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Monica Lundh, Leif W. Rydstedt. *A static organization in a dynamic context – A qualitative study of changes in working conditions for Swedish engine officers.* Pages 1-7.

During the last decades the shipping industry has undergone rapid technical developments and experienced hard economic conditions and increased striving for profitability. This has led to reduced staffing and changes in task performance, which has been reported to increase workload for the remaining seafarers. The working conditions on board have a number of distinct and in many ways unique characteristics, which makes the job demands and resources for seafarers unique in several ways. The purpose of this study was to assess how engine room staff perceives how these major technical and organizational changes in the shipping industry have affected job demands as well as resources. The study compiled individual interviews and focus groups interviews with engine crew members where they were asked to elaborate on the psychosocial work environment and the major changes in the working conditions on board. Engine crew describes a work situation where they feel a lack of resources. The content of the work has changed, staffing has been reduced, new tasks are being added but the organization of the crew and the design of the work place remains unaltered.

- **Keywords:** Working conditions; Engine officers; Ships; Grounded theory; Focus groups; Automation

Sang-Young Yoon, Jeonghan Ko, Myung-Chul Jung. *A model for developing job rotation schedules that eliminate sequential high workloads and minimize between-worker variability in cumulative daily workloads: Application to automotive assembly lines.* Pages 8-15.

The aim of study is to suggest a job rotation schedule by developing a mathematical model in order to reduce cumulative workload from the successive use of the same body region. Workload assessment using rapid entire body assessment (REBA) was performed for the model in three automotive assembly lines of chassis, trim, and finishing to identify which body part exposed to relatively high workloads at workstations. The workloads were incorporated to the model to develop a job rotation schedule. The proposed schedules prevent the exposure to high workloads successively on the same body region and minimized between-worker variance in cumulative daily workload. Whereas some of workers were successively assigned to high workload workstation under no job rotation and serial job rotation. This model would help to reduce the potential for work-related musculoskeletal disorders (WMSDs) without additional cost for engineering

work, although it may need more computational time and relative complex job rotation sequences.

- **Keywords:** Job rotation; Musculoskeletal disorder; Cumulative workload; REBA; Assembly line

R. Schnittker, M. Schmettow, F. Verhoeven, J.M.C. Schraagen. *Combining situated Cognitive Engineering with a novel testing method in a case study comparing two infusion pump interfaces. Pages 16-26.*

We validated the usability of a new infusion pump interface designed with a situated Cognitive Engineering approach by comparing it to a reference interface using a novel testing method employing repeated measurements and process measures, in addition to traditional outcome measures. The sample consisted of 25 nurses who performed eight critical tasks three times. Performance measures consisted of number and type of errors, deviations from a pre-established normative path solution, task completion times, number of keystrokes, mental effort and preferences in use. Results showed that interaction with the new interface resulted in 18% fewer errors, 90% fewer normative path deviations, 42% lower task completion times, 40% fewer keystrokes, 39% lower mental effort and 76% more subjective preferences in use. These outcomes suggest that within the scope of this case study, combining the situated Cognitive Engineering approach with a novel testing method addresses various shortcomings of earlier testing methods.

- **Keywords:** Medical device usability testing; Infusion pump; Human-machine interaction

J.C. Olaso Melis, J.I. Priego Quesada, A.G. Lucas-Cuevas, J.C. González García, S. Puigcerver Palau. *Soccer players' fitting perception of different upper boot materials. Pages 27-32.*

The present study assessed the influence of upper boot materials on fitting perception. Twenty players tested three soccer boots only differing in the upper boot material (natural calf leather, natural kangaroo leather and synthetic leather). Players reported fitting perception and preference on specific foot areas using a perceived fitting scale. Ratings were averaged for every foot area. Repeated measures ANOVA was used to analyze the differences between boots. The kangaroo leather boots were perceived tighter and closer to the preferred fitting in general fitting, metatarsals area and instep area. The synthetic leather boots were perceived as the loosest and as the most distant boot from the preferred fitting in medial front area and instep area. In conclusion, the type of upper boot material influences the fitting perception of soccer players. The kangaroo leather was the material whose fitting was perceived closest to the players fitting preference.

- **Keywords:** Football; Soccer; Shoes; Footwear; Comfort; Leather; Upper; Fitting; Perception

Thomas Franke, Matthias Georg Arend, Rich C. McIlroy, Neville A. Stanton. *Ecodriving in hybrid electric vehicles – Exploring challenges for user-energy interaction. Pages 33-45.*

Hybrid electric vehicles (HEVs) can help to reduce transport emissions; however, user behaviour has a significant effect on the energy savings actually achieved in everyday usage. The present research aimed to advance understanding of HEV drivers' ecodriving strategies, and the challenges for optimal user-energy interaction. We conducted interviews with 39 HEV drivers who achieved above-average fuel efficiencies. Regression

analyses showed that technical system knowledge and ecodriving motivation were both important predictors for ecodriving efficiency. Qualitative data analyses showed that drivers used a plethora of ecodriving strategies and had diverse conceptualisations of HEV energy efficiency regarding aspects such as the efficiency of actively utilizing electric energy or the efficiency of different acceleration strategies. Drivers also reported several false beliefs regarding HEV energy efficiency that could impair ecodriving efforts. Results indicate that ecodriving support systems should facilitate anticipatory driving and help users locate and maintain drivetrain states of maximum efficiency.

- **Keywords:** Hybrid electric vehicles; Ecodriving; User-energy interaction; Driving behaviour

A. Azadeh, S. Motevali Haghghi, Z. Gaeini, N. Shabanpour. *Optimization of healthcare supply chain in context of macro-ergonomics factors by a unique mathematical programming approach. Pages 46-55.*

This study presents an integrated approach for analyzing the impact of macro-ergonomics factors in healthcare supply chain (HCSC) by data envelopment analysis (DEA). The case of this study is the supply chain (SC) of a real hospital. Thus, healthcare standards and macro-ergonomics factors are considered to be modeled by the mathematical programming approach. Over 28 subsidiary SC divisions with parallel missions and objectives are evaluated by analyzing inputs and outputs through DEA. Each division in this HCSC is considered as decision making unit (DMU). This approach can analyze the impact of macro-ergonomics factors on supply chain management (SCM) in healthcare sector. Also, this method ranks the relevant performance efficiencies of each HCSC. In this study by using proposed method, the most effective macro-ergonomics factor on HCSC is identified as "teamwork" issue. Also, this study would help managers to identify the areas of weaknesses in their SCM system and set improvement target plan for the related SCM system in healthcare industry. To the best of our knowledge, this is the first study for macro-ergonomics optimization of HCSC.

- **Keywords:** Human factors; Healthcare supply chain (HCSC); Data envelopment analysis (DEA); Macro-ergonomics; Sensitivity analysis

T.N. Brown, K.L. Loverro, J.M. Schiffman. *Soldier-relevant body borne load impacts minimum foot clearance during obstacle negotiation. Pages 56-62.*

Soldiers often trip and fall on duty, resulting in injury. This study examined ten male soldiers' ability to negotiate an obstacle. Participants had lead and trail foot minimum foot clearance (MFC) parameters quantified while crossing a low (305 mm) and high (457 mm) obstacle with (19.4 kg) and without (6 kg) body borne load. To minimize tripping risk, participants increased lead foot MFC ($p = 0.028$) and reduced lead ($p = 0.044$) and trail ($p = 0.035$) foot variability when negotiating an obstacle with body borne load. While obstacle height had no effect on MFC ($p = 0.273$ and $p = 0.126$), placing the trail foot closer to the high obstacle when crossing with body borne load, resulted in greater lead ($R = 0.640$, $b = 0.241$, $p = 0.046$) and trail ($R = 0.636$, $b = 0.287$, $p = 0.048$) MFC. Soldiers, when carrying typical military loads, may be able to minimize their risk of tripping over an obstacle by creating a safety margin via greater foot clearance with reduced variability.

- **Keywords:** Body borne load; Obstacle negotiation; Minimum foot clearance

Melissa T. Baysari, Nicola Jackson, Sheena Ramasamy, Priscila Santiago, Juan Xiong, Johanna Westbrook, Abdullah Omari, Richard O. Day.

Exploring sub-optimal use of an electronic risk assessment tool for venous thromboembolism. Pages 63-69.

International guidelines and consensus groups recommend using a risk assessment tool (RAT) to assess Venous Thromboembolism (VTE) risk prior to the prescription of prophylaxis. We set out to examine how an electronic RAT was being used (i.e. if by the right clinician, at the right time, for the right purpose) and to identify factors influencing utilization of the RAT. A sample of 112 risk assessments was audited and 12 prescribers were interviewed. The RAT was used as intended in only 40 (35.7%) cases (i.e. completed by a doctor within 24 h of admission, prior to the prescription of prophylaxis). We identified several reasons for sub-optimal use of the RAT, including beliefs about the need for a RAT, poor awareness of the tool, and poor RAT design. If a user-centred approach had been adopted, it is likely that a RAT would not have been implemented or that problematic design issues would have been identified.

- **Keywords:** Venous thromboembolism; VTE prophylaxis; Electronic risk assessment tool

Catarina Nordander, Gert-Åke Hansson, Kerstina Ohlsson, Inger Arvidsson, Istvan Balogh, Ulf Strömberg, Ralf Rittner, Staffan Skerfving. Exposure-response relationships for work-related neck and shoulder musculoskeletal disorders – Analyses of pooled uniform data sets. Pages 70-84.

There is a lack of quantitative data regarding exposure-response relationships between occupational risk factors and musculoskeletal disorders in the neck and shoulders. We explored such relationships in pooled data from a series of our cross-sectional studies.

We recorded the prevalence of complaints/discomfort (Nordic Questionnaire) and diagnoses (physical examination) in 33 groups (24 female and 9 male) within which the workers had similar work tasks (3141 workers, of which 817 were males). In representative sub-groups, we recorded postures and velocities of the head (N = 299) and right upper arm (inclinometry; N = 306), right wrist postures and velocities (electrogoniometry; N = 499), and muscular activity (electromyography) in the right trapezius muscle (N = 431) and forearm extensors (N = 206). We also assessed the psychosocial work environment (Job Content Questionnaire).

Uni- and multivariate linear meta-regression analysis revealed several statistically significant group-wise associations. Neck disorders were associated with head inclination, upper arm elevation, muscle activity of the trapezius and forearm extensors and wrist posture and angular velocity. Right-side shoulder disorders were associated with head and upper arm velocity, activity in the trapezius and forearm extensor muscles and wrist posture and angular velocity.

The psychosocial work environment (low job control, job strain and isostrain) was also associated with disorders. Women exhibited a higher prevalence of neck and shoulder complaints and tension neck syndrome than men, when adjusting for postures, velocities, muscular activity or psychosocial exposure.

In conclusion, the analyses established quantitative exposure-response relationships between neck and shoulder disorders and objective measures of the physical workload on the arm. Such information can be used for risk assessment in different occupations/work tasks, to establish quantitative exposure limits, and for the evaluation of preventive measures.

- **Keywords:** Occupational exposure; Physical; Psychosocial; Velocity; Movement; Posture; Muscular activity; Wrist; Upper arm; Neck

Katie Li, Ashutosh Tiwari, Jeffrey Alcock, Pablo Bermell-Garcia. *Categorisation of visualisation methods to support the design of Human-Computer Interaction Systems. Pages 85-107.*

During the design of Human-Computer Interaction (HCI) systems, the creation of visual artefacts forms an important part of design. On one hand producing a visual artefact has a number of advantages: it helps designers to externalise their thought and acts as a common language between different stakeholders. On the other hand, if an inappropriate visualisation method is employed it could hinder the design process. To support the design of HCI systems, this paper reviews the categorisation of visualisation methods used in HCI. A keyword search is conducted to identify a) current HCI design methods, b) approaches of selecting these methods. The resulting design methods are filtered to create a list of just visualisation methods. These are then categorised using the approaches identified in (b). As a result 23 HCI visualisation methods are identified and categorised in 5 selection approaches (The Recipient, Primary Purpose, Visual Archetype, Interaction Type, and The Design Process).

- **Keywords:** Visual artefacts; Selection approach; Human-Computer Interaction

Camilla Dahlqvist, Gert-Åke Hansson, Mikael Forsman. *Validity of a small low-cost triaxial accelerometer with integrated logger for uncomplicated measurements of postures and movements of head, upper back and upper arms. Pages 108-116.*

Repetitive work and work in constrained postures are risk factors for developing musculoskeletal disorders. Low-cost, user-friendly technical methods to quantify these risks are needed. The aims were to validate inclination angles and velocities of one model of the new generation of accelerometers with integrated data loggers against a previously validated one, and to compare measurements when using a plain reference posture with that of a standardized one. All mean (n = 12 subjects) angular RMS-differences in 4 work tasks and 4 body parts were $\leq 2.5^\circ$ and all mean median angular velocity differences ≤ 5.0 °/s. The mean correlation between the inclination signal-pairs was 0.996. This model of the new generation of triaxial accelerometers proved to be comparable to the validated accelerometer using a data logger. This makes it well-suited, for both researchers and practitioners, to measure postures and movements during work. Further work is needed for validation of the plain reference posture for upper arms.

- **Keywords:** Work-related musculoskeletal disorders; Quantitative exposure-response relationships; Technical measurements

Yi Ding, Fu Guo, Xuefeng Zhang, Qingxing Qu, Weilin Liu. *Using event related potentials to identify a user's behavioural intention aroused by product form design. Pages 117-123.*

The capacity of product form to arouse user's behavioural intention plays a decisive role in further user experience, even in purchase decision, while traditional methods rarely give a fully understanding of user experience evoked by product form, especially the feeling of anticipated use of product. Behavioural intention aroused by product form designs has not yet been investigated electrophysiologically. Hence event related potentials (ERPs) were applied to explore the process of behavioural intention when users browsed different smart phone form designs with brand and price not taken into account for mainly studying the brain activity evoked by variety of product forms. Smart phone pictures with different anticipated user experience were displayed with equiprobability randomly. Participants were asked to click the left mouse button when certain picture gave them a feeling of behavioural intention to interact with. The brain signal of each participant was recorded by Curry 7.0. The results show that pictures with an ability to

arouse participants' behavioural intention for further experience can evoke enhanced N300 and LPPs (late positive potentials) in central-parietal, parietal and occipital regions. The scalp topography shows that central-parietal, parietal and occipital regions are more activated. The results indicate that the discrepancy of ERPs can reflect the neural activities of behavioural intention formed or not. Moreover, amplitude of ERPs occurred in corresponding brain areas can be used to measure user experience. The exploring of neural correlated with behavioural intention provide an accurate measurement method of user's perception and help marketers to know which product can arouse users' behavioural intention, maybe taken as an evaluating indicator of product design.

- **Keywords:** Behavioural intention; User experience; Event related potentials; N300; Late positive potential

Ben Beck, Kane J. Middleton, Greg L. Carstairs, Daniel C. Billing, Joanne N. Caldwell. *Predicting stretcher carriage: Investigating variations in bilateral carry tests. Pages 124-132.*

Carrying a casualty on a stretcher is a critical task within military and emergency service occupations. This study evaluated the impact of manipulating carry speed and the object type in bilateral carries on the ability to predict performance and reflect the physical and physiological requirements of a unilateral stretcher carry. We demonstrated that three task-related predictive tests; a jerry can carry performed at 4.5 km h⁻¹ or 5.0 km h⁻¹ and a kettle-bell carry performed at 5.0 km h⁻¹ were strongly predictive of the physical and physiological demands of an individual participating as part of a four-person stretcher carry team. Therefore, bilateral predictive assessments have the utility for predicting the suitability of employees to effectively and safely conduct a four-person unilateral stretcher carry.

- **Keywords:** Employment standards; Job fitness test; Physical performance

Z.G. Gao, S.Q. Sun, R.S. Goonetilleke, D.H.K. Chow. *Effect of an on-hip load-carrying belt on physiological and perceptual responses during bimanual anterior load carriage. Pages 133-137.*

Manual load carriage continues to be a major contributor of musculoskeletal injury. This study investigates the physiological and subjective effects of an on-hip load-carrying belt (HLCB) during bimanual anterior load carriage. Fifteen healthy male participants walked on a level ground treadmill at 4.5 km/h for 5 min carrying 5, 10 and 15 kg loads with hands and arms in front of the body, with and without using the HLCB (WD and ND). Heart rate, normalized oxygen uptake, minute ventilation and, central and peripheral ratings of perceived exertion were the dependent variables. The mean heart rate, normalized oxygen uptake, minute ventilation and peripheral rating of perceived exertion increased significantly with load under both WD and ND conditions. At a load of 15 kg, the mean heart rate, normalized oxygen uptake, minute ventilation and peripheral rating of perceived exertion were significantly lower by 6.6%, 8.0%, 11.8% and 13.9% respectively in WD condition when compared to the ND condition. There was no significant difference between WD and ND conditions with 5 or 10 kg load. It can be concluded that the HLCB could reduce a person's physiological and peripheral perceptual responses when walking on a level ground treadmill at 4.5 km/h with a load of 15 kg. Using a HLCB or similar device is therefore recommended for bimanual anterior load carriage for loads of 15 kg or probably larger.

- **Keywords:** Anterior load carriage; Energy cost; Heart rate; Load carrying device

David R. Large, Elizabeth Crundall, Gary Burnett, Catherine Harvey, Panos Konstantopoulos. *Driving without wings: The effect of different*

digital mirror locations on the visual behaviour, performance and opinions of drivers. Pages 138-148.

Drivers' awareness of the rearward road scene is critical when contemplating or executing lane-change manoeuvres, such as overtaking. Preliminary investigations have speculated on the use of rear-facing cameras to relay images to displays mounted inside the car to create 'digital mirrors'. These may overcome many of the limitations associated with traditional 'wing' and rear-view mirrors, yet will inevitably effect drivers' normal visual scanning behaviour, and may force them to consider the rearward road scene from an unfamiliar perspective that is incongruent with their mental model of the outside world. We describe a study conducted within a medium-fidelity simulator aiming to explore the visual behaviour, driving performance and opinions of drivers while using internally located digital mirrors during different overtaking manoeuvres. Using a generic UK motorway scenario, thirty-eight experienced drivers conducted overtaking manoeuvres using each of five different layouts of digital mirrors with varying degrees of 'real-world' mapping. The results showed reductions in decision time for lane changes and eyes-off road time while using the digital mirrors, when compared with baseline traditional reflective mirrors, suggesting that digital displays may enable drivers to more rapidly pick up the salient information from the rearward road scene. Subjectively, drivers preferred configurations that most closely matched existing mirror locations, where aspects of real-world mapping were largely preserved. The research highlights important human factors issues that require further investigation prior to further development/implementation of digital mirrors within vehicles. Future work should also aim to validate findings within real-world on-road environments whilst considering the effects of digital mirrors on other important visual behaviour characteristics, such as depth perception.

- **Keywords:** Digital mirrors; Driving; Visual behaviour; Simulation

Joy Goodman-Deane, Sam Waller, Keziah Latham, Holly Price, Raji Tenneti, P. John Clarkson. [Differences in vision performance in different scenarios and implications for design](#). Pages 149-155.

To design accessibly, designers need good, relevant population data on visual abilities. However, currently available data often focuses on clinical vision measures that are not entirely relevant to everyday product use. This paper presents data from a pilot survey of 362 participants in the UK, covering a range of vision measures of particular relevance to product design. The results from the different measures are compared, and recommendations are given for relative text sizes to use in different situations. The results indicate that text needs to be 17–18% larger for comfortable rather than perceived threshold viewing, and a further 20% larger when users are expected to wear their everyday vision setup rather than specific reading aids.

- **Keywords:** Visual ability; Text size; Product design; Inclusive design

Siné McDougall, Irene Reppa, Jozef Kulik, Alisdair Taylor. *What makes icons appealing? The role of processing fluency in predicting icon appeal in different task contexts*. Pages 156-172.

Although icons appear on almost all interfaces, there is a paucity of research examining the determinants of icon appeal. The experiments reported here examined the icon characteristics determining appeal and the extent to which processing fluency – the subjective ease with which individuals process information – was used as a heuristic to guide appeal evaluations. Participants searched for, and identified, icons in displays. The initial appeal of icons was held constant while ease of processing was manipulated by systematically varying the complexity and familiarity of the icons presented and the type

of task participants were asked to carry out. Processing fluency reliably influenced users' appeal ratings and appeared to be based on users' unconscious awareness of the ease with which they carried out experimental tasks.

- **Keywords:** Icons; Processing fluency; User experience; Aesthetics; Appeal

Yasuyo Sunaga, Naohiko Kanemura, Masaya Anan, Makoto Takahashi, Koichi Shinkoda. [*Estimation of inertial parameters of the lower trunk in pregnant Japanese women: A longitudinal comparative study and application to motion analysis.*](#) **Pages 173-182.**

We aimed to quantify the inertial parameters of the lower trunk segment in pregnant Japanese women and compare kinetic data during tasks calculated with parameters estimated in this study to data calculated with standard parameters. Eight pregnant women and seven nulliparous women participated. Twenty-four infrared reflective markers were attached to the lower trunk, and the standing position was captured by eight infrared cameras. The lower trunk was divided into parts, and inertial parameters were calculated. Pregnant women performed a movement task that involved standing from a chair, picking up plates, and walking forward after turning to the right. Kinetic analysis was performed using standard inertial parameters and the newly calculated parameters. There were more significant differences between methods in the kinetic data at the latter stages of pregnancy. The inertial parameters calculated in this study should be used to ensure the validity of biomechanical studies of pregnant Japanese women.

- **Keywords:** Pregnant women; Body segment inertial parameters; Motion analysis

Priyadarshini Sengupta Dasgupta, Laura Punnett, Susan Moir, Sarah Kuhn, Bryan Buchholz. ***Does drywall installers' innovative idea reduce the ergonomic exposures of ceiling installation: A field case study.*** **Pages 183-193.**

Objective: The study was conducted to assess an intervention suggested by the workers to reduce the physical or ergonomic exposures of the drywall installation task. **Methods:** The drywall installers were asked to brainstorm on innovative ideas that could reduce their ergonomic exposures during the drywall installation work. The workers proposed the idea of using a 'deadman' (narrow panel piece) to hold the panels to the ceiling while installing them. The researcher collected quantitative exposure data (PATH, 3DSSPP) at the baseline and intervention phases and compared the phases to find out any change in the exposure while using the 'deadman'. **Results:** Results showed that ergonomic exposures (such as overhead arm and awkward trunk postures and heavy load handling) were reduced at the intervention phase while using the 'deadman' with an electrically operated lift. **Conclusion:** The concept of the 'deadman', which was shown to help reduce musculoskeletal exposures during ceiling installation, can be used to fabricate a permanent ergonomic tool to support the ceiling drywall panel.

- **Keywords:** Drywall ceiling installation; Innovative ideas; Exposure reduction

Thierry Ellena, Aleksandar Subic, Helmy Mustafa, Toh Yen Pang. ***The Helmet Fit Index – An intelligent tool for fit assessment and design customisation.*** **Pages 194-207.**

Helmet safety benefits are reduced if the headgear is poorly fitted on the wearer's head. At present, there are no industry standards available to assess objectively how a specific protective helmet fits a particular person. A proper fit is typically defined as a small and uniform distance between the helmet liner and the wearer's head shape, with a broad coverage of the head area. This paper presents a novel method to investigate and

compare fitting accuracy of helmets based on 3D anthropometry, reverse engineering techniques and computational analysis. The Helmet Fit Index (HFI) that provides a fit score on a scale from 0 (excessively poor fit) to 100 (perfect fit) was compared with subjective fit assessments of surveyed cyclists. Results in this study showed that quantitative (HFI) and qualitative (participants' feelings) data were related when comparing three commercially available bicycle helmets. Findings also demonstrated that females and Asian people have lower fit scores than males and Caucasians, respectively. The HFI could provide detailed understanding of helmet efficiency regarding fit and could be used during helmet design and development phases.

- **Keywords:** 3D anthropometry; Helmet; Fit assessment

Jennie A. Jackson, Svend Erik Mathiassen, Per Liv. *Observer performance in estimating upper arm elevation angles under ideal viewing conditions when assisted by posture matching software. Pages 208-215.*

Selecting a suitable body posture measurement method requires performance indices of candidate tools. Such data are lacking for observational assessments made at a high degree of resolution. The aim of this study was to determine the performance (bias and between- and within-observer variance) of novice observers estimating upper arm elevation postures assisted by posture matching software to the nearest degree from still images taken under ideal conditions. Estimates were minimally biased from true angles: the mean error across observers was less than 2°. Variance between observers was minimal. Considerable variance within observers, however, underlined the risk of relying on single observations. Observers were more proficient at estimating 0° and 90° postures, and less proficient at 60°. Thus, under ideal visual conditions observers, on average, proved proficient at high resolution posture estimates; further investigation is required to determine how non-optimal image conditions, as would be expected from occupational data, impact proficiency.

- **Keywords:** Measurement error; Working postures; Observation

Yeongmi Kim, Arturo Moncada-Torres, Jonas Furrer, Markus Riesch, Roger Gassert. *Quantification of long cane usage characteristics with the constant contact technique. Pages 216-225.*

While a number of Electronic Travel Aids (ETAs) have been developed over the past decades, the conventional long cane remains the most widely utilized navigation tool for people with visual impairments. Understanding the characteristics of long cane usage is crucial for the development and acceptance of ETAs. Using optical tracking, cameras and inertial measurement units, we investigated grasp type, cane orientation and sweeping characteristics of the long cane with the constant contact technique. The mean cane tilt angle, sweeping angle, and grip rotation deviation were measured. Grasp type varied among subjects, but was maintained throughout the experiments, with thumb and index finger in contact with the cane handle over 90% of the time. We found large inter-subject differences in sweeping range and frequency, while the sweeping frequency showed low intra-subject variability. These findings give insights into long cane usage characteristics and provide critical information for the development of effective ETAs.

- **Keywords:** Long cane usage characteristics; Design guidelines; Visual impairment; Electronic travel aids

Arthur Stewart, Robert Ledingham, Graham Furnace, Natasha Schranz, Alan Nevill. *The ability of UK offshore workers of different body size and shape to egress through a restricted window space. Pages 226-233.*

404 male offshore workers aged 41.4 ± 10.7 y underwent 3D body scanning and an egress task simulating the smallest helicopter window emergency exit size. The 198 who failed were older ($P < 0.01$), taller ($P < 0.05$) and heavier ($P < 0.0001$) than the 206 who passed. Using all extracted dimensions from the scans, binary logistic regression identified a model (refined using backward elimination) which predicted egress outcome with 75.2% accuracy. Using only weight, bideltoid breadth and maximum chest depth, the model achieved ~70% accuracy. When anatomical dimensions categorise individuals for small window egress, 25% or more will be misclassified, with false positives (those predicted to fail, but pass) slightly outnumbering false negatives (those predicted to pass, but fail), highlighting the limitations of a predictive approach which treats the body as a rigid object. Differences in flexibility and technique may explain these observations, which may be important considerations for future research.

- **Keywords:** Offshore workers; Window egress; Binary logistic regression; 3D scanning

Yasuhiro Shimazaki, Toshiki Matsutani, Yayoi Satsumoto. *Evaluation of thermal formation and air ventilation inside footwear during gait: The role of gait and fitting.* Pages 234-240.

Comfort is an important concept in footwear design. The microclimate inside footwear contributes to the perception of thermal comfort. To investigate the effect of ventilation on microclimate formation inside footwear, experiments with subjects were conducted at four gait speeds with three different footwear sizes. Skin temperature, metabolism, and body mass were measured at approximately 25 °C and 50% relative humidity, with no solar radiation and a calm wind. The footwear occupancy and ventilation rate were also estimated, with the latter determined using the tracer gas method. The experimental results revealed that foot movement, metabolism, evaporation, radiation, convection, and ventilation were the main factors influencing the energy balance for temperature formation on the surface of the foot. The cooling effect of ventilation on the arch temperature was observed during gait. The significance of the amount of air space and ventilation on the improvement in the thermal comfort of footwear was clarified.

- **Keywords:** Foot temperature; Air behavior; Energy balance

Kazuma Ishimatsu, Anders Meland, Tor Are S. Hansen, Jan Ivar Kåsin, Anthony S. Wagstaff. *Action slips during whole-body vibration.* Pages 241-247

Helicopter aircrew members engage in highly demanding cognitive tasks in an environment subject to whole-body vibration (WBV). Sometimes their actions may not be according to plan (e.g. action slips and lapses). This study used a Sustained Attention to Response Task (SART) to examine whether action slips were more frequent during exposure to WBV. Nineteen participants performed the SART in two blocks. In the WBV block participants were exposed to 17 Hz vertical WBV, which is typical of larger helicopter working environments. In the No-WBV block there was no WBV. There were more responses to the rare no-go digit 3 (i.e. action slips) in the WBV block, and participants responded faster in the WBV block. These results suggest that WBV influences response inhibition, and can induce impulsive responding. WBV may increase the likelihood of action slips, mainly due to failure of response inhibition.

- **Keywords:** Response inhibition; Sustained attention; Human error

Yueng-Hsiang Huang, Jin Lee, Anna C. McFadden, Lauren A. Murphy, Michelle M. Robertson, Janelle H. Cheung, Dov Zohar. [*Beyond safety outcomes: An investigation of the impact of safety climate on job*](#)

[satisfaction, employee engagement and turnover using social exchange theory as the theoretical Framework.](#) Pages 248-257.

Safety climate, a measure of the degree to which safety is perceived by employees to be a priority in their company, is often implicated as a key factor in the promotion of injury-reducing behavior and safe work environments. Using social exchange theory as a theoretical basis, this study hypothesized that safety climate would be related to employees' job satisfaction, engagement, and turnover rate, highlighting the beneficial effects of safety climate beyond typical safety outcomes. Survey data were collected from 6207 truck drivers from two U.S. trucking companies. The objective turnover rate was collected one year after the survey data collection. Results showed that employees' safety climate perceptions were linked to employees' level of job satisfaction, engagement, and objective turnover rate, thus supporting the application of social exchange theory. Job satisfaction was also a significant mediator between safety climate and the two human resource outcomes (i.e., employee engagement and turnover rate). This study is among the first to assess the impact of safety climate beyond safety outcomes among lone workers (using truck drivers as an exemplar).

- **Keywords:** Safety climate; Job satisfaction; Employee engagement; Objective turnover rate; Social exchange theory

***Roberto Deboli, Angela Calvo, Christian Preti. Vibration and impulsivity analysis of hand held olive beaters.* Pages 258-267.**

To provide more effective evaluations of hand arm vibration syndromes caused by hand held olive beaters, this study focused on two aspects: the acceleration measured at the tool pole and the analysis of the impulsivity, using the crest factor. The signals were frequency weighted using the weighting curve W_h as described in the ISO 5349-1 standard. The same source signals were also filtered by the W_h -bl filter (ISO/TS 15694), because the weighting filter W_h (unlike the W_h -bl filter) could underestimate the effect of high frequency vibration on vibration-induced finger disorders. Ten (experienced) male operators used three beater models (battery powered) in the real olive harvesting condition. High vibration total values were obtained with values never lower than 20 m^{-2} . Concerning the crest factor, the values ranged from 5 to more than 22. This work demonstrated that the hand held olive beaters produced high impulsive loads comparable to the industry hand held tools.

- **Keywords:** HAV; Impulsivity; Olive harvester