

## **Ergonomics– rok 2010, ročník 53**

### **Číslo 5**



**C. Collet; A. Guillot; C. Petit. *Phoning while driving I : a review of epidemiological, psychological, behavioural and physiological studies.* Pages 589 – 601.**

The impact of cell (mobile) phone use on driving performance has been widely questioned for 20 years. This paper reviews the literature to evaluate the extent to which phoning may impact behaviour with a risk to affect safety. After analysing epidemiological studies that give an overview of cell phone use, this paper examines the experimental results and focuses on variables showing that driving is impacted by holding a mobile-phone conversation. Information processing (e.g. reaction time and detection rate of cues related to driving information) and variables associated with vehicle control (e.g. lane-keeping, headway and vehicle speed) seem the most relevant. Although less studied than behavioural indices, physiological data give information about the supplementary potential strain that the driver may undergo under dual-task conditions. This first part of the review highlights common findings, questionable results and differences among studies, which originate from specific experimental designs with particular dependent variables, i.e. self-report, behavioural and physiological indicators. Finally, how drivers try to compensate for the additional load brought by phone use is described. **Statement of Relevance:** The two papers review the influence of mobile-phone use on driving performance. While there is ample evidence that this dual task is likely to increase the risk of car crash, the review analyses the variables eliciting detrimental conditions and, conversely, those that may preserve acceptable conditions for safety, close to usual driving. The decision of answering or initiating a cell phone call while driving depends upon the complex interaction among several variables, including driving conditions and driver's own characteristics. In addition, this decision remains under driver's awareness of being able or not to manage the two tasks simultaneously.

- **Keywords:** cellular phone; distraction; driving; sharing attention

**C. Collet; A. Guillot; C. Petit. *Phoning while driving II : a review of driving conditions influence.* Pages 602 – 616.**

The first paper examined how the variables related to driving performance were impacted by the management of holding a phone conversation. However, the conditions under which this dual task is carried out are dependent upon a set of factors that may particularly influence the risk of crash. These conditions are defined by several

independent variables, classified into five main categories: i) legislation; ii) phone type (hands-free or hand-held); iii) drivers' features regarding age, gender, personal individual profile and driving experience; iv) conversation content (casual or professional) and its context (held with passengers or with a cell (mobile) phone); v) driving conditions (actual or simulated driving, road type, traffic density and weather). These independent variables determine the general conditions. The way in which these factors are combined and interact one with another thus determines the risk that drivers undergo when a cell phone is used while driving. Finally, this review defined the general conditions of driving for which managing a phone conversation is likely to elicit a high risk of car crash or, conversely, may provide a situation of lower risk, with sufficient acceptance to ensure safety.

- **Keywords:** cell phone; distraction; driving; review; sharing attention

**Daniel P. Jenkins; Paul M. Salmon; Neville A. Stanton; Guy H. Walker. *A new approach for designing cognitive artefacts to support disaster management. Pages 617 – 635.***

The public display of information is not a new phenomenon; whiteboards (and blackboards before them) have commonly been used to share information. Once annotated, these collaborative information sources have clear benefits for cognition, reducing the burden on short-term memory and supporting parallel processing. This paper introduces a structured approach for considering the design and development of these cognitive artefacts with the aim of enhancing system performance. To illustrate this approach, a case study of military support to large-scale civilian emergencies is used. Using the introduced process, a number of displays are developed supporting individual and shared understanding of the domain, enhancing the crisis planning and management process. The case study demonstrates how the proposed structured approach can inform the designer and lead to domain specific designs. A clear trail can be plotted between the analysis of the domain and the development of the cognitive artefacts. **Statement of Relevance:** This paper presents a generic approach for the design of cognitive artefacts to enhance system performance. Illustrated by a case study, it is contended that the approach, and adaptations of it, are applicable to supporting the design of information aids for a wide range of complex domains.

- **Keywords:** cognitive artefacts; cognitive work analysis; collaborative working; multi-agency

**Kyeong-Ah Jeong; Gavriel Salvendy; Robert W. Proctor. *Smart home design and operation preferences of Americans and Koreans. Pages 636 – 660.***

The purpose of the present study was to generate both culture-specific and universal design and operational guidelines for smart homes. Questionnaire surveys were performed in the USA and South Korea to collect data on preferences for various aspects of the design and operation of smart homes. The factors that the survey participants considered most important were derived through factor analyses of the survey data and the responses of Americans and Koreans were compared to generate culture-specific guidelines. The five factors derived were: 1) environmental connection and control; 2) smart devices (appliances) and their control; 3) physical safety and security concerns; 4) comfort and relaxation issues; 5) control restriction issues. The two cultures showed different preference structures with statistical significance for all five factors. Prediction capability of the derived factors was also examined through multiple regressions for buying intention, interest, self-vision of living, moving intention, living satisfaction and perceived time and effort savings. 'Environmental connection and control' and 'smart devices (appliances) and their control' seemed to be the most influential factors for Americans and Koreans, respectively. **Statement of Relevance:** Analysis of a survey of

design and operational preferences for smart homes yielded five factors on which US and South Korean respondents differed. These factors form the basis for culture-specific guidelines, which, along with universal guidelines, should be followed in design of user-centred smart homes.

- **Keywords:** cross-cultural survey; culture; smart home; user-centred design

**Ziqing Zhuang; Stacey Benson; Dennis Viscusi. *Digital 3-D headforms with facial features representative of the current US workforce. Pages 661 – 671.***

Existing headforms are based on anthropometric data collected over 30 years ago. In 2003, the National Institute for Occupational Safety and Health conducted an anthropometric survey of 3997 respirator users, of which 1013 subjects were scanned with a Cyberware 3-D Rapid Digitizer. The objective of this study was to create headforms representative of the current US workforce. Ten facial dimensions relevant to respirator fit were chosen for defining a principal component analysis model, which divides the user population into five face-size categories. Mean facial dimensions were then computed to target the ideal facial dimensions for each size category. Five scans in each category were chosen and averaged to construct a representative headform for each size category. Five digital 3-D headforms were developed: small, medium, large, long/narrow and short/wide. All dimensions are within 3 mm of the computed means for the sample population in each size category. **Statement of Relevance:** This manuscript describes a new approach to constructing headforms that takes into account the facial form (size and shape) of the US workforce. These headforms could be incorporated into respirator research, certification standards and design in efforts to reduce the risk of injury or illness caused by inhalation hazards.

- **Keywords:** anthropometrics; facial dimensions; headforms; respirator; sizing

**Leon Straker; Amity Campbell; Jemma Coleman; Marina Ciccarelli; Wim Dankaerts. *In vivo laboratory validation of the physiometer : a measurement system for long-term recording of posture and movements in the workplace. Pages 672 – 684.***

Posture and movement are thought to be important risk factors for the development of work-related musculoskeletal disorders. Whole day occupational exposure assessment has typically used self-report or observation techniques, but the need for more accurate measurement is now recognised. The aim of this study was to compare the kinematic recordings of a frequently used field system (physiometer) with two laboratory-based systems (Fastrak and Peak) *in vivo*. Head, thorax and right arm kinematics were recorded simultaneously by the three systems whilst a subject performed 27 single and multiple plane physiological and simulated daily living task movement trials. Errors observed in the Fastrak and Peak data included gimbal lock and quadrant errors. Physiometer data errors included undervalues, overvalues and temporal errors of slow response and resonance. All three systems showed some cross-talk. Agreement between the physiometer and the other systems was generally high for physiological movements ( $R^2 > 0.8$ ) and less for functional movements ( $R^2 > 0.5$ ). **Statement of Relevance:** The physiometer recording device can provide an indication of posture across time in the workplace; however, its accuracy is limited, particularly during functional movements. Further technology should be developed to unobtrusively capture accurate all day 3-D kinematics.

- **Keywords:** field based; in vivo; motion analysis; posture assessment; validity

**Heather L. Butler; Cheryl L. Hubley-Kozey; John W. Kozey. *Characterisation of trunk muscle activation amplitude patterns during a simulated checkstand operation with continuously changing flexor and lateral moment demands.* Pages 685 – 695.**

While the typical physical exposure to modern-day workers has changed from heavy to low level repetitive demands, there is limited research that examines light occupations. This study examined trunk muscle recruitment strategies in response to a simulated checkout operation. Surface electromyography and kinematic variables were recorded from 29 healthy subjects. Four principal patterns accounted for 95.3% of the variation. Significant differences in scores captured different strategies in response to reach conditions and external moment directions. Synergistic co-activation of ipsilateral back sites and differential activation among external oblique and erector spinae sites suggests that the central nervous system may control different regions of the trunk musculature to optimally account for asymmetrical demands. The strategy between the internal oblique and back extensor sites suggests that a specific co-activation strategy may be needed during lighter work. During low-load occupational tasks, several recruitment strategies were required to maintain spinal stability and account for changing external moments.

**Statement of Relevance:** Different recruitment strategies found in response to changing external moments offer new insights into neuromuscular control for lighter work. Specifically, multiple trunk muscle sites interact in a complex manner, taking into account task specificity and individual variation that are valuable in workstation design, evaluating injury risk and estimating spinal loads.

- **Keywords:** activation amplitude patterns; checkstand operations; lifting; pattern recognition; trunk muscle

**R. J. Jack; M. Oliver; J. P. Dickey; S. Cation; G. Hayward; N. Lee-Shee. *Six-degree-of-freedom whole-body vibration exposure levels during routine skidder operations.* Pages 696 – 715.**

This research focuses on quantifying six-degree-of-freedom (6-DOF) whole-body vibration (WBV) exposure levels that occur in Northern Ontario skidders during routine field operating tasks. 6-DOF vibration running root-mean-square (RMS) acceleration levels at the operator/seat interface were determined for eight skidders while driving loaded, driving unloaded, picking up a load, dropping off a load and ploughing logs under field operating conditions. The acceleration data were weighted in accordance with ISO 2631-1:1997 and evaluated for both health and comfort outcomes. The mean running RMS weighted translational and rotational accelerations all exceeded  $0.36 \text{ m/s}^2$  and  $0.14 \text{ rad/s}^2$ . The greatest average accelerations occurred while driving unloaded with this condition displaying translational vibration total values (VTV) that exceeded the upper limit of the ISO 2631-1:1997 health caution zone within an average of 2.3 h. Utilizing 6-DOF VTV, virtually all operating conditions would be designated as uncomfortable.

**Statement of Relevance:** This study provides one of the most comprehensive reports on vibration exposures in seated vehicle operators. The results are geared towards ergonomists with discussions on health effects and measurement concerns, while providing the raw vibration exposure data that will be useful to vehicle, component and vibration sensor designers.

- **Keywords:** acceleration exposures; musculoskeletal disorders; vehicle ergonomics; whole-body vibration

**Chuansi Gao; Kalev Kuklane; Ingvar Holmér. *Cooling vests with phase change material packs: the effects of temperature gradient, mass and covering area.* Pages 716 – 723.**

Phase change material (PCM) absorbs or releases latent heat when it changes phases, making thermal-regulated clothing possible. The objective of this study was to quantify the relationships between PCM cooling rate and temperature gradient, mass and covering area on a thermal manikin in a climatic chamber. Three melting temperatures (24, 28, 32°C) of the PCMs, different mass, covering areas and two manikin temperatures (34 and 38°C) were used. The results showed that the cooling rate of the PCM vests tested is positively correlated with the temperature gradient between the thermal manikin and the melting temperature of the PCMs. The required temperature gradient is suggested to be greater than 6°C when PCM vests are used in hot climates. With the same temperature gradient, the cooling rate is mainly determined by the covering area. The duration of the cooling effect is dependent on PCM mass and the latent heat. **Statement of Relevance:** The study of factors affecting the cooling rate of personal cooling equipment incorporated with PCM helps to understand cooling mechanisms. The results suggest climatic conditions, the required temperature gradient, PCM mass and covering area should be taken into account when choosing personal PCM cooling equipment.

- **Keywords:** cooling rate; covering area; mass; phase change material; temperature gradient