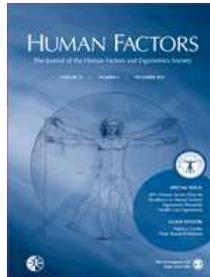# Human Factors – rok 2011, roč. 53

Číslo 4

ACCIDENTS, SAFETY AND HUMAN ERROR

Loïc Damm, Claudine Nachtergaële, Mohamed Meskali, Catherine Berthelon. *The Evaluation of Traditional and Early Driver Training With Simulated Accident Scenarios*. S. 323-337.

Objective: We assessed the driving skills of novice traditionally trained, novice early-trained, and experienced drivers to evaluate whether supervised early training could improve young drivers' skills. **Background:** The overall representation of young male drivers in car crashes is a recurrent problem in developed countries. To prevent this overrepresentation, France institutes an early driver training program from the age of 16 with the supervision of an adult. However, evidence of the positive effects of this system is still lacking. **Method:** Three groups of drivers (12 participants each) were confronted with five prototypical accident scenarios introduced in a simulated urban circuit. Drivers' response time, speed, and vehicle position in the lane were analyzed. **Results:** No difference was detected across groups regarding obstacle detection, as revealed by the analysis of response times. But in some unexpected scenarios, position control by traditionally trained drivers was more conservative than for more experienced drivers, and early-trained drivers were far more likely to respond with efficient evasive action. **Conclusion:** The exposure gained by an early training program could thus increase the development of visuomotor coordination and involve better skills in challenging situations. **Application:** The supplementary driving experience gained with the supervision of an adult during early training could promote the skills necessary to deal with risky situations. Driving simulators could be used to confront young drivers with a broad range of hazardous scenarios not commonly encountered in natural driving.

- ▪ **Keywords:** simulator, driving, training, young, novice, virtual reality, skill development, driver behavior, safety

ATTENTIONAL PROCESSES

Heather F. Neyedli, Justin G. Hollands, Greg A. Jamieson. *Beyond Identity: Incorporating System Reliability Information Into an Automated Combat Identification System*. S. 338-355.

Objective: The aim of this study was to evaluate display formats for an automated combat identification (CID) aid. **Background:** Verbally informing users of automation reliability improves reliance on automated CID systems. A display can provide reliability information in real time. **Method:** We developed and tested four visual displays that showed both target identity and system reliability information. Display type (pie, random

mesh) and display proximity (integrated, separated) of identity and reliability information were manipulated. In Experiment 1, participants used the displays while engaging targets in a simulated combat environment. In Experiment 2, participants briefly viewed still scenes from the simulation. **Results:** Participants relied on the automation more appropriately with the integrated display than with the separated display. Participants using the random mesh display showed greater sensitivity than those using a pie chart. However, in Experiment 2, the sensitivity effects were limited to lower reliability levels. **Conclusion:** The integrated display format and the random mesh display were the most effective displays tested. **Application:** We recommend the use of the integrated format and a random mesh display to indicate identity and reliability information with an automated CID system.

- **Keywords:** automation, combat identification, decision aids, integrated displays, proximity compatibility principle, reliance, simulation, signal detection theory, system reliability, visual attention, visual displays

AUTOMATION, EXPERT SYSTEMS

Stephanie M. Merritt. *Affective Processes in Human–Automation Interactions*. S. 356-370.

Objective: This study contributes to the literature on automation reliance by illuminating the influences of user moods and emotions on reliance on automated systems. **Background:** Past work has focused predominantly on cognitive and attitudinal variables, such as perceived machine reliability and trust. However, recent work on human decision making suggests that affective variables (i.e., moods and emotions) are also important. Drawing from the affect infusion model, significant effects of affect are hypothesized. Furthermore, a new affectively laden attitude termed *liking* is introduced. **Method:** Participants watched video clips selected to induce positive or negative moods, then interacted with a fictitious automated system on an X-ray screening task. At five time points, important variables were assessed including trust, liking, perceived machine accuracy, user self-perceived accuracy, and reliance. These variables, along with propensity to trust machines and state affect, were integrated in a structural equation model. **Results:** Happiness significantly increased trust and liking for the system throughout the task. Liking was the only variable that significantly predicted reliance early in the task. Trust predicted reliance later in the task, whereas perceived machine accuracy and user self-perceived accuracy had no significant direct effects on reliance at any time. **Conclusion:** Affective influences on automation reliance are demonstrated, suggesting that this decision-making process may be less rational and more emotional than previously acknowledged. **Application:** Liking for a new system may be key to appropriate reliance, particularly early in the task. Positive affect can be easily induced and may be a lever for increasing liking.

- **Keywords:** trust, reliance, emotions

BIOMECHANICS

Xu Xu, Chien-chi Chang, Gert S. Faber, Idsart Kingma, Jack T. Dennerlein. *The Validity and Interrater Reliability of Video-Based Posture Observation During Asymmetric Lifting Tasks*. S. 371-382.

Objective: The objective was to evaluate the validity and interrater reliability of a video-based posture observation method for the major body segment angles during asymmetric lifting tasks. **Background:** Observational methods have been widely used as an awkward-posture assessment tool for ergonomics studies. Previous research proposed a video-based posture observation method with estimation of major segment angles during lifting tasks. However, it was limited to symmetric lifting tasks. The current study

extended this method to asymmetric lifting tasks and investigated the validity and the interrater reliability. **Method:** Various asymmetric lifting tasks were performed in a laboratory while a side-view video camera recorded the lift, and the body segment angles were measured directly by a motion tracking system. For this study, 10 raters estimated seven major segment angles using a customized program that played back the video recording, thus allowing users to enter segment angles. The validity of estimated segment angles was evaluated in relation to measured segment angles. Interrater reliability was assessed among the raters. **Results:** For all the segment angles except trunk lateral bending, the estimated segment angles were strongly correlated with the measured segment angles ($r > .8$), and the intraclass correlation coefficient was greater than 0.75. **Conclusion:** The proposed observational method was able to provide a robust estimation of major segment angles for asymmetric lifting tasks based on side-view video clips. The estimated segment angles were consistent among raters. **Application:** This method can be used for assessing posture during asymmetric lifting tasks. It also supports developing a video-based rapid joint loading estimation method.

- ▪ **Keywords:** posture observation, asymmetric lifting tasks, side-view video, body segment angles

DISPLAYS AND CONTROLS

Jochen Müsseler, Eva-Maria Skottke. *Compatibility Relationships With Simple Lever Tools*. S. 383-390.

Objective: The study focuses on potential compatibility relationships when simple lever tools are used. **Background:** Spatial compatibility between stimuli and responses determines performance. However, many tasks require the use of simple tools, such as levers that transform hand movements into tool movements. We explore with such a tool whether and how the correspondence or noncorrespondence between stimulus-side and hand movement (stimulus-response compatibility), between stimulus-side and tool-effect movement (stimulus-effect compatibility), and/or between hand movement and tool-effect movement (response-effect compatibility) affects performance. **Method:** *U*-shaped and inverted-*U*-shaped levers were used as tools, allowing us to examine the contribution of each compatibility relationship to response times and errors without any confounds and omissions. **Results:** Responding was delayed and error prone when the hand movement and the movement of the effect point of the tool did not correspond. Effects of stimulus-response compatibility and stimulus-effect compatibility were observed only when the hand movement direction remained untransformed in the tool-effect movement. **Conclusion:** The results point out that the inversion or noninversion of tool-effect movements plays an underlying role when handling a tool. **Application:** Potential applications of this research include the prediction and possibly manipulation of unwanted behavioral tendencies in laparoscopic surgery and other lever movements.

- ▪ **Keywords:** SR compatibility, reaction time, stool use, sensorimotor transformation, laparoscopic surgery, teleoperation

MACROERGONOMICS AND THE ENVIRONMENT

Douglas P. Meador, Raymond R. Hill. *Modeling Training Effects Using a Human Performance Taxonomy*. S. 391-402.

Objective: The aim of this study was to characterize skill acquisition during training and skill retention as a function of training strategy, retention period, and task type in the form of a numerical model and then apply that model to make predictions of performance on an unknown task. **Background:** Complex systems require efficient and effective training programs for the humans who operate them in discontinuous fashion. Although there are several constructs for learning theory, models that enable analysts to predict

training outcomes are needed during the design of training programs. **Method:** This study involved 60 participants who were trained on five tasks relevant to RQ-1 Predator unmanned aircraft system sensor operators by one of three strategies that represented a continuum of instructor interactivity. After training, performance data for all five tasks were collected. Participants completed the same tasks 30 or 60 days later to determine skill retention and the rate at which task proficiency was reacquired. **Results:** Models built from tasks that isolate human performance channels adequately predicted performance on a task that combined those channels. **Conclusion:** Models that predict performance on tasks that isolate human performance channels can be used to make predictions on tasks that draw on multiple channels. This model provided a distribution of performance data that was statistically similar to actual performance data. **Application:** System designers trained with human performance data on a set of tasks can apply those tasks' characteristics to future tasks to make reasonably accurate performance predictions, thereby allowing the designers to make early decisions regarding training strategy to teach those tasks.

- ▪ **Keywords:** human performance modeling, learning curve, performance prediction, human performance channels, modeling and simulation, skill acquisition, skill retention, skill reacquisition, training strategy, retention interval

PSYCHOLOGICAL STATES AND NEUROERGONOMICS

R. Andy McKinley, Lindsey K. McIntire, Regina Schmidt, Daniel W. Repperger, John A. Caldwell. *Evaluation of Eye Metrics as a Detector of Fatigue*. **S. 403-414.**

Objectives: This study evaluated oculometrics as a detector of fatigue in Air Force–relevant tasks after sleep deprivation. Using the metrics of total eye closure duration (PERCLOS) and approximate entropy (ApEn), the relation between these eye metrics and fatigue-induced performance decrements was investigated. **Background:** One damaging effect to the successful outcome of operational military missions is that attributed to sleep deprivation-induced fatigue. Consequently, there is interest in the development of reliable monitoring devices that can assess when an operator is overly fatigued. **Method:** Ten civilian participants volunteered to serve in this study. Each was trained on three performance tasks: target identification, unmanned aerial vehicle landing, and the psychomotor vigilance task (PVT). Experimental testing began after 14 hr awake and continued every 2 hr until 28 hr of sleep deprivation was reached. **Results:** Performance on the PVT and target identification tasks declined significantly as the level of sleep deprivation increased. These performance declines were paralleled more closely by changes in the ApEn compared to the PERCLOS measure. **Conclusion:** The results provide evidence that the ApEn eye metric can be used to detect fatigue in relevant military aviation tasks. **Application:** Military and commercial operators could benefit from an alertness monitoring device.

- ▪ **Keywords:** fatigue, alertness, eye tracker, monitoring device, sleep deprivation

SIMULATION AND VIRTUAL REALITY

Behrang Keshavarz, Heiko Hecht. *Validating an Efficient Method to Quantify Motion Sickness*. **S. 415-426.**

Objective: Motion sickness (MS) can be a debilitating side effect associated with motion in real or virtual environments. We analyzed the effect of expectancy on MS and propose and validate a fast and simple MS measure. **Background:** Several questionnaires measure MS before or after stimulus presentation, but no satisfactory tool has been established to quickly capture MS data during exposure. To fill this gap, we introduce the Fast MS Scale (FMS), a verbal rating scale ranging from zero (*no sickness at all*) to 20

(*frank sickness*). Also, little is known about the role of expectancy effects in MS studies. We conducted an experiment that addressed this issue. **Method:** For this study, 126 volunteers participated in two experiments. During stimulus presentation, participants had to verbally rate the severity of MS every minute before filling in the Simulator Sickness Questionnaire (SSQ). To measure expectancy effects, participants were separated into three groups with either positive, negative, or neutral expectations. **Results:** We compared the verbal ratings with the SSQ scores. Pearson correlations were high for both the SSQ total score (*r* = .785) and the nausea subscore (*r* = .828). No expectancy effects were found. **Conclusion:** The FMS is a fast and valid method to obtain MS data. It offers the possibility to record MS during stimulus presentation and to capture its time course. We found expectancy not to play a crucial role in MS. However, the FMS has some limitations. **Application:** The FMS offers improved MS measurement. It is fast and efficient and can be performed online in environments such as virtual reality.