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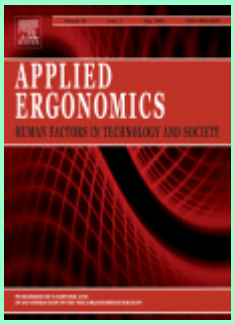

Stefanie Hensler, Daniel B. Herren, Miriam Marks. *New technical design of food packaging makes the opening process easier for patients with hand disorders*. Pages 1-7.

Opening packaged food is a complex daily activity carried out worldwide. Peelable packaging, as used for cheese or meat, causes real problems for many consumers, especially elderly people and those with hand disorders. Our aim was to investigate the possibility of producing meat packaging that is easier for patients with hand disorders to open. One hundred patients with hand osteoarthritis were asked to open a meat package currently available in supermarkets (Type A) and a modified, newly designed version (Type B), and rate their experiences with a consumer satisfaction index (CSI). The mean CSI of the Type B packs was 68.9%, compared with 41.9% for Type A (p < 0.0001). These results show that manufacturers today can produce easy-to-open food packages that afford greater consumer satisfaction. Such future packaging would benefit not only people with hand disorders but also the population as a whole.

- **Keywords:** Food packaging; Activities of daily living; Consumer satisfaction

Kai-Chieh Lin, Chih-Fu Wu. *Practicing universal design to actual hand tool design proces*. Pages 8-18.

UD evaluation principles are difficult to implement in product design. This study proposes a methodology for implementing UD in the design process through user participation. The original UD principles and user experience are used to develop the evaluation items. Difference of product types was considered. Factor analysis and Quantification theory type I were used to eliminate considered inappropriate evaluation items and to examine the relationship between evaluation items and product design factors. Product design specifications were established for verification. The results showed that converting user evaluation into crucial design verification factors by the generalized evaluation scale based on product attributes as well as the design factors applications in product design can improve users' UD evaluation. The design process of this study is expected to contribute to user-centered UD application.

- **Keywords:** User participation; Product design process; Universal design (UD)

Angela Weber Righi, Tarcisio Abreu Saurin. *Complex socio-technical systems : characterization and management guidelines*. Pages 19-30.

Although ergonomics has paid increasing attention to the perspective of complexity, methods for its operationalization are scarce. This study introduces a framework for the operationalization of the "attribute view" of complexity, which involves: (i) the delimitation of the socio-technical system (STS); (ii) the description of four complexity attributes, namely a large number of elements in dynamic interactions, a wide diversity of elements, unexpected variability, and resilience; (iii) the assessment of six management guidelines, namely design slack, give visibility to processes and outcomes, anticipate and monitor the impacts of small changes, monitor the gap between prescription and practice, encourage diversity of perspectives when making decisions, and create an environment that supports resilience; and (iv) the identification of leverage points for improving the STS design, based on both the analysis of relationships among the attributes and their classification as irreducible/manageable complexity, and liability/asset. The use of the framework is illustrated by the study of an emergency department of a University hospital. Data collection involved analysis of documents, observations of work at the front-line, interviews with employees, and the application of questionnaires.

- **Keywords:** Complexity; Socio-technical systems; Emergency department

Flore Barcellini, Lorène Prost, Marianne Cerf. *Designers' and users' roles in participatory design : what is actually co-designed by participants?* Pages 31-40.

This research deals with an analysis of forms of participation in a participatory design (PD) process of a software that assesses the sustainability of agricultural cropping systems. We explore the actual forms of participation of designers and users by adapting an Actual Role Analysis in Design approach (Barcellini et al., 2013) to capture the levels of abstraction (conceptual, functional and operational) of participants' discussions. We show that: (1) the process does not only concern the design of the artifact itself, but also the design of the concept of sustainability; (2) all participants (users & designers) have a role in co-designing the concept (in our case, sustainability); (3) some roles and profiles are key to this co-design. We discuss our contributions to both the research and the practices of participatory design. These contributions deal with the production of a method and related knowledge about actual activities in participatory design situations. They may support the development of relevant training programs regarding participatory situations, or be reflexive activities that can help those who are involved in designing and leading in participatory situations, to make improvements.

- **Keywords:** Participatory design; Sustainable agriculture; Roles

Julien Tardieu, Nicolas Misdariis, Sabine Langlois, Pascal Gaillard, Céline Lemercier. *Sonification of in-vehicle interface reduces gaze movements under dual-task condition*. Pages 41-49.

In-car infotainment systems (ICIS) often degrade driving performances since they divert the driver's gaze from the driving scene. Sonification of hierarchical menus (such as those found in most ICIS) is examined in this paper as one possible solution to reduce gaze movements towards the visual display. In a dual-task experiment in the laboratory, 46 participants were requested to prioritize a primary task (a continuous target detection task) and to simultaneously navigate in a realistic mock-up of an ICIS, either sonified or not. Results indicated that sonification significantly increased the time spent looking at the primary task, and significantly decreased the number and the duration of gaze saccades towards the ICIS. In other words, the sonified ICIS could be used nearly exclusively by ear. On the other hand, the reaction times in the primary task were increased in both silent and sonified conditions. This study suggests that sonification of secondary tasks while driving could improve the driver's visual attention of the driving scene.

- **Keywords:** Sonification; Dual-task; Eye-tracking

Jen-Fang Yu, Kun-Che Lee, Ren-Hung Wang, Yen-Sheng Chen, Chun-Chieh Fan, Ying-Chin Peng, Tsung-Hsien Tu, Ching-I. Chen, Kuei-Yi Lin. *Anthropometry of external auditory canal by non-contactable measurement*. Pages 50-55.

Human ear canals cannot be measured directly with existing general measurement tools. Furthermore, general non-contact optical methods can only conduct simple peripheral measurements of the auricle and cannot obtain the internal ear canal shape-related measurement data. Therefore, this study uses the computed tomography (CT) technology to measure the geometric shape of the ear canal and the shape of the ear canal using a non-invasive method, and to complete the anthropometry of external auditory canal. The results of the study show that the average height and width of ear canal openings, and the average depth of the first bend for men are generally longer, wider and deeper than those for women. In addition, the difference between the height and width of the ear canal opening is about 40% (p < 0.05). Hence, the circular cross-section shape of the earplugs should be replaced with an elliptical cross-section shape during manufacturing for better fitting.

- **Keywords:** External auditory canal; Computed tomography; Anthropometry

Steven Visser, Gert S. Faber, Marco J.M. Hoozemans, Henk F. van der Molen, P. Paul F.M. Kuijer, Monique H.W. Frings-Dresen, Jaap H. van Dieën. *Lumbar compression forces while lifting and carrying with two and four workers*. Pages 56-61.

Team lifting and carrying is advised when loads exceed 25 kg and mechanical lifting is not feasible. The aim of this study was to assess mean, maximum and variability of peak lumbar compression forces which occur daily at construction sites. Therefore, 12 ironworkers performed 50-kg two-worker and 100-kg four-worker lifting and carrying tasks in a laboratory experiment. The 50-kg two-worker lifts resulted in significantly higher mean (Δ 537 N) and maximum (Δ 586 N) peak lumbar compression forces compared with the 100-kg four-worker lifts. The lowest mean and maximum peak lumbar compression forces were found while carrying on level ground and increased significantly when stepping over obstacles and up platforms. Lifting 100 kg with four workers in a rectangular line up resulted in lower compression forces compared with lifting 50 kg with two workers standing next to each other. When loads are carried manually routes should be free of any obstacles to be overcome.

- **Keywords:** Team lifting; Team carrying; Compression force

Brennan J. Thompson, Eric D. Ryan, Eric J. Sobolewski. *The influence of occupation and age on maximal and rapid lower extremity strength*. Pages 62-67.

The aims of this study were to 1) examine the influence of age and occupation on maximal and rapid strength of the lower-extremity muscles and 2) examine the relationship between maximal and rapid strength and physical workload (work index (WI)) in the blue-collar (BC) cohort. Peak torque (PT) and peak rate of torque development (peakRTD) of the leg extensors (LE), leg flexors (LF), and plantar flexors (PF) were assessed in 47 young (age = 24.1 ± 2.4 years) and 41 middle-aged (52.4 ± 5.2 years) white-collar (WC) and BC men. Middle-aged workers exhibited lower PT for all muscles, and peakRTD for the LF and PF muscles. A positive relationship (r = 0.59; P < 0.01) was observed between WI and peakRTD for the PF in the young BC workers, however, this relationship was negative (r = −0.45; P = 0.053) for the LF of

the middle-aged BC workers. Lowering physical work demands and/or incorporating effective health-related practices for employees may be appealing strategies to enhance aging workers' productivity and longevity in the workforce.

- **Keywords:** Rate of force development; Blue collar; Aging

Ahmet Kolus, Daniel Imbeau, Philippe-Antoine Dubé, Denise Dubeau. *Adaptive neuro-fuzzy inference systems with k-fold cross-validation for energy expenditure predictions based on heart rate*. Pages 68-78.

This paper presents a new model based on adaptive neuro-fuzzy inference systems (ANFIS) to predict oxygen consumption (V ˙ O 2) from easily measured variables. The ANFIS prediction model consists of three ANFIS modules for estimating the Flex–HR parameters. Each module was developed based on clustering a training set of data samples relevant to that module and then the ANFIS prediction model was tested against a validation data set. Fifty-eight participants performed the Meyer and Flenghi step-test, during which heart rate (HR) and V ˙ O 2 were measured. Results indicated no significant difference between observed and estimated Flex–HR parameters and between measured and estimated V ˙ O 2 in the overall HR range, and separately in different HR ranges. The ANFIS prediction model (MAE = 3 ml kg−1 min−1) demonstrated better performance than Rennie et al.'s (MAE = 7 ml kg−1 min−1) and Keytel et al.'s (MAE = 6 ml kg−1 min−1) models, and comparable performance with the standard Flex–HR method (MAE = 2.3 ml kg−1 min−1) throughout the HR range. The ANFIS model thus provides practitioners with a practical, cost- and time-efficient method for V ˙ O 2 estimation without the need for individual calibration.

- **Keywords:** Flex–HR method; Physical workload; Adaptive neuro-fuzzy inference system (ANFIS)

Eva Garcia-Lopez, Antonio Garcia-Cabot, Luis de-Marcos. *An experiment with content distribution methods in touchscreen mobile devices*. Pages 79-86.

This paper compares the usability of three different content distribution methods (scrolling, paging and internal links) in touchscreen mobile devices as means to display web documents. Usability is operationalized in terms of effectiveness, efficiency and user satisfaction. These dimensions are then measured in an experiment (N = 23) in which users are required to find words in regular-length web documents. Results suggest that scrolling is statistically better in terms of efficiency and user satisfaction. It is also found to be more effective but results were not significant. Our findings are also compared with existing literature to propose the following guideline: "try to use vertical scrolling in web pages for mobile devices instead of paging or internal links, except when the content is too large, then paging is recommended". With an ever increasing number of touchscreen web-enabled mobile devices, this new guideline can be relevant for content developers targeting the mobile web as well as institutions trying to improve the usability of their content for mobile platforms.

- **Keywords:** Mobile usability; Empirical study; Scrolling

Steven A. Lavender, Jay P. Mehta, Glenn E. Hedman, Sanghyun Park, Paul A. Reichelt, Karen M. Conrad. *Evaluating the physical demands when using sled-type stair descent devices to evacuate mobility-limited occupants from high-rise buildings*. Pages 87-97.

The physical demands on evacuators were investigated when using different types of sled-type stair descent devices designed for the emergency evacuation of high rise

buildings. Twelve firefighters used six sled-type stair descent devices during simulated evacuations. The devices were evaluated under two staircase width conditions (1.12, and 1.32 m). Dependent measures included electromyographic (EMG) data, heart rates, Borg Scale ratings, and descent velocities. All stair descent speeds were below those reported during pedestrian egress trials. With the exception of the inflatable device, the devices operated by two evacuators had higher descent speeds than those operated by a single evacuator. High friction materials under the sleds facilitated control and reduced the muscle demands on stairs but increased physical demands on the landings. Usability assessments found devices with shorter overall lengths had fewer wall contacts on the landing, and handles integrated in the straps were preferred by the evacuators.

- **Keywords:** EMS/firefighter; Healthcare facility evacuation; Evacuating individuals with dissabilities

David M. Kietrys, Michael J. Gerg, Jonathan Dropkin, Judith E. Gold. *Mobile input device type, texting style and screen size influence upper extremity and trapezius muscle activity, and cervical posture while texting*. Pages 98-104.

This study aimed to determine the effects of input device type, texting style, and screen size on upper extremity and trapezius muscle activity and cervical posture during a short texting task in college students. Users of a physical keypad produced greater thumb, finger flexor, and wrist extensor muscle activity than when texting with a touch screen device of similar dimensions. Texting on either device produced greater wrist extensor muscle activity when texting with 1 hand/thumb compared with both hands/thumbs. As touch screen size increased, more participants held the device on their lap, and chose to use both thumbs less. There was also a trend for greater finger flexor, wrist extensor, and trapezius muscle activity as touch screen size increased, and for greater cervical flexion, although mean differences for cervical flexion were small. Future research can help inform whether the ergonomic stressors observed during texting are associated with musculoskeletal disorder risk.

- **Keywords:** Text messaging; Ergonomic exposure; SMS (short message service)

Marta Pereira, Matthias Beggiato, Tibor Petzoldt. *Use of adaptive cruise control functions on motorways and urban roads : changes over time in an on-road study*. Pages 105-112.

The study aimed at investigating how drivers use Adaptive Cruise Control and its functions in distinct road environments and to verify if changes occur over time. Fifteen participants were invited to drive a vehicle equipped with a Stop & Go Adaptive Cruise Control system on nine occasions. The course remained the same for each test run and included roads on urban and motorway environments. Results showed significant effect of experience for ACC usage percentage, and selection of the shortest time headway value in the urban road environment. This indicates that getting to know a system is not a homogenous process, as mastering the use of all the system's functions can take differing lengths of time in distinct road environments. Results can be used not only for the development of the new generation of systems that integrate ACC functionalities but also for determining the length of training required to operate an ACC system.

- **Keywords:** Changes in behaviour; In-vehicle systems; On-road study

Latif Al-Hakim, Nick Sevdalis, Tanaphon Maiping, Damrongpan Watanachote, Shomik Sengupta, Charuspong Dissaranan. *Human error*

***identification for laparoscopic surgery : development of a motion economy perspective*. Pages 113-125.**

This study postulates that traditional human error identification techniques fail to consider motion economy principles and, accordingly, their applicability in operating theatres may be limited. This study addresses this gap in the literature with a dual aim. First, it identifies the principles of motion economy that suit the operative environment and second, it develops a new error mode taxonomy for human error identification techniques which recognises motion economy deficiencies affecting the performance of surgeons and predisposing them to errors. A total of 30 principles of motion economy were developed and categorised into five areas. A hierarchical task analysis was used to break down main tasks of a urological laparoscopic surgery (hand-assisted laparoscopic nephrectomy) to their elements and the new taxonomy was used to identify errors and their root causes resulting from violation of motion economy principles. The approach was prospectively tested in 12 observed laparoscopic surgeries performed by 5 experienced surgeons. A total of 86 errors were identified and linked to the motion economy deficiencies. Results indicate the developed methodology is promising. Our methodology allows error prevention in surgery and the developed set of motion economy principles could be useful for training surgeons on motion economy principles.

- **Keywords:** Human error identification technique; Motion economy; Laparoscopic surgery

Huey-Min Sun, Shang-Phone Li, Yu-Qian Zhu, Bo Hsiao. *The effect of user's perceived presence and promotion focus on usability for interacting in virtual environments*. Pages 126-132.

Technological advance in human–computer interaction has attracted increasing research attention, especially in the field of virtual reality (VR). Prior research has focused on examining the effects of VR on various outcomes, for example, learning and health. However, which factors affect the final outcomes? That is, what kind of VR system design will achieve higher usability? This question remains largely. Furthermore, when we look at VR system deployment from a human–computer interaction (HCI) lens, does user's attitude play a role in achieving the final outcome? This study aims to understand the effect of immersion and involvement, as well as users' regulatory focus on usability for a somatosensory VR learning system. This study hypothesized that regulatory focus and presence can effectively enhance user's perceived usability. Survey data from 78 students in Taiwan indicated that promotion focus is positively related to user's perceived efficiency, whereas involvement and promotion focus are positively related to user's perceived effectiveness. Promotion focus also predicts user satisfaction and overall usability perception.

- **Keywords:** Presence; Promotion focus; Virtual reality

Göran M. Hägg, Lotta Runeson. *Adapting the force characteristics of a staple gun to the human hand*. Pages 133-138.

Three prototype staple guns with modified force characteristics were compared with a commercially available standard staple gun with a linearly increasing force resistance during squeezing. The force characteristics of the prototypes were more or less adapted to the force characteristics of the human hand, and in one of the staple guns the general force level was also reduced by one third. Evaluation instruments were electromyography of the forearm flexors and extensors, subjective rating of forearm exertion and subjects' free comments about the four tools. Twelve professional craftsmen were recruited as test subjects. The results show significantly lower readings for two of the three prototypes compared with the standard gun in electromyography as well as subjective ratings. The squeezing times are also reduced for two of the prototypes. It is concluded that the

choice of force characteristics of a staple gun is important both to minimize forearm muscular exertion and to increase tool efficiency.

- **Keywords:** Hand; Repetitive work; Tool

Giulia Liberati, Alessia Pizzimenti, Luca Simione, Angela Riccio, Francesca Schettini, Maurizio Inghilleri, Donatella Mattia, Febo Cincotti. *Developing brain-computer interfaces from a user-centered perspective: Assessing the needs of persons with amyotrophic lateral sclerosis, caregivers, and professionals*. Pages 139-146.

By focus group methodology, we examined the opinions and requirements of persons with ALS, their caregivers, and health care assistants with regard to developing a brain-computer interface (BCI) system that fulfills the user's needs. Four overarching topics emerged from this analysis: 1) lack of information on BCI and its everyday applications; 2) importance of a customizable system that supports individuals throughout the various stages of the disease; 3) relationship between affectivity and technology use; and 4) importance of individuals retaining a sense of agency. These findings should be considered when developing new assistive technology. Moreover, the BCI community should acknowledge the need to bridge experimental results and its everyday application.

- **Keywords:** Amyotrophic lateral sclerosis; Brain-computer interfaces; User-centered approach

Ana Francisca Rozin Kleiner, Manuela Galli, Aline Araujo do Carmo, Ricardo M.L. Barros. *Effects of flooring on required coefficient of friction : elderly adult vs. middle-aged adult barefoot gait*. Pages 147-152.

The aim of this study was to investigate the effect of flooring on barefoot gait according to age and gender. Two groups of healthy subjects were analyzed: the elderly adult group (EA; 10 healthy subjects) and the middle-aged group (MA; 10 healthy subjects). Each participant was asked to walk at his or her preferred speed over two force plates on the following surfaces: 1) homogeneous vinyl (HOV), 2) carpet, 3) heterogeneous vinyl (HTV) and 4) mixed (in which the first half of the pathway was covered by HOV and the second by HTV). Two force plates (Kistler 9286BA) embedded in the data collection room floor measured the ground reaction forces and friction. The required coefficient of friction (RCOF) was analyzed. For the statistical analysis, a linear mixed-effects model for repeated measures was performed. During barefoot gait, there were differences in the RCOF among the flooring types during the heel contact and toe-off phases. Due to better plantar proprioception during barefoot gait, the EA and MA subjects were able to distinguish differences among the flooring types. Moreover, when the EA were compared with the MA subjects, differences could be observed in the RCOF during the toe-off phase, and gender differences in the RCOF could also be observed during the heel contact phase in barefoot gait.

- **Keywords:** Gait; Elderly; Barefoot

Neil Mansfield, George Sammonds, Linh Nguyen. *Driver discomfort in vehicle seats : effect of changing road conditions and seat foam composition*. Pages 153-159.

Discomfort in vehicle seats is a multi-factorial problem with contributions occurring from effects of sitting duration, seat design, and the dynamic environment to which the occupant is exposed. This paper reports laboratory studies investigating the extent to which reports of discomfort are affected by vibration commencing or ceasing, and whether methods of assessment are sensitive enough to detect small changes in foam

composition. Study 1 measured discomfort ratings for two conditions of 60 min each, comprising 30 min of vibration exposure followed by 30 min of static sitting in a car seat, and vice-versa. Study 2 measured discomfort ratings for three conditions over a period of 40 min each, whilst participants were sitting in one of two car seat compositions, and either exposed to vibration or not. In both studies participants operated a driving simulator. It is shown that exposure to vibration increases the rate of discomfort onset in comparison to periods of static sitting. When vibration stopped, there was an acute improvement in comfort but discomfort did not drop to the levels reported by those who had been unexposed. When vibration started after 30 min of static sitting, there was an acute increase in discomfort but not to the levels reported by those who had been exposed to 30 min of vibration. After 40 min of continuous exposure it was possible to detect significant differences in overall discomfort between the two seat compositions, although trends could be observed in less time.

- **Keywords:** Comfort; Vibration; Driving

Krista Hoffmeister, Alyssa Gibbons, Natalie Schwatka, John Rosecrance. *Ergonomics Climate Assessment : a measure of operational performance and employee well-being*. Pages 160-169.

Ergonomics interventions have the potential to improve operational performance and employee well-being. We introduce a framework for ergonomics climate, the extent to which an organization emphasizes and supports the design and modification of work to maximize both performance and well-being outcomes. We assessed ergonomics climate at a large manufacturing facility twice during a two-year period. When the organization used ergonomics to promote performance and well-being equally, and at a high level, employees reported less work-related pain. A larger discrepancy between measures of operational performance and employee well-being was associated with increased reports of work-related pain. The direction of this discrepancy was not significantly related to work-related pain, such that it didn't matter which facet was valued more. The Ergonomics Climate Assessment can provide companies with a baseline assessment of the overall value placed on ergonomics and help prioritize areas for improving operational performance and employee well-being.

- **Keywords:** Ergonomics climate; Well-being; Performance

S.M. Van Niekerk, S.M. Fourie, Q.A. Louw. *Postural dynamism during computer mouse and keyboard use : a pilot study*. Pages 170-176.

Prolonged sedentary computer use is a risk factor for musculoskeletal pain. The aim of this study was to explore postural dynamism during two common computer tasks, namely mouse use and keyboard typing. Postural dynamism was described as the total number of postural changes that occurred during the data capture period. Twelve participants were recruited to perform a mouse and a typing task. The data of only eight participants could be analysed. A 3D motion analysis system measured the number of cervical and thoracic postural changes as well as, the range in which the postural changes occurred. The study findings illustrate that there is less postural dynamism of the cervical and thoracic spinal regions during computer mouse use, when compared to keyboard typing.

- **Keywords:** Sitting posture; Computer use; Postural dynamism

S. Del Ferraro, S. Iavicoli, S. Russo, V. Molinaro. *A field study on thermal comfort in an Italian hospital considering differences in gender and age*. Pages 177-184.

The hospital is a thermal environment where comfort must be calibrated by taking into account two different groups of people, that is, patients and medical staff. The study involves 30 patients and 19 medical staff with a view to verifying if Predicted Mean Vote (PMV) index can accurately predict thermal sensations of both groups also taking into account any potential effects of age and gender. The methodology adopted is based on the comparison between PMV values (calculated according to ISO 7730 after having collected environmental data and estimated personal parameters) and perceptual judgments (Actual Mean Vote, AMV), expressed by the subjects interviewed. Different statistical analyses show that PMV model finds his best correlation with AMV values in a sample of male medical staff under 65 years of age. It has been observed that gender and age are factors that must be taken into account in the assessment of thermal comfort in the hospital due to very weak correlation between AMV and PMV values.

- **Keywords:** Patients and medical staff; Thermal comfort; Gender and age

Myounghoon Jeon, Bruce N. Walker, Thomas M. Gable. *The effects of social interactions with in-vehicle agents on a driver's anger level, driving performance, situation awareness, and perceived workload*. Pages 185-199.

Research has suggested that interaction with an in-vehicle software agent can improve a driver's psychological state and increase road safety. The present study explored the possibility of using an in-vehicle software agent to mitigate effects of driver anger on driving behavior. After either anger or neutral mood induction, 60 undergraduates drove in a simulator with two types of agent intervention. Results showed that both speech-based agents not only enhance driver situation awareness and driving performance, but also reduce their anger level and perceived workload. Regression models show that a driver's anger influences driving performance measures, mediated by situation awareness. The practical implications include design guidelines for the design of social interaction with in-vehicle software agents.

- **Keywords:** In-vehicle agent; Road rage; Situation awareness

Miyuki Morioka, Michael J. Griffin. *Masking of thresholds for the perception of fore-and-aft vibration of seat backrests*. Pages 200-206.

The detection of a vibration may be reduced by the presence of another vibration: a phenomenon known as 'masking'. This study investigated how the detection of one frequency of vibration is influenced by vibration at another frequency. With nine subjects, thresholds for detecting fore-and-aft backrest vibration were determined (for 4, 8, 16, and 31.5-Hz sinusoidal vibration) in the presence of a masker vibration (4-Hz random vibration, 1/3-octave bandwidth at six intensities). The masker vibration increased thresholds for perceiving vibration at each frequency by an amount that reduced with increasing difference between the frequency of the sinusoidal vibration and the frequency of the masker vibration. The 4-Hz random vibration almost completely masked 4-Hz sinusoidal vibration, partially masked 8- and 16-Hz vibration, and only slightly masked 31.5-Hz vibration. The findings might be explained by the involvement of different sensory systems and different body locations in the detection of different frequencies of vibration.

- **Keywords:** Perception; Whole-body vibration; Masked threshold

Jinshuan Peng, Yingshi Guo, Rui Fu, Wei Yuan, Chang Wang. *Multi-parameter prediction of drivers' lane-changing behaviour with neural network model*. Pages 207-217.

Accurate prediction of driving behaviour is essential for an active safety system to ensure driver safety. A model for predicting lane-changing behaviour is developed from the results of naturalistic on-road experiment for use in a lane-changing assistance system. Lane changing intent time window is determined via visual characteristics extraction of rearview mirrors. A prediction index system for left lane changes was constructed by considering drivers' visual search behaviours, vehicle operation behaviours, vehicle motion states, and driving conditions. A back-propagation neural network model was developed to predict lane-changing behaviour. The lane-change-intent time window is approximately 5 s long, depending on the subjects. The proposed model can accurately predict drivers' lane changing behaviour for at least 1.5 s in advance. The accuracy and time series characteristics of the model are superior to the use of turn signals in predicting lane-changing behaviour.

- **Keywords:** Lane change prediction; Naturalistic driving experiment; Neural network model

Jennifer Hsu, Yue Li, Tilak Dutta, Geoff Fernie. *Assessing the performance of winter footwear using a new maximum achievable incline method*. Pages 218-225.

More informative tests of winter footwear performance are required in order to identify footwear that will prevent injurious slips and falls on icy conditions. In this study, eight participants tested four styles of winter boots on smooth wet ice. The surface was progressively tilted to create increasing longitudinal and cross-slopes until participants could no longer continue standing or walking. Maximum achievable incline angles provided consistent measures of footwear slip resistance and demonstrated better resolution than mechanical tests. One footwear outsole material and tread combination outperformed the others on wet ice allowing participants to successfully walk on steep longitudinal slopes of 17.5° ± 1.9° (mean ± SD). By further exploiting the methodology to include additional surfaces and contaminants, such tests could be used to optimize tread designs and materials that are ideal for reducing the risk of slips and falls.

- **Keywords:** Slips and falls; Footwear; Slip resistance

Ren-Jye Dzeng, Shih-Hsu Wang, Yi-Cho Fang. *Quantitative evaluation of the impact of night shifts and alcohol consumption on construction tiling quality*. Pages 226-236.

The adverse effects of night-shift work and alcohol consumption on performance have received considerable attention. However, how night shifts and alcohol affect productivity in workers has not been quantified. This paper describes the experiments featuring multiple tiling tasks and patterns. The tiling quality performed by the graduate student participants in four different statuses was objectively evaluated by an edge-detection computer program. The results indicate that both night shift and alcohol significantly reduce the quality in general, and the effects of the factors on position and alignment-angle qualities were dissimilar in distinct areas due to tile patterns and size. Both night-shift and alcohol conditions affected the basic (−34.01% and −25.79%) and advanced tiling abilities (−40.14% and −26.16%), and night shift had a larger impact than alcohol. These results provide jobsite managers with usable information regarding how night shifts and alcohol affect workers' abilities to execute basic and advanced tasks.

- **Keywords:** Night shift; Alcohol; Tiling quality

Mark G. Blanchette, Christopher M. Powers. *The influence of footwear tread groove parameters on available friction*. Pages 237-241.

The purpose of this study was to determine how footwear tread groove parameters influence available friction (COF). Utilizing a whole shoe tester (SATRA STM 603), 3 groove parameters (width, depth and orientation) were evaluated. Groove orientation had 3 levels (parallel, oblique and perpendicular), width had 3 levels (3, 6 and 9 mm) and depth had 3 levels (2, 4 and 6 mm). In total, the COF of 27 shoes, each with a distinct groove combination, was assessed on wet porcelain tile. The 27 groove combinations produced a wide range of COF values (0.080–0.344). Groove orientation had the greatest impact on COF, explaining the greatest variance in observed COF values ($\eta 2 = 0.81$). The most slip resistant groove combination was an oblique orientation, with 3 mm width and 2 mm depth. The least slip resistant groove combination was a parallel orientation, with a 6 mm width and 6 mm depth.

- **Keywords:** Slips; Footwear; Tread; Friction

Valérie Saint-Dizier de Almeida, Marie-France Agnoletti. *Impact of online training on delivering a difficult medical diagnosis : acquiring communication skills*. Pages 242-250.

This paper deals with developing and assessing the training of physicians to deliver a difficult diagnosis to patients. The training is provided by a web-based self-training package. This online training emphasizes the structural, functional and relational dimensions of interviews delivering a serious diagnosis, and a logical set of recommendations for behavior towards the patient. The content is illustrated by numerous delivery interview sequences that are described and for which commentary is provided. This online package was expected to enable physicians to acquire new skills and change their mental picture of diagnosis delivery. Here we discuss the assessment of training in managing the delivery of a serious diagnosis. The approach taken and the methods used to measure knowledge and skills are presented.

- **Keywords:** Training; Assessment; Skill

Tim Schürmann, Christina Binder, Gesche Janzarik, Joachim Vogt. *Movement transformation on multi-touch devices: Intuition or instructional preparation?* Pages 251-255.

Multi-touch technology is a key part of computer interaction today, yet little is known about the distinction between direct and indirect input devices in terms of intuitive interaction. An experimental study aims to identify the difficulties of interaction with indirect multi-touch devices by applying the action regulation theory and the principle of movement transformation to common computer tasks involving gesture utilization. An analysis of the data acquired from 54 subjects working with an Apple Magic Trackpad implies that gestures on indirect multi-touch devices are not utilized intuitively without instructions that bypass conceptual difficulties of indirect gesture usage. It is shown that gesture use influences product assessment measured by User Experience questionnaires and that prior experience with direct multi-touch devices does not influence gesture usage or product assessment. We advise that product developers utilize video instructions to create a sense of intuitive interaction.

- **Keywords:** Intuitive interaction; Multi-touch; Input devices