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Bridget A. Russell, Mathew J. Summers, Peter J. Tranent, Matthew A. Palmer, P. Dean Cooley & Scott J. Pedersen. *A randomised control trial of the cognitive effects of working in a seated as opposed to a standing position in office workers*. Pages 737-744.

Sedentary behaviour is increasing and has been identified as a potential significant health risk, particularly for desk-based employees. The development of sit-stand workstations in the workplace is one approach to reduce sedentary behaviour. However, there is uncertainty about the effects of sit-stand workstations on cognitive functioning. A sample of 36 university staff participated in a within-subjects randomised control trial examining the effect of sitting vs. standing for one hour per day for five consecutive days on attention, information processing speed, short-term memory, working memory and task efficiency. The results of the study showed no statistically significant difference in cognitive performance or work efficiency between the sitting and standing conditions, with all effect sizes being small to very small (all *ds* < .2). This result suggests that the use of sit-stand workstations is not associated with a reduction in cognitive performance. **Practitioner Summary:** Although it has been reported that the use of sit-stand desks may help offset adverse health effects of prolonged sitting, there is scant evidence about changes in productivity. This randomised control study showed that there was no difference between sitting and standing for one hour on cognitive function or task efficiency in university staff.

- **Keywords:** Sitting, standing, sedentary, cognitive function, work efficiency, randomised control trial

Mariel Grassmann, Elke Vlemincx, Andreas von Leupoldt & Omer Van den Bergh. *The role of respiratory measures to assess mental load in pilot selection*. Pages 745-753.

While cardiovascular measures have a long tradition of being used to determine operator load, responsiveness of the respiratory system to mental load has rarely been investigated. In this study, we assessed basic and variability measures of respiration rate (RR), partial pressure of end-tidal carbon dioxide (petCO_2) as well as performance measures in 63 male pilot candidates during completion of a complex cognitive task and

subsequent recovery. Mental load was associated with an increase in RR and a decrease in respiratory variability. A significant decrease was also found for petCO_2. RR and respiratory variability showed partial and complete effects of recovery, respectively, whereas petCO_2 did not return to baseline level. Overall, a good performance was related to a stronger reactivity in RR. Our findings suggest that respiratory parameters would be a useful supplement to common measures for the assessment of mental load in pilot selection. **Practitioner Summary:** Respiratory measures are a promising yet poorly investigated approach to monitor operator load. For pilot selection, we assessed respiration in response to multitasking in 63 candidates. Task-related changes as well as covariation with performance strongly support the consideration of respiratory parameters when evaluating reactivity to mental load.

- **Keywords:** Mental load, multiple task performance, respiration rate, respiratory variability, end-tidal CO2

Vanessa Beanland, Michael G. Lenné, Paul M. Salmon & Neville A. Stanton. *Variability in decision-making and critical cue use by different road users at rail level crossings*. Pages 754-766.

Collisions at rail level crossings (RLXs) are typically high-severity and high-cost, often involving serious injuries, fatalities and major disruptions to the transport network. Most research examining behaviour at RLXs has focused exclusively on drivers and consequently there is little knowledge on how other road users make decisions at RLXs. We collected drivers', motorcyclists', bicyclists' and pedestrians' self-reported daily experiences at RLXs for two weeks, focusing on behaviour, decision-making and information use in the presence of a train and/or activated RLX signals. Both information use and behaviour differed between road users. Visual information (e.g. flashing lights) was more influential for motorists, whereas pedestrians and cyclists relied more on auditory information (e.g. bells). Pedestrians were also more likely to violate active RLX warnings and/or cross before an approaching train. These results emphasise the importance of adopting holistic RLX design approaches that support cognition and behaviour across for all road users. **Practitioner Summary:** This study explores how information use and decision-making at rail level crossings (RLXs) differ between road user groups, using a two-week self-report study. Most users make safe decisions, but pedestrians are most likely to violate RLX warnings. Information use (visual vs. auditory) also differs substantially between road user groups.

- **Keywords:** Rail level crossings, grade crossings, decision-making, situation awareness

Juergen Sauer, Alain Chavaillaz & David Wastell. *Experience of automation failures in training: effects on trust, automation bias, complacency and performance*. Pages 767-780.

This work examined the effects of operators' exposure to various types of automation failures in training. Forty-five participants were trained for 3.5 h on a simulated process control environment. During training, participants either experienced a fully reliable, automatic fault repair facility (i.e. faults detected and correctly diagnosed), a misdiagnosis-prone one (i.e. faults detected but not correctly diagnosed) or a miss-prone one (i.e. faults not detected). One week after training, participants were tested for 3 h, experiencing two types of automation failures (misdiagnosis, miss). The results showed that automation bias was very high when operators trained on miss-prone automation encountered a failure of the diagnostic system. Operator errors resulting from automation bias were much higher when automation misdiagnosed a fault than when it missed one. Differences in trust levels that were instilled by the different training experiences disappeared during the testing session. **Practitioner Summary**: The experience of automation failures during training has some consequences. A greater

potential for operator errors may be expected when an automatic system failed to diagnose a fault than when it failed to detect one.

- **Keywords:** Automation failure, trust, adaptable automation, complacency, automation bias

Basil Wahn, Jessika Schwandt, Matti Krüger, Daina Crafa, Vanessa Nunnendorf & Peter König. *Multisensory teamwork: using a tactile or an auditory display to exchange gaze information improves performance in joint visual search*. Pages 781-795.

In joint tasks, adjusting to the actions of others is critical for success. For joint visual search tasks, research has shown that when search partners visually receive information about each other's gaze, they use this information to adjust to each other's actions, resulting in faster search performance. The present study used a visual, a tactile and an auditory display, respectively, to provide search partners with information about each other's gaze. Results showed that search partners performed faster when the gaze information was received via a tactile or auditory display in comparison to receiving it via a visual display or receiving no gaze information. Findings demonstrate the effectiveness of tactile and auditory displays for receiving task-relevant information in joint tasks and are applicable to circumstances in which little or no visual information is available or the visual modality is already taxed with a demanding task such as air-traffic control. **Practitioner Summary:** The present study demonstrates that tactile and auditory displays are effective for receiving information about actions of others in joint tasks. Findings are either applicable to circumstances in which little or no visual information is available or when the visual modality is already taxed with a demanding task.

- **Keywords:** joint action, visual search, tactile display, auditory display, sensory motor contingencies, multisensory processing

Jangwoon Park, Sheila M. Ebert, Matthew P. Reed & Jason J. Hallman. *A statistical model including age to predict passenger postures in the rear seats of automobiles*. Pages 796-805.

Few statistical models of rear seat passenger posture have been published, and none has taken into account the effects of occupant age. This study developed new statistical models for predicting passenger postures in the rear seats of automobiles. Postures of 89 adults with a wide range of age and body size were measured in a laboratory mock-up in seven seat configurations. Posture-prediction models for female and male passengers were separately developed by stepwise regression using age, body dimensions, seat configurations and two-way interactions as potential predictors. Passenger posture was significantly associated with age and the effects of other two-way interaction variables depended on age. A set of posture-prediction models are presented for women and men, and the prediction results are compared with previously published models. This study is the first study of passenger posture to include a large cohort of older passengers and the first to report a significant effect of age for adults. The presented models can be used to position computational and physical human models for vehicle design and assessment. **Practitioner Summary:** The significant effects of age, body dimensions and seat configuration on rear seat passenger posture were identified. The models can be used to accurately position computational human models or crash test dummies for older passengers in known rear seat configurations.

- **Keywords:** Passenger posture, rear seat, hip location, eye location, age

Gavin Lenton, Brad Aisbett, Daniel Neesham-Smith, Alvaro Carvajal & Kevin Netto. *The effects of military body armour on trunk and hip*

***kinematics during performance of manual handling tasks*. Pages 806-812.**

Musculoskeletal injuries are reported as burdening the military. An identified risk factor for injury is carrying heavy loads; however, soldiers are also required to wear their load as body armour. To investigate the effects of body armour on trunk and hip kinematics during military-specific manual handling tasks, 16 males completed 3 tasks while wearing each of 4 body armour conditions plus a control. Three-dimensional motion analysis captured and quantified all kinematic data. Average trunk flexion for the weightiest armour type was higher compared with control during the carry component of the ammunition box lift ($p < 0.001$) and sandbag lift tasks ($p < 0.001$). Trunk rotation ROM was lower for all armour types compared with control during the ammunition box place component ($p < 0.001$). The altered kinematics with body armour occurred independent of armour design. In order to optimise armour design, manufacturers need to work with end-users to explore how armour configurations interact with range of personal and situational factors in operationally relevant environments. **Practitioner Summary:** Musculoskeletal injuries are reported as burdening the military and may relate to body armour wear. Body armour increased trunk flexion and reduced trunk rotation during military-specific lifting and carrying tasks. The altered kinematics may contribute to injury risk, but more research is required.

- **Keywords:** Body armour, biomechanics, posture, injury

Benjamin Beck, Greg L. Carstairs, Joanne N. Caldwell Odgers, Tim L. A. Doyle & Kane J. Middleton. *Jerry can carriage is an effective predictor of stretcher carry performance*. Pages 813-820.

Carrying a casualty on a stretcher is a critical task conducted in a range of occupations. To ensure that personnel have the requisite physical capacity to conduct this task, two bilateral jerry can carries were used to predict individual performance in a four-person stretcher carry. Results demonstrated a bilateral 22-kg jerry can carry ($R^2 = 0.59$) had superior predictive ability of stretcher carry performance than a bilateral 15-kg jerry can carry ($R^2 = 0.46$). Pre- to post-carry changes in grip endurance ($p > 0.05$), back–leg isometric strength ($p > 0.05$) and leg power ($p > 0.05$) were not significantly different between carry tasks. There was no significant difference in heart rate ($p > 0.05$) and oxygen consumption ($p > 0.05$) between the stretcher carry and either jerry can carry. Thus, on the basis of performance correlations and physiological measures, the 22-kg jerry can carry is an appropriate predictive assessment of four-person stretcher carriage. **Practitioner Summary:** This study investigated the ability of a jerry can carry to predict individual performance on a four-person stretcher carry. Performance correlations were substantiated with physiological measures to demonstrate similar physical requirements between task and test. These results can be used to set physical employment standards to assess stretcher carriage.

- **Keywords:** Physical employment standards, job related testing, physical performance, task-related predictive test

Ping-Hsin Ko, Yaw-Huei Hwang & Huey-Wen Liang. *Influence of smartphone use styles on typing performance and biomechanical exposure*. Pages 821-828.

Twenty-seven subjects completed 2-min typing tasks using four typing styles: right-hand holding/typing (S-thumb) and two-hand typing at three heights (B-low, B-mid and B-high). The styles had significant effects on typing performance, neck and elbow flexion and muscle activities of the right trapezius and several muscles of the right upper limb ($p < 0.0001$ by repeated-measure analysis of variance). The subjects typed the fewest

words (error-adjusted characters per minute: 78) with the S-thumb style. S-thumb style resulted in similar flexion angles of the neck, elbow and wrist, but significantly increased muscle activities in all tested muscles compared with the B-mid style. Holding the phone high or low reduced the flexion angles of the neck and right elbow compared with the B-mid style, but the former styles increased the muscle activity of the right trapezius. Right-hand holding/typing was not a preferable posture due to high muscle activities and slow typing speed. **Practitioner Summary:** Right-hand holding/typing was not favoured, due to increased muscle activities and slower typing speed. Holding the phone high or low reduced the flexion angles of the neck and right elbow, but the former styles increased the muscle activity of the right trapezius compared with holding the phone at chest level.

- **Keywords:** Mobile phone, posture, muscle activity, surface electromyography, ergonomics

Peter Palm, Malin Josephson, Svend Erik Mathiassen & Katarina Kjellberg. *Reliability and criterion validity of an observation protocol for working technique assessments in cash register work*. Pages 829-839.

We evaluated the intra- and inter-observer reliability and criterion validity of an observation protocol, developed in an iterative process involving practicing ergonomists, for assessment of working technique during cash register work for the purpose of preventing upper extremity symptoms. Two ergonomists independently assessed 17 15-min videos of cash register work on two occasions each, as a basis for examining reliability. Criterion validity was assessed by comparing these assessments with meticulous video-based analyses by researchers. Intra-observer reliability was acceptable (i.e. proportional agreement >0.7 and kappa >0.4) for 10/10 questions. Inter-observer reliability was acceptable for only 3/10 questions. An acceptable inter-observer reliability combined with an acceptable criterion validity was obtained only for one working technique aspect, 'Quality of movements'. Thus, major elements of the cashiers' working technique could not be assessed with an acceptable accuracy from short periods of observations by one observer, such as often desired by practitioners. **Practitioner Summary**: We examined an observation protocol for assessing working technique in cash register work. It was feasible in use, but inter-observer reliability and criterion validity were generally not acceptable when working technique aspects were assessed from short periods of work. We recommend the protocol to be used for educational purposes only.

- **Keywords:** Repetitive work, observational reliability, upper extremity disorders, prevention, workstyle

Carlos Aceves-González, Andrew May & Sharon Cook. *An observational comparison of the older and younger bus passenger experience in a developing world city*. Pages 840-850.

passengers in Guadalajara, Mexico. A set of data were collected for each observed passenger, as well as more general observations related to driver behaviour, bus design and bus service characteristics. There were significant differences between older and younger passengers in terms of boarding and alighting times, use of handrails, seat location preferences, passenger stability and coping strategies in order to maintain postural stability. The conditions of travel are conducive to a poor passenger experience for the older passengers in particular. Although the problems may be attributed to bus design and driver behaviour typical of that in developing countries, they are also influenced by the wider transport infrastructure, and a lack of a regulatory regime which places drivers under time pressure and in direct competition with each other.**Practitioner Summary:** Bus services must cater for all ages of passengers, including the elderly. This unobtrusive observational study investigated the passenger

experience in a developing world city. Bus and wider service design were found to compromise the journey experience, with the older users being particularly negatively impacted. Design recommendations are provided.

- **Keywords:** Developing world, bus passenger, observational study, traveller experience, public transport, driver behaviour, bus design

Dwayne Van Eerd, Trevor King, Kiera Keown, Tesha Slack, Donald C. Cole, Emma Irvin, Benjamin C. Amick III & Philip Bigelow. *Dissemination and use of a participatory ergonomics guide for workplaces*. Pages 851-858.

Musculoskeletal disorders (MSDs) result in lost-time injury claims and lost productivity worldwide, placing a substantial burden on workers and workplaces. Participatory ergonomics (PE) is a popular approach to reducing MSDs; however, there are challenges to implementing PE programmes. Using evidence to overcome challenges may be helpful but the impacts of doing so are unknown. We sought to disseminate an evidence-based PE tool and to describe its use. An easy-to-use, evidence-based PE Guide was disseminated to workplace parties, who were surveyed about using the tool. The greatest barrier to using the tool was a lack of time. Reported tool use included for training purposes, sharing and integrating the tool into existing programmes. New actions related to tool use included training, defining team responsibilities and suggesting programme implementation steps. Evidence-based tools could help ergonomists overcome some challenges involved in implementing injury reduction programmes such as PE. **Practitioner Summary:** Practitioners experience challenges implementing programmes to reduce the burden of MSDs in workplaces. Implementing participatory interventions requires multiple workplace parties to be 'on-board'. Disseminating and using evidence-based guides may help to overcome these challenges. Using evidence-based tools may help ergonomics practitioners implement PE programmes.

- **Keywords:** Participative ergonomics, musculoskeletal disorders, research to practice, evidence-based tools, knowledge transfer and exchange