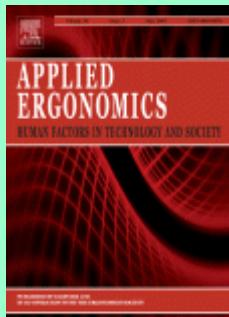


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Kirsten M.A. Revell, Neville A. Stanton. *Case studies of mental models in home heat control : searching for feedback, valve, timer and switch theories.*

An intergroup case study was undertaken to determine if: 1) There exist distinct mental models of home heating function, that differ significantly from the actual functioning of UK heating systems; and 2) Mental models of thermostat function can be categorized according to Kempton's (1986) valve and feedback shared theories, and others from the literature. Distinct, inaccurate mental models of the heating system, as well as thermostat devices in isolation, were described. It was possible to categorise thermostat models by Kempton's (1986) feedback shared theory, but other theories proved ambiguous. Alternate control devices could be categorized by Timer (Norman, 2002) and Switch (Peffer et al., 2011) theories. The need to consider the mental models of the heating system in terms of an integrated set of control devices, and to consider user's goals and expectations of the system benefit, was highlighted. The value of discovering shared theories, and understanding user mental models, of home heating, are discussed with reference to their present day relevance for reducing energy consumption.

- **Keywords:** Mental models; Home heating; Device models; Energy consuming behaviour; Usability

Heejin Kim, Sunghyuk Kwon, Jiyoong Heo, Hojin Lee, Min K. Chung. *The effect of touch-key size on the usability of In-Vehicle Information Systems and driving safety during simulated driving.*

Investigating the effect of touch-key size on usability of In-Vehicle Information Systems (IVISs) is one of the most important research issues since it is closely related to safety issues besides its usability. This study investigated the effects of the touch-key size of IVISs with respect to safety issues (the standard deviation of lane position, the speed variation, the total glance time, the mean glance time, the mean time between glances, and the mean number of glances) and the usability of IVISs (the task completion time, error rate, subjective preference, and NASA-TLX) through a driving simulation. A total of 30 drivers participated in the task of entering 5-digit numbers with various touch-key sizes while performing simulated driving. The size of the touch-key was 7.5 mm, 12.5 mm, 17.5 mm, 22.5 mm and 27.5 mm, and the speed of driving was set to 0 km/h (stationary state), 50 km/h and 100 km/h. As a result, both the driving safety and the usability of the IVISs increased as the touch-key size increased up to a certain size (17.5 mm in this study), at which they reached asymptotes. We performed Fitts' law

analysis of our data, and this revealed that the data from the dual task experiment did not follow Fitts' law.

- **Keywords:** Touch-key size; In-Vehicle Information System; Touch-screen

Steven A. Lavender, Glenn E. Hedman, Jay P. Mehta, Paul A. Reichelt, Karen M. Conrad, Sanghyun Park. *Evaluating the physical demands on firefighters using hand-carried stair descent devices to evacuate mobility-limited occupants from high-rise buildings.*

The physical demands on firefighting personnel were investigated when using different types of hand-carried stair descent devices designed for the emergency evacuation of high rise buildings as a function of staircase width and evacuation urgency. Twelve firefighters used three hand-carried stair descent devices during simulated urgent and non-urgent evacuations. The devices were evaluated under three staircase width conditions (0.91, 1.12, and 1.32 m). For comparison, an urgent manual carry was also performed on the 1.12 m wide stairs. Dependent measures included electromyographic (EMG) data, heart rates, Borg Scale ratings, task durations and descent velocities. Results indicated that the stair chair with extended front handles, which allows the front person to descend the stairs facing forward, reduced the time integrated back muscle EMG by half and showed a descent velocity that was 1.8 times faster than the other stair descent devices in the study. There were no differences across staircase widths.

- **Keywords:** EMS; Firefighter; Emergency evacuation; Stair descent devices; Evacuation of individuals with disabilities

Janice D. Chen, Torbjörn Falkmer, Richard Parsons, Jennifer Buzzard, Marina Ciccarelli. *Impact of experience when using the Rapid Upper Limb Assessment to assess postural risk in children using information and communication technologies.*

The Rapid Upper Limb Assessment (RULA) is an observation-based screening tool that has been used to assess postural risks of children in school settings. Studies using eye-tracking technology suggest that visual search strategies are influenced by experience in the task performed. This study investigated if experience in postural risk assessments contributed to differences in outcome scores on the RULA and the visual search strategies utilized. While wearing an eye-tracker, 16 student occupational therapists and 16 experienced occupational therapists used the RULA to assess 11 video scenarios of a child using different mobile information and communication technologies (ICT) in the home environment. No significant differences in RULA outcome scores, and no conclusive differences in visual search strategies between groups were found. RULA can be used as a screening tool for postural risks following a short training session regardless of the assessor's experience in postural risk assessments.

- **Keywords:** Child; ICT; Rapid Upper Limb Assessment (RULA)

Łukasz Dziuda, Marcin P. Biernacki, Paulina M. Baran, Olaf E. Truszczyński. *The effects of simulated fog and motion on simulator sickness in a driving simulator and the duration of after-effects.*

In the study, we checked: 1) how the simulator test conditions affect the severity of simulator sickness symptoms; 2) how the severity of simulator sickness symptoms changes over time; and 3) whether the conditions of the simulator test affect the severity of these symptoms in different ways, depending on the time that has elapsed since the performance of the task in the simulator.

We studied 12 men aged 24–33 years ($M = 28.8$, $SD = 3.26$) using a truck simulator. The SSQ questionnaire was used to assess the severity of the symptoms of simulator sickness. Each of the subjects performed three 30-minute tasks running along the same route in a driving simulator. Each of these tasks was carried out in a different simulator configuration: A) fixed base platform with poor visibility; B) fixed base platform with good visibility; and C) motion base platform with good visibility. The measurement of the severity of the simulator sickness symptoms took place in five consecutive intervals.

The results of the analysis showed that the simulator test conditions affect in different ways the severity of the simulator sickness symptoms, depending on the time which has elapsed since performing the task on the simulator. The simulator sickness symptoms persisted at the highest level for the test conditions involving the motion base platform. Also, when performing the tasks on the motion base platform, the severity of the simulator sickness symptoms varied depending on the time that had elapsed since performing the task. Specifically, the addition of motion to the simulation increased the oculomotor and disorientation symptoms reported as well as the duration of the after-effects.

- **Keywords:** Disorientation symptoms; Driving task; Nausea; Oculomotor disturbance; Simulator sickness

Christopher James Vincent, Yunqiu Li, Ann Blandford. *Integration of human factors and ergonomics during medical device design and development: It's all about communication.*

Manufacturers of interactive medical devices, such as infusion pumps, need to ensure that devices minimise the risk of unintended harm during use. However, development teams face challenges in incorporating Human Factors. The aim of the research reported here was to better understand the constraints under which medical device design and development take place. We report the results of a qualitative study based on 19 semi-structured interviews with professionals involved in the design, development and deployment of interactive medical devices. A thematic analysis was conducted. Multiple barriers to designing for safety and usability were identified. In particular, we identified barriers to communication both between the development organisation and the intended users and between different teams within the development organisation. We propose the use of mediating representations. Artefacts such as personas and scenarios, known to provide integration across multiple perspectives, are an essential component of designing for safety and usability.

- **Keywords:** Interface; User computer; Multidisciplinary communication; Medical device design

Danuta Roman-Liu. *Comparison of concepts in easy-to-use methods for MSD risk assessment.*

This article presents a comparative analysis of easy-to-use methods for assessing musculoskeletal load and the risk for developing musculoskeletal disorders. In all such methods, assessment of load consists in defining input data, the procedure and the system of assessment. This article shows what assessment steps the methods have in common; it also shows how those methods differ in each step. In addition, the methods are grouped according to their characteristic features. The conclusion is that the concepts of assessing risk in different methods can be used to develop solutions leading to a comprehensive method appropriate for all work tasks and all parts of the body. However, studies are necessary to verify the accepted premises and to introduce some standardization that would make consolidation possible.

- **Keywords:** Musculoskeletal disorders; Muscle load; Assessment methods

Denise L. Smith, Logan Arena, Jacob P. DeBlois, Jeannie M. Haller, Eric M. Hultquist, Wesley K. Lefferts, Tim Russell, Annie Wu, Patricia C. Fehling. *Effect of base layer materials on physiological and perceptual responses to exercise in personal protective equipment.*

Ten men (non-firefighters) completed a 110 min walking/recovery protocol (three 20-min exercise bouts, with recovery periods of 10, 20, and 20 min following successive bouts) in a thermoneutral laboratory while wearing firefighting personal protective equipment over one of four base layers: cotton, modacrylic, wool, and phase change material. There were no significant differences in changes in heart rate, core temperature, rating of perceived exertion, thermal discomfort, and thermal strain among base layers. Sticking to skin, coolness/hotness, and clothing humidity sensation were more favorable ($p < 0.05$) for wool compared with cotton; no significant differences were identified for the other 7 clothing sensations assessed. Separate materials performance testing of the individual base layers and firefighting ensembles (base layer + turnout gear) indicated differences in thermal protective performance and total heat loss among the base layers and among ensembles; however, differences in heat dissipation did not correspond with physiological responses during exercise or recovery.

- **Keywords:** Heat stress; Firefighting; Clothing

Iman Dianat, Nasibeh Sorkhi, Aida Pourhossein, Arezou Alipour, Mohammad Asghari-Jafarabadi. *Neck, shoulder and low back pain in secondary schoolchildren in relation to schoolbag carriage : should the recommended weight limits be gender-specific?*

The occurrence of neck, shoulder and low back complaints in relation to schoolbag carriage and other potential risk factors were investigated in a cross-sectional study of 586 Iranian schoolchildren aged 12–14 years. The average load carried by schoolchildren was 2.8 kg. Neck, shoulder and low back complaints during the preceding month were reported by 35.3%, 26.1% and 33% of the students, respectively. Gender was an independent factor predicting musculoskeletal symptoms in schoolchildren. Girls were more likely than boys to suffer from neck, shoulder and low back complaints, although there was no significant difference between genders in terms of schoolbag carriage variables. The findings suggest that the recommended weight limit for schoolbag carriage may need to differ between boys and girls. The associations between schoolbag variables and reported symptoms are also discussed. The results provide evidence that the current weight limit should consider a broader combination of factors that influence the use of schoolbags.

- **Keywords:** Musculoskeletal pain; Adolescents; Backpack

Cheol-Min Lim, Yong-Ku Kong. *Effects of the resting time associated with the number of trials on the total and individual finger forces in a maximum grasping task.*

The repetitive and excessive workload accompanying grip strength- or hand-intensive tasks are often considered to be common causes of work-related upper limb musculoskeletal disorders. For this reason, numerous experimental studies have been performed on maximum grip strength. However, due to an absence of standard guidelines, researchers have adopted different resting times and number of trials suited for their particular research purposes. The effects of resting time and the number of trials on the maximum total grip strength and individual finger forces of 24 participants over 20 trials were investigated. Results showed that the total grip strength and individual finger strengths differed significantly according to the resting time and the number of trials ($p < 0.05$). Overall, grip strength tended to increase with a

reduction in resting time (% reduction: 7.8%, 9.1%, 11.1%, and 13.0% for 3 min, 2 min, 1 min, and 30 s resting time, respectively) as well as with an increase in the number of trials (% reduction: 8%, 10%, 13%, and 16% for 5th, 10th, 15th, and 20th trials). The effects of resting time and the number of trials also showed statistically significant effects on individual finger forces. Regression equations of total grip strength and finger forces with resting time and number of trials were established. These equations were then applied to formulate guidelines for appropriate resting times in experiments based on the number of trials and acceptable reductions in grip strength. Data from this and future studies regarding decreasing grip strength and the contribution of each finger are expected to form the groundwork for ergonomic hand tool design and development.

- **Keywords:** Maximum gripping task; Resting time; Trial

Kihyo Jung. Effects of slanted ergonomic mice on task performance and subjective responses.

The biomechanical benefits (e.g., muscular activity) of slanted ergonomic mice have been comprehensively identified; however, their effects on task performance and subjective responses have not been fully investigated. The present study examined the effects of two slanted mice (slant angle = 30° and 50°) in comparison with a conventional mouse (slant angle = 0°) in terms of task performance (task completion time and error rate) and subjective responses (perceived discomfort score and overall satisfaction score). Experimental results showed that all of the task and subjective measures worsened as the slant angle of the target mice increases. For example, the task completion time (unit: ms) and overall satisfaction score (unit: point) of the 30° slanted mouse (time = 0.71, satisfaction = -0.09) and 50° slanted mouse (time = 0.73, satisfaction = -0.79) significantly deteriorated than the conventional mouse (time = 0.65, satisfaction = 1.21). The slanted mice seem to compromise biomechanical benefits with task performance and subjective responses.

- **Keywords:** Slanted mouse; Ergonomic mouse; Mouse evaluation

Fabrizio Perroni, Lamberto Cignitti, Cristina Cortis, Laura Capranica. Physical fitness profile of professional Italian firefighters : differences among age groups.

Firefighters perform many tasks which require a high level of fitness and their personal safety may be compromised by the physiological aging process. The aim of the study was to evaluate strength (bench-press), power (countermovement jump), sprint (20 m) and endurance (with and without Self Contained Breathing Apparatus – S.C.B.A.) of 161 Italian firefighters recruits in relation to age groups (<25 yr; 26–30 yr; 31–35 yr; 36–40 yr; 41–42 yr). Descriptive statistics and an ANOVA were calculated to provide the physical fitness profile for each parameter and to assess differences ($p < 0.05$) among age groups. Anthropometric values showed an age-effect for height and BMI, while performances values showed statistical differences for strength, power, sprint tests and endurance test with S.C.B.A. Wearing the S.C.B.A., 14% of all recruits failed to complete the endurance test. We propose that the firefighters should participate in an assessment of work capacity and specific fitness programs aimed to maintain an optimal fitness level for all ages.

- **Keywords:** Aerobic power; Self-contained breathing apparatus; Strength

A. Naweed. Investigations into the skills of modern and traditional train driving.

Rail operations are housed inside a complex and extremely dynamic system where work is distributed in time and space. The train driver has traditionally relied on their own decisions, plans, and actions to navigate the rail environment, but the use of modern driver systems that force how these activities are regulated has altered this dynamic. This paper reports the findings of a study that set out to investigate the skills of modern (enhanced display-based) and traditional (real world) train driving. Data were collected from a variety of UK domain experts ($n = 45$) using an innovative methodology that converged multiple techniques for knowledge elicitation and analysis. The findings are represented in a model of dynamic train control and discussed according to the specific features and nature of tracking skill in the rail domain. The utility of the model is demonstrated through work of its application to the design of a train simulator and research tool for systematic study of rail human factor issues.

- **Keywords:** Train driver performance; Cognitive engineering; Models of human performance

A. Plamondon, A. Delisle, S. Bellefeuille, D. Denis, D. Gagnon, C. Larivière. RSST MMH Research Group, Lifting strategies of expert and novice workers during a repetitive palletizing task.

Thirty manual material handlers (15 experts and 15 novices) were invited to perform series of box transfers under conditions similar to those of large distribution centers. The objective of the present study was to verify whether multiple box transfers leading to fatigue would also lead to differences between expert and novice workers in joint motions and in back loading variables (L5/S1 moments). The task consisted in transferring 24 15-kg boxes from one pallet to another (4 layers of boxes; 6 boxes/layer: 3 in the front row, 3 in the back) at a self-determined pace and then at an imposed pace of 9 lifts/min for a total of 240 lifts. The underlying idea was to set a challenging task that would force the experts to use their skills. Full-body 3D kinematic data were collected as well as external foot forces. A dynamic 3D linked segment model was used to estimate the net moments at L5/S1. The results clearly show that the experts bent their lumbar spine less (10° less) and were closer (4 cm) to the box than novice workers. Knee flexions were similar in both groups except when the box was lifted from ground level (expert $\approx 71^\circ$, novice $\approx 48^\circ$). The peak resultant moment was not statistically different (expert = 168 Nm, novice = 184 Nm) although experts had lower values on average than novices when lifting heights (and deposit heights) of the boxes increased. Therefore, experts differed from novice workers mostly in the posture-related variables. These differences are especially important to consider when the box is located on the ground, as the back posture and back loading are then at their greatest magnitude and could have a major impact on the distribution of internal forces on the spine.

- **Keywords:** Manual material handling; Lifting; Expert

Tyson A.C. Beach, David M. Frost, Jack P. Callaghan. FMS™ scores and low-back loading during lifting : whole-body movement screening as an ergonomic tool?

Previous research suggests that a general whole-body movement screen could be used to identify personal movement attributes that promote potentially injurious low-back loading patterns at work. The purpose of this study was to examine the relationship between Functional Movement Screen™ (FMS) composite scores and the low-back loading response to lifting.

Methods: Fifteen men who scored greater than 14 on the FMS (high-scorers) and 15 height- and weight-matched low-scorers (FMS < 14) performed sagittally symmetric and asymmetric laboratory-based lifting tasks. A three-dimensional dynamic biomechanical model was used to calculate peak low-back loading levels, and the angle

of the lumbar spine was captured at the instant when the peak compressive force was applied.

Results: Regardless of the lifting task performed, there were no differences in peak low-back compression ($p \geq 0.4157$), anterior/posterior reaction shear ($p \geq 0.5645$), or medial/lateral reaction shear ($p \geq 0.2581$) forces between the high- and low-scorers. At the instant when peak compressive forces were applied, differences in the lumbar spine angle between high- and low-scores were not statistically significant about the lateral bend ($p \geq 0.4215$), axial twist ($p \geq 0.2734$), or flexion/extension ($p \geq 0.1354$) axes, but there was a tendency for the lumbar spine to be more deviated in the low-scorers.

Conclusions: Using the previously established injury prediction threshold value of 14, the composite FMS score was not related to the peak low-back loading magnitudes in lifting. Though not statistically significant, the tendency for the lumbar spines of low-scorers to be more deviated when the peak low-back compression force was imposed could be biomechanically meaningful because spinal load tolerance varies with posture. Future attempts to modify or reinterpret FMS scoring are warranted given that several previous studies have revealed links between composite FMS scores and musculoskeletal complaints.

- **Keywords:** Musculoskeletal injury prevention; Movement quality; Functional movement screen

Li Lan, Paweł Wargocki, Zhiwei Lian. *Thermal effects on human performance in office environment measured by integrating task speed and accuracy.*

We have proposed a method in which the speed and accuracy can be integrated into one metric of human performance. This was achieved by designing a performance task in which the subjects receive feedback on their performance by informing them whether they have committed errors, and if did, they can only proceed when the errors are corrected. Traditionally, the tasks are presented without giving this feedback and thus the speed and accuracy are treated separately. The method was examined in a subjective experiment with thermal environment as the prototypical example. During exposure in an office, 12 subjects performed tasks under two thermal conditions (neutral & warm) repeatedly. The tasks were presented with and without feedback on errors committed, as outlined above. The results indicate that there was a greater decrease in task performance due to thermal discomfort when feedback was given, compared to the performance of tasks presented without feedback.

- **Keywords:** Human performance; Speed; Accuracy

Lynne Clay, Gareth J. Treharne, E.Jean C. Hay-Smith, Stephan Milosavljevic. *Is workplace satisfaction associated with self-reported quad bike loss of control events among farm workers in New Zealand?*

This study investigated whether rural workers who have higher workplace satisfaction are less likely to report quad bike loss of control events (LCEs). Two independent samples of farmers completed a survey regarding LCEs and workplace satisfaction. In the first sample ($n = 130$) analysis revealed no relationship ($p = 0.74$) between workplace satisfaction and LCEs but lower rates of LCEs were reported by employees (IRR 0.52, 95%CI 0.31–0.86) compared to self-employed participants. In the second sample ($n = 112$), workplace satisfaction was weakly related to LCEs (IRR 1.04, 95%CI 1.00, to 1.09) with participants who found their job more psychologically demanding more likely to have had an LCE (IRR 1.14, 95%CI 1.05–1.23). Exploring the role of psychological demands on safety behaviour with respect to quad bike use, may help to address this important safety issue.

- **Keywords:** Agriculture; Quad bike; Loss of control events; Workplace satisfaction

Muhammad Jawad Hashim, Mariam Salem Khamis Matar Alkaabi, Sulaiman Bharwani. *Interpretation of way-finding healthcare symbols by a multicultural population : navigation signage design for global health.*

The interpretation of way-finding symbols for healthcare facilities in a multicultural community was assessed in a cross-sectional study. One hundred participants recruited from Al Ain city in the United Arab Emirates were asked to interpret 28 healthcare symbols developed at Hablamos Juntos (such as vaccinations and laboratory) as well as 18 general-purpose symbols (such as elevators and restrooms). The mean age was 27.6 years (16–55 years) of whom 84 (84%) were females. Healthcare symbols were more difficult to comprehend than general-purpose signs. Symbols referring to abstract concepts were the most misinterpreted including oncology, diabetes education, outpatient clinic, interpretive services, pharmacy, internal medicine, registration, social services, obstetrics and gynecology, pediatrics and infectious diseases. Interpretation rates varied across cultural backgrounds and increased with higher education and younger age. Signage within healthcare facilities should be tested among older persons, those with limited literacy and across a wide range of cultures.

- **Keywords:** Symbols; Way-finding; Culture

Yang Zhang, Gytis Balilionis, Catalina Casaru, Colleen Geary, Randall E. Schumacker, Yasmin H. Neggers, Matthew D. Curtner-Smith, Mark T. Richardson, Phillip A. Bishop, James M. Green. *Effects of caffeine and menthol on cognition and mood during simulated firefighting in the heat.*

This study examined the separate effects of caffeine and menthol on cognition and mood during simulated firefighting in the heat. Participants ($N = 10$) performed three trials in a counterbalanced order, either with 400 mg caffeine, menthol lozenges, or placebo. The simulated firefighting consisted of 2 bouts of 20-min treadmill exercise and one bout of 20-min stepping exercise in the heat with two brief 15-min rest periods between each exercise phase. Exercise induced significant dehydration ($>3\%$) and elevated rectal temperature ($>38.9^{\circ}\text{C}$), for all three conditions. Neither caffeine nor menthol reduced perceived exertion compared to placebo ($p > 0.05$). Mood ratings (i.e., alertness, hedonic tone, tension) significantly deteriorated over time ($p < 0.05$), but there was no difference among the three conditions. Simple reaction time, short-term memory, and retrieval memory did not alter with treatments or repeated evaluations. Reaction accuracy from a math test remained unchanged throughout the experimental period; reaction time from the math test was significantly faster after exposure to the heat ($p < 0.05$). It is concluded that, exhaustive exercise in the heat severely impacted mood, but minimally impacted cognition. These treatments failed to show ergogenic benefits in a simulated firefighting paradigm in a hot environment.

- **Keywords:** Hyperthermia; Dehydration; Protective clothing; Cognitive performance

Patrick Hofer, Michael Hasler, Gulnara Fauland, Thomas Bechtold, Werner Nachbauer. *Microclimate in ski boots : temperature, relative humidity, and water absorption.*

Ski boot quality is determined by mechanical properties and comfort. Comfort is strongly affected by cold feet. The purpose of this study was to determine the microclimate in ski boots. Climate chamber tests with five male subjects and field tests with two male subjects were conducted. Temperature and relative humidity were measured using four sensors placed on the foot and one on the liner. Absorbed water in liners and socks was

measured with a precision balance. The subjects gave subjective ratings for comfort. The toe sensor temperature dropped below 20 °C at an ambient temperature of 0 °C, -10 °C, and -20 °C. Relative humidity values at the foot were as high as 78% in the climate chamber and 93% in the field. Water absorption in socks and liners ranged from 4 to 10 g in the climate chamber and 19 to 45.5 g in the field. The results reveal the importance of keeping the feet and in particular the toes warm during skiing. One possible improvement may be to construct the liner so that sweat and melted snow are kept as far away as possible from the foot. Liner material with high water absorption capacity and hydrophobic socks were suggested to prevent wet feet.

- **Keywords:** Ski boots; Foot temperature; Foot relative humidity

Behrang Keshavarz, Heiko Hecht. *Pleasant music as a countermeasure against visually induced motion sickness.*

Visually induced motion sickness (VIMS) is a well-known side-effect in virtual environments or simulators. However, effective behavioral countermeasures against VIMS are still sparse. In this study, we tested whether music can reduce the severity of VIMS. Ninety-three volunteers were immersed in an approximately 14-minute-long video taken during a bicycle ride. Participants were randomly assigned to one of four experimental groups, either including relaxing music, neutral music, stressful music, or no music. Sickness scores were collected using the Fast Motion Sickness Scale and the Simulator Sickness Questionnaire. Results showed an overall trend for relaxing music to reduce the severity of VIMS. When factoring in the subjective pleasantness of the music, a significant reduction of VIMS occurred only when the presented music was perceived as pleasant, regardless of the music type. In addition, we found a gender effect with women reporting more sickness than men. We assume that the presentation of pleasant music can be an effective, low-cost, and easy-to-administer method to reduce VIMS.

- **Keywords:** Visually induced motion sickness; Music; Countermeasures; Motion sickness; Simulator sickness

Kait Clark, Matthew S. Cain, R. Alison Adcock, Stephen R. Mitroff. *Context matters : the structure of task goals affects accuracy in multiple-target visual search.*

Career visual searchers such as radiologists and airport security screeners strive to conduct accurate visual searches, but despite extensive training, errors still occur. A key difference between searches in radiology and airport security is the structure of the search task: Radiologists typically scan a certain number of medical images (fixed objective), and airport security screeners typically search X-rays for a specified time period (fixed duration). Might these structural differences affect accuracy? We compared performance on a search task administered either under constraints that approximated radiology or airport security. Some displays contained more than one target because the presence of multiple targets is an established source of errors for career searchers, and accuracy for additional targets tends to be especially sensitive to contextual conditions. Results indicate that participants searching within the fixed objective framework produced more multiple-target search errors; thus, adopting a fixed duration framework could improve accuracy for career searchers.

- **Keywords:** Visual search; Radiology; Airport security screening

A.Virgílio M. Oliveira, Adélio R. Gaspar, Jorge S. André, Divo A. Quintela. *Subjective analysis of cold thermal environments.*

The present work is dedicated to the study of cold thermal environments in food distribution industrial units through a subjective assessment based on an individual

questionnaire which aims to describe the working conditions of employees often exposed to cold. The survey was carried out in Portugal and the sample consists of 1575 valid responses obtained in 61 industrial units. The results show that the food distribution activity sector is characterized by a female population (78.1%) and by a young work force (63.4% of the workers are less than 35 years old). Despite the availability of cold protective clothing (52.8% of the workers indicate one garment) its characteristics require improvements. In addition almost 1/3 of the respondents consider the thermal environment cold and 79.6% of the workers report that working in the cold is harder in wintertime. The results also highlight that 37.3% of the workers report having health problems.

- **Keywords:** Cold thermal environments; Questionnaires; Subjective assessment

Anita Ljubičić, Veda M. Varnai, Branko Petrinec, Jelena Macan. Response to thermal and physical strain during flashover training in Croatian firefighters.

Flashover training (FOT) for firefighters is a simulation of the flashover phenomenon under controlled conditions. This study assessed arterial blood pressure (BP) and its response to thermal and physical strain during FOT in 48 professional and 18 volunteer firefighters. A high prevalence of obesity (27%), basal hypertensive (53%) and prehypertensive (33%) BP values was found. FOT induced mild hyperthermia and physical strain (average increase of 1.1 °C in tympanic temperature and 61% of the maximal heart beat predicted for age). Compared to professional firefighters, FOT in the volunteers induced a higher increase in pulse ($P = 0.050$) and tympanic temperature ($P = 0.025$). Systolic BP did not vary significantly, and diastolic BP slightly decreased in both groups. Results confirm that FOT induced only physiological cardiovascular responses to thermal and physical strain in firefighters. High prevalence of obesity and elevated BP values indicate the need for better physical fitness and BP control among firefighters.

- **Keywords:** Cardiac strain; Arterial blood pressure; Body mass index

Yunyi Wang, Daiwei Wu, Mengmeng Zhao, Jun Li. Evaluation on an ergonomic design of functional clothing for wheelchair users.

Researchers have pointed out that people with physical disabilities find it difficult to obtain suitable clothing. In this study a set of wheelchair user oriented functional clothing was designed. Attention was paid to the wheelchair users' daily living activities related with clothing. An evaluating system combined with sports tournament and rehabilitation medicine was introduced to assess the new designed clothing. Six wheelchair users (3 males and 3 females) were invited to wear the clothing. A set of normal functional clothing was employed as a comparison (Control). The time required to complete three different daily living activities, i.e. dressing and undressing, going to toilet and bathing were recorded. Results showed that with the new clothing wheelchair users' competence of managing toilet was increased by 52.9%. The time needed for toilet was reduced by 45.7%. Their capability of managing dressing and undressing was improved by 24.6%. The study indicated that the newly designed clothing could facilitate wheelchair users' daily living activities related with clothing.

- **Keywords:** Wheelchair users; Functional clothing; Ergonomic design

D. Ng, C. McNee, J. Kieser, M. Farella. Neck and shoulder muscle activity during standardized work-related postural tasks.

The aim of the present study was to assess the activity levels of the sternocleidomastoid muscle and upper trapezius muscle during static postures under controlled and

standardized conditions, and to determine whether the muscle activity differed between sexes. Electromyographic (EMG) activity was recorded unilaterally from the sternocleidomastoid and upper trapezius muscle in 17 participants whilst they were performing various postural tasks. EMG amplitude was measured by the root mean square values of the raw signals and normalized to peak maximum contractile values for each muscle (%MVC). The intensity of muscle activity was ranked as light ($<3\%$ MVC), moderate ($3\% \leq \text{EMG} \leq 8\%$ MVC), and substantial ($>8\%$ MVC). During most tasks the two muscles contracted light to moderately. Head leaning and shoulder shrugging postures yielded substantial muscle activity in both muscles. Muscle activity did not differ significantly between male and female participants ($F = 3.1$; $p = 0.078$). Our findings provided normative values, which will enhance future studies of muscle activity during work in a natural, unrestrained environment.

- **Keywords:** Electromyography; Sternocleidomastoid; Trapezius

Lynn C. Onyebekere, Justin G. Young, Matthieu B. Trudeau, Jack T. Dennerlein. *Effects of forearm and palm supports on the upper extremity during computer mouse use.*

The use of forearm and palm supports has been associated with lower neck and shoulder muscle activity as well as reduced musculoskeletal discomfort during keyboard use, however, few studies have investigated their effect during computer mouse use. Eight men and eight women completed several computer mousing tasks in six arm support conditions: Forearm Support, Flat Palm Support, Raised Palm Support, Forearm + Flat Palm Support, Forearm + Raised Palm Support, and No Support. Concurrently, an infrared three-dimensional motion analysis system measured postures, six-degree-of-freedom force-torque sensors measured applied forces & torques, and surface electromyography measured muscle activity. The use of forearm support compared to the no support condition was significantly associated with less shoulder muscle activity & torque, and the raised palm support was associated with less wrist extension. Forearm supports reduced shoulder flexion torque by 90% compared to no support. The use of either support also resulted in lower applied forces to the mouse pad. Participants reported less musculoskeletal discomfort when using a support. These results provide recommendations for office workstation setup and inform ergonomists of effective ways to reduce musculoskeletal exposures.

- **Keywords:** Computer mouse use; Office workstation design; Arm supports

Steve N.H. Tsang, Errol R. Hoffmann, Alan H.S. Chan. *Preference for newspaper size.*

The past few years has seen a change in the size of newspapers, with publishers moving to a smaller size format. Five 'standard' newspaper sizes are used in different countries: Broadsheet, Rhensch, Tabloid, Tall Tabloid and Berliner. These papers vary in both width and height of pages and hence there are implications for human reading comfort, which may be dependent on reading location such as on a lounge chair or on a train. Experiments were carried out to determine preferences for the different sizes and to relate these preferences to the geometric characteristics of the newspapers. For both comfortable and cramped/uncomfortable reading conditions, the rank order of preference for paper types was, from least to most-preferred, Broadsheet, Rhensch, Berliner, Tall Tabloid and Tabloid. Preferences were much stronger when determined in cramped/uncomfortable reading conditions, where most comparisons were significantly different. There was good correlation between participant ratings on several scales and preference, where most factors were related to comfort of holding and controlling the paper.

- **Keywords:** Reading comfort; Newspaper size; Scaling

Gregor Harih, Bojan Dolšak. Recommendations for tool-handle material choice based on finite element analysis.

Huge areas of work are still done manually and require the usages of different powered and non-powered hand tools. In order to increase the user performance, satisfaction, and lower the risk of acute and cumulative trauma disorders, several researchers have investigated the sizes and shapes of tool-handles. However, only a few authors have investigated tool-handles' materials for further optimising them. Therefore, as presented in this paper, we have utilised a finite-element method for simulating human fingertip whilst grasping tool-handles. We modelled and simulated steel and ethylene propylene diene monomer (EPDM) rubber as homogeneous tool-handle materials and two composites consisting of EPDM rubber and EPDM foam, and also EPDM rubber and PU foam. The simulated finger force was set to obtain characteristic contact pressures of 20 kPa, 40 kPa, 80 kPa, and 100 kPa. Numerical tests have shown that EPDM rubber lowers the contact pressure just slightly. On the other hand, both composites showed significant reduction in contact pressure that could lower the risks of acute and cumulative trauma disorders which are pressure-dependent. Based on the results, it is also evident that a composite containing PU foam with a more evident and flat plateau deformed less at lower strain rates and deformed more when the plateau was reached, in comparison to the composite with EPDM foam. It was shown that hyper-elastic foam materials, which take into account the non-linear behaviour of fingertip soft tissue, can lower the contact pressure whilst maintaining low deformation rate of the tool-handle material for maintaining sufficient rate of stability of the hand tool in the hands. Lower contact pressure also lowers the risk of acute and cumulative trauma disorders, and increases comfort whilst maintaining performance.

- **Keywords:** Tool-handle material; Ergonomics; Finite element analysis

Subas Neupane, Pekka Virtanen, Tiina Luukkaala, Anna Siukola, Clas-Håkan Nygård. A four-year follow-up study of physical working conditions and perceived mental and physical strain among food industry workers.

This study hypothesized that in a longitudinal setting deteriorating physical working conditions increases the perceived physical and mental strain among food processing employees. The study was conducted in 2003 and 2007. It examined 248 blue-collar workers, all of whom were in the same occupation throughout the entire follow-up period. The data were obtained through a structural questionnaire distributed to the employees at the workplace. Mental strain had increased (7%) significantly among younger employees during the follow-up. The changes in mental strain for the younger employees were positively associated with the changes in physical strain. The changes in physical strain were also significantly associated with the changes in physical working conditions among both younger and the older workers. The results of this study partly support the study hypothesis, namely that deteriorating physical working condition increases physical strain and also increases mental strain, especially among younger employees.

- **Keywords:** Environmental factors; Ergonomic factors; Food factory

Charles Pontonnier, Mark de Zee, Afshin Samani, Georges Dumont, Pascal Madeleine. Strengths and limitations of a musculoskeletal model for an analysis of simulated meat cutting tasks.

This study assessed the capacity of a musculoskeletal model to predict the relative muscle activation changes as a function of the workbench height and the movement direction during a simulated meat cutting task. Seven subjects performed a cutting task

alternating two cutting directions for 20 s at four different workbench heights. Kinematics, electromyography (EMG), and cutting force data were collected and used to drive a musculoskeletal model of the shoulder girdle. The model predicted the muscle forces exerted during the task. Both the recorded and computed activation of the muscles was then compared by means of cross-correlation and by comparison of muscle activation trends with respect to the workstation parameters, i.e. cutting direction and workbench height. The results indicated that cutting movements involving arm flexion are preferable to movement requiring internal arm rotation and abduction. The optimal bench height for meat cutting tasks should be between 20 and 30 cm below the worker's elbow height. The present study underlines a beneficial use of musculoskeletal models for adjusting workstation parameters.

- **Keywords:** Electromyography; Trend analysis; Physical risk factors

Sylvain Fleury, Éric Jamet. *Facilitating the comparison of multiple visual items on screen : the example of electronic architectural plan correction.*

This paper describes two experiments designed to (1) ascertain whether the way in which architectural plans are displayed on a computer screen influences the quality of their correction by humans, and (2) identify the visual exploration strategies adopted in this type of task. Results of the first "spot the difference" experiment showed that superimposing the plans yielded better error correction performances than displaying them side by side. Furthermore, a sequential display mode, where the second plan only gradually appeared on the screen, improved error search effectiveness. In the second experiment, eye movement recordings revealed that superimposition increased plan comparison efficiency by making it easier to establish coreference between the two sources of information. The improvement in effectiveness in the sequential condition was shown to be linked to the attentional guidance afforded by this display mode, which helped users to make a more thorough exploration of the plans.

- **Keywords:** Plan correction; Spatial integration; Attentional guidance

Sae Hoon Kim, Timothy B. Neuschwander, Brandon R. Macias, Larry Bachman Jr., Alan R. Hargens. *Upper extremity hemodynamics and sensation with backpack loads.*

Heavy backpacks are often used in extreme environments, for example by military during combat, therefore completion of tasks quickly and efficiently is of operational relevance. The purpose of this study was to quantify hemodynamic parameters (brachial artery Doppler and microvascular flow by photoplethysmography; tissue oxygenation by near-infrared spectroscopy; arterial oxygen saturation by pulse oximeter) and sensation in upper extremities and hands (Semmes-Weinstein monofilament test and 2-point discrimination test) while wearing a loaded backpack (12 kg) in healthy adults for 10 min. All values were compared to baseline before wearing a backpack. Moderate weight loaded backpack loads significantly decreased upper extremity sensation as well as all macrovascular and microvascular hemodynamic values. Decreased macrovascular and microvascular hemodynamics may produce neurological dysfunction and consequently, probably affect fine motor control of the hands.

- **Keywords:** Paresthesia; Upper extremity; Blood flow

A. Ant Ozok, Huijuan Wu, Melissa Garrido, Peter J. Pronovost, Ayse P. Gurses. *Usability and perceived usefulness of personal health records for preventive health care : a case study focusing on patients' and primary care providers' perspectives.*

Personal Health Records (PHR) are electronic applications for individuals to access, manage and share their health information in a secure environment. The goal of this study was to evaluate the usefulness and usability of a Web-based PHR technology aimed at improving preventive care, from both the patients' and primary care providers' perspectives. We conducted a multi-method descriptive study that included direct observations, concurrent think-aloud, surveys, interviews and focus groups in a suburban primary care clinic. Patients found the tailored health recommendations useful and the PHR easy to understand and use. They also reported asking useful health-related questions to their physicians because of using the system. Generally, care providers were interested in using the system due to its useful content and impact on patient activation. Future successful systems should be better integrated with hospital records; put more emphasis on system security; and offer more tailored health information based on comprehensive health databases.

- **Keywords:** Personal health records; Usefulness; Usability

Beverley Norris, Jonathan West, Oliver Anderson, Grace Davey, Andrea Brodie. *Taking ergonomics to the bedside : a multi-disciplinary approach to designing safer healthcare.*

A multi-disciplinary approach to designing safer healthcare was utilised to investigate risks in the bed-space in elective surgical wards. The Designing Out Medical Error (DOME) project brought together clinicians, designers, psychologists, human factors and business expertise to develop solutions for the highest risk healthcare processes. System mapping and risk assessment techniques identified nearly 200 potential failure modes in hand hygiene, isolation of infection, vital signs monitoring, medication delivery and handover of information. Solutions addressed issues such as the design of equipment, reminders, monitoring, feedback and standardisation. Some of the solutions, such as the CareCentre™, which brings many of the processes and equipment together into one easy to access workstation at the foot of the bed, have been taken forward to clinical trials and manufacture. The project showed the value of the multi-disciplinary and formal human factors approaches to healthcare design for patient safety. In particular, it demonstrates the application of human factors to a complete design cycle and provides a case study for the activities required to reach a safe, marketable product.

- **Keywords:** Medical devices; Patient safety; FMEA

Tibor Petzoldt, Stephanie Brüggemann, Josef F. Krems. *Learning effects in the lane change task (LCT) : realistic secondary tasks and transfer of learning.*

Driver distraction is a factor that is heavily involved in traffic crashes. With in-vehicle devices like navigation systems or mobile phones on the rise, the assessment of their potential to distract the driver has become a pressing issue. Several easy-to-use methods have been developed in recent years to allow for such an assessment in the early stages of product development. One of these methods is the lane change task (LCT), a simple driving simulation in which the driver has to change lanes as indicated by different signs along the road. Although the LCT is an ISO sanctioned procedure, there are still open questions. One issue are learning effects which have been found in previous studies and which have the potential to compromise the comparability of test results. In this paper, we present results on two experiments that further explored the effect of previous experience on LCT and secondary task performance. The results confirm that learning effects occur when combining the LCT with a realistic secondary task. Also, we found evidence for the transfer of learning from one secondary task to another to some degree, provided that the two tasks are sufficiently similar.

- **Keywords:** Inattention; In-vehicle information systems; Evaluation methods

Lene Bjerg Hall-Andersen, Ole Broberg. *Integrating ergonomics into engineering design : the role of objects.*

The objective of this study was to explore the role of objects in integrating ergonomic knowledge in engineering design processes. An engineering design case was analyzed using the theoretical concepts of boundary objects and intermediary objects: Boundary objects facilitate collaboration between different knowledge domains, while the aim of an intermediary object is to circulate knowledge and thus produce a distant effect. Adjustable layout drawings served as boundary objects and had a positive impact on the dialog between an ergonomist and designers. An ergonomic guideline document was identified as an intermediary object. However, when the ergonomic guidelines were circulated in the design process, only some of the guidelines were transferred to the design of the sterile processing plant. Based on these findings, recommendations for working with objects in design processes are included.

- **Keywords:** Engineering design; Intermediary objects; Boundary objects

Han-Chi Hsiao, Fong-Gong Wu, Chien-Hsu Chen. *Design and evaluation of small, linear QWERTY keyboards.*

Miniature keyboard design is motivated by the need for smaller mobile devices with maximum user display area. Thus, this study developed four miniature keyboard designs which varied from conventional keyboard design in terms of their configuration and layout. The purpose of this study was to evaluate the input speed, accuracy, comfort, likability and learnability of four miniature keyboards. Sixteen fast typists and 16 slow typists were recruited to use these four miniature keyboards. The results showed that the rectangular-shaped keycaps of 3 letters with separated keycaps of numerals obtained the best proficiency speed, highest comfort and greatest user acceptance among the four keyboards. Moreover, the keyboards with square-shaped keycaps had better input accuracy compared to rectangular-shaped keycaps. Finally, the proposed keyboards were smaller than current keyboards, and the performance for all of the small keyboards was worse than that of the conventional keyboard.

- **Keywords:** Keyboard design; Miniature keyboard; Ergonomic keyboard

Miyo Yokota, Larry G. Berglund, Xiaojiang Xu. *Thermoregulatory modeling use and application in the military workforce.*

Thermoregulatory models have been used in the military to quantify probabilities of individuals' thermal-related illness/injury. The uses of the models have diversified over the past decade. This paper revisits an overall view of selected thermoregulatory models used in the U.S. military and provides examples of actual practical military applications: 1) the latest military vehicle designed with armor and blast/bulletproof windows was assessed to predict crews' thermal strains levels inside vehicles under hot environment (air temperature [Ta]: 29–43 °C, dew point: 13 °C); 2) a military working dog (MWD) model was developed by modifying existing human thermoregulatory models with canine physical appearance and physiological mechanisms; 3) thermal tolerance range of individuals from a large military group ($n = 100$) exposed to 35 °C/40% relative humidity were examined using thermoregulatory modeling and multivariate statistical analyses. Model simulation results assist in the decisions for the strategic planning and preventions of heat stress.

- **Keywords:** Thermoregulatory model; Heat stress; Military operations

Cornelis P. Bogerd, Ian Walker, Paul A. Brühwiler, René M. Rossi. The effect of a helmet on cognitive performance is, at worst, marginal : a controlled laboratory study.

The present study looked at the effect of a helmet on cognitive performance under demanding conditions, so that small effects would become more detectable. Nineteen participants underwent 30 min of continuous visual vigilance, tracking, and auditory vigilance (VTT + AVT), while seated in a warm environment ($27.2 (\pm 0.6) ^\circ\text{C}$, humidity $41 (\pm 1)\%$, and $0.5 (\pm 0.1) \text{ m s}^{-1}$ wind speed). The participants wore a helmet in one session and no helmet in the other, in random order. Comfort and temperature perception were measured at the end of each session. Helmet-wearing was associated with reduced comfort ($p = 0.001$) and increased temperature perception ($p < 0.001$), compared to not wearing a helmet. Just one out of nine cognitive parameters showed a significant effect of helmet-wearing ($p = .032$), disappearing in a post-hoc comparison. These results resolve previous disparate studies to suggest that, although helmets can be uncomfortable, any effect of wearing a helmet on cognitive performance is at worst marginal.

- **Keywords:** Helmet; Cognitive performance; Headgear

John Meusch, Salam Rahmatalla. Whole-body vibration transmissibility in supine humans : effects of board litter and neck collar.

Whole-body vibration has been identified as a stressor to supine patients during medical transportation. The transmissibility between the input platform acceleration and the output acceleration of the head, sternum, pelvis, head-sternum, and pelvis-sternum of eight supine subjects were investigated. Vibration files were utilized in the fore-aft, lateral, and vertical directions. The power spectral density across the bandwidth of 0.5–20 Hz was approximately flat for each file. A comparison between a baseline rigid-support and a support with a long spinal board strapped to a litter has shown that the latter has considerable effects on the transmitted motion in all directions with a double magnification in the vertical direction around 5 Hz. The results also showed that the neck-collar has increased the relative head-sternum flexion-extension because of the input fore-aft vibration, but reduced the head-sternum extension-compression due to the input vertical vibration.

- **Keywords:** Transmissibility; Relative-Transmissibility; Litter; Spinal board; Injury

N. Hollak, R. Soer, L.H. van der Woude, M.F. Reneman. Towards a comprehensive Functional Capacity Evaluation for hand function.

The aim of this study was to develop a more efficient (i.e. shortened) protocol for hand function capacity evaluation and to test the agreement of the protocol compared to the original protocol. 643 Healthy subjects performed tests for hand function. Agreement between two shortened protocols was compared with an existing protocol. The original protocol was performed once and the proposed shortened protocol differed in the number of trials which were reduced by statistical elimination. Agreement was determined with Intraclass Correlation Coefficients (ICC) and Limits of Agreement (LoA). Excellent ICCs (≥ 0.91) were observed in all proposed protocols except for the one trial purdue pegboard test protocol. For all tests of hand function, shorter protocols are valid to determine hand function. For Tip Pinch Strength testing, Palmar Pinch Strength testing and the Purdue Pegboard test, a two-trial protocol is recommended, because the LoA were considerable, which could affect decision-making with regards to hand capacity. For the Hand Grip strength test, the Key Pinch Strength test and the Complete Minnesota Dexterity Test, a one-trial protocol is recommended, because the LoA were acceptable. It was concluded that for healthy subjects, this shorter protocol is a reliable measure. Further testing of

the short form hand FCE protocols should be completed on patients with disabling conditions prior to widespread use of these protocols among clinical samples.

- **Keywords:** Hand function; Hand strength; Functional Capacity Evaluation

Jung Hyup Kim, Ling Rothrock, Jason Laberge. *Using Signal Detection Theory and Time Window-based Human-In-The-Loop simulation as a tool for assessing the effectiveness of different qualitative shapes in continuous monitoring tasks.*

This paper provides a case study of Signal Detection Theory (SDT) as applied to a continuous monitoring dual-task environment. Specifically, SDT was used to evaluate the independent contributions of sensitivity and bias to different qualitative gauges used in process control. To assess detection performance in monitoring the gauges, we developed a Time Window-based Human-In-The-Loop (TWHITL) simulation bed. Through this test bed, we were able to generate a display similar to those monitored by console operators in oil and gas refinery plants. By using SDT and TWHITL, we evaluated the sensitivity, operator bias, and response time of flow, level, pressure, and temperature gauge shapes developed by Abnormal Situation Management® (ASM®) Consortium (www.asmconsortium.org). Our findings suggest that display density influences the effectiveness of participants in detecting abnormal shapes. Furthermore, results suggest that some shapes elicit better detection performance than others.

- **Keywords:** Signal Detection Theory; Human-In-The-Loop simulation; Continuous monitoring task

Guy H. Walker, Neville A. Stanton, Paul M. Salmon, Daniel P. Jenkins. *Human performance under two different command and control paradigms.*

The paradoxical behaviour of a new command and control concept called Network Enabled Capability (NEC) provides the motivation for this paper. In it, a traditional hierarchical command and control organisation was pitted against a network centric alternative on a common task, played thirty times, by two teams. Multiple regression was used to undertake a simple form of time series analysis. It revealed that whilst the NEC condition ended up being slightly slower than its hierarchical counterpart, it was able to balance and optimise all three of the performance variables measured (task time, enemies neutralised and attrition). From this it is argued that a useful conceptual response is not to consider NEC as an end product comprised of networked computers and standard operating procedures, nor to regard the human system interaction as inherently stable, but rather to view it as a set of initial conditions from which the most adaptable component of all can be harnessed: the human.

- **Keywords:** Command and control; System design and evaluation; Time series analysis

Chiuhsiang Joe Lin, Chi-Chan Chang, Yung-Hui Lee. *Evaluating camouflage design using eye movement data.*

This study investigates the characteristics of eye movements during a camouflaged target search task. Camouflaged targets were randomly presented on two natural landscapes. The performance of each camouflage design was assessed by target detection hit rate, detection time, number of fixations on display, first saccade amplitude to target, number of fixations on target, fixation duration on target, and subjective ratings of search task difficulty. The results showed that the camouflage patterns could significantly affect the eye-movement behavior, especially first saccade amplitude and

fixation duration, and the findings could be used to increase the sensitivity of the camouflage assessment. We hypothesized that the assessment could be made with regard to the differences in detectability and discriminability of the camouflage patterns. These could explain less efficient search behavior in eye movements. Overall, data obtained from eye movements can be used to significantly enhance the interpretation of the effects of different camouflage design.

- **Keywords:** Camouflage; Eye movement; Visual search

Anne-Claire Macquet, Neville A. Stanton. *Do the coach and athlete have the same «picture» of the situation? : Distributed Situation Awareness in an elite sport context.*

Athletes and their coach interpret the training situations differently and this can have important implications for the development of an elite athlete's performance. It is argued that, from a schema-theoretic perspective, the difference in these interpretations needs to be better understood. A post-performance, self-confrontation, interview was conducted with a number of athletes and their coaches. The interviews revealed differences between the athlete and their coach in the information they are aware of. In comparison with athletes, coaches more frequently compared the phenotype with genotype schemata rather than just describing the phenotype schemata. Results suggest SA information elements showed some common ground but also revealed some important differences between the athlete and coach. The awareness was directed externally towards the environment and internally, towards the individual, depending on his/her role. The investigation showed that the schemata used to 'frame' the information elements were different, but compatible, between athlete and coach.

- **Keywords:** Collaborative system; Joint cognitive system; Expertise in sports

Amit Shahar, Virginie Dagonneau, Séphane Caro, Isabelle Israël, Régis Lobjois. *Towards identifying the roll motion parameters of a motorcycle simulator.*

This study aimed at identifying the roll motion parameters of a motorcycle simulator prototype. Experienced motorcyclists tuned the angular physical movement of the mock-up and that of the visual scene to achieve an optimal riding experience during curves. The participants exceeded the rolling angles that would be required in real-world riding, while avoiding leaning the mock-up beyond 10°. In addition, they were more influenced by the speed of the virtual motorcycle than by road curvature, especially in a wide field of view. Heterogeneity was found in the roll applied to the visual scene. The overall patterns suggest that at least when washout is not applied to remove the side forces that in real-world riding are compensated by a centrifugal force, greater roll of the visual at the expense of the mock-up is mandatory to avoid performance biases that might be enhanced due to fear of falling off the simulator. Future roll motion models must take into consideration factors such as riding postures, which might not only influence the forces operating on the rider-motorcycle system, but also how motorcyclists perceive the visual world.

- **Keywords:** Driving simulation; Simulator fidelity; Field of view

Corinne Nicoletti, Christina M. Spengler, Thomas Läubli. *Physical workload, trapezius muscle activity, and neck pain in nurses' night and day shifts : a physiological evaluation.*

The purpose of this study was to compare physical workload, electromyography (EMG) of the trapezius muscle, neck pain and mental well-being at work between night and day

shifts in twenty Swiss nurses. Work pulse (average increase of heart rate over resting heart rate) was lower during night (27 bpm) compared to day shifts (34 bpm; $p < 0.01$). Relative arm acceleration also indicated less physical activity during night (82% of average) compared to day shifts (110%; $p < 0.01$). Rest periods were significantly longer during night shifts. Trapezius muscle rest time was longer during night (13% of shift duration) than day shifts (7%; $p < 0.01$) and the 50th percentile of EMG activity was smaller ($p = 0.02$), indicating more opportunities for muscle relaxation during night shifts. Neck pain and mental well-being at work were similar between shifts. Subjective perception of burden was similar between shifts despite less physical burden at night, suggesting there are other contributing factors.

- **Keywords:** Electromyography; Shift work; Stress

A. Joy Rivera. A socio-technical systems approach to studying interruptions : understanding the interrupter's perspective.

The purpose of this study was to understand the cognitive processes underlying nurses' decision to interrupt other nurses. The Institute of Medicine (2000) reported that interruptions are likely contributors to medical errors. Unfortunately, the research to date has been quite homogenous, focusing only on the healthcare provider being interrupted, ignoring the true complexities of interruptions. This study took a socio-technical approach being the first to examine interruptions from the viewpoint of the interrupting nurse. Over 15 h of observations and 10 open-ended interviews with expert nurses in a Neuroscience Surgical Intensive Care Unit were conducted. It was found that nurses conduct a quick cost-benefit assessment to determine the interruptibility of other nurses and whether an interruption is value-added vs. non-value added. To complete the assessment, nurses consider several conditional factors related to the interruptee, the interrupter, and the nature of the interruption content, and different potential consequences of the interruption.

- **Keywords:** Socio-technical systems; Interruptions; Healthcare

Juliya Golubovich, Chu-Hsiang Chang, Erin M. Eatough. Safety climate, hardiness, and musculoskeletal complaints : a mediated moderation model.

This study explores the mechanisms linking the psychosocial characteristics of the workplace with employees' work-related musculoskeletal complaints. Poor safety climate perceptions represent a stressor that may elicit frustration, and subsequently, increase employees' reports of musculoskeletal discomforts. Results from an employee sample supported that when employees' perceived safety was considered a priority, they experienced less frustration and reported fewer work-related upper body musculoskeletal symptoms. Psychological hardiness, a personality trait that is indicative of individuals' resilience and success in managing stressful circumstances, moderated these relationships. Interestingly, employees with high hardiness were more affected by poor safety climate.

- **Keywords:** Work-related musculoskeletal disorders; Safety climate; Psychological hardiness

Sonya Goostrey, Julia Treleaven, Venerina Johnston. Evaluation of document location during computer use in terms of neck muscle activity and neck movement.

This study evaluated the impact on neck movement and muscle activity of placing documents in three commonly used locations: in-line, flat desktop left of the keyboard

and laterally placed level with the computer screen. Neck excursion during three standard head movements between the computer monitor and each document location and neck extensor and upper trapezius muscle activity during a 5 min typing task for each of the document locations was measured in 20 healthy participants. Results indicated that muscle activity and neck flexion were least when documents were placed laterally suggesting it may be the optimal location. The desktop option produced both the greatest neck movement and muscle activity in all muscle groups. The in-line document location required significantly more neck flexion but less lateral flexion and rotation than the laterally placed document. Evaluation of other holders is needed to guide decision making for this commonly used office equipment.

- **Keywords:** Document holder; Computer; Muscle activity

Anne Pisarski, Jennifer P. Barbour. *What roles do team climate, roster control, and work life conflict play in shiftworkers' fatigue longitudinally?*

The study aimed to examine shiftworkers fatigue and the longitudinal relationships that impact on fatigue such as team climate, work life conflict, control of shifts and shift type in shift working nurses. We used a quantitative survey methodology and analysed data with a moderated hierarchical multiple regression. After matching across two time periods 18 months apart, the sample consisted of 166 nurses from one Australian hospital. Of these nurses, 61 worked two rotating day shifts (morning & afternoon/evening) and 105 were rotating shiftworkers who worked three shifts (morning afternoon/evening and nights). The findings suggest that control over shift scheduling can have significant effects on fatigue for both two-shift and three-shift workers. A significant negative relationship between positive team climate and fatigue was moderated by shift type. At both Time 1 and Time 2, work life conflict was the strongest predictor of concurrent fatigue, but over time it was not.

- **Keywords:** Shiftwork; Fatigue; Nursing

José Orlando Gomes, Marcos R.S. Borges, Gilbert J. Huber, Paulo Victor R. Carvalho. *Analysis of the resilience of team performance during a nuclear emergency response exercise.*

The current work presents results from a cognitive task analysis (CTA) of a nuclear disaster simulation. Audio-visual records were collected from an emergency room team composed of individuals from 26 different agencies as they responded to multiple scenarios in a simulated nuclear disaster. This simulation was part of a national emergency response training activity for a nuclear power plant located in a developing country. The objectives of this paper are to describe sources of resilience and brittleness in these activities, identify cues of potential improvements for future emergency simulations, and leveraging the resilience of the emergency response system in case of a real disaster. Multiple CTA techniques were used to gain a better understanding of the cognitive dimensions of the activity and to identify team coordination and crisis management patterns that emerged from the simulation exercises.

- **Keywords:** Nuclear emergency response; Simulation exercises; Resilience

Huhn Kim, Haewon Song. *Evaluation of the safety and usability of touch gestures in operating in-vehicle information systems with visual occlusion.*

Nowadays, many automobile manufacturers are interested in applying the touch gestures that are used in smart phones to operate their in-vehicle information systems (IVISs). In

this study, an experiment was performed to verify the applicability of touch gestures in the operation of IVISs from the viewpoints of both driving safety and usability. In the experiment, two devices were used: one was the Apple iPad, with which various touch gestures such as flicking, panning, and pinching were enabled; the other was the SK EnNavi, which only allowed tapping touch gestures. The participants performed the touch operations using the two devices under visually occluded situations, which is a well-known technique for estimating load of visual attention while driving.

In scrolling through a list, the flicking gestures required more time than the tapping gestures. Interestingly, both the flicking and simple tapping gestures required slightly higher visual attention. In moving a map, the average time taken per operation and the visual attention load required for the panning gestures did not differ from those of the simple tapping gestures that are used in existing car navigation systems. In zooming in/out of a map, the average time taken per pinching gesture was similar to that of the tapping gesture but required higher visual attention. Moreover, pinching gestures at a display angle of 75° required that the participants severely bend their wrists. Because the display angles of many car navigation systems tends to be more than 75°, pinching gestures can cause severe fatigue on users' wrists. Furthermore, contrary to participants' evaluation of other gestures, several participants answered that the pinching gesture was not necessary when operating IVISs. It was found that the panning gesture is the only touch gesture that can be used without negative consequences when operating IVISs while driving. The flicking gesture is likely to be used if the screen moving speed is slower or if the car is in heavy traffic. However, the pinching gesture is not an appropriate method of operating IVISs while driving in the various scenarios examined in this study.

- **Keywords:** In-vehicle information systems; Touch gestures; Occlusion technique; Visual distraction

Thomas Karakolis, Jack P. Callaghan. *The impact of sit-stand office workstations on worker discomfort and productivity : a review.*

This review examines the effectiveness of sit-stand workstations at reducing worker discomfort without causing a decrease in productivity. Four databases were searched for studies on sit-stand workstations, and five selection criteria were used to identify appropriate articles. Fourteen articles were identified that met at least three of the five selection criteria. Seven of the identified studies reported either local, whole body or both local and whole body subjective discomfort scores. Six of these studies indicated implementing sit-stand workstations in an office environment led to lower levels of reported subjective discomfort (three of which were statistically significant). Therefore, this review concluded that sit-stand workstations are likely effective in reducing perceived discomfort. Eight of the identified studies reported a productivity outcome. Three of these studies reported an increase in productivity during sit-stand work, four reported no affect on productivity, and one reported mixed productivity results. Therefore, this review concluded that sit-stand workstations do not cause a decrease in productivity.

- **Keywords:** Sit-stand; Discomfort; Productivity

Heow Pueh Lee, Siak Piang Lim. *Comparative studies of perceived vibration strength for commercial mobile phones.*

A mobile phone, also known as cell phone or hand phone, is among the most popular electrical devices used by people all over the world. The present study examines the vibration perception of mobile phones by co-relating the relevant design parameters such as excitation frequency, and size and mass of mobile phones to the vibration perception survey by volunteers. Five popular commercially available mobile phone models were

tested. The main findings for the perception surveys were that higher vibration frequency and amplitude of the peak acceleration would result in stronger vibration perception of the mobile phones. A larger contact surface area with the palms and figures, higher peak acceleration and the associated larger peak inertia force may be the main factors for the relatively higher vibration perception. The future design for the vibration alert of the mobile phones is likely to follow this trend.

- **Keywords:** Mobile phones; Vibration alert; Vibration perception

Wen-Ruey Chang, Simon Matz, Chien-Chi Chang. *The stochastic distribution of available coefficient of friction for human locomotion of five different floor surfaces.*

The maximum coefficient of friction that can be supported at the shoe and floor interface without a slip is usually called the available coefficient of friction (ACOF) for human locomotion. The probability of a slip could be estimated using a statistical model by comparing the ACOF with the required coefficient of friction (RCOF), assuming that both coefficients have stochastic distributions. An investigation of the stochastic distributions of the ACOF of five different floor surfaces under dry, water and glycerol conditions is presented in this paper. One hundred friction measurements were performed on each floor surface under each surface condition. The Kolmogorov-Smirnov goodness-of-fit test was used to determine if the distribution of the ACOF was a good fit with the normal, log-normal and Weibull distributions. The results indicated that the ACOF distributions had a slightly better match with the normal and log-normal distributions than with the Weibull in only three out of 15 cases with a statistical significance. The results are far more complex than what had heretofore been published and different scenarios could emerge. Since the ACOF is compared with the RCOF for the estimate of slip probability, the distribution of the ACOF in seven cases could be considered a constant for this purpose when the ACOF is much lower or higher than the RCOF. A few cases could be represented by a normal distribution for practical reasons based on their skewness and kurtosis values without a statistical significance. No representation could be found in three cases out of 15.

- **Keywords:** Available friction; Surface contamination; Footwear material/floor interface