

Europe Chapter  
conference



Leeds, UK



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===== ORAL PRESENTATIONS =====

### Session 1: Automation / Situation Awareness 1

#### **Developing a method for measuring Situation Awareness in rail signalling**

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Situation awareness (SA) has previously been identified as an important factor in rail control, and quantifying SA may be a useful approach in the design of new rail control systems, procedures and training. Theoretical accounts of SA, and specific examination of rail signalling, suggests a critical role for distributed cognition. In order to reflect this, a rail signalling SA measure was developed based on SPAM (Situation Present Assessment Method) - an approach that allows the operator / participant to draw on the display during queries. This paper reports a trial of such a method with experienced signallers in a simulation environment. The trial found that factors such as identifying appropriate queries, timing the presentation of queries so that they were non-trivial, simulation realism and identifying an appropriate independent variable were all issues in the effective implementation of the method. While it may not be possible to detect subtle factors such as the state of working memory, the trial suggests this approach could be developed to capture more gross distinctions, such as the influence of workstation layout and operator strategy. Practical and theoretical implications are discussed.

#### **Connect 4? The compatibility of driver, motorcyclist, cyclist, and pedestrian situation awareness**

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Situation awareness (SA) is a critical commodity for road users, with poor SA, or components of it, having previously been identified as key causal factors in road accidents. This paper describes an on-road study conducted to explore the nature of, and differences between, different road users SA, and how the road system currently augments the SA development and maintenance of its different road users. 20 participants (5 drivers, 5 motorcyclists, 5 cyclists, 5 pedestrians) took part in the study, with the drivers/motorcyclists/cyclists negotiating the same pre-defined route in an instrumented vehicle (i.e. car/motorbike/bicycle depending on road user group), and the pedestrian group negotiating a series of pedestrian crossings along

the route on foot. All participants provided verbal protocols throughout and were subject to a post trial critical decision method interview. The propositional network methodology was used to model each participants SA and network statistics were used to analyse the structure and content of participants' SA networks. The analysis revealed key differences both in the content (i.e. information/knowledge underpinning SA) and structure (i.e. connectedness of information) of each road user groups' SA. Further, aspects of the road system where different road users SA development and maintenance is not supported were identified.

### **Varying the degree of shared control between drivers and steering automation**

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Sharing control between drivers and steering automation aims at facilitating lane keeping for improved safety and comfort. Based on the preview of road curvature, the system applies a torque on the steering wheel to provide haptic guidance to the driver. A crucial point is to determine what would be the optimal level of steering assistance for a good cooperation between drivers and automation. The present simulator study investigated the effects of 5 degrees of shared control on the torque applied by the drivers on the steering wheel, trajectory profiles and various subjective indicators. In addition, the road scene visibility was manipulated (good visibility, fog, and visual demand). In the visual demand condition, a transient view (1s) of the road was available when the driver asked for it by pulling the wiper handle. Self-reported sense of comfort and safety were rated higher when drivers and automation applied comparable torques on the steering wheel. For this degree of shared control, a reduction of visual demand was observed. Shared control similarly reduced lateral position variability when driving with and without fog. Higher degrees of shared control did not yield higher benefits. These results will be discussed in relation to current approaches of man-machine cooperation.

### **HMI Efficiency of an ADAS with Longitudinal Guidance during System Failure**

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As the traffic volume in Europe continues to rise, the benefits of mobility are accompanied with negative aspects such as road accidents. To improve traffic safety Advanced Driver Assistance Systems (ADAS) are being developed. They change the drivers' role from active driving to system observing. Because a technical system will never be 100% reliable, the focus shifts to the drivers' abilities to intervene in case of system errors or failures. A similar study conducted in 2009 (Niederée & Vollrath) showed that with increased system reliability drivers had more problems detecting system failures and reacting to them adequately. Consequently solutions to support the driver in detecting system failures early and reacting adequately are needed as a step to autonomous driving.

The on-going study examines the influence of three different Human Machine Interfaces (HMI) and two interaction strategies of an ADAS on driving performance. The ADAS provides speed control. The interfaces should improve the drivers' abilities to detect system failures and react appropriately. Driving performance, gaze behaviour and questionnaire data will be analysed. 72 drivers participate in the study. Based on the results of this study, the efficiency of HMI strategies for driver support when monitoring an ADAS interface will be discussed.

## **Session 2: PIE- Psychophysiology in Ergonomics**

### **Effects of a sleep cycle based temperature control on sleep quality**

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Nine male participants were instructed to live regularly for one week before the experiment and sleep in a sound proof room for six nights successively after that period. The first three nights were spent for the adaptation of the experimental settings. The baseline room temperature was set by the declaration of each participant. A unique sensor installed between a mattress and a bed detects body movements and heart beats during a sleep. These data were used to identify each participant's sleep rhythm. The temperature was set to the constant baseline degree in the control condition (CTRL). On the contrary, the temperature was shifted up by 1 degree from the baseline during REM stages in the experimental condition (EXP). A polysomnographic (EEG, EOG and EMG) evaluation of sleep quality was done. Subjective feelings of thermal sensation and subjective sleep quality indexes were obtained also. In results, % stage I was significantly smaller and the percentage of slow wave sleep plus REM sleep was significantly larger in EXP than CTRL. These results suggest that the temperature control based on sleep cycle provides a better sleep quality even though the subjective sleep quality indexes show no significant difference between two conditions.

### **Linking brainwaves to mental effort in a driving simulator; developing criteria for an interactive human-machine feedback loop**

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Finding appropriate measures to trigger machine changes in an adaptive system remains a huge challenge in the field of adaptive automation. Trigger candidates include the alpha, beta, and theta frequency bands of the EEG. These measures have been linked to mental effort and could therefore potentially be used in an adaptive control loop aimed at keeping mental effort investment high enough to prevent boredom related problems yet low enough to prevent overload related problems. Both of these unwanted states of mental effort are relevant for the driving task and may be viewed as a predictor for unsafe driving. When driving, task demands and mental effort investment may be regulated by changing driving speed. This could be handled by a biocybernetic system monitoring mental effort investments. To explore which EEG locations (8) and frequency bands (5) are most informative for such a system, drivers were exposed to a range of driving speeds, relative to the driver's preferred speed, in a rural environment during a pilot study. Results indicate that an increase in speed is accompanied by a linear increase of subjective mental effort while lateral vehicle control deteriorates. Speed effects on EEG measures are diffused across locations and frequency bands, although within subject contrast revealed a linear power decrease with speed increase for all affected EEG measures. It is concluded these observations are promising for using EEG measures of mental effort in an implicit closed-loop biocybernetic system.

### **The influence of music on cardiovascular responses on anger while driving**

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It has been proposed that the impact of negative emotions, such as anger, on physiological markers may be moderated by exposure to music - particularly music forms known to reduce physiological activation and prompt the experience of positive valence. A study was conducted where five groups of participants (N=100) performed a simulated car journey. Four groups were exposed to music with different affective properties: high activation/positive valence (HA-PA), high activation/negative valence (HA-NA), low activation/positive valence (LA-PA)

and low activation/negative valence (LA-NA). A fifth control group were included who were not exposed to music during the simulated journey. All participants were instructed to complete a simulated journey to a deadline; anger was induced by exposing them to sustained delays due to stationary traffic and driving violations were coupled to monetary punishments. A range of cardiovascular measures were collected, including blood pressure, heart rate and indices related to impedance. It was found that systolic blood pressure during stationary traffic was reduced for HA-PA, LA-PA, LA-NA compared to HA-NA and the control group. Effects on cardiovascular impedance will also be discussed with reference to previous research. Taken together, music can reduce/prevent anger induction and physiological stress during anger provoking journeys.

### **A Phonetic Approach for Detecting Sleepiness from Speech in Simulated Air Traffic Controller-Communication**

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The aim of the study was to develop a phonetic based instrument to estimate sleepiness within Air Traffic Controller-Communication. Many efforts have been reported in the literature for measuring sleepiness. But these electrode- or video-based instruments still do not fulfil the demands of an everyday life measurement system. The major drawbacks are (a) a lack of robustness against environmental and individual-specific variations (e.g. bright light, wearing correction glasses, angle of face or narrow palpebral fissures) and (b) a lack of comfort and longevity due to electrode sensor application. Sleepiness related cognitive-physiological changes like decreased muscle tension or reduced body temperature can indirectly influence voice characteristics at the following stages of speech production: (a) Cognitive speech planning, (b) respiration, (c) phonation, (d) articulation/resonance, and (e) radiation. In this study we recorded 475 speech samples of simulated Air Traffic Controller-Communication from N = 86 participants. We conducted a within-subject partial sleep deprivation design (20.00 - 04.00 h). During the night of sleep deprivation a well established, standardized self-report sleepiness measure, the Karolinska Sleepiness Scale (KSS; scores range from extremely alert (1) to extremely sleepy, cannot stay awake (10)), and a KSS Observer Scale (used by two experimental assistants rated each time just before the speech recordings) was applied to determine the sleepiness reference value (ground truth), which was further used for machine modelling purposes. The 170 phonetic features which have been computed partially represent auditive-perceptual concepts of prosody (pitch, intensity, rhythm, pause pattern, and speech rate), articulation (slurred speech, reduction and elision phenomena), and speech quality (breathy, whispery, tense, sharp, hoarse, or modal voice). Several acoustic features show significant correlations to KSS ratings, e.g. lower intensity variation (standard deviation of intensity,  $r = -.42$ ), a monotonous speech-pause rhythmicity in sleepy speakers (shorter voiced segment duration,  $r = -.45$ , less variation in the length of voiced segments,  $r = -.46$ ). Applying a simple linear regression method using a 10-fold crossvalidation protocol reaches  $r = .67$  and a mean absolute prediction error of 1.13 KSS-Points.

## **Session 3: Aviation**

### **Controller-Pilot Communication in a Multiple-Airport-Control Scenario**

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In a future remote airport traffic control centre, a single air traffic controller will be responsible for the management of several small airports at the same time during times of low traffic volume. The increased complexity of such a multiple-airport-control scenario certainly requires major changes of many well established routines and procedures. An example is the controller-pilot communication via voice radio. Today, controllers and pilots within a given sector exchange information over a shared radio frequency. The so-called "party line" allow pilots to overhear both their own conversations as well as those of the other aircraft tuned to the same frequency. In a multiple-airport-control situation this practice may lead to problems both from the controllers' and the pilots' perspective. In a first empirical study, participants were asked to manage three airports simultaneously using two different design options for the communication environment. Reaction times, error rates and subjective workload ratings were collected as dependent variables. Results of the study will be presented and discussed with respect to their impact on the design of the communication environment from the controllers' point of view. In addition, the implications of these findings for a second experimental study considering the pilots' perspective will be addressed.

### **Air Traffic Controller Assistance Systems for Attention Direction: Comparing Visual, Auditory, and Tactile Feedback**

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Modern aircrafts have the capability to perform fuel-efficient and noise-reduced continuous descent approaches (CDA). A major obstacle to use these capabilities for approaching an airport is the synchronization of CDA-traffic and conventional non CDA-traffic. By developing assistance systems to direct the attention towards relevant events, air traffic controllers are supported when merging both aircraft streams. This leads to a complexity reduction of the information gathering process. Visual, auditory and tactile assistance systems were implemented in a microworld simulation. 55 participants had to merge CDA and non CDA-traffic, shortly before landing. The participants controlled the non CDA-traffic via radio, while monitoring the CDA traffic at the same time. Whenever a CDA airplane passed a critical waypoint, a visual, auditory, or tactile feedback was given to the participant to maintain a sufficient level of situation awareness. Visual feedback was presented via aircraft label blinking; auditory feedback was given via radio and tactile feedback was given via a vibrotactile feedback device attached to the wrist. The results indeed indicate that additional feedback about the CDA traffic has a positive effect on the visual attention and the situation awareness.

### **The Eurofighter Typhoon Cockpit Assessment Process**

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Since the early days of the Eurofighter Typhoon, Human Factors has had a major part to play in its development. Initial mission analyses, an ergonomics handbook and principles of cockpit design informed the early cockpit layout and philosophy and today's current processes still rely on these alongside HF specialists working together with engineers and the end users in order to provide a platform that is both highly usable and operationally effective. Cockpit Assessments (CA) continue to be an integral part of the design cycle and are carried out regularly as a de-risking exercise in order to allow aircrew to review and comment on the

proposed design whilst also allowing Cockpit Group the opportunity to collect data prior to design freeze. A variety of assessments are carried out by Cockpit group so as to evaluate such issues as layout, lighting and the moding of displays and controls.

This paper provides an overview of the initial design process, discusses the steps involved in the development of the assessment methodology and presents the various tools and techniques used throughout the assessment in order to ensure acceptability of the intended product.

### **Introduction of ramp LOSA at KLM ground services**

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Airline ground operations are subject to the conflicting demands of short turn-around times and safety requirements. Not surprisingly, more than a quarter of all aircraft incidents occur on the ground (NLR 2011). These incidents lead to aircraft damage and associated costs, risk of injuries, and can potentially impact in-flight safety. KLM Ground Services has targeted platform safety performance as an area for improvement

A new development is the Line Observation Safety Audit (LOSA), first developed by the Texas University for in the cockpit. In LOSA operational errors are tallied (even if inconsequential), and are reported anonymously and periodically. The results are expected to have a direct link with actual safety performance, better than existing safety programs.

The LOSA platform variant has recently become available (October 2011). The original material was tailored to the specific KLM circumstances. Error codes required alignment with applicable documents and observer forms were simplified. The theoretical background of threat and error management is also addressed as the original material seems to be flawed regarding threat identification and error-threat interaction.

With these modifications, platform LOSA is a useful tool to quantify safety performance and to generate trend data. The effect of safety interventions can now be monitored.

## **Session 4: Vulnerable Road Users**

### **How to improve the visibility of bicycle infrastructure**

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The visual characteristics of road infrastructure play a major role in a substantial number of single-bicycle crashes in the Netherlands. The focus of this research was on finding the most common situations that result in poorly visible bicycle infrastructure, and investigating how to improve these conditions for vulnerable cyclist populations, specifically the visually impaired and older cyclists. Three studies were performed, a questionnaire study amongst visually impaired cyclists, focus group discussions with older cyclists, and an experiment on a closed track where participants' vision, in particular their contrast sensitivity, was impaired. The results reveal that bollards, kerbs, and cycle path markings/shoulders are the most critical visual elements in the road infrastructure. In addition, cycling performance and cyclists' feelings of safety worsened in conditions where the visibility of obstacles and the road's course were the poorest. Visibility can be enhanced by placing red-white bollards, painting kerbs white, and through the placement of a clear shoulder, or by applying high contrast road markings on the side of the cycle path/road.

### **Driver's visual behaviour at cycle crossings**

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A previous literature review and focus group study on road users experiences and needs in night-time traffic implied that most problems in urban areas are related to the visibility of vulnerable road users. Drivers as well as pedestrians and bicyclists arrived at the conclusion that especially bicyclists at night bear a risk to be overlooked by other road users. Two field studies on drivers' ability to detect bicyclists and cycle crossings were carried out. The first one show that the recognition distance of stationary bicyclists is significantly higher compared with cycle crossings (59 m vs. 18 m). Thus the present design of cycle crossings do not help the driver to become observant of the crossing until the vehicle is very close to it, where it might be too late to stop. The second study deals with drivers' eye scanning behaviour at cycle crossings immediately following a right turn. 21 drivers between 25 and 46 years of age took part in that field study. Each subject had to drive two times along a predefined test track including five cycle crossings. One drive was performed during daytime and one at night. Gaze and driving behaviour results will be presented at the conference.

### **Towards understanding hazard perception abilities among child-pedestrians**

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The present study examined child and adult pedestrians' perception of hazards through a traffic-scene categorization task. Twenty young-children (6-8 years-old), twenty-two older-children (9-12 years-old) and twenty-one adults (24-28 years-old) were requested to observe 12 traffic-scene still photos taken from a pedestrian's perspective and to categorize them according to similarities in their hazardousness. Results have shown that experienced adult pedestrians tended to be more aware of potential hazards (i.e., obscured field of view from where a hazard instigator might appear) than both younger and older child-pedestrians. Consistent with our hypothesis, child pedestrians categorized the photos on the basis of a single criterion (e.g., a hazard instigator) while adult pedestrians established a categorization criterion based on a combination of aspects from the traffic environment (e.g., hazard instigator and traffic environment). The present study used an innovative paradigm to investigate child pedestrians' conceptions regarding road crossing situations. Understanding child-pedestrians shortcomings in accurately assessing the traffic situation may help in creating intervention techniques which may increase child-pedestrians' awareness to potential and hidden hazards and help in reducing their over-involvement in traffic crashes. Conclusions and implications of the categorization task will be discussed.

### **Keynote**

#### **Between the devil and the deep blue sea: moving offshore control rooms to land**

Mark Green  
Human Centred Design

Recent years have seen fundamental changes in the way oil companies operate in the Norwegian sector. Increased data capacity and new technology are considered a means of increasing efficiency, safety and profitability through improved decision making and reduced offshore staffing. This change is blurring the traditional split between offshore and onshore functions and the impact on design and operation of control centres is receiving considerable attention - especially as many new projects and modifications aim to operate the platform either completely, or partially, from land.

The Norwegian Regulators require human factors to be addressed in the design and modification of control rooms, typically using ISO 11064. Changes in operating models will change the scope of the human factors work needed and present human factors practitioners with new challenges.

While the basic functions and tasks of controlling production remain the same, whether the control is from offshore or onshore, many companies want the flexibility either to do both or to hand some aspects of control and operation back and forth. This presents challenges not only in, e.g., process control interfaces and alarm systems, but may also be introducing an overly complex situation for control room operators, who's mental models of 'who controls what and from where' can alter on a daily basis.

This paper will discuss what these challenges are and together with examples show how they are or are not being dealt with in today's designs.

## Session 5: Skills-Remote control

### **On-shore supervision of off-shore gas production - a human factors challenge**

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Moving off-shore control of gas production to on-shore control centres requires an operator task analysis. Technology enables remote process supervision and control, thus reducing manpower off-shore to maintenance and local control. Contract management (production volume control) has become a new control task. Engineering a control centre requires working on highly related human factors, such as console design, information and navigation, alarm management and job load. Two cases of Human Factors Engineering of "the move to shore" are presented, including lessons learned.

Case 1 concerns the redesign of an on-shore control centre and the reallocation of operator tasks. A hierarchical task analysis was performed to determine the number of workplaces and displays. A powerful overall process overview display was created. Later, an alarm-management philosophy has been developed and implemented. Key issues: contextual information unique for an off-shore location; possibilities to bring data on-shore; and how to visualise and group alarms?

Case 2 concerns centralizing process data of >40 assets into one central on-shore control room. Approximately 1800 local process graphics had to be reduced and standardized in order to enable 3 operators to supervise all processes adequately.

### **CAMMI: design of a distributed real-time Cognitive Monitor architecture**

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Safe and efficient design of human-in-the-loop systems is of central importance in Interaction Design, Human Factors, and Ergonomics. In this area, Human Information Processing models, theories of cognition and mental workload, Machine Learning research, Psychophysiology, and latest discoveries in Neuroscience, all converge to the study of principles to detect, in order to prevent, human error in complex task environments, while trying to maintain optimal levels of performance and overall safety of execution. In this paper we introduce the distributed, real-time CAMMI Cognitive Monitor architecture: a cross-domain architectural solution, designed within the context of the European CAMMI Project (Cognitive Adaptive Man-Machine Interface) for the monitoring of operators' workload-related features in real-time, to support context-aware, adaptive automation studies in a wide spectrum of target domains: unmanned and manned air vehicles, civil emergencies, automotive, and agriculture. The proposed solution is designed to achieve cross-domain portability, through a distributed, modular approach to workload monitoring and classification; high degree of flexibility, to account for inclusion of very different assessment techniques - from electro-physiological quantities, to contactless multi-camera feature

streams, to task-activity related quantities; and scalability, allowing for both single and multiple operators concurrent monitoring.

**A Human Centred Methodology for the Identification of Communication Needs and the Assessment of Hand-held Communication Devices Used to Support Communication Flow in High Consequence Emergency Management**

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Communication has been identified as a critical component in the outcome of emergency response. Post-mortems of "what went wrong" in disaster responses often point toward breakdown in communication between first responders, those directing rescue efforts, and the general population, as one of the primary impediments to rendering timely aid and communicating safety and weather information. Before making improvements in regard to communication flow in emergency management, it is critical to first identify the needs of the users. In this study funded by the National Science Foundation, knowledge acquisition techniques including text analysis, interview analysis, and surveys on Bahamian emergency management officials and civilians were used to develop a baseline for current emergency management operations and device use in The Bahamas. Device selection factors were identified based upon identified equipment needs and literature review. AHP analysis was used to determine the weighted priority of each selection factor, including portability, usability and battery life, resulting in a mathematical model for the selection of hand-held communication devices based upon human factors principles. The result was the development of a mathematical model that can be developed to holistically represent human factors issues associated with the use of hand-held communication devices in emergency management.

**Impact of NC support on skill acquisition on surgical novices**

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"Navigated-Control" (NC) represents an advanced technology that provides automation support to surgeons for both, navigating through the patient's anatomy, as well as protecting risk structures in the area where the surgeon is working. It has been proven that NC-support can improve surgical outcome. However, it remains an open question to what extent the provision of these systems already during surgical training might interfere with the development of surgical skills. It was expected that surgeons trained with NC-support would be less able to conduct the surgery without compromising patient safety than conventionally trained surgeons in case the NC system is not available. N=21 advanced medical students were trained to perform a simulated Mastoidectomy by practicing it either with or without NC-support. Based on a monitoring of training progress and a comparison of performance after training in a condition without NC-support, it was investigated to what extent the provision of NC-support during practice would affect the acquisition of surgical skills. Different aspects of surgical outcome, patient safety, situation awareness, and workload were considered. The results show that NC-support does not compromise skill acquisition. This has important practical consequences for the use of these systems already during surgical training.

## **Refresher Training for Skill Retention of Complex Tasks**

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Refresher training is commonly used and even mandatory in many high-risk environments (e.g., aviation, process control). Despite this prevalence, the design of refresher training has not been a focus of human factors research. The goal of a refresher training is to restore a performance level after a certain period of non-use. We compared the effectiveness of two refresher training approaches -practice and symbolic rehearsal- to a control group (CG) without refresher training. Fifty-nine engineering students were trained for one hour on a simulated waste water treatment plant (a process control task). A week later, the refresher training sessions (20 min) took place. The practice group performed the start-up procedure of the plant four times in direct interaction with the system while the symbolic rehearsal group carried out four cognitive tasks without any interaction with the system. All groups were tested two weeks after initial training. Results showed a significant main effect of group and a significant interaction between time and group, with post-hoc tests revealing that the practice group performed significantly better in the primary and secondary task than the CG. These findings are promising as they allow deriving criteria to design efficient training for skill retention.

## **Session6: Surface Transportation -1**

### **Lane Change Test: United Kingdom Results from a Multi-Laboratory Calibration Study**

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Dual task scenarios have long been used to evaluate the demands imposed by secondary in-vehicle information systems. International effort has been expended to develop standardised methodologies for valid, reliable, and efficient system assessment. The “Lane Change Test” is an example of one of these protocols. A multi-laboratory coordinated data calibration exercise was undertaken to explore the utility of the Lane Change Test. This paper reports on UK data contributed to this exercise. The Lane Change Test encompasses a primary task representative of some control aspects of the driving task. It was evaluated in the context of several secondary tasks, with easy and difficult variations. These tasks were an auditory one, a visual one and an integrated audio-visual route guidance task.

Results indicate broadly the same directionality of findings for all laboratories. For example, mean lane deviations were found to be smallest for the auditory tasks, followed by the visual only tasks, with the integrated tasks being most disruptive of primary task lane deviation. However, some laboratory-specific findings were identified. The data and their implications are discussed in more detail in the paper.

### **Electric Vehicle: An eco-friendly mode of transport which induces changes in driving behaviour**

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Electric vehicle (EV) represents a new eco-friendly mode of transport which involves different kinds of constraints to use that are likely to affect driving behaviour. In order to study the impact of the electric technology on driving behaviour a MINI E France Project is led by IFSTTAR and carried out under contract for BMW Germany. 25 “private users” from Paris have driving during 6 months, an electric MINI. The study focuses on how drivers use EV through analysis of their trips and the behaviours they adopt in their daily routine. For that, travel and charge diaries, questionnaires and focus groups have been used to collect and analyse self-report behaviours. The paper will show how EV characteristics induce changes in driving behaviours that affect the different levels of the driving task: The strategic level in terms of route planning due to the limited range of the vehicle and the necessity to save the electric charge, the tactical level in terms of interactions with other road users to deal with the silent nature of the EV, the operational level in terms of braking behaviour to master regenerative braking. The differences and similarities between eco-friendly and safety behaviour will be discussed.

### **Interaction between Driver and Infotainment-System using a Touchpad with Haptic Feedback**

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More and more functions are integrated into modern car-infotainment-systems, which the driver must be able to handle with a minimum of distraction using a limited number of control elements even while driving. A new approach to actualize a preferably facile and intuitive interaction between driver and infotainment-system is the usage of a touchpad. Based upon the findings of Hamberger (2010) and Spies et al. (2009, 2010) the development of a new touchpad with haptic feedback is accomplished. For technical reasons the realization of a touchpad with a haptic feedback via vibration is less complicated than a touchpad with realistic haptic feedback. Hence there is need for research to check the hypothesis that a touchpad with haptic feedback via vibration leads to comparably good interaction, driving and visual behaviour results as the touchpad of Spies et al. (2009) with realistic haptic feedback via sensible and operable elements in a dual-task situation.

In the context of this contribution the results of a field experiment are presented, which was conducted in order to compare the touchpad of Spies et al. (2009) to a touchpad with haptic feedback via vibration of the touchpad surface in a real driving situation. The results of this experiment provide the basis for the further development and the technical concept of a new touchpad with haptic feedback, in order to assure a preferably facile and intuitive interaction between driver and infotainment-system even while driving.

### **Behaviour of deck officers with new assistance systems in the maritime domain**

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The maritime domain is seeing new developments in systems aimed at increasing safety and efficiency of transport. These systems are tested for norm compliance and technical capability, but human factor aspects are not often part of the evaluation. Two new systems related to collision warning and speed management were tested on 32 participants in full mission bridge simulators. Factors of interest were officers' experience, attitudes and workload. Data on officers' behaviour were collected for complete runs and for different events related to possible collisions for the one system, and areas where speed would be limited for the second system. The systems would provide officers with warnings once dangerous situations occur, and when approaching or exceeding speed limits. Differences in officers' behaviour were observed in relation to several variables. The study claims that in addition to ensuring the

technical capability of systems, a number of human factors issues have to be taken into account. Important aspects of the evaluation are highlighted.

## Session 7: Automation – 2

### **Adaption to Unreliability - Imperfect alarm systems and the impact on attention allocation and performance**

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In multi-tasking environments like process control, operators are supported by alarm systems indicating when to shift attention to certain tasks. But as alarms are not perfectly reliable, operators have to select an appropriate strategy of attention allocation in order to compensate for unreliability and maintain overall performance. Wickens and Dixon (2007) argue that below an alarm-reliability of 70% compensation is associated with a disproportional effort and performance gets even worse than when working with no automation at all. Therefore this study investigated how people adapt to differing reliabilities and to which degree attention strategies change. Within a multi-tasking flight simulation (Multi-Attribute-Task-Battery) participants were randomly assigned to three alarm-reliability conditions (68,5%, 75%, 93%) and one control group (n=13). In experimental conditions one out of three subtasks was supported by an alarm system. Independent of reliability, groups benefited from alarms in the supported task with best results for the highest reliability condition. No differences occurred in non-supported tasks. Eye-tracking results showed that in the lowest reliability group the benefit was associated with an increased effort and a more demanding attention allocation strategy. Therefore results support Wickens and Dixon's (2007) findings regarding cognitive effort, but also point out that people are able to compensate for unreliable systems.

### **Trust is good - control is better! Development of a model predicting the use of assistance systems**

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Common theories on operators' use of assistance systems often involve the concept of trust. It is assumed that operators need to develop an appropriate level of trust in the system in order to use it properly. Based on this amount of trust, they decide whether to follow the system's advice or to extract further information in order to confirm the system's decisions. Several models exist describing the development of trust in regard to different aspects of the technical system. However, a model which is able to predict the usage of an assistance system is missing so far. Based on a meta-analysis of eight experimental studies investigating the effect of decision aids on human behaviour, we have developed a model predicting the use of decision aids. The model does not only focus on the technical components and the level of trust, but also takes the perceived risk of the anticipated output and the perceived uncertainty of the situation, i.e. interpretability into account. The model assumes that risk and uncertainty have a stronger influence on using a assistance system than trust towards the system. Empirical studies will show if uncertainty and risk moderate the relationship of trust or if they directly influence the use of an aid.

### **The effects of preliminary information about an Adaptive Cruise Control (ACC) on trust, acceptance and the mental model of the system. A matched sample longitudinal driving simulator study**

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Advanced driver assistance systems like the Adaptive Cruise Control (ACC) aim to support the driver by automating certain driving subtasks like the speed and distance control. In order to use such systems in an adequate and safe manner, a correct mental model of the system functionality is required. The present study investigates the effects of different preliminary information about an ACC on trust, acceptance and the mental model of the system and its development over time. A matched sample of 51 participants out of 396 applicants has been created and allocated to three experimental conditions (no statistical differences in gender, age, driving experience, driving style, sensation seeking, locus of control, five personality factors as well as perceptual speed). The three experimental groups received different descriptions of an ACC: a realistic one containing all the potential system failures, an idealistic one containing no information about the failures and a wrong one with additional information about failures that will not occur. All participants drove the same 56km highway-track in a driving simulator three times within 6 weeks. The changes in trust, acceptance and the mental model of the system according to the type of preliminary information will be presented.

### **Allocation of functions: A socio-technical systems perspective**

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Allocation of functions, the distribution of tasks (or functions) between humans and machines in a system, is traditionally seen as a human factors/ergonomics problem. It is typically concerned with whether a human or machine is better suited to undertake a set of tasks under certain circumstances; thus, behavioural, social and organisational aspects are predominantly overlooked. It is also rarely discussed explicitly during systems design, but is simply implicit in design activities or emerges as the system evolves. In this paper, I argue it is time to offer a new view on this classic problem. I reframe the issue of function allocation within a socio-technical systems framework, striving to bring it to the attention of those with a wider interest in the human and organisational aspects of IT systems, and to offer ways forward for future allocation choices. I argue that decisions over the roles of humans and computers in complex systems need to be made early in the design process, addressed explicitly, and on the agenda of a wide range of stakeholders, in particular those concerned with how the system will work and how well it will perform. I also consider how such issues can be addressed during systems development.

## **Session 8: Cognitive performance in Extreme environments**

### **Cognitive performance limitations in operating rooms**

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Currently there is a lack of validated and applied models concerning cognitive performance limitations and human error in medical work environments. Hence, the dirty dozen model (Dupont, 1997), an established model of human performance limitations and error causation in aviation maintenance, was applied to the surgical context - especially to ophthalmology.

The 12 categories presented in this model are: lack of resources, complacency, lack of teamwork, stress, lack of communication, distraction, lack of knowledge, lack of awareness, lack of assertiveness, fatigue, social norms and pressure. For this reason, roughly the whole population of surgically practicing ophthalmologists in Germany (N = 1063) were surveyed regarding the relevance of different performance limiting factors. The questionnaire included a quantitative as well as a qualitative section, where participants were able to state experienced examples for each category. The response rate of this survey was about 20 %. The results indicate that pressure, lack of communication and stress are the most considerable categories. A factor analysis based on these 12 categories yielded two factors. They were classified as organizational context and social interaction. Thus, the results indicate a strong negative impact of organizational and social factors on the cognitive performance of surgeons in operating rooms.

### **Collecting Battlefield Information using a Multimodal Personal Digital Assistant**

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The project “Smart Information for Mission Success” (SIMS), aims to improve military Force Protection by delivering a proof of concept system to support the dissemination of battlefield information. A necessary pre-cursor to information distribution is information collection; an activity completed in-part by regular soldiers within a platoon or company. We examined soldier preferences for capturing battlefield information when given a Personal Digital Assistant (PDA) that can record and store five different modalities: Photos, Videos, Audio, Text, and Icons. Twenty one Polish soldiers completed a simulated reconnaissance mission in a virtual environment (VBS2). Participants moved through VBS2 with a confederate; together playing the role of a two-person reconnaissance team. The participant was commanded to collect information and was required to do so using the PDA. The participant was free to choose any modality (including multiple modalities) for each VBS2 event. Soldiers subjectively preferred to use the Photo and Video modalities approximately equally followed by Audio, Icon and lastly, Text. This pattern of modality preferences matched closely the objective performance data. We also examined the influence of audio-visual properties on modality selection; these results will be reported. These results apply to similar domains such as search and rescue, and disaster management.

### **Cognitive Task Analysis - a relevant method for the development of simulation**

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The insufficient amount of adequate practical experience for German surgeons in training has been criticised. Realistic haptic simulations are needed to enhance the training and to improve the patients' safety. Initial research of the literature and several observations in operating rooms indicated the relevance of dissection simulation for neurosurgeons. An applied Cognitive Task Analysis (CTA) was performed to define a realistic and helpful scenario-based simulation. Important technical skills, cognitive aspects (e.g. strategies of decision-making), and implicit behavioural knowledge essential for performing high-quality surgery were analysed. The applied CTA was done in iterative cycles based on the results of the interviews with surgical experts and the progress of the developmental process. The results of the CTA are used as the basis for the development of a simulation system for surgical expert training. The relevance of analysing cognitive processes (especially evaluation of the surgical steps) have been proven and the important elements of a realistic surgical simulator (i.e. bleeding) were analysed. Due to the close interdisciplinary cooperation of engineers and psychologists together with surgeons and the user-centered design based on the

CTA the first validation of the simulator showed that the concept of the simulator is highly relevant for surgical training.

### Session 9: Automation -3

#### **Technologies to Support Socially Connected Journeys: Designing to encourage user acceptance and utilisation**

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Financial, practical and environmental incentives are increasingly encouraging people to seek opportunities to share journeys taken by car. Location-enabled mobile technologies provide opportunities to support real-time dynamic communications to support transport decision making in general and car sharing in particular. Technology to support car sharing can facilitate matching of potential sharers, calculate effective routes, support communications and planning between sharers, measure financial savings from shared journeys and even provide a means of distributing incentives from participating in car sharing schemes. This paper presents the emerging priorities from a series of human factors studies that were conducted to investigate user attitudes to and requirements for technologies to support car sharing. Methods applied included: user interviews, to examine barriers to car share and requirements for mobile enabled dynamic car sharing technologies; mobile diary studies, to examine journey types, and identify situations in which users would or would not be happy to share journeys; usability evaluations of a web-based car share “buddying” system and informal evaluation of prototype dynamic car and taxi share technologies. A model to inform the design of technologies to support socially connected travel, that highlights issues of privacy, security, flexibility, planning and social context of use will be presented.

#### **User Trust and Acceptance of Real Time Rail Planning Tools**

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As the UK railway modernises, new tools and systems are being introduced to support increasing levels of train performance. This paper examines the introduction of one such tool, the Train Graph. The Train Graph has been implemented as a pilot scheme on the UK network to support operators in identifying future train delays, with two different roles having use of the technology. While not providing new information, it moves away from the traditional UK representation of the railway as a schematic or list and towards a more abstract graph of distance against time, with trains plotted as lines. The Technology Acceptance Model (Davis, 1989) and Innovation Diffusion Theory (Rogers, 1995) are used as a basis for analysis of operator use of the new system. Data collection is ongoing, but early results indicate that operator trust in the system has been undermined by poor data quality, resulting in reduced acceptance and use. Differences have also been found in the adoption of the technology between the two different roles, with acceptance among front line staff much lower than operators more removed from the front line operations. Theories are put forward as to what may have prompted these differences, including the difference in mental representations at different operational levels and differences in the relative advantage of the new display format to different roles.

#### **Exploring the acceptance of mobile technologies using walking interviews**

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To investigate aspects of acceptance and adoption of digital technologies we developed an ethnographic method to elicit responses and opinions of older persons to new mobile technologies. Large numbers of older people in Europe never use the internet or a computer and miss out on the communication and travelling benefits of new mobile devices. We designed a scenario in which people over 65 years old could experience the use of a tablet computer. In the scenario we walked around the university campus, using a table computer with Google maps and other relevant applications. We started by previewing a route on Google maps and Google Earth, walked the route, navigated using map and a GPS signal, used landmarks, searched for information about nearby services including busstops, used Skype, made photographs, and used a travelplanner for a bus journey home. During the 1.5 hour interview, we asked questions about their experiences. Walking and talking stimulated naturalistic and informal conversations and was an excellent method for, (a) getting a deeper understanding of the impact of technology on daily life of older people; (b) their concerns and problems in using technology and mobile technologies; and (c) the importance of the social context for positive benefits.

### **The medium of prototype presentation in usability testing: effects on performance, psychophysiology and subjective evaluation**

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Various forms of prototypes are commonly used in usability testing, ranging from clickable to paper-based systems. Previous research comparing these different prototypes has hardly found any differences with respect to user performance or the identification of usability problems. However, the type of task could well play an important role as to whether such differences in performance between different prototype media do occur. In a 3 x 3 mixed design, the present study implemented a direct experimental comparison between the completion of three different task types with three different forms of prototype presentation. Participants were working on an explorative task, a task for which it was crucial to take in information by reading, and a navigational task. 90 participants were observed solving these tasks with a web application, either presented as a paper prototype, as a clickable website on screen, or on a touch tablet computer. Performance data, subjective measures and physiological parameters (heart-rate variability) were recorded. Results clearly show that performance differed between forms of prototype presentation, depending on task type. Especially for reading tasks there were clear performance advantages when using a paper-based as opposed to a clickable system on screen.

### **The existence and impact of the Psychological Refractory Period effect in the driving environment**

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Driver distraction from in-vehicle tasks can have negative impacts on longitudinal and lateral vehicle control. The distraction problem is increasing due to advances in the functionality, availability, and number of in-vehicle systems. One approach to a solution is managing in-vehicle task presentation to reduce associated distraction. This paper reports three driving simulator experiments, designed to investigate the existence of the Psychological Refractory Period in the driving context and its effect on driver performance. The first two studies demonstrate that the effect is present when one or two surrogate in-vehicle tasks are presented in close temporal proximity to a lead vehicle braking event. Brake responding is subject to an increasing delay as the interval to an in-vehicle task is decreased. In-vehicle task modality and task presentation order modulate this effect. The final study will investigate whether the Psychological Refractory Period exists for a range of safety-critical driving events

such as lead vehicle decelerations, swerving away from an out-of-control vehicle, and performing a lane-change manoeuvre. The advances on prior work include the use of an advanced driving simulator, and presentation of unpredictable safety-critical events and real-world in-vehicle tasks. The results have implications for the management of in-vehicle distractions – and driver safety; specifically through controlling the timing and modality of task presentation.

## Session 10: Modelling

### **The effect of masked images on driving**

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Many modern theories of driver behaviour suggest a role for unconscious emotions in the shaping of driving behaviour. In this study the effects of emotive masked images on driver behaviour were examined to gain some insight into the role of such unconscious emotions. While driving a simulator, participants were exposed to negative and neutral emotionally laden images which were masked by emotionally neutral images. These images were encountered across two different trials, each of which consisted of 3-4 minutes of driving on a rural road. The results indicate a main effect of the images, with participants driving slower when exposed to the negative images. This is complicated by a significant interaction between the type of image shown, and the order in which it was encountered. Participants had a general tendency to drive faster in the second trial; however they did so to a larger extent if they encountered the neutral image second. The participants ratings of risk and effort were unaffected by the images, and the images produced no detectable main effect on psychophysiological measures. These findings are discussed in terms of their significance for models of driver behaviour, and suggest that unconscious emotional stimuli may influence driver behaviour.

### **Developing a unified model of driving behaviour for cars and trains**

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In the European project ITERATE a unified model of driver behaviour and driver interaction with innovative technologies is developed. The model will be applicable to all surface transport modes. As a basis of the model development it is assumed that the underlying factors influencing human behaviour such as age, gender, culture and so forth are constant between transport modes. The model developed will be of great use when designing innovative technologies since it will allow for assessment and tuning of the systems in a safe and controllable environment without actually putting them to use in real traffic.

This paper presents the results of driving simulator experiments conducted to support the model development process. The experiments are unique in the sense that common scenarios run on a common portable car/train driving platform as well as full scale train and car driving simulators. Two identical portable driving simulator platforms were used among the project partners across five countries allowing a large number of subjects to take part in the experiments.

An important finding from the experiments is that country was found to be a significant factor for almost all performance indicators and events in both the car and train experiments.

Further results will be presented in the paper.

### **Implementation of a Unified Model of Driver into numerical algorithms for a predictive simulation of behaviour in different transportation contexts**

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Modelling driver behaviour has been an endeavour developed since a number of years. Several approaches have been generated following different theoretical background with the goal of enabling to predict the activity and response of human beings in control of a vehicle operating in dynamically changing environments.

The research presented in this paper follows these same basic goals, but stems from the hypothesis that “driver” behaviour is based on certain fundamental characteristics that can be shared amongst different working contexts. Consequently, it is possible to define a “Unified Model of Driver” (UMD) that captures the basic aspects of behaviour of a human being in control of a vehicle. The variation associated to diverse contexts is obtained simply by modifying the parameters that affect the fundamental modelling correlations.

Following this hypothesis, a research initiative has been performed within a EU funded Project that has studied automotive, rail and ship domains through a theoretical development, associated to substantial experimental activity in the three domains. The experiments leading to the implementation of the computerised simulation approach consist of close to 400 subjects from five different countries, probably making it the largest controlled experiment in the transport domain.

In this paper, the simulation tool resulting from the research work and experimental activity is presented. The basic theoretical framework is briefly introduced and the simulation approach is discussed in detailed, showing the numerical implementation of the basic human behaviour correlations and the mechanism that enables to differentiate amongst the three different domains, while maintaining the same theoretical architecture. A number of simulation runs are presented demonstrating the feasibility of the approach.

Finally, it is important to note that the feedback of the experimental activity on the model is of paramount importance in such a research initiative. The simulation instrument has fully accounted for the outcome of experimental results. However, the discussion on such activities falls outside the scope of this paper and it is only referenced in this paper, while it has been reported somewhere else.

### **How is Surrounding Traffic Complexity Related to Driver Workload?**

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Driving a car can involve extreme fluctuations in mental workload and some vehicle manufacturers are attempting to develop systems that manage workload. Such system is needed to manage the attentional processing demands placed on the driver both from outside the vehicle (i.e. traffic density and visibility) and within the vehicle (i.e. mobile phones and in-vehicle displays). As modern driving task is a driver-vehicle-environment (DVE) interaction, this research explores the possible methods in quantifying the workload imposed by the dynamic surrounding traffic.

Establishing methods of assessing the differential demands placed on drivers by environmental variables have been the focus of a recent series of investigations. There are two parts to this study; firstly, this study suggests traffic density affects driver workload and secondly, this study suggest using tactile detection task (TDT) to measure the impact of traffic complexity on mental workload apart from using performance-based, subjective and physiological workload measurements. These fluctuations in attentional processing requirements resulting from dynamic surrounding traffic are an important piece of information in understanding the DVE interaction. This contributes towards developing a workload estimator that can be implemented by vehicle manufacturers with the aim of managing driver workload optimally.

## **Session 11: Surface Transportation -2**

### **Investigating driver reaction in critical events based on naturalistic driving data**

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Rear-end collisions are common accident scenarios which are generally estimated to account for approximately 30% of all police-reported accidents and about 5% of all fatalities.

Previous studies have shown that driver inattention just before the collision or near collision is a major cause of these accidents. To improve active safety systems development and assessment it is important to understand when and how the driver reacts from the moment the driver becomes aware of the potential threat.

Using 100Car naturalistic driving data, this paper investigates the reaction (braking, steering, combined steering and braking and no reaction) selection that drivers make in a potential critical rear-end crash situation.

Given the relative state of the host vehicle and the forward vehicle as well as the environment, the probability of driver selecting one of the possible reactions is presented. The distributions of different parameters like reaction time and accelerations are analysed, and their correlations are investigated. Knowledge gathered from this study could help improve development of quantitative driver models.

### **Contributing Factors to Driving Errors in Trucking Industry: Drivers' Individual, Task and Organizational Attributes**

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Objective: To identify contributing factors to driving incidents in the trucking industry.

Methods: Safety records, individual job-related and personal data were collected from 1292 professional drivers working for 18 trucking firms in Japan. Each driver's safety record included the number of injury and non-injury incidents that he/she made each year in recent ten years. The job-related data collected from each driver were employment type, vehicle type, daily driving type and annual working days. As drivers' personal data, we collected age, gender, work experience, driving penalty points, fuel-effectiveness of driving, and nine aptitude test scores (i.e., emotional stability, cooperative, reaction speed, etc.). Selecting drivers having ten years or longer professional experience, Chi-square test was primarily used to examine differences between 'no-incident' drivers and 'incident-involving' drivers by each driver attribute.

Results: 'No-incident' and 'incident-involving' drivers varied by age, fuel effectiveness, employment type, annual working days, mean age of drivers in the company, and magnanimity of mind. We will discuss reasons for their effects on incident likelihood in the final paper. We will also report results of hierarchical logistic regression analysis, which accounted for 34% of the variance in distinguishing 'no-incident' and 'incident-involving' drivers and its impact on trucking industry.

### **Don't be upset! Can cars regulate anger by communication?**

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In a driving simulator study we explore several strategies targeted to regulate drivers' anger via particular communications initiated by the car. The simulator drive included several critical driving events as well as several emotion regulation strategies initiated by the system.

The events impeded drivers' progress towards their destination, and were caused by another driver. Following a driving event the driver was involved with one out of four different communication strategies. One strategy was based on the idea to change the nature of the current driving situation by providing an alternate route (Situation Modification). A second strategy tried to shift drivers' attention to a non-driving related topic (Attentional Deployment). A third strategy induced an alternate interpretation of the emotion eliciting event (Cognitive Change). The fourth strategy attempted to modulate drivers' affective state using a relaxation technique (Response Modulation). All strategies included in the study are concerned with down-regulating emotions that typically have a negative valence such as anxiety, fear, sadness, and anger. Participants rated their experienced emotion via the Self Assessment Manikin. Preliminary results indicate that under some conditions a technical system such as a car may be able to modify drivers' affective state.

### **Reducing Speeding Behaviour in Young Drivers: A Cognitive Perspective**

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Young drivers continue to be over-represented in accident statistics throughout most western countries, including Australia (Road and Traffic Authority, 2010). Risk-taking in terms of speeding is thought to be a precursor to many of the fatal accidents involving young drivers. One method that has shown promise in reducing young drivers' tendency to speed is a training technique known as Episodic training. However, little is known about how the modified behaviour resulting from Episodic training impacts on other related tasks. Therefore, the present study aimed to investigate how cognitive resources are utilized to implement this behavioural change. 60 participants divided equally into four groups completed a simulated training drive in week 1 followed by a simulated test drive in week 2. In week 2, two of the experimental groups also simultaneously completed a secondary mental arithmetic task in addition to the 10 km test drive. The results reflected favourably on a speed management strategy elicited by Episodic training, however such a technique was cognitively taxing when performed in conjunction with the secondary task. From an applied perspective, these results suggest compartmentalising driver training in order to build the foundations for driving, hence maximising learning potential while at the same time reducing cognitive load.

===== POSTER PRESENTATIONS =====

**Function oriented task analysis of agricultural vehicles**

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Today the best view in automation of human-machine systems is that a system should be designed so that the human and the machine are able to work together and to complement one another. Therefore, the design of any autonomous or semi-autonomous agricultural vehicle should be based on allocation of functions. This paper provides the critical background knowledge necessary for proper allocation of functions that ensures the high system performance and minimizes the impacts, both physical and mental, on the operator of a semi-autonomous agricultural vehicle. In this study a tractor air-seeder system (TAS) is considered as a case study. A function oriented hierarchical task analysis technique is used to characterize tasks, sub-tasks and task activities associated with operating a TAS in the field. Finally the required features were determined to develop an efficient TAS simulator to investigate TAS from human factors issue

**Participant motivation in usability testing: effects of topic interest and incentives on state motivation, performance and subjective evaluation**

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In usability practice, it is commonly assumed that motivation of participants might influence the outcomes of usability tests considerably. This aspect, however, has hardly ever been assessed or systematically investigated, although participant's motivation to participate in the evaluation (intrinsic or extrinsic) might influence task performance and user satisfaction. In a 2 x 2 between-subjects design, intrinsic and extrinsic motivation have been examined in a quasi-experimental set-up. Prior assessment of the interest of potential test participants in the website topic to be tested allowed us to recruit individuals with high and low intrinsic motivation. In addition, extrinsic motivation was manipulated by offering a substantial financial incentive to half of the sample for their participation. 60 participants were tested, solving tasks with the website in the usability laboratory. As dependent variables performance, perceived usability and emotions were recorded. While results showed that intrinsic motivation had a significant positive effect on current task motivation, extrinsic motivation did not. There were no main effects of intrinsic or extrinsic motivation on performance. However, extrinsic motivation in the form of a financial incentive had a positive effect on performance, but only for those participants who were not intrinsically motivated. Implications for recruiting test participants are discussed.

**The usefulness and usability of tablet computers for older people**

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New technologies have potential to contribute to older people's quality of life, but there is a gap between those connected to the digital world who understand its concepts and ways of interaction, and those who are not yet engaged. Bridging this requires more intuitive interfaces for non-users and support for building adequate mental models of the way digital products work. In the BRIDGE (Building Relationships with the Invisible in the Digital Global

Economy) project we investigated uses and ease-of-use for a tablet computer with 13 participants over 65 years old. Interviews were conducted during a walk, using a tablet with Google maps and other applications supporting navigation, information and on-line communication. Half the participants had never used computers and none had used a tablet. In a detailed study on usability, 10 participants performed tasks such as entering a password. Although most did not have major problems with the touchscreen, several interaction issues emerged, for example menu structures and confusing iconography. Difficulties often related to people not having compatible mental models, especially when they had limited prior experience of digital interfaces and computers. Participants were positive about the usefulness of such devices and how such technologies could benefit their personal lives.

### **The size-force illusion for push-button switches: Implications for interface design**

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Physical aspects of control elements, such as the load required to close a push-button switch, are relevant for ergonomic design. However, control elements with equivalent physical properties may still be perceived to function differently depending on their visual appearance. To address this issue, the present study investigated how the size of push-button switches affects perceived load. Two simple push-buttons were presented within a virtual environment and were actuated with a 3D haptic device. Simulated force-displacement characteristics were chosen to approximate that of real switches. The left switch served as the standard the right switch as the comparison. The size of the comparison switch was either equal to that of the standard or reduced by half. In each trial, participants pressed the standard and comparison once and then judged the load of the comparison (heavier/lighter). Based on these judgments, the required load of the comparison switch was adjusted using an adaptive stair-case procedure. The results revealed the presence of a size-force illusion: The small-sized comparison switch was perceived to be about 8% heavier than the standard-sized one. These findings further suggest how psychophysical methods can be helpful to assess and design how visual dimensions influence the perceived functionality of control elements.

### **Evaluation of Camera Monitor Systems in Lane-change Situations**

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Amendments of ECE R46 and a new proposal as ISO16505 are being prepared in order to make an application of CMS (= Camera Monitor Systems) for all classes of devices for indirect vision possible. It is necessary to evaluate the influence of CMS for driver behaviour and adaptation because not enough research has been conducted in this area. This study focused on driver behaviour when CMS are used instead of conventional mirrors in lane-change situations. Three sizes of monitors : large (7.1 inches, 699 arcmin wide from driver's ocular point), medium (5.6 inches, 554 arcmin wide), and small (3.5 inches, 348 arcmin wide) were put on the base of the driver side A-pillar. A 1400R mirror (663 arcmin wide) was also used for comparison. Differences in size showed that behaviour changed comparing to that of the mirror. The rate of underestimating the following vehicle was 6% (large), 3% (medium) and 8% (small) while that of overestimating was 11% (large), 9% (medium) and 7% (small). It is suggested a too small display may lead to risk-taking behaviour. Sensory rating by experts ranked the small one as the worst. These results indicated many factors including size should carefully be taken into account.

### **What tells the driver's voice about driving situations and driving behaviour?**

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From the psychological point of view car driving is not only a cognitive task but also a social activity where emotions emerge and have to be regulated. Thereby the most prominent emotions are anger, happiness and fear. In a series of experiments it was investigated under which conditions these types of emotions emerge and how driving behaviour is influenced by them. One option to get information about the different emotional states of the driver during the ride consists in analyzing physical aspects of his or her voice. In several studies performed in the driving simulator as well as in the natural traffic environment it could be shown that on the one hand voice characteristics inform about the emotional appraisal of the actual traffic situation and on the other hand these voice characteristics also allow to predict safety-relevant aspects of driving behaviour. A system is presented which automatically detects the emotional state of the driver by analyzing his voice while driving. The predictive power of such a system for safe driving is evaluated and possible applications within the automotive industry are discussed.

### **Influences of arousing driver attention on car-following behaviour and the risk of rear-end collisions**

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In order to improve road safety, automobile manufacturers have been developing several types of Advanced Driver Assistance Systems (ADAS), such as forward collision warnings and automatic emergency brake systems. As for avoiding rear-end collisions however, such systems that do work under emergency situations may not be enough for preventing collisions. It might be effective to arouse attention of drivers to enhance situation awareness when a collision has not been imminent yet but the potential of a collision is increased in that situation. A driving simulator study was conducted to assess influences of arousing attention of drivers on car-following behaviour and the risk of rear-end collisions. Results showed that compared to a non-assisted driving condition arousing attention led to increased time headway during car-following in case of experimentally induced visual distraction. As a result, it was clarified that the assistance of arousing attention might have the potential to decrease risk of collision in a critical situation where a lead vehicle suddenly decreased its speed. Moreover subjective ratings of system effectiveness for arousing attention were relatively high. Potential applications of these results include methods for evaluating driver assistance systems due to arousing attention and their impact on improved road safety.

### **Development of a simulation-based diagnostic tool for professional truck drivers**

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In Germany there are about 470.000 professional truck drivers of which approximately 35% are older than 50 years, with an increasing proportion. Additionally, the shortage of young truck drivers poses challenges to forwarding companies. In order to warrant a smooth freight service in the future solutions must be found as for example by focusing the abilities of older drivers.

A possible way to face these challenges may be the development of a simulation-based training for older truck drivers. A first step to reach this goal can be seen in the examination of factors that are critical for truck driving. Therefore interviews with truck drivers (N = 30) were conducted using the Critical Incident Technique. By that means a set of critical situations was generated. In a second step these results were incorporated into a simulator based diagnostic route. The situations of the diagnostic tool include factors such as perception, shifts of attention within the driving context and the correct projection of an ongoing situation into the future. Using this simulation scenario it is possible to generate

performance profiles showing the strengths and weaknesses of truck drivers' abilities. These profiles are used to develop a specific training.

### **Assisting Train Driver's Braking Operation by Indicating Predicted Stopping Position**

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This study examines the braking assistance system for train drivers when stopping at a station to prevent an overrun. The assistance system informs a driver visually of a predicted stopping position based on present vehicle velocity and deceleration. If the predicted stopping position is in front of (over) the desired position, it is presented in green (red) colour. This predicted position is calculated by assuming constant deceleration. In general braking behaviour, however, a driver gradually releases a brake handle. Therefore, when the driver cannot decrease the deceleration even if the predicted position is in front of the desired position, i.e. the green colour, the predicted position is coloured in yellow. This assistance system makes the driver aware not only the predicted stopping position, but also the appropriate braking operation. Train-driving simulator experiments are examined with several subjects who are required train driving with the mental calculation which assumes the mental workload. Subjects with the braking assistance system can operate the brake handle smoothly as well as the usual driving without the mental calculation, while subjects without the braking assistance system repeat the modified braking operations.

### **Constraint and object management in industrial scheduling: differences between experts and novices**

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This study aims to gain insight into scheduling expertise by comparing the work of experts and novices when designing a Gantt chart. We describe scheduling activity at two levels: strategic and tactical. The strategic dimension involves procedure and goal management. The tactical dimension involves constraint and object management, which takes place in dual spaces: the Constraints Space (CS) and the Objects Space (OS). Constraints are defined as relations between variables that cannot be represented in the Gantt chart, whereas objects are constraint satisfactions that can be thus represented (one operation of a job in the Gantt chart). We code verbal reports of constraint management (e.g. constraint formulation), and obvious behaviour on objects, without constraints verbalization. The study shows a difference in expertise in strategic operations (i.e. goal formulation and evaluation during scheduling, and constraints violation during rescheduling) and in tactical operations (i.e. constraint and object management). Experts were more likely than novices to use external representations as activity support (OS operations), whereas novices devoted more time to managing constraints in their heads (CS operations). We conclude that the OS could be a suitable activity support for experts. Novices, on the other hand, could benefit from support in managing constraints and translating constraints into objects.

Keywords: Expertise, Scheduling, Constraint Management

### **Detection Response Task as a Method to Evaluate Cognitive Demand of Secondary Tasks**

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The integration of driver information and infotainment systems requests evaluation methods to assess the demand they put to the driver. This study focuses on the evaluation of cognitive demand. Merat et al. (2008) showed the potential of different detection paradigms to assess cognitive demand.

The experimental setup of Merat et al. (2008) was partially replicated using a tactile and a visual detection task.

24 subjects had to react on a visual stimulus (red LEDs at 0°, 11° and 23°) one meter in front of the test person or to a tactile stimulus (vibrator at the wrist of the subdominant hand).

Responses are given by pressing a switch in the dominant hand of the test person.

Simultaneously subjects had to perform a backward counting task on three task levels and a listening task simulating in-vehicle tasks. Response times and misses for the detection tasks and counting performance and detection performance in the secondary tasks show that it is possible to discriminate the different difficulty levels of the counting task by the reaction time delays in the detection tasks and via misses for the listening task. Thus DRT settings prove as a valuable setting whereby cognitive secondary tasks need more differentiation.

### **The impact of a large-screen projection of the entire technical process on shared mental model congruency and team performance in a furnace control room**

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Large screen projections (LSP) are applied in control rooms in order to facilitate a shared overview of running processes for shift staff. So far little is known about the teamwork related impact of LSP. We assumed that LSP affect a) the congruency of mental models of interdependently working teammates and b) team performance. Congruency is a prerequisite for effective teamwork because of its impact on team-coordination-processes. Shared mental models (SMM) regarding task and team-interaction affect mutual expectations regarding the teammate's behaviours. They facilitate tacit coordination, mutual performance monitoring, and proactive offering of support. In a pre-posttest design 21 operator-teams of 3 engineering students each (n = 63), divided into two groups (LSP on/off) were investigated regarding their SMM-acquisition within a furnace simulator. Following 45 minutes of training, task- and team-SMM were measured. Afterwards the groups worked either with or without LSP to produce raw iron for 45 minutes. The posttest SMM followed and team-related self-efficacy was measured. Team performance was measured as the amount and quality of produced raw iron. We found that although LSP did not significantly affect task and team-interaction-SMM, LSP positively affected knowledge acquisition and increased team performance significantly. Additionally, SMM-congruency was positively related to team-related self-efficacy.

### **Reality-Based Interaction for Control Rooms**

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Multi-touch technology has recently enjoyed great popularity by the rise of smart phones and various other touch-sensitive devices in the consumer market. However, the potentials of this technology have not yet been uncovered for the industrial realm as applications in this field have to satisfy security relevant issues rather than user experience and thus require more functional concepts. The present paper examines control rooms as highly security relevant

workspaces where the major tasks consist of monitoring and intervention into processes. This is performed through the manipulation of process variables such as temperature, pressure and speed. In terms of interaction design, this task can be described as the manipulation of numeric values in an accurate and fast way. Both, the concerns regarding security issues as well as the lack of adequate concepts can be seen as major reasons why multi-touch scenarios could not yet been transferred into control room scenarios. This paper addresses the lack of touch interaction concepts for the manipulation of process variables by proposing a guide to the visual and the interaction design for the manipulation of numeric values. The presented principles assume industrial requirements and base on an alphabet of standard gestures and their individual properties.

### **An effect of knowledge about PSFs on detection of unsafe acts**

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The decrease of workers' hazard perception (the ability to detect unsafe acts) has become a problem in workplace. Although it is important to improve workers' ability to detect unsafe acts for obviating accidents caused by these acts, it's still not clear what factors improve the ability. Since unsafe acts are caused by PSFs (performance shaping factors), it is expected that the more knowledge about PSFs workers have, the easier workers predict and detect unsafe acts. Nine subjects were requested to identify PSFs of the unsafe act after they saw films in which an unsafe act included. The number and the kinds of PSFs which each subject identified were counted. Then, these indices were compared with the number of identifications of unsafe acts gained from our previous studies. The results showed that the more kinds of PSFs the subjects could think about, the more the subjects detected unsafe acts. therefore it was suggested that it is important to build extensive knowledge about PSFs for improving individual hazard perception. The future issues are discussed for the effective method to build extensive knowledge about PSFs and the simplified method to derive the knowledge about PSFs from subjects.

### **Complexity of traffic scenarios and mental effort in car driving**

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The degree of how someone is mentally preoccupied by a traffic scenario depends on factors as traffic density, roadway arrangement, number of different participants, and the amount of distracting objects. It can be assumed that with an increasing complexity of these aspects, the mental workload of the driver is growing up. The idea of the present study was to characterize traffic scenarios by measuring their structural complexity and compare these measures with the perceived mental effort of the car driver. Therefore from the driver's perspective two videos with different traffic situations were recorded. These videos were analyzed by counting the structural complexity of each frame on the basis of a luminance-change algorithm. In a further step the videos were shown to 16 participants who had to judge the mental demands relating to the different traffic situations. The judgments were continuously registered by a hand-held potentiometer so that a time-series of mental effort characterizing values resulted. A correlation analysis with this time-series and the numeric measures of complexity revealed a substantial correlation. The result shows that the estimated mental effort related to a certain traffic situation can be predicted to some extent by a formal complexity analysis of the traffic scene.

### **The Influence of Trust in Automation on Drivers' Reactions during Highly-Automated Driving**

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Automation increases in everyday life. Of special importance for human factors research are changes in a safety relevant part of daily life - driving. The driver's task is changing because of an increasing amount and influence of advanced driving assistance systems. Dealing with this increase in automation poses a challenge to future drivers. The compliance with and reliance on automated systems is especially determined by the operator's trust in automation; however, little is known about the behaviour of drivers when driving highly automated cars. Therefore, the experimental study to be reported aims to identify constructs which help us to understand driver's trust and behaviour in highly-automated driving. Three groups of subjects were given different instructions about the reliability of highly-automated driving scenarios in a driving simulator. For all three groups the actual system reliability was kept constant. The dependent variable was the time till the subjects intervene when experiencing standardised critical situations. Multiple questionnaire data were gathered to identify personality traits and technology-related attitudes that may differentiate between participants' different intervening behaviours. Additionally, participants' monitoring behaviour while driving was recorded. Implications for further research as well as for applied issues will be discussed.

### **Lane switch time as index of risk taking behaviour: effects of workload on safety**

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As we move forward more of the driving task is being controlled by automated systems. This is likely to have an impact on driver workload and performance. For example automation could adapt workload if a driver is overloaded and prevent performance degradation. Or if the driver is underloaded, automation could increase workload to prevent boredom, drowsiness and the underestimation of risk (Young and Stanton, 2007). Iversen & Rundmo (2001) have indicated that sensation seeking, which may occur in response to boredom, is one predictor of risky driving behaviour. To study the effects of workload manipulation on performance, and how this interacts with sensation seeking, a driving simulator study was carried out in which participants drove on a six lane highway with varying levels of traffic and switched lanes whenever a navigation device indicated. A strong negative correlation was found between lane change time and sensation seeking. Also, participants who scored low on sensation seeking reported a decrease in mental effort over time, while those scoring high reported a sustained level of effort. This suggests that the safety of drivers from the high scoring group may benefit from increased workload, preventing them from taking more risks in monotonous low workload situations.

### **Automatic Emotion Detection by Facial Expressions in Human-Computer Interaction: The Example of a Chat-based Interview Agent**

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Facial expression recognition provides a promising basis for future-oriented human centred design of emotional human-machine interfaces. Although there have been different approaches on this research topic, it is still not at all clear how algorithms can learn to encode or decode a human face and especially the emotions expressed, since faces are complex, multi-dimensional, and they differ from each other. Within this context our research focuses on the automatic recognition of emotions by facial expressions. However, in contrast to the majority of studies, we suggest a new and rather simple dynamic approach to recognize emotions by facial expressions in a first step. By analysing the deviations of areas defined by several dots

placed on the face, we are able to extract variables to classify participants' emotions. To achieve a reliable evaluation, the system was tested on a large database of emotional facial expressions. Taking into account the results of our novel way to categorise emotions, this dynamic application of detecting emotions aims at a facilitation of human-machine communication. It will be discussed with respect to its application to human-computer interaction, e.g., automatic and adaptive chat-based interview agents. Implications for further research and for practice will be outlined.

### **A Distributed Cognition-based Cognitive Analysis Tool for Knowledge Management**

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A system that supports operators should not only have high performance but should also be user-friendly and give good accessibility to information. To better support the operator, it is necessary to analyse the functional elements during the system design process in order to understand the functions themselves. We believe that distributed cognition is an effective approach for understanding the interactions between agents (humans or artefacts) in a system that involves collaborative work, such as air traffic control.

In this research, we attempted to apply a method based on distributed cognition to analyse the activity that takes place in an Air Traffic Control (ATC) centre. Distributed cognition analysis makes explicit the dependencies between human actors and artefacts by examining the transformation and propagation of information through various forms of representations. In this paper, we introduce a framework of knowledge management by Air Traffic Controllers, and describe the development of a prototype system to support analysis of this knowledge management. We attempt to formalize the basic knowledge held by controllers in order to assist their tasks as well as to understanding their knowledge structures and the logical relationships between them based on a distributed cognitive perspective.

### **Damage-Mitigation Level of Collision-Prevention Support Braking**

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In this study, collision-prevention support braking was used as an example, and a methodology for estimating the collision mitigation ratio using this system is discussed. A method for analyzing the collision-mitigation ratio is discussed through a time series Monte-Carlo simulation based on the integrated error of driver and system. First, driver performance in terms of braking timing and deceleration level for collision avoidance was analyzed in a driving simulator when the control timing of the braking-support system was changed. Next, a driver model simulating braking operation, when a preceding vehicle started slowdown was constructed. Through time series simulations using this driver model, the frequency of collisions with a preceding vehicle and the collision velocity were estimated. One result analyzed through this simulation study based on the integrated error of driver and system considering the driver's risk taking behavior during the use of the system estimates that the frequency of collisions decreased from  $6.64 \sim 10^{-1}$  to  $1.00 \sim 10^{-5}$  when the driver used the driving support system for collision avoidance. Although further verification regarding the driver error and system error will be necessary, a methodology for evaluating effectiveness of driving-support system is shown in this study.

### **Deafness and its relevance to the driving task**

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Past evidence has suggested that both deaf and hearing sign language users react more quickly to stimuli presented in their peripheral vision than their non-signing counterparts (Bevelier et al., 2000). It is hypothesised that this may result in a better performance on the hazard perception task, an integral part of the UK driving test, in sign language users. This study investigated whether hazard perception was improved in a sample of deaf signing individuals, compared to age- and driving experience-matched normally hearing non-signers. A questionnaire regarding driving habits was also disseminated amongst both of these groups. Preliminary results suggest that there was no difference in the performance of this task between the two groups. The questionnaire data exhibited that the deaf group perceived no problems in their driving performance. Some interesting points for discussion have been brought to light regarding provisions for the deaf in the current driver licensing set-up in the UK. Preliminary findings suggest that the deaf signing community have substantial difficulties in performing their practical driving test, and struggle to comprehend the theory questions, even with an interpreter present. The implications of these findings on the equity implications of the UK licensing system will be discussed.

### **Development of reproducing method of traffic accident and conflict scene using actual vehicle**

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Observing drivers' behaviour by reproducing traffic accidents and conflict situations are effective methods for investigating their causes and improving active safety technologies. In previous studies, driving simulators were often used for investigating accidents and conflict scenes, but such systems had difficulties in reproducing realistic situations. Therefore, an instrumented vehicle was developed to reproduce realistic traffic accident and conflict scenarios without the dangers of an actual collision. In our previous study, we reported on the vehicle which a person drove by viewing a frontal scene projected to a LCD fixed to the hood of the vehicle. Traffic accidents and conflict situations were reproduced by replacing the frontal scenes with pre-recorded critical scenes. In this study, the instrumented vehicle was improved; LCD was added to expand the frontal view, and a superimposing method was adopted for a more natural look. For example, if we wanted to reproduce a vehicle-pedestrian accident, a virtual pedestrian was superimposed on the frontal scene. This presentation contains three main topics; drivers' acceptability of driving, system description of the vehicle, and examples of conflict scenes which reproduced rear-end, angle, and vehicle-pedestrian accidents. The results indicated that the instrumented vehicle is effective in reproducing these critical situations.

### **A Deceleration Control for Collision Avoidance based on Driver's Perceptual Risk and Its Influence on Drivers Behaviours**

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Automatic braking systems that judge the collision risk to the lead vehicle and start to decelerate have been developed to mitigate collision damage or to avoid collisions to the leading vehicle. It is expected that such braking systems are effective to mitigate crash damage or reduce crash itself. However, it has been pointed out that change of driver's behaviors was concerned when such braking systems were equipped. Therefore, it is important that change of driver's behaviors is figured out and it is applied to designing of system.

On the other hand, we proposed a deceleration assistance control for collision avoidance based on driver's perceptual risk. This system has an advantage that activation timing of the

automatic braking can be changed by changing a parameter in the control method that allows the system to generate deceleration profile uniformly without any complex calculation. In this research, a new automatic braking method for collision avoidance using the drivers perceptual risk model will be introduced. The method can determine its activation timing by taking individual differences into account. Then, effect of the activation timing of the automatic braking system on the driver's behavioral changes will be investigated using driving simulator.

### **Can Passenger's Active Head Tilt Decrease Severity of Carsickness?**

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The purpose of this study was to investigate the effect of passengers' head tilt strategy in automobiles on the severity of carsickness in lateral acceleration situations. A passenger car was driven on an oval track containing a pylon slalom while the participant sat in its navigator's seat. The experiment was terminated when the participant felt initial symptoms of motion sickness or the car reached 20 laps. There are two levels of the head-tilt condition. The natural condition was with no instruction, while the participant tilts his/her head against centrifugal acceleration in an active condition that imitates a driver's head tilt. A within-subject factorial experiment design was employed. The number of laps to the driving endpoint with the active condition was significantly greater than that with the normal condition. In addition, subjective ratings of motion sickness and symptoms with the active condition were significantly lower than with the normal condition. These results demonstrate that an active head tilt against centrifugal acceleration has the effect of reducing the severity of motion sickness.

### **Validation of simulated driving with on-road measured driving behaviour**

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This contribution concerns validation studies of a fixed-base driving simulator that was used for research purposes regarding a variety of topics.

The first study was carried out to verify the driving simulator's usefulness as a tool for measuring speed behaviour. Fifteen drivers were monitored two months non-stop via GPS devices in their own cars. Road types with an indicated speed of 30, 50, 80, 100 or 120 km/h were analysed for speed limit violations. The same road types were reiterated in the University's driving simulator. The results indicated that speed violations committed in the simulator and in the private car depended on road type e.g. the percentage of speed violations was higher when the indicated speed was lower. Speed violation patterns were similar for both settings, but not equivalent, especially in the lower speed ranges (30-80 km/h). Furthermore, the participants' perceived physical correspondence between private car and simulator was related to the extent that speed patterns in both environments were similar. Conclusion is that the driving simulator is a relatively valid instrument to assess speed violations, predominantly in the higher speed ranges.

The second study was conducted to match behavioural changes as a consequence of drug administration (dronabinol, aka marihuana) in a similar driving simulator compared to driving in an instrumented vehicle in actual traffic. Twenty volunteers were paid to participate in a study on the effects of 300mg marihuana (administered as dronabinol tablets) on driving performance, in actual traffic and in a comparable, simulated world. The effects of dronabinol on the amount of swerving (SD lateral position) demonstrated a comparably low effect, while the Reaction Time to speed changes of a car in front differed slightly but was in the same direction. Conclusion is again that the driving simulator is a reasonable valid instrument to assess the effects of recreational drugs such as marihuana on driving performance.

### **Task analysis for job aid design: indicators for the suitable application of head mounted displays in complex working environments**

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Head mounted displays (HMDs) and other innovative technologies offer new possibilities for performance support and error prevention in complex working environments. Information can be provided on-demand, independent of location and hands-free. However, job aids are not coercively helpful and may cause unintended effects. A detailed analysis of eligible tasks is therefore necessary to judge which tasks should be supported and how information should be expressed. Moreover, extreme environments impose special requirements on technology that have to be considered.

Methods of data collection and task analysis were comparatively assessed in a pre-test in industrial maintenance. Requirements on supporting technology were derived for suitable tasks. An expert workshop was held to determine which requirements could be complied with HMDs. Supplementary, practitioners in the fields of maintenance, emergency services and further were asked about application of job aids using an online questionnaire. Research was conducted within a project of the German Federal Institute for Occupational Safety and Health (BAuA) aiming at strain-optimised application of HMDs. Preliminary results will be presented.

Results are relevant for coping with difficult working conditions and specific work organisations (e.g. execution of maintenance tasks by external companies). To overcome the research-practice gap, guidelines for practitioners will be developed.

### **Situation Awareness Concept Case of the night flight in helicopter with night vision systems**

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This work deals with the study of cooperation among operators on the construction of a spatial representation of the environment. This study concerns the crews of helicopters (Tiger and Gazelle Viviane) using systems to aid night vision in low altitude flights. In the course of a distributed and shared activity mobilizing significant cognitive resources, pilots must work together to accomplish their mission(s) with aircrafts equipped with information displaying media such as image intensifier and thermal imagers. Indeed, those systems offer very specific features of the outside world and require a long and permanent learning effort for users. Pilots have complementary tasks, but sometimes with large overlapping (safety from obstacles, etc...) and an uneven use of sensors. Crews must develop cooperative mechanisms of information collecting in the environment and human-machine interface. Perception and communication allowing the construction of individual and collective consciousness of the situation consistent with the current situation. We seek to identify and analyze the cognitive strategies for selecting and sharing of visual-spatial information contained in sensors within the collective. Thanks to interviews and questionnaires that this work should help, to improve the procedures implemented by the crews in this activity.

### **Locomotion with head-mounted display: performance and adaptative strategy**

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Soldiers performing nighttime operations often use night-vision goggles, with a field of view that is typically limited to 40°. To enhance the situation awareness, it is now possible to fuse the images of two sensors, e.g. image intensifier and thermal camera. However, the fusion will cause a temporal delay between image acquisition and image presentation. The present study aims to investigate how people wearing indirect vision HMD (Head-Mounted Displays) perform a locomotion task in outdoor environment. To do so, individuals walked along a

tactical path through a wooden area in daylight and at night, as fast as they could, with or without an indirect vision HMD. We measured the time for the completion of the course and recorded the head movements. The time to complete the course increases when the individuals wear the HMD, meaning participants moved at reduced speed. The characteristics of head movements (head pitch, yaw angles and velocity, and head tilt angle from the vertical axis) are different between conditions. Overall, we find a change in gaze direction that may indicate an adaptative strategy based on the reduction of anticipation and an on-line visual control of locomotion. The present results show that the use of such indirect vision HMDs may decrease manoeuvring speed in complex environments. This result should be taken into account in the tactical scheme.

### **Does time pass and fly by relaxed with (de-)activating light? - Psychophysiological investigation of the impact of LED-technology on long-haul flights**

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The likelihood of achieving the destination after a long haul flight relaxed depends on many factors. In addition to seats, cabin climate, vibrations, turbulences and external influences on the flight, light in the aircraft cabin plays another important role. The use of activating lighting systems based on LED (Light Emitting Diode) could improve recreational and comfort values for passengers (PAXs) on long-haul flights. Warm white light e.g. promotes relaxation and comfort (wellbeing); the flight may become more comfortable for the passenger. Cold white light with a high proportion of blue has activating effects, the suppression of the amount of the sleep hormone melatonin is achieved. This could allow the passenger to reach the destination fitter and also counteract the jet lag. The validation study is to compare currently used cabin lighting with new technology based on LED. In the context of simulated long-haul flights variables to assess the stress and mood of 30 participants are covered multimodal (within-subject-design; 22.00 - 06.00 h). In addition to self-assessments and ratings by observers also automated mimic-based systems and psycho-neuroendocrine (salivary) measures are used. Beside video-based mimic detections video-based plethysmographic heart rate detection and video-based motion tracking to assess stress and comfort is carried out for the first time.

### **Do the goods at stake (human life versus the technical equipment) affect the willingness to take the risk of violating safety-relevant rules?**

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Violations are a problem for safety-critical organizations which need to trust in their workers' compliance with guidelines. In our prior experiments, subjects acting as production plant workers violated against safety-rules more often if they expect to fail to reach a targeted output (loss framing), although there was a 20% chance to cause a deflagration. Preparing a new series of experiments, we pretested whether subjects tend to behave in the same way even though they endanger residents' health instead of a deflagration.

Three cover stories with different "goods at stake" were developed and presented as an online study. Participants (n = 99) were asked to imagine being a production supervisor running a plant. Experimental conditions were risking (a) a deflagration, (b) that 20 people were slightly and (c) 20 people were seriously injured. Participants were randomly assigned to one of these scenarios.

Scenarios where people were injured were perceived as significantly more dramatic and emotionally touching. Additionally, there is a significantly stronger expression of reprehensibility of taken this kind of risk. Results suggest how possible risk accompanied by a violation should be communicated to employees, to activate social norms and to reduce the likelihood of violations.

### **Monitoring of processes and manipulation of process variables in the context of a multi-user setting in a traffic control room**

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Control rooms, such as those used for power generation and traffic control, are safety critical technical facilities for monitoring and controlling processes. Context-sensitive information is of vital importance to the monitoring of processes, but its incorporation in present-day user interfaces is inadequate. Taking a traffic control center as an example, this work proposes a holistic interaction concept for monitoring a complex network and manipulating process variables. For these main tasks operators generally have two display types at their disposal: large public displays showing the process being monitored, and small private displays showing detailed information on a particular section of the process and at the same time allowing process variables to be manipulated. Analysis revealed that such work environments do not provide any interlinking between the individual displays. While each private display is controlled by a single user, the public displays are used by more than one operator. The goal is to improve the navigation of the road network, the availability of context-sensitive information and the manipulation of process variables in the context of the multi-user setting in a traffic control centre. This is reached through the use of new interaction technologies like multi-touch tables and the reality based interaction paradigm.

### **User evaluation of the design and features of a military watch: A survey of active duty Canadian Military personnel**

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There are many examples of chronometers (watches) specifically designed for use by military personnel having a wide range of features and costs. In this study 350 Canadian military personnel on active duty in Afghanistan responded to an electronic survey about the features deemed most important in the design and acceptance of a watch. The survey examined physical construction features including the type of watch face, strap, and power source. Participants also rated the importance of 20 possible design features such as GPS capability, durability, water-resistance, self winding ability, and light-discipline features. They also made numerous written recommendations and suggestions. The results show strong preferences including construction from non-conductive high impact resistant material, water resistance (20 bars), dust resistance, and an unbreakable crystal face. The most important design features included multiple time zone capability, red-light illumination to preserve light discipline, an alarm capability, a mirrored back for use as a signal device, as well as a compass feature. GPS capability, and other "high tech" features did not generally receive high importance ratings. The study demonstrates the human factors involved in the acceptance of and features deemed most important by the end users of a military watch, active military personnel.

### **Precision of congestion warnings: Do drivers really need warnings with precise information about the congestion tail's position?**

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In a driving simulator with motion system, warnings were provided to N = 16 participants (25-72 years) en route to the tail of congestion. Two different kinds of congestion tails were simulated: surrounding traffic abruptly decelerates shortly vs. the speed of the surrounding traffic is gradually reduced before reaching the congestion tail. Additionally, the moment of the warnings' presentation ("3.5 km" vs. "1.5 km" vs. "0.3 km" prior to the congestion tail) and its content ("precise warning": distance to the congestion is indicated and updated regularly vs. "imprecise warning": without a clear distance indication) were varied. Furthermore, the tail was approached without any warning. During the whole simulator ride the drivers were asked to work on a secondary task (handling a menu system). Overall, precise warnings have greater effects on driving safety while approaching a congestion tail with surrounding traffic than imprecise warnings. The lowest driving safety was shown when approaching the congestion tail without any warning. Precise warnings in a distance of 1.5 km, which are preferred by the drivers, show the highest driving safety. The results are discussed in a technical context (e.g. Car-to-X communication). The presented study was funded by the Federal Highway Research Institute (bast, Germany).

### **Empirical study of effective information for preventing intentional risky driving behaviours**

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Risky driving behaviours often result in accidents. However, warnings about the risks have little effect on the prevention of these behaviours because drivers may believe that their driving is still safe. It may be also because the intentional risky driving is considered to be valued more greatly than the safe driving. According to the previous study on motivation, this study examined what information is effective for preventing intentional risky behaviours. We performed an experiment using a driving simulator aimed at measuring effects of the information to inhibit running through at the intersection when the lights turned red. Four types of the information were used to motivate drivers to stop at the intersection. Two of four types of information were related to extrinsic factors of the motivation such as reward and punishment. Thirdly, we used the information concerning the reputational motivational factors. Finally, feedbacks were provided to stimulate intrinsic motivational factors. Each of the information was auditory presented near the intersection. As a result, any information reduced the number of passing the intersection. However, the variation of the effects over time and the impacts of the absence of the information on driving were different among the type of the information.

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