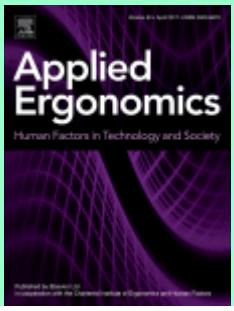
Applied Ergonomics - rok 2017, Volume 64

October 2017



Benjamin Noah, Jingwen Li, Ling Rothrock. *An evaluation of touchscreen versus keyboard/mouse interaction for large screen process control displays*. Pages 1-13.

he objectives of this study were to test the effect of interaction device on performance in a process control task (managing a tank farm). The study compared the following two conditions: a) 4K-resolution 55‟ screen with a 21” touchscreen versus b) 4K-resolution 55” screen with keyboard/mouse. The touchscreen acted both as an interaction device for data entry and navigation and as an additional source of information. A within-subject experiment was conducted among 20 college engineering students. A primary task of preventing tanks from overfilling as well as a secondary task of manual logging with situation awareness questions were designed for the study. Primary Task performance (including tank level at discharge, number of tank discharged and performance score), Secondary Task Performance (including Tank log count, performance score), system interaction times, subjective workload, situation awareness questionnaire, user experience survey regarding usability and condition comparison were used as the measures. Parametric data resulted in two metrics statistically different means between the two conditions: The 4K-keyboard condition resulted in faster Detection + Navigation time compared to the 4K-touchscreen condition, by about 2 s, while participants within the 4K-touchscreen condition were about 2 s faster in data entry than in the 4K-keyboard condition. No significant results were found for: performance on the secondary task, situation awareness, and workload. Additionally, no clear significant differences were found in the non-parametric data analysis. However, participants showed a slight preference for the 4K-touchscreen condition compared to the 4K-keyboard condition in subjective responses in comparing the conditions. Introducing the touchscreen as an additional/alternative input device showed to have an effect in interaction times, which suggests that proper design considerations need to be made. While having values shown on the interaction device provides value, a potential issue of visual distraction exists when having an additional visual display. The allocation of visual attention between primary displays and the touchscreen should be further investigated.

- **Keywords:** Touchscreen; Interaction method; Process control display; Touch input

N. Goode, P.M. Salmon, N.Z. Taylor, M.G. Lenné, C.F. Finch. *Developing a contributing factor classification scheme for Rasmussen's AcciMap: reliability and validity evaluation*. Pages 14-26.

One factor potentially limiting the uptake of Rasmussen's (1997) Accimap method by practitioners is the lack of a contributing factor classification scheme to guide accident analyses. This article evaluates the intra- and inter-rater reliability and criterion-referenced validity of a classification scheme developed to support the use of Accimap by led outdoor activity (LOA) practitioners. The classification scheme has two levels: the system level describes the actors, artefacts and activity context in terms of 14 codes; the descriptor level breaks the system level codes down into 107 specific contributing factors. The study involved 11 LOA practitioners using the scheme on two separate occasions to code a pre-determined list of contributing factors identified from four incident reports. Criterion-referenced validity was assessed by comparing the codes selected by LOA practitioners to those selected by the method creators. Mean intra-rater reliability scores at the system (M = 83.6%) and descriptor (M = 74%) levels were acceptable. Mean inter-rater reliability scores were not consistently acceptable for both coding attempts at the system level (MT1 = 68.8%; M T2 = 73.9%), and were poor at the descriptor level (MT1 = 58.5%; M T2 = 64.1%). Mean criterion referenced validity scores at the system level were acceptable (MT1 = 73.9%; M T2 = 75.3%). However, they were not consistently acceptable at the descriptor level (MT1 = 67.6%; M T2 = 70.8%). Overall, the results indicate that the classification scheme does not currently satisfy reliability and validity requirements, and that further work is required. The implications for the design and development of contributing factors classification schemes are discussed.

- **Keywords:** Systems thinking; Reliability; Validity; Incident classification

Siobhan M. Heiden, Richard J. Holden, Catherine A. Alder, Kunal Bodke, Malaz Boustani. *Human factors in mental healthcare: a work system analysis of a community-based program for older adults with depression and dementia*. Pages 27-40.

Mental healthcare is a critical but largely unexplored application domain for human factors/ergonomics. This paper reports on a work system evaluation of a home-based dementia and depression care program for older adults, the Aging Brain Care program. The Workflow Elements Model was used to guide data collection and analysis of 59 h of observation, supplemented by key informant input. We identified four actors, 37 artifacts across seven types, ten action categories, and ten outcomes including improved health and safety. Five themes emerged regarding barriers and facilitators to care delivery in the program: the centrality of relationship building; the use of adaptive workarounds; performance of duplicate work; travel and scheduling challenges; and communication-related factors. Findings offer new insight into how mental healthcare services are delivered in a community-based program and key work-related factors shaping program outcomes.

- **Keywords:** Mental health; Workflow Elements Model; Alzheimer's Disease; Dementia; Work system analysis; Field research

Verena Wagner, K. Wolfgang Kallus, Ulrich Foehl. *Dimensions of vehicle sounds perception*. Pages 41-46.

Vehicle sounds play an important role concerning customer satisfaction and can show another differentiating factor of brands. With an online survey of 1762 German and American customers, the requirement characteristics of high-quality vehicle sounds were determined. On the basis of these characteristics, a requirement profile was generated for every analyzed sound. These profiles were investigated in a second study with 78 customers using real vehicles. The assessment results of the vehicle sounds can be represented using the dimensions “timbre”, “loudness”, and “roughness/sharpness”. The comparison of the requirement profiles and the assessment results show that the sounds which are perceived as pleasant and high–quality, more often correspond to the requirement profile. High-quality sounds are characterized by the fact that they are

rather gentle, soft and reserved, rich, a bit dark and not too rough. For those sounds which are assessed worse by the customers, recommendations for improvements can be derived.

- **Keywords:** Sound perception; Vehicle sound; Customer assessments

Martine Annie Gilles, Jean-Charles Guélin, Kévin Desbrosses, Pascal Wild. *Motor adaptation capacity as a function of age in carrying out a repetitive assembly task at imposed work paces*. Pages 47-55.

The working population is getting older. Workers must adapt to changing conditions to respond to the efforts required by the tasks they have to perform. In this laboratory-based study, we investigated the capacities of motor adaptation as a function of age and work pace. Two phases were identified in the task performed: a collection phase, involving dominant use of the lower limbs; and an assembly phase, involving bi-manual motor skills. Results showed that senior workers were mainly limited during the collection phase, whereas they had less difficulty completing the assembly phase. However, senior workers did increase the vertical force applied while assembling parts, whatever the work pace. In younger and middle-aged subjects, vertical force was increased only for the faster pace. Older workers could adapt to perform repetitive tasks under different time constraints, but adaptation required greater effort than for younger workers. These results point towards a higher risk of developing musculoskeletal disorders among seniors.

- **Keywords:** Age; Work pace; Motor adaptation

P. Bazilinskyy, J.C.F. de Winter. *Analyzing crowdsourced ratings of speech-based take-over requests for automated driving*. Pages 56-64.

Take-over requests in automated driving should fit the urgency of the traffic situation. The robustness of various published research findings on the valuations of speech-based warning messages is unclear. This research aimed to establish how people value speech-based take-over requests as a function of speech rate, background noise, spoken phrase, and speaker's gender and emotional tone. By means of crowdsourcing, 2669 participants from 95 countries listened to a random 10 out of 140 take-over requests, and rated each take-over request on urgency, commandingness, pleasantness, and ease of understanding. Our results replicate several published findings, in particular that an increase in speech rate results in a monotonic increase of perceived urgency. The female voice was easier to understand than a male voice when there was a high level of background noise, a finding that contradicts the literature. Moreover, a take-over request spoken with Indian accent was found to be easier to understand by participants from India than by participants from other countries. Our results replicate effects in the literature regarding speech-based warnings, and shed new light on effects of background noise, gender, and nationality. The results may have implications for the selection of appropriate take-over requests in automated driving. Additionally, our study demonstrates the promise of crowdsourcing for testing human factors and ergonomics theories with large sample sizes.

- **Keywords:** Auditory displays; Autonomous driving; Speech perception; Human-automation interaction

Chiuhsiang J. Lin, Bereket H. Woldegiorgis. *Egocentric distance perception and performance of direct pointing in stereoscopic displays*. Pages 66-74.

In this study, the interaction performances and spatial perceptions in stereoscopic environments were investigated. The experiment compared direct user interactions during pointing at a target, which was continuously visible or presented briefly and disappeared, in both stereoscopic and real environments, at three parallax/depth levels. The position data, collected by a motion system, were used to compute accuracy, signed error, movement time, and throughput. The results showed inaccurate egocentric distance judgment in stereoscopic displays and accurate perceptions in the real world. The overall inaccuracy, which was overestimation of about 10 cm, was relatively better than that achieved in previous studies. The overestimation decreased as the egocentric distance increased. However, providing visual objects did not improve the accuracy. The study concluded that direct pointing could minimize the underestimation problems commonly reported in stereoscopic viewing studies and showed practical significance for developers to focus on incorporating more direct and natural human-virtual reality interactions for improved performance. The findings of this study provide insight towards the development of less expensive displays and their applications. Implications of this work and engineering solutions are also discussed.

- **Keywords:** Stereoscopic displays; Space perception; Direct pointing