, Professur für Allgemeine und Arbeitspsychologie
Chemnitz
Germany

Minimizing driver distraction has been a major research area over the past decades. With SAE level 2 driving automation the driver's role changes from actively driving to supervising an automated system. Previous research could show that under such conditions controlled engagement in secondary tasks may have different effects on drivers' supervisory and fall-back performance. We conducted a fixed-based driving simulator study (N = 40) to investigate the effect of different secondary tasks (radio tuning, browsing, text scrolling, watching videos, surrogate reference task [SuRT]) on drivers' supervisory behaviour and reaction times to missed warnings, the most challenging kind of level 2 driving automation errors. No reliance effects between first and repeated error occurrence was found. The Alliance of Automotive Manufacturers' visual-manual driver distraction guidelines were only met when participants were not engaged in a secondary task. However, no significant differences in reaction times to automation errors were found whether participants were or were not engaged with secondary tasks, suggesting compensatory behaviour. Corroborating earlier research, the current findings indicate that existing driver distraction guidelines may need to be amended to take best advantage of partially automated driving systems' safety benefits.

New technology enabling wellbeing, independence, successful ageing, and relationship centred care, for seniors domicile in residential homes

Joan Cahill, S. McLoughlin, M. O'Connor, R. Portales, & S. Wetherall
School of Psychology, Trinity College Dublin
Ireland

This paper reports on human factors research concerning the advancement of new technology enabling wellbeing, independence, dignity, successful ageing and relationship centred care for seniors domicile in residential homes. The purpose and functionalities of gerontechnologies are often led by the requirements of their social and caregiving environments. Often, their functionalities do not match end user motivations and expected benefits. In a residential context, technology has a role beyond that of (1) managing and reporting on a resident's physical health and security, and (2) supporting operational and organisational goals (i.e. staffing, risk management and compliance). Technology has a role in terms of enabling the well-being of both patients and staff alike, enabling life/job satisfaction and social participation, and fostering an environment that provides a sense of purpose for all stakeholders (i.e. residents, staff and families). Overall, the human factors design approach is premised on the assumption that solutions for seniors and other actors are necessarily interrelated. As such, a stakeholder evaluation based approach is adopted. The proposed technology is conceptualized in relation to stakeholder relationships and promoting relationship centred care. The proposed functionality addresses the three pillars of wellbeing (i.e. biopsychosocial) - promoting wellbeing, dignity, self-management and successful ageing.

Cold legs do not matter - investigating the effect of leg cooling to overcome passive fatigue

Elisabeth Schmidt, André Dettmann, Ralf Decke, Angelika C Bullinger
BMW AG
Munich
Germany

Passive fatigue generally results from low levels of cognitive workload and lack of stimulation. While driving, it leads to inattention and results in reduced traffic safety. In the past, countermeasures like secondary tasks or sensory stimulation have been proposed to fight this type of driver fatigue. To explore methods of sensory stimulation which are effective while avoiding a reduction in drivers' comfort, this research focuses on the effect of thermal stimulation, in particular local, short-term cooling of the driver's legs. To induce passive fatigue, participants of the driving simulator study drove for 30 minutes on a monotonous highway with no traffic. One group of drivers (n=21) received a treatment consisting of 4 minute cooling at 15°C after driving for 20 minutes. The control group (n=21) completed the same drive without intervention. Analysis of results shows that cooling of the legs reduced subjective sleepiness on a significant level (p=0.04). Objective physiological measures (heart rate, skin conductance, evidence of eye closures and pupil diameter) were not affected by the treatment, as could have been expected from earlier studies. The article closes with possible explanations for the inefficiency of the treatment and suggestions of alternative countermeasures to reduce passive fatigue beyond leg cooling.

Using Paper, E-ink device or Desktop-PC for office work and subjective strain - a comparative study

Patricia Tegtmeier & Sascha Wischniewski
Federal Institute for Occupational Safety and Health (BAuA), Unit "Human Factors, Ergonomics"
Dortmund
Germany

A new generation of large e-ink devices enable mobile digital uses which are similar to paper use. Unlike studies concerning effects of tablet-pcs use, so far, it is unclear to what extent these e-ink devices are more like paper or computers in respect of resulting strain. The aim of the presented study was a comparison between an e-ink device (US letter format), a conventional desktop-pc and common paper for a reading and a correction task. It was conducted as a within-design with 36 participants with an emphasis on subjective strain measured applying the NASA-TLX. The subject's current level of paper preference, technical affinity (TA-EG), as well as age and gender were included as between subject factors. In addition, preferences for the three different working media and performance parameters were determined. For reading and correcting on the desktop-pc the overall subjective strain was of medium intensity. Subjective strain for paper handling as well as the e-ink device was significantly lower than in the computer condition. No interactions between subjective strain and the between subject factors conducted were found. The results indicate that an e-ink device can be an alternative or a useful addition to using paper in the office.

To warn or not to warn? Towards an assistance strategy that reduces unnecessary collision alerts

Christina Kaß, Gerald Schmidt, Norbert Schneider, Wilfried Kunde
Adam Opel GmbH
Germany

Present-day advanced driver assistance systems base their collision alerts mainly on the time to collision (TTC) criterion. Such a warning strategy, which is determined by physical criteria alone, often yields warning signals that drivers judge as being unnecessary. To increase user acceptance, automobile manufacturers aim to reduce alert rates by tailoring system activation to the driver's needs. The present driving simulator study investigated if the driver's need for assistance in potential collision situations is primarily predicted by the objective risk for collision or by the driver's subjective hazard perception. Thirty participants encountered traffic situations with varying levels of objective risk (TTC). Each situation was experienced with two different manoeuvre intentions to vary the relevance of the potential hazard. A multilevel moderated mediation analysis revealed that the driver's subjective hazard perception mediated the relationship between the objective risk for collision and the driver's self-reported need for assistance. Additionally, the mediated relationship was significantly stronger when the hazard interfered with the intended manoeuvre. These results suggest that to appropriately adapt driver assistance to the driver's needs, a warning strategy is required which considers both objective risk factors and the driver's manoeuvre intentions.

Effects of Latency on Perception of Augmented Reality in Head-Up Displays

Matthias Walter, Tim Wendisch, Klaus Bengler
Technical University of Munich, Chair of Ergonomics
Germany

Augmented reality is an important topic in the development of human machine interfaces. One way of integrating augmented reality into vehicles is through the contact-analogue head-up display (ARHUD). The main problem for ARHUDs is the lack of precise positioning of virtual content in the real environment. Pfannmüller, Walter and Bengler (2014) showed that deviations of 3 to 6 meters from the ideal position already have a negative effect on system usability. This criterion is problematic to verify in an on the road experiment because the deviation between virtual content and the environment cannot be determined. In the presented study, latency between physical event and displayed content are considered in order to provide a quantifiable criterion. In a driving simulator, the influence of a contact-analogue lane marker, which was subjected to different latencies (17 ms, 50 ms, 100 ms), is examined in terms of driving behaviour, perceived stress, reaction times and usability while driving along curves and lane changes. Changes in latency have a significant influence on stress and usability. Specifically the highest latency have the most negative effect on the dependent variables. Results suggest that latencies of up to 50 ms are still considered acceptable in terms of usability as evaluated in the implemented use case.

User Expectations vs. Web Design Patterns: User Expectations for the Location of Web Objects Revisited

Ulrich Nikolaus, Sarah Bohnert
Faculty of Media, Leipzig University of Applied Sciences (HTWK Leipzig)
Germany

The positioning of web design elements should reflect the average user's mental models in order to improve a web site's usability – but how to assess these expectations? As early as 2001, two different approaches were proposed to deal with this issue: While Michael L. Bernard used a survey-based method to measure user expectations in order to derive recommendations for web designers, Jakob Nielsen and Marie Tahir used their 14 years of web usability experience to specify standard UI design conventions that were supposed to shape the user's mental models in the first place. In this paper, both approaches are compared and updated to the present situation, in order to identify benefits and limitations and to put them into context with current changes in professional web design (responsive or centred web layouts, touch screen compatible navigations, one-pagers etc.). The results allow for a better understanding of the interdependencies between user expectations and real world web design patterns, point towards an increasing convergence of user expectations and web layout standards and allow for an assessment of actual web design trends (decreasing popularity of L-scheme navigation or web titles, diminishing or more targeted use of web advertisements etc.).

Driver behaviour at sleepy state while performing a car following task

Alina Mashko, Adam Orlický, Stanislav Novotný, Petr Bouchner
Czech Technical university in Prague, Faculty of Transportation sciences
Czech Republic

The paper presents observation of driver and vehicle behaviour in a fatigued state while following a proceeding vehicle. Lateral behaviour (lane position, steering) reaction time and headway are being observed. The measured data are presented as a comparison between two age groups (senior and young) of drivers. The task of car following allows to demonstrate the increased time of reaction for fatigued drivers which can lead to collision with preceding vehicle, while safer headways kept by senior drivers can mitigate the risk of impact. Inability of maintaining constant headway is a sign of driver impaired attention, eventually, sleepiness.

Designing for visual appeal, simplicity and concreteness: the development and evaluation of design standards to manipulate icon characteristics

Romain Collaud, Lara Défayes, Sine McDougall, Irene Reppa, Nicolas Henchoz, Andreas Sonderegger
Design Research, EPFL+ECAL Lab
Switzerland

Good icon design is now recognized as crucial in determining user experience with mobile, PC and other applications. However, research examining icon use and processing is based on the use of existing icon sets. This leaves many questions about how new icons can be created with specific characteristics. Based on extensive design research, specific design principles were established. In an experimentally controlled study, a set of 64 icons was then developed by designers applying these design principles to create 8 versions for 8 new icon-functions, differing with regard to visual appeal (appealing vs. unappealing), simplicity (complex vs. simple) and concreteness (concrete vs. abstract icons). Once created, participants (N = 276) were asked to rate visual appeal, simplicity and concreteness of 8 icons (from the 64 versions created) in order to ascertain the extent to which the design principles were effective in creating icon sets with different characteristics. Results demonstrated that an independent manipulation of each design dimension was successful, indicating that the suggested design principles provide valuable hints for the design of icons. These findings will be used to illustrate how experimental design can shed light on building guidelines for creating effective interaction designs.

Stop reading, start looking - Pictorial scales for the evaluation of interactive products

Juergen Baumgartner, Andreas Sonderegger, Juergen Sauer
Department of Psychology, University of Fribourg
Switzerland

In order to develop a pictorial alternative for verbal scales in product evaluation, several bipolar scales were created to measure relevant concepts, such as perceived usability, ease of use, workload, flow, aesthetics and emotion. In the first phase, a range of pictorial items were designed based on verbal items of established questionnaires. They were iteratively pretested using think-aloud protocols and comprehensibility tests. The pictorial scales were validated in the second phase conducting a lab study (N=60) where participants had to interact with a smartphone prototype. After interaction, they filled in pictorial and verbal questionnaires to evaluate the prototype. The level of comprehensibility was manipulated by giving half of the participants pictorial scales with an additional verbal hint (keyword). Verbal questionnaires were used as comparison (PEOU, SUS, NASA-TLX, FSS, VisAWI and PANAS). Data analysis is ongoing and the results will be presented at the conference. The outcome of this project is expected to contribute to a better understanding of the validity of such instruments and represents the first steps towards the development of a pictorial user experience scale.

Improving medication safety through labels background characteristics

Yuval Bitan, Abed El Hamid
Department of Industrial Engineering & Management, Ben-Gurion University of the Negev
Israel

Medication administration is an important part of the clinical treatment. In most healthcare organizations the task of selecting and verifying the medication is still a manual task, prone to errors. Our study is seeking ways to improve this task. Efforts to foster safe medication include many changes in the way medication are packed, stored and distributed to caregivers. However, lack of standards and varied "best practices" leave room for improvements. Our approach focus on improving the interface between the caregivers and the medication label. While holding the package or the vial at a distance that is not longer than arm's length, the label need to provide information that will support the cognitive process of identifying the correct label. Following studies that found that relying on reading the medication name is not a safe method, we are focusing on the label background, seeking for characteristics that will provide caregivers with additional signals to identify the correct medication. We will present an experiment where we compared the medication identification task under three types of backgrounds. Conclusions we draw from the subject's success in identifying the correct label led us to recommendations about the use of backgrounds patterns that reduce errors.

Video in control rooms - effects of autocycling frequency and video complexity on operators' mental workload

Fabian Ries, Floria Krusche, Barbara Deml
Institute of Human and Industrial Engineering (ifab)
Karlsruhe Institute of Technologie (KIT)
Germany

In the context of control rooms where video cameras are used for the surveillance of scenes or processes, operators are sometimes faced with autocycling of images from different cameras. However, not only the frequency of autocycling but also the visual complexity of the presented material can have an impact on the operator's state. In order to gain insights into these processes, an experimental laboratory study with control room operators (N = 34) from different domains (security, traffic, industry) was conducted. Within this, we investigated the influence of different autocycling frequencies as well as the visual complexity of the video material on the operators' mental workload and the perceived usability of the system. Statistical analyses indicate that both factors account for a significant amount of variance in the subjective ratings. Results are being discussed with regard to the consequences for workplace design in control rooms.

Gamified eco-driving - personal or social game? Investigation of motivation and distraction potential in an experimental field trial

Maria Kreusslein, Anna-Elisabeth Leonhardt
Chemnitz University of Technology, Cognitive and Engineering Psychology
Germany

Eco-driving (ED) is a helpful technique to support the reduction of CO2 emissions while driving. Especially, the gamification approach seems to be a promising opportunity to motivate people to drive or act environmentally friendly (Kreusslein & Koch, 2016; Castri et al., 2016). According to the Self- Determination Theory (Ryan & Deci, 2000), feedback addressing competence (personal feedback) and relatedness (social comparison), beside autonomy, induces a long-lasting behavioural change. However, the questions remains which factor or combination is the most motivating for visual ED feedback interfaces (EDFIs) while driving. Moreover, there might be a discrepancy between motivational benefits and harms to traffic safety due to the distraction in terms of eyes off the road. The objective of the present study was the investigation of motivation and distraction potential (eye-glances) of two EDFIs (laboratory pre-tested). 35 subjects were tested in a 3x2 mixed-design in an experimental field trial. Subjects completed a baseline drive in real traffic, followed by a test drive with either of two EDFIs addressing one factor (between-subject factor) and a third test drive with an EDFI combining two factors. The study will shed light on the motivation and distraction (eye-glances) effects caused by the different gamified EDFIs.

Efficiency evaluation of an assistance system for text annotations

Robert Greinacher, Nils Backhaus
Psychology and Ergonomics Technische Universität Berlin
Germany

Introduction: Smart personal assistants like Siri or Alexa use machine learning based text analysis to understand commands and questions. Underlying technologies require a huge amount of training data, and their production often involves human annotators doing repetitive and monotonous work. Objectives: The purpose of the present study is to identify possibilities to support the text annotation task with automated assistance. Since these annotation assistance systems cannot be perfectly accurate, the influence of reliability is analysed, too. Methods: An assistance for making annotation suggestions was simulated. Subjects accomplished annotation tasks with and without the system in a counterbalanced order. Three levels of reliability (10, 50, or 90% correct suggestions) of the system were benchmarked. Dimensions measured were correct annotations (hits), misses of annotations, and total task time. A 2 (assistance present) x 3 (reliability, between) mixed design (N = 66) was used. Results: An assistance system providing a reliability of 50% or 90% improves accuracy and reduces misses of the human annotations significantly. Suggestions with a reliability of 90% lead to a significant decrease of human processing time. Conclusions: Supporting the task of text annotation using an automated assistance will improve human's performance, if the suggestions of the system are mature.

Acceptability beyond usability: a manufacturing case study

Silvia Gilotta, Stefania Spada, Lidia Ghibaudo, Monica Isoardi
Fiat Chrysler Automobiles SpA, Manufacturing Planning and Control – Ergonomics
Italy

This study is part of an innovation project carried on ErgoLab, the ergonomic laboratory of FCA in Turin, to evaluate the use of a passive exoskeleton for upper limbs in automotive manufacturing tasks. The introduction of new technologies into a production environment is not always effective, because operators do often not use them. For this reason it is important that future users accept the innovation.

With the aim to evaluate Usability and Acceptance, the testing protocol included different data gathering techniques: observation during simulated working tasks, interviews, TAM2 questionnaire to analyse acceptance, and finally a focus group. Overall results showed that operators judge positively the exoskeleton because of evidence in carrying on activities with less physical effort. The device is perceived useful especially in tasks where precision is required. The evaluation showed a good interaction human-device, but the operators involved in the tests consider the work-device interaction a critical point. More in deep, workers refer perceived ease of use, voluntariness and results demonstrability but low intention to use and perceived usefulness. The results of focus group show compliance to individual results: operators affirm that exoskeleton is useful to carry on some specific activities, but the use has to be voluntary.

The Impact of Keyboard Layouts on Dwell-Free Eye-Driven Typing Performance

Bernine Caruana, Chris Porter
Faculty of ICT, University of Malta
Malta

The modern technique of dwell-free eye typing enables more efficient communication than the conventional dwell-based technique. Nevertheless speech and motor impaired individuals, who are also digital immigrants, may experience challenges with this technique due to their unfamiliarity with keyboard layouts. Whereas studies evaluated the performance of different keyboard layouts with dwell-based eye typing and paper mock-ups, their findings cannot be generalised for dwell-free eye typing since this technique is characterised by fundamental interaction differences. The purpose of this study is to provide speech and occupational therapists with insights on keyboard recommendations based on patients' aptitudes for and experience with technology. This study considers three standard keyboards; QWERTY, Dvorak and the alphabetical layout, in light of deriving an optimised layout for users with limited typing experience. Twenty digital immigrants used all three keyboards during 45-minute experiment sessions. Results emerging from this study informed the design of a new layout (DF-AJR) which mitigates observed shortcomings in standard layouts for dwell-free eye-typing. DF-AJR utilises the English-letter frequency list and adopts an alphabetical bias. Initial results show that the participants' performance improved with the DF-AJR keyboard and was also preferred by participants. An optimised client-side web-based tool was also developed with the aim to reduce financial burdens associated with acquiring eye-driven AAC devices.

AniSAM and AniSmiley - Development of an animated tool to measure affective states

Andreas Sonderegger, Annelaure Blanc, Martina Studer, Juergen Baumgartner
EPFL+ECAL-LAB Lausanne
Switzerland

The Self-Assessment Manikin scale (SAM) is a pictorial scale to assess affective states. Although well-known and widely used, the SAM has often been criticised as being sketchy, oversimplified and difficult to understand. Therefore, we set out to develop a more comprehensive tool to assess valence and arousal as the two main dimensions of the circumplex model of affect. Two versions of an animated measurement tool were developed: AniSAM and AniSmiley. They were evaluated in a mood-elicitation study in which participants (N = 70) rated their affective state either with the AniSAM or the AniSmiley after watching six extracts of different films (Latin square design). Each extract aimed to induce specific affective states (e.g. high arousal & negative valence, low arousal & positive valence). In addition, the original SAM and the Geneva Emotion Wheel (GEW) were applied after each film extract. Results indicate that AniSAM and AniSmiley differentiate well between the affective states elicited by the films. In addition, correlational analyses indicate high correlations with the original SAM scale and various emotions assessed with the GEW. The findings can be considered to be initial indicators of the validity and usefulness of the AniSAM and AniSmiley.

Peripheral Colour Contrast Sensitivity under Perceptual Load

Joshua Shive, Joseph J. Schlesinger, & Jasmine K. Jester
Tennessee State University
USA

How does paying attention to information presented in central vision affect peripheral vision? Our current project uses the QUEST adaptive psychometric method to estimate thresholds for perceiving coloured dots presented laterally from a fixation point. Dot location responses on each trial are used to adjust the dot's brightness value in the hue/saturation/value (HSV) colour space for the next estimation trial. Observers also perform a rapid serial visual presentation (RSVP) task where they report the colour of a single letter appearing in a stream of white letters presented at fixation for 50 milliseconds each. We estimate detection thresholds for four different peripheral dot colours (red, blue, green, or blue) presented at two different eccentricities, with and without the RSVP task (16 thresholds total). We predict that psychophysical thresholds will increase when the participant performs both the dot location task and RSVP task. We also predict that psychophysical thresholds will increase as the distance from fixation increases. These data will add to knowledge about peripheral colour vision and the effects of perceptual load on peripheral vision, as perceptual load in high-consequence industries has been shown to impact human performance. Understanding optimal visual display and information transfer can improve ergonomics and safety.

Investigating the Impact of Gamification on Training in Process Plant Operators through Eye Tracking

Laya Das, Babji Srinivasan, Rajagopalan Srinivasan
Department of Electrical Engineering, Indian Institute of Technology Gandhinagar
India

Process plant operators require adequate knowledge of process structure (interconnections between variables) and dynamics (sensitivity to changes in manipulated variables) to efficiently control the plant and handle abnormal situations. Operators acquire this knowledge during training programs in simulated environments. The effectiveness of these environments, referred to as operator training systems (OTS) greatly depends on the design of tasks and the operator's cognitive abilities and state of mind such as interest and motivation. Training sessions should therefore be designed to account for the cognitive abilities and mental states of trainees. Gamification has been studied in the context of improving simulated learning environments and has been known to keep learners actively engaged and enhance learning. In this study we investigate if gamification of the training environment influences learning in operators. We use eye tracking to monitor the operator's attention allocation in both the treatment (gamified environment) and control (non-gamified environment) groups; feedback about process knowledge is collected from participants at the beginning of each task and their actions recorded during the tasks. These direct and indirect measures are merged to distinguish the attention allocation and performance of participants.

My data is mine - rights and personal information on mobile device

Sven Bock, Felix Wilhelm Siebert, Mathias Rötting
TU Berlin
Germany

Two studies were conducted to investigate users' handling of mobile phone related data. In a first questionnaire study (N=50), users' awareness of data collection through mobile phone applications was researched. Further, users were asked about their position of surrendering the rights of their personal data to the application provider and it resulted that most of them are concerned about the data transfer. A second survey (N=30) was conducted to find out how severe this problem is being perceived in a real life environment with real data. To examine this research question, about the subjective importance of protecting one's own digital data, an application called "A-Ware" was designed and integrated into the operating system on mobile phones in Karlstad, Sweden, and Berlin, Germany. The application tracks the digital data rights management on mobile phones, and allows users to allow or block access to personal data by applications on the device. Another function of A-Ware for more transparency is to monitor which data is send to the application provider. The second study was conducted for two weeks, and 15 devices were equipped with A-Ware. Analysis of the logs from A-Ware shows that mobile phones transmit personal data even when they were not running.

An assistant system intervening as much as necessary, but as little as possible: An experimental evaluation

Nikolaus Theißing, Axel Schulte
Institute of Flight Systems, University Bundeswehr Munich
Germany

In the investigated unmanned aerial reconnaissance system, a single human operator commands an unmanned aircraft in a supervisory control relationship. The operator is supported by an assistant system that is integrated into the HMI of the operator's ground control station. This assistant system is designed to mitigate human erroneous behaviour in situations in which the commands of the operator lead to dangerous situations, e.g. situations in which the aircraft enters a restricted airspace or exceeds its fuel limits. The intervention takes place via alerts, cues and suggestions offered to the operator on the HMI. Instead of providing a complete solution as soon as a problem is detected, the assistant system is rather designed to intervene only late and only in small steps: According to the criticality of the situation, an escalating sequence of interventions is used to support the operator as much as necessary, but as little as possible in order to prevent the manifestation of out-of-the-loop-effects. This intervention strategy of the assistant system has been evaluated in a human-machine experimental campaign with pilots conducting simulated reconnaissance missions. This article presents quantitative results on the effectiveness of the intervention concept as well as a qualitative analysis and lessons learnt.

Head-worn displays for patient monitoring

Tsz-Lok Tang, Ismail Mohamed, Caitlin Browning, Birgit Brecknell, Penelope Sanderson
School of Psychology, The University of Queensland
Australia

In clinical contexts, clinicians often move away from stationary visual and auditory patient monitoring displays, and lose awareness of their patients' well-being. A potential solution is to provide clinicians with continuous patient information on a head-worn display (HWD). HWDs are suitable for clinical work environments because they move with the clinician and can be operated 'hands-free' while the clinician does other tasks. The HWD visual display should therefore capture clinicians' attention when needed. We investigated the effects of visual contrast and perceptual-motor task load on participants' ability to detect patient vital sign alerts on a HWD. Thirty-six non-clinician participants monitored the vital signs of six patients on a HWD with either high or low visual contrast alerts. They also performed a manual tracking task imposing difficult or easy perceptual-motor task load. Participants detected alerts significantly faster in the high visual contrast condition (1.9 sec) than in the low visual contrast condition (3.3 sec), and when task load was easy (2.3 sec) than when task load was difficult (2.7 sec). Higher levels of contrast on HWDs can help people detect alerts even while they perform another visual task, without resorting to auditory alerts. These results contribute to our understanding the kinds of visual displays that will be effective for HWDs.

Experimental Evaluation of a Mixed-Initiative Planning Associate for Multi-Vehicle Missions

Fabian Schmitt, Axel Schulte
Munich University of the German Armed Forces, Aerospace Engineering Department, Institute of Flight Systems Neubiberg
Germany

In this article we present our concept of a mixed-initiative planning associate system, as well as the experimental evaluation of a prototype. In future military applications, a single operator shall manage multiple unmanned systems from the cockpit of a manned aircraft. Critical mission situations involving mission re-planning may result in a significant increase in workload, including a loss of situation and plan awareness. In order to heal such unwanted states, we propose a mixed-initiative planning approach in which a pilot cooperates with a cognitive agent to (re-)plan missions on board. The implemented prototype of the associate system monitors the outside environment (i.e., the tactical situation), as well as pilot activities, and assists if required. The agent proposes future tasks, solves conflicts (which arise through e.g., pop-up threats, loss of resources), and helps optimizing a given mission plan. Thereby, interaction is mostly dialog-based. We conducted a series of experiments to evaluate effects (e.g., on workload, performance, complacency) the associate system had on pilots and their mission planning performance. The results prove the potential of the proposed approach. The proposed configuration could reduce workload and increase planning performance significantly.

Frequency and Variance of Communication Characteristics in Aviation Safety Events

Nektarios Karanikas, Steffen Kaspers
Aviation Academy, Amsterdam University of Applied Sciences
The Netherlands

In the aviation sector, communication problems have contributed into 70% to 80% of safety occurrences. However, to date we haven't depicted which communication aspects have affected aviation safety most frequently. Based on literature, we developed a tool which includes communication characteristics related to actors, signal, coder, channel, decoder, direction, timing, distance, predictability and interference. After achieving inter-rater reliability, the tool was used to analyse 103 safety investigation reports that correspond to events occurred in various regions and which included in total 256 communication problems. The results suggest that communication between humans and representation media, visual and audio signalling and decoding, air-transmitted messages, and verbal, unidirectional, local and synchronous communication contributed most frequently into safety events. Statistical tests showed that the frequencies of most of those characteristics were significantly different across regions, time periods, types of operations and event severity. The tool developed can be used by different organisations and industry sectors to distil and analyse data from mandatory and voluntary reports and identify weak communication areas. Depending on the findings, analysts might need to alert designers of technical systems, inform management of organisations, warn end-users about most frequent pitfalls, modify/enrich communication training and steer research efforts.

Neck muscle fatigue in military high performance aircraft pilots

Francesco Draicchio, Alessio Silvetti, Giorgia Chini, Marco Lucertini
Lab of Physiology and Ergonomic
Italy

In this study we present time-frequency parameters of the surface myoelectric signal for assessing neck muscle fatigue in military high performance aircraft pilots. (to be updated after permission of military authorities)

Conveying patient monitoring data to clinicians using time-compressed speech

Penelope Sanderson, SokYee Leong, Tsz-Lok Tang, Erik Wolf, Sara Klueber, Anna Hickling, Emilea Bell
The University of Queensland
Australia

Recently there has been concern about clinicians' failure to respond to medical equipment alarms. Field studies show that between 64%-99% of alarms do not indicate a patient state that requires intervention. If clinicians fail to respond, patients occasionally suffer serious harm. One way to improve outcomes is to increase the informativeness of alarms. Another way is to provide displays that give clinicians continuous but peripheral awareness of their patients' well-being. Over several studies, we have explored the potential for time compressed speech to give clinicians such awareness, without disturbing patients or their families. Trained participants can understand short time-compressed speech notifications of an individual patient's heart rate and oxygen saturation, achieving median accuracies of 96% (Leong, 2016). By contrast, participants unaware of the contents of the compressed speech can achieve median accuracies lower than 10% (Hickling et al., 2017). When the status of five multiple patients is conveyed through a series of time-compressed speech bursts, participants can accurately (86%) identify which three patients have abnormal vital signs, but accuracy of identifying vital sign values drops as the number of patients increases, due to working memory load. Overall, these results reveal a surprising potential for compressed speech for workplace notifications. We discuss potential applications of these findings to healthcare, and other contexts.

Behavioural and physiological non-technical skills assessment in simulated electricity distribution tasks

Fabrizio Bracco, Michele Masini, Donald Glowinski
Department of Education Sciences, University of Genova
Italy

Simulation has proved to be a useful method to improve learning and increase the safety of work operations in several domains (healthcare, road safety, etc.), both for technical and non-technical skills (NTS). However, the observation, assessment and feedback about these skills is particularly complex, because the process needs expert observers and the feedback is often provided in judgmental and ineffective ways during the post-simulation debriefing. In our research, we wanted to apply simulation to the electric domain as a new method to enhance the NTS and foster best practices. We developed and tested a set of observation and rating forms of the NTS behavioural markers of electric workers. In addition, we outlined the framework for observing behaviours based on non-verbal cues, like movement in the operational environment. The analysis of social signals and face-to-face communication patterns (e.g., kinesics, proxemics, interpersonal synchronization), could be combined with performance metrics (e.g., feedback on the NTS, self and peer assessment of performance efficiency, etc.). By automatically quantifying human behaviour using wearable and non-invasive sensors, we can find relationships between sensor data and team performance and thus identify optimal behaviour patterns that would lead to improved and safe performance.

A new nuclear safety guide: A comparison of designers' and users' priorities

Julie Albentosa, Anaïs Nouailles-Mayeur, Françoise Darses, Anthony Vacher
Action and Cognition in Operational Situation Department – Safety of At-Risk Systems Unit/French Armed Forces Biomedical Research Institute
France

Safety rules (laws, guides, policies, procedures, etc.) remain a key component of safety management in at-risk systems. The design of these rules is a challenge for both regulatory bodies and regulated industries. A principal issue that users encounter seems to be attributable to how the rules are designed. Our study focused on the design process for a new nuclear safety guide. Seventeen stakeholders, divided into 2 groups: 8 designers (working for the French Nuclear Safety Regulatory Body) and 9 user representatives (working for various electricity providers) participated. The aim was to compare their points of view regarding the contents of a new safety guide. First, the user representatives group evaluated the guide, highlighting areas where they believed it was inconsistent with their tasks, and identified 28 issues (discrepancies in terminology, lack of detail, etc.). Next, both groups were asked to assess: (i) the importance of these issues, and (ii) whether they would be taken into account in the process of designing the new guide. The results highlighted areas of agreement and disagreement between the two groups. These findings may help to target areas where improvements can be made in the design of nuclear safety rules.

Effects of Cognitive fatigue on the human resilience

Mick Salomone, Bruno Berberian, Colin Blättler, Boris Burle, Ludovic Fabre
French Air Force Research Center, The French Aeropace Lab ONERA
France

Fatigue is always present at work. Contrary to sleepiness effects on performance, less is known about cognitive fatigue (CF) effects. This study aimed at furthering our understanding of CF effects, notably on a second task. To induce CF while alleviating limitations associated with long tasks, participants performed for twenty-four minutes the TimeLoadDuck paradigm (Borragan et al., 2017), a dual task in which levels of cognitive load induced were high (HLC) or low (LCL) and adjusted individually. Then, they performed a second TLDB for ten minutes while cognitive load was lower than the first task and equal for the two groups. In the first task, the subjective feeling of CF increased similarly in the two conditions while the feeling of sleepiness increased only in the LCL condition. Accuracy was better for the LCL condition suggesting higher CF in the HCL condition. Interestingly, while accuracy decreased for the two groups, only participants in LCL condition improved their performance, which returned to its initial level after the decrease. On the second task, participants in the LCL condition were able to improve their performance whereas the performance of participants in the HCL condition decreased. Improving and maintaining performances depend on the type of CF.

German Non-professional vs. Professional Drivers' Driving Anger Experience and Expression – Validation of Measures and Cross-cultural Comparison

Michael Oehl, Stefan Brandenburg
Leuphana University Lueneburg
Germany

Driving anger is related to aggressive driving behaviour and a higher rate of traffic accidents. Numerous studies assessed driving anger in countries all over the world. To date, no study has examined in depth Deffenbacher's concept of driving anger in Germany as well as the applicability of his internationally widespread measures for driving anger, i.e., the Driving Anger Scale (DAS) and the Driving Anger Expression Inventory (DAX). Our current study fills this gap. We measured driving anger experience with the DAS and driving anger expression with the DAX of non-professional car drivers vs. professional taxi drivers. Confirmatory factor analysis showed that the model fit of the assessment of driving anger was better for the sample of non-professional drivers. Non-professional drivers experienced significantly more driving anger, but professional drivers expressed more driving anger. Additionally, professional drivers reported less non-driving related anger experience, but here both groups did not differ in terms of non-driving related anger expression. We conclude that Deffenbacher's concept of driving anger does only apply to non-professional German drivers. We made modifications of the measures for professional drivers. Moreover, cross-cultural differences in driving anger between German drivers and drivers from other countries were visible and will be discussed.

Change of perspective approach to Hazard Prediction assessment and training: The first study.

Candida Castro, Pedro Garcia-Fernandez, Andres Gugliotta, Eduardo Eisman, Petya Ventsislavova, Jose Luis Padilla & David Crundall
CIMCYC (Mind, Brain and Behaviour Research Centre)
Granada
Spain

For a holistic understanding of the traffic situation, it is important that both the driver and other road users comprehend how all other road users will act. We therefore believe that training that manages to put the driver in the shoes of other users (as actor-observer) will enrich their awareness of hazardous situations that could arise, thus avoiding modal biases that might contribute to accidents. This first study aims to ascertain whether Perception of Traffic Hazards improves with holistic training in the global understanding of traffic situations, training in hazard perception from the various different perspectives of road users. A new traffic perception test with submodules of videos recorded from the perspective of the driver, pedestrian and cyclist was developed. Moreover, the effect of training from a change of perspective was analysed. The results are discussed in order to evaluate whether: A) A better understanding of the global traffic situation brings a better perception of the danger and B) A global understanding of the situation could be another means of evaluation for acquiring a driving licence and a psychotechnical assessment. C) The effect of this training in Hazard Perception is sensitive to gender, age, driver experience or profile.

Activating illumination at the flight deck - a new way to reduce pilot fatigue during night-time?

Maximilian Peukert, André Wiggerich
TU Dresden
Germany

Fatigue among airline pilots leads to severe cognitive and psychomotor performance decrements, and is linked to a higher rate of aircrew errors. Among others, the dimmed cockpit lighting during night time seems to be an important contributor in causing fatigue. Recent results suggest that an increase in illuminance can lead to higher psychophysiological activation and lower fatigue. This study attempted to investigate to what extent an activating illumination on the flight deck can decrease fatigue and increase performance. Nineteen subjects conducted simulated night flights, once with standard and once with activating illumination (intensive light [320lx] and blue enriched [460nm]). Aside from subjective fatigue and perceived well-being, we examined situational awareness and flight control accuracy. With activating illumination, reduced subjective fatigue, increased well-being, as well as improved situational awareness and psychomotor performance were found. These findings suggest that a notable increase in illuminance had an activating effect on subjects. Therefore, we conclude that activating illumination on the flight deck has the potential to reduce fatigue and increase performance on night flights, thereby contributing to aviation safety.

The Future of Real-Time Control Room Simulation

Hugh David
R+D Hastings
United Kingdom

This poster sketches the probable future evolution of Control Rooms, and the consequent development of Real-Time Simulation. The problems of current simulations are discussed, and the current development of standardised control rooms is illustrated (Paired operators, Common large display, ISO 11064 standard furniture). The increased modularisation of control software, the trend towards supervisory rather than 'hands-on' control, Integration of data sources, pro-active displays, 'emergency' displays and the role of 'artificial Intelligence' suggest that there will in future be a large number of simulators integrated into existing control rooms, using field specific data and generalised recording, simulation, replay and analysis modules to maintain/restore skills, practice emergencies, for adaptation and mentoring and for examining 'incidents'. There will also be a few very generalised simulators, capable of simulating control rooms in air, rail, road electricity, oil and gas networks, using. These will be use the same modular programs, with field specific data to replay site recordings or generate simulated situations, for training, particularly before a new installation, validation of changes to procedures and equipment, development, forensic investigation, where the actual control room is destroyed or unavailable, or even for sales. (poster previously presented at CIEngHF 2016 conference, Daventry, UK)

User-Centred Evaluation of Medical Software: Developing a Multidimensional Questionnaire for Medical Professionals

Bettina Seifert, Michael Minge, Anna-Maria von Saucken, Manfred Thüring
Technische Universität Berlin
Germany

As part of a user-centred design approach, usability measures play an essential role in the development process of interactive systems. For medical technologies, this process is regulated by the ISO 62366. However, in practice, numerous cases of usage errors and usability problems with medical software are reported (e.g., Seyffert et al., 2011; Schubert et al., 2013). Standardized instruments, such as quantitative questionnaires, are a valuable tool to compare different implementation concepts and to evaluate design improvements from a user's point of view. Therefore, we aimed at developing a standardized questionnaire that covers relevant aspects of medical work systems in a comprehensive way. Based on the review of existing questionnaires, theoretical assumptions, and contextual interviews, an initial pool of 94 items was generated. In the evaluation phase, 133 medical professionals were instructed to rate a known software for therapeutic and/ or diagnostic purposes. The data was used to select items and to explore the factorial structure with a Principle Component Analysis (PCA). The resulting questionnaire consists of 43 items measuring eleven dimensions which refer to goal achievement, safety, comprehensibility, comparability, work processes, alarms, feedback, teamwork, aesthetics, emotions, and skill awareness. All scales show very good reliability with high Cronbach's Alpha values.

A study on the factors that contribute to the practice of organizational behaviour as coping with unexpected events - Exploration of the factors through the case survey of the Great East Japan Earthquake

Kenichi Hayase
Human Factors Research Center, Nuclear Technology Research Laboratory, Central Research Institute of Electric Power Industry
Japan

In the organizations in the face of unexpected events in the 2011 Great East Japan Earthquake, the organizational behaviour which was coped with by their members was seen. It is important to prepare emergency that the backgrounds of those organizational behaviour were understood. This study aimed to explore the factors that contribute to the practice of organizational behaviour as coping with unexpected events through the case survey of the Great East Japan Earthquake. This study carried out literature survey and interview survey of personnel in charge of disaster prevention, BCP in the 10 organizations which coped with the earthquake. As the result, the following two outcomes were obtained. 1) Factors that contribute to the practice of the 13 kinds of the organizational behaviour were clarified. 2) Discussion from the view point of the factors classification indicated the importance of the factors which are classified into normal business and features of organization.

Rapid Serial Visual Presentation: Degradation of inferential comprehension as a function of speed

Francesco Di Nocera, Orlando Ricciardi, James F. Juola
Department of Psychology, Sapienza University of Rome
Italy

There is increasing interest in the readability of text presented on small digital screens. Designers have come up with novel text presentation methods, such as moving text from right to left, line-stepping (scrolling text up one line at a time), or showing successive text segments such as phrases or single words in a rapid, serial visual presentation (RSVP) format. Comparative studies have indicated that RSVP is perhaps the best method of presenting text in a limited space. Recently, a technical innovation, called Spritz, was designed to be a near-optimal RSVP method at high word per minute (wpm) rates. We tested the method using 209 participants divided into six groups. The groups included traditional reading, and RSVP reading at rates of 250, 300, 350, 400, and 450 wpm. The results showed no significant differences in comprehension for normal reading (78.2% correct) and RSVP reading at rates of 250 and 300 wpm (77.0% and 74.0%, respectively). However, higher rates produced significantly lower comprehension scores, 72.2%, 68.2%, and 67.6% for wpm rates of 350, 400, and 450, respectively. It remains to be determined if, with additional practice and improved methods, good levels of reading comprehension at high rates can be achieved with RSVP.

Ambient Light Display - Light based HMI for automated driving

Marc Dziennus, Johann Kelsch, Anna Schieben
German Aerospace Center (DLR)
Germany

The poster presents results of a simulator study testing a novel HMI for automated vehicles. Vehicle manufactures are ready to implement the first generation of automated driving on public roads. Automated vehicles will enable drivers to perform secondary tasks while the automation is controlling the vehicle. However, the current generation of sensors will not be good enough to handle all kinds of traffic scenarios. Therefore, there might be situations in which the driver needs to monitor the automated vehicle control (transition from SAE level 3 or higher to SAE level 2). For this monitoring task the driver needs to build up a good situation awareness to understand and judge the automation behaviour and intervene if the automation behaves inappropriate. To support the driver we tested a 360° LED Ambient Light Display to present information about the current automation level and objects detected by the automation. The poster presents the results of a simulator study with 40 participants tested in a between-subject design who experienced different interaction designs. The results indicate that additional information regarding objects detected by the automation is beneficial for building up a better situation awareness and support drivers in understanding and foreseeing the behaviour of the automation. This results in faster reaction times of the driver in case of an automation failure.

Predicting driving cessation in patients with cognitive impairments

Dafne Piersma, Dick de Waard, Anselm Fuermaier, Ragnhild Davidse, Ruud Bredewoud, Wiebo Brouwer, Oliver Tucha
Department of Clinical and Developmental Neuropsychology, University of Groningen
The Netherlands

Background: People tend to outlive their fitness to drive related to health problems of old age, in particular cognitive impairments. Even though driving cessation may be important for personal and public safety, it may also lead to a reduced social network, lower activity levels, and faster health decline. For individuals, it is difficult to decide when it is time to cease driving. Objective: The aim of this study is to predict driving cessation of patients with cognitive impairments. Methods: Patients with cognitive impairments (n=167) received driving recommendations after a fitness-to-drive assessment and were followed up around seven months later. Binary logistic regression analysis was used to determine which personal, interpersonal, and environmental factors predicted driving cessation. Results: The factors that contributed significantly to the prediction were gender, Clinical Dementia Rating-score, health decline, and recommendations of driving cessation. Conclusion: Patients with cognitive impairment were more likely to cease driving if they were recommended to cease driving, were female, and had relatively severe cognitive impairment and/or pronounced health decline. The importance of both health problems and driving recommendations implies that physicians should discuss driving cessation with patients with cognitive impairments.

Predicting the Optimal Time for Interruptions by Pupil Dilation Data

Hagit Shaposhnik, Jelmer P. Borst, Niels A. Taatgen
Institute of Artificial Intelligence (ALICE), University of Groningen
The Netherlands

Nowadays, we are often interrupted. Especially interruptions in the middle of a task are known to have considerable performance costs. Our goal is to develop an algorithm for an interruption management system that will determine the best moment to present interruptions to minimize the attentional cost. To this end, we developed a simulated Air Traffic Control task, and to determine workload we measured pupil dilation. In the experiment, we manipulated working memory (WM) across three conditions: no WM, passive WM, and active WM. In the no WM condition participants did not have to memorize anything. In the passive WM condition, they had to memorize the altitude of several planes. In the active WM condition, participants also had to memorize the altitudes, but now planes could also leave and enter the airspace resulting in updates to WM. Results showed that no WM led to the least dilation, followed by passive and active WM. The next step is to train our algorithm to schedule interruptions at opportune moments during an ongoing task.

Effects of taking drivers' hands off the steering wheel on manual control recovery from highly automated vehicles

Genya Abe, Kenji Sato, Nobuyuki Uchida, Makoto Itoh, Dick de Waard
Japan Automobile Research Institute
Japan

Increased vehicle automation is becoming a reality. For the time being, it still is crucial for human drivers to be able to appropriately resume control of the vehicle when the limits of system functioning are reached. The aim of this study was to shed more light on the effects of taking the hands off the steering wheel while driving automatically on manual control recovery. A driving simulator with thirty-two participants was used to study this. Manual control recovery due to the limits of system functioning occurred in two different types of time critical situations. In one situation a bicycle suddenly cut an automated vehicle off, inducing the collision between the two vehicles (high time criticality). In another situation a strong crosswind induced a lane departure (low time criticality). Drivers' reactions at the limits of system functioning were tested under the two conditions such as hands-on and hands-off driving modes. As expected, compared to hands-off driving hands-on driving led to faster take-over of control and resulted in a more stable lateral position. In high time critical situations this effect was stronger than in low time critical situation.

Development of a driving simulator with eye-tracking functionality to assess driving fitness for visual field defect patients

Junpei Kuwana, Makoto Itoh, Hiroshi Ono, Shiho Kunimatsu-Sanuki
SoftEther Corporation
Japan

In this study, we developed a driving simulator with an eye-tracking device to assess driving fitness for visual defect patients. The driving simulator logs driving behaviour and eye movements of the drivers (patients). With this setup we are able to assess the effects of visual field defects when driving hazards are present. The data of driving behaviour are combined with data of the eye tracking device. Additionally, this driving simulator has fixed type eye-tracking device to analyse the driving fitness automatically. A wide screen is necessary to assess the effect of the visual field defects. However, fixed type eye-tracking device usually supports only a small screen. Hence, to get good accuracy of eye-tracking results, the eye-tracking system of the driving simulator calibrates only necessary parts of the screen for driving and has an accuracy check process after the calibration.

To cope with unknown problems, performance and metacognition of collective decisions

Damien L'Haridon, Laurent Chaudron, Yves Gourinat, Anne-Lise Marchand
Centre de Recherche de l'Armée de l'air
France

Operational and extreme environments may imply to cope with unknown problems (neither expected nor lived) despite the highest level of training experts have. Apollo 13 is a major example. This PhD's goal is to evaluate the influence of the two year French air force academy's training (military exercises, engineer courses, traditions, boarding school, etc.) on teams' performance (quantitative approach) to resolve unknown problems. The aspect of metacognition is more precisely studied (qualitative approach). The hypotheses deal with the gains of the two year training. First, a team living together this training is more efficient in resolving an unknown problem. Second, a team living together diversified and with quality experiences develops metacognitive knowledge and skills and, third, these metacognitive knowledge and skills are useful to cope with unknown problems. Fourth, the study of metacognitive clearness permits to target an optimal value of the metacognitive phases' mixture. Thus the creation of a two year protocol, it is called LETUCA for longitudinal evaluation of teams via unknown and collective activities. Three teams take part to this protocol. Two teams are composed by students, one performs all the air force training together and the other one performs the same training but separately. The last team is built by service women and men without any relationship with one another.

Effects of different level of automation on responsibility feelings and cross-checking behaviour

Helene Cymek, Dietrich Manzey
Technische Universität Berlin
Germany

This study focuses on two forms of human automation collaboration that differ with respect to whether the human needs to confirm or reject actions of an automation or just vetoes when the human believes an action is inadequate. Thirty-four participants performed a paradigm that mimics basic tasks of a control room operator in a chemical plant. The paradigm features three concurrent tasks of which one is the supervision of a highly reliable and autonomously running process. Half of the participants worked with a version in which they permitted or rejected each action proposed by the automation before it was initiated. The other half worked with a version in which they accepted an action proposed by the automation by default. In the latter case, operators had a predefined time to veto a planned action, before it was executed autonomously. We expected a decreased feeling of responsibility, a less precise automation cross-checking behaviour, and more missed automation failures in the group that worked with the default confirmation. Our results will be discussed in view of default option effects on choice, the causal discounting principle and the first failure effect.

Maintain of Basic flight skills during real flight interruption: the effects of glider training simulation

Thomas Bernadou, Colin Blättler, Ludovic Fabre
French Air Force Research Center (CReA)
France

According to the European Gliding Development Association, the number of pilot licensing has decreased in the last decade. The duration of the training depends on the weather and then many interruptions could be observed. The present study aimed at testing maintain of flight skills on a flight simulator and the transfer of skills. In order to find the skills that could be trained on flight simulator, 25 ab-initio student pilot of the French air force academy has been tested in a first experiment. Results showed two types of skills: the basics (e.g., pitch) and the complex ones (coordination of basic competences). Moreover, only complex skills seemed to be affected by the interruption of training. In a second experiment, we tend to test the complex skill transfer, trained in a flight simulator, in real flight. In this vein we split a pilot entry following the same training in two groups. During an interruption one went through flight simulator sessions and the other did not (control group). We hypothesized that flight skills for the flight simulator group would improve along the experiment. Moreover the simulator group would have better real flight performances than the control group.

Speed choice as a trade-off between time pressure and driving task complexity

Anne Goralzik, Mark Vollrath
Technische Universität Braunschweig
Germany

Drivers' choice of speed has been argued to be the result of a conflict between the motivations to make progress and to avoid collisions. Understanding which driving situations give rise to the motivation to drive faster rather than slower has important safety implications. Therefore, the objective of this study was to investigate how time pressure and the complexity of the driving task affect speed. Sixty-four participants completed a set of four distinct simulated driving scenarios embedded in an urban residential district with a 30 km/h speed limit. Road geometry and behaviour of other road users were varied as different levels of task complexity to manipulate the demands on drivers' information processing and vehicle operation. Half of the participants drove under time pressure while the other half did not. As expected, time pressure increased speed while an increase in task complexity led drivers to reduce speed. However, drivers under time pressure failed to reduce speed enough so as to match speed levels of drivers not under time pressure. Also, time pressure produced greater speeding for a longer period of time regardless of task complexity. These results indicate that drivers accept some loss in safety in exchange for a timely arrival.

Autostereoscopic 3D displays for in-vehicle applications

Andre Dettmann, Angelika C. Bullinger
Chemnitz University of Technology
Germany

Novel technologies like autostereoscopic 3D displays are providing better user performance in recognizing and classifying on-screen objects as well as enabling better judgements of positions and distances. Those features, if implemented user-friendly into Advanced Driver Assistance Systems (ADAS) or In-Vehicle Information Systems (IVIS), can increase the effectiveness of such systems. They allow a better understanding of complex user interfaces and are capable of lowering the total eyes-off-road time and therefore, benefit towards traffic safety. The study examines the technology with regard to in-vehicle applications with their special requirements and influence on human factors. We present a study with 40 participants judging the criticality of an intersection manoeuvre in a simulated traffic environment. Two cars approached an intersection with time-to-intersection values ranging from highly critical to non-critical situations (0.3 – 2.0 seconds). All manoeuvres were presented randomly on an autostereoscopic and a non-stereo display using a between study design. Data from visual function and fatigue questionnaires as well as socio-demographic data were collected. Results show, that 3D displays enable a better judgement of positions in simulated traffic situations. Also visual fatigue seems to be unproblematic regarding 3D displays despite a long exposure time. To conclude, a suitability for ADAS/IVIS applications is demonstrated.

Finding your way: investigating tourists' attitudes toward paper-based and smartphone-based urban maps

Valeria Orso, Alice Bettelli, Luciano Gamberini
Department of General Psychology, Padua University
Italy

Tourists typically employ maps for finding their way towards relevant landmarks when exploring a new city. Traditionally, this has been accomplished using paper-based maps, but recently, thanks to the advancement of mobile technology, users are increasingly relying on smartphone-based maps. The aim of the present study is to assess users' attitudes towards paper-based and smartphone-based urban maps. Participants are asked to reach a predefined landmark through a prefixed touristic itinerary. They have at their disposal both the paper- and smartphone-based map, each providing a slightly different route (yet equal in terms of travel time and length). More specifically, directions provided by the two supports are consistent up to a fixed point and then they become incongruent until the landmark is reached. Participants have to choose which route to follow. Despite the data-collection is still ongoing, preliminary data, comprising post-experience questionnaire, semi-structured interview and video-analysis, suggest that both supports are considered credible and reliable by users, nevertheless they were more prone to rely on the directions provided by the smartphone-based map. Participants motivated their choice referring mainly to the convenience of the location-based indications and the familiarity with the device.

Naturalistic Study of PC Mouse Usability

Denis Coelho, Miguel Lourenço
Universidade da Beira Interior
Portugal

An uncontrolled study was set up in a course setting. Thirty third year undergraduate industrial design students participated for course credit. Standard graphical tasks were generated through a dedicated software application. Subjects used their own pointing device, plus the pointing device of two other subjects. Efficiency in pointing device use was calculated within each small group of 3 to 4 subjects setting. The hypothesis behind the study is that subjects attain higher levels of efficiency in standard pointing and dragging tasks, with the use of their own pointing device, and that there is a degradation of efficiency when they switch to other devices, that might have the same archetype, but different dimensions and shape details, as well as activation thresholds. The analysis investigates the particular cases where the hypothesis is not verified by the results. Based on literature review, and prior experimental results, authors suggest tentative explanations to support the understanding of subjects' improvement in efficiency when changing to unfamiliar pointing devices. The discussion points at the familiarity with the tasks and the familiarity with the devices as a potential motivator for the efficiency gains observed that do not comply with the stated hypothesis.

Practice makes perfect - driving experience with a multi stage warning system

Susann Winkler, Juela Kazazi, Mark Vollrath
Technische Universität Braunschweig
Germany

Drivers have to master various critical situations in everyday road traffic without resulting in accidents. Driver assistance systems like collision warnings are to support them in this. Contrary to most research this driving simulator study used a multi stage collision warning system, which adapts its output according to the drivers' behaviour and the currently critical situation in two warning stages (W1 – warning and W2 – urgent warning), and examined it in diverse critical situations instead of one very specific use case, while also regarding possible learning effects. The driving behaviour and subjective evaluations of twenty-four participants were measured in order to analyse whether and how much the drivers benefit from the system over partially repetitive trials of various critical situations, including a baseline drive without assistance and a transfer drive with completely new situations. The scenarios differed in their criticality as intended. The brake reaction time varied significantly over the trials and situations. The drivers benefited from the assistance and learned to react faster, while being able to transfer their system experience onto new situations. As the multi stage collision warning system was also well accepted by the drivers it can be recommended. Assistance training might maximize its benefit.

Impulsivity modulates pilot decision-making under uncertainty

Julia Behrend, Frédéric Dehais, Etienne Koechlin
Laboratoire de Neurosciences Cognitives, ENS, INSERM, PSL Research University, Paris
Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse
France

The ability to decide flexibly and to adapt to uncertain environments is the distinctive element of human intelligence. Impulsivity is a personality construct that describes a tendency to act rapidly with less forethought. This study shows data of forty airline pilots who responded to uncertain landing decisions in a questionnaire. We used the Barratt Impulsiveness Scale (BIS 11-; Patton, Stanford & Barratt, 1995) to assess their level of impulsivity. Pilots scored lower on the BIS than healthy controls or normative data (Spinella, 2005). Pilots, who expressed their indecisiveness at least once, had a significant lower motor impulsivity score than decisive pilots with a consequent action plan for every landing decision. Pilots with higher attentional impulsivity were more likely to change the current action plan. By contrast, technical aspects, such as flight experience, hierarchy or age, had no significant impact on pilots' response behaviour to uncertainty. Although previous research has emphasized the pathological character of impulsivity and its negative consequences on decisions, our study sheds light on the adaptive trait of impulsivity.