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Richelle Baker, Pieter Coenen, Erin Howie, Jeremy Lee, Ann Williamson & Leon Straker. *A detailed description of the short-term musculoskeletal and cognitive effects of prolonged standing for office computer work.* Pages: 877-890.

Due to concerns about excessive sedentary exposure for office workers, alternate work positions such as standing are being trialled. However, prolonged standing may have health and productivity impacts, which this study assessed. Twenty adult participants undertook two hours of laboratory-based standing computer work to investigate changes in discomfort and cognitive function, along with muscle fatigue, movement, lower limb swelling and mental state. Over time, discomfort increased in all body areas (total body IRR [95% confidence interval]: 1.47[1.36–1.59]). Sustained attention reaction time ($\beta = 18.25[8.00-28.51]$) deteriorated, while creative problem solving improved ($\beta = 0.89[0.29-1.49]$). There was no change in erector spinae, rectus femoris, biceps femoris or tibialis anterior muscle fatigue; low back angle changed towards less lordosis, pelvis movement increased, lower limb swelling increased and mental state decreased. Body discomfort was positively correlated with mental state. The observed changes suggest replacing office work sitting with standing should be done with caution. **Practitioner Summary:** Standing is being used to replace sitting by office workers; however, there are health risks associated with prolonged standing. In a laboratory study involving 2 h prolonged standing discomfort increased (all body areas), reaction time and mental state deteriorated while creative problem-solving improved. Prolonged standing should be undertaken with caution.

- **Keywords:** Human-computer interaction, musculoskeletal disorders, biomechanics, mental work capacity, office ergonomics

Linda M. Rose, Catherine A. A. Beauchemin & W. Patrick Neumann. *Modelling endurance and resumption times for repetitive one-hand pushing.* Pages: 891-901.

This study's objective was to develop models of endurance time (ET), as a function of load level (LL), and of resumption time (RT) after loading as a function of both LL and loading time (LT) for repeated loadings. Ten male participants with experience in

construction work each performed 15 different one-handed repeated pushing tasks at shoulder height with varied exerted force and duration. These data were used to create regression models predicting ET and RT. It is concluded that power law relationships are most appropriate to use when modelling ET and RT. While the data the equations are based on are limited regarding number of participants, gender, postures, magnitude and type of exerted force, the paper suggests how this kind of modelling can be used in job design and in further research. **Practitioner Summary:** Adequate muscular recovery during work-shifts is important to create sustainable jobs. This paper describes mathematical modelling and presents models for endurance times and resumption times (an aspect of recovery need), based on data from an empirical study. The models can be used to help manage fatigue levels in job design.

- **Keywords:** Modelling, endurance, recovery, work-rest, repetitive load

Shaboo Valipoor, Debajyoti Pati, Matt S. Stock & Doug Bazuin. *Safer chairs for elderly patients: design evaluation using electromyography and force measurement.* Pages: 902-912.

A vast majority of patient fall events in hospitals involve the elderly. In inpatient care settings, despite the risk of fall, patients are encouraged to leave their bed, move around their room, and sit on their chair to progress in their healing. Despite the vital role of patient chair design in improving recovery, few studies have examined the ergonomic requirements of safe patient chairs. This study examined the impact of manipulating horizontal and vertical positions of armrests in a test chair on required physical effort during Stand-to-Sit-to-Stand (St-Si-St) transitions among 15 elderly women. Physical effort was measured using: (1) surface electromyography (sEMG); (2) force measurement by load cells; (3) video recording. Findings showed non-linear patterns of change in required physical effort due to changes in armrests' height and distance. It was also found that minimum effort is associated with armrests higher and farther apart than those in typical patient chairs. **Practitioner Summary:** Safe chairs are essential for inpatient recovery, yet their ergonomic features are not investigated. Impact of changes in chair armrests on required physical effort was examined using electromyography, force measurement and video recording. Armrests higher and farther apart than those in typical patient chairs may be safer for elderly patients.

- **Keywords:** Patient chair, ergonomic seating, patient fall, healthcare furniture design, surface electromyography

Chuan Sun, Bryan Buchholz, Margaret Quinn, Laura Punnett, Catherine Galligan & Rebecca Gore. *Ergonomic evaluation of slide boards used by home care aides to assist client transfers.* Pages: 913-922.

Home care aides risk musculoskeletal injury because they lift and move clients; the body weight of most adults exceeds the NIOSH recommended limit for lifting. Methods to reduce manual patient lifting in institutional settings are often technically or economically infeasible in home care. Our goal was to identify suitable, safe, low-technology transfer devices for home care use. Sixteen experienced home care aides performed client transfers from wheelchair to bed (upward) and bed to wheelchair (downward) in a simulated home care environment (laboratory), using four different slide boards and by hand without a device. Aides' hand forces were measured during client transfers; aides also evaluated usability of each board. Hand forces exerted while using slide boards were mostly lower than in manual transfer, and forces were lower in downward versus upward transfers. Aides judged a board with a sliding mechanism easier to use than boards without a sliding mechanism. **Practitioner Summary:** This paper provides quantitative biomechanical measurements showing that slide boards reduced the hand forces needed by home care aides to transfer clients from bed to wheel chair and vice versa, compared

to manual lifting. Using a semi-quantitative usability survey, aides identified boards with a sliding mechanism easiest to use.

- **Keywords:** Patient lifting, patient transfer devices, musculoskeletal disorders, home care, occupational health and safety, ergonomics

Kannan Anil Kumar & Matthew B. Parkinson. *Reweighting anthropometric data using a nearest neighbour approach.* Pages: 923-932.

When designing products and environments, detailed data on body size and shape are seldom available for the specific user population. One way to mitigate this issue is to reweight available data such that they provide an accurate estimate of the target population of interest. This is done by assigning a statistical weight to each individual in the reference data, increasing or decreasing their influence on statistical models of the whole. This paper presents a new approach to reweighting these data. Instead of stratified sampling, the proposed method uses a clustering algorithm to identify relationships between the detailed and reference populations using their height, mass, and body mass index (BMI). The newly weighted data are shown to provide more accurate estimates than traditional approaches. The improved accuracy that accompanies this method provides designers with an alternative to data synthesis techniques as they seek appropriate data to guide their design practice. **Practitioner Summary:** Design practice is best guided by data on body size and shape that accurately represents the target user population. This research presents an alternative to data synthesis (e.g. regression or proportionality constants) for adapting data from one population for use in modelling another.

- **Keywords:** Anthropometry, design for human variability, weighting, reweighting, binning, clustering, NHANES, CAESAR

Yue Wei, Jiayue Zheng & Richard H. Y. So. *Allocating less attention to central vision during vection is correlated with less motion sickness.* Pages: 933-946.

Visually induced motion sickness (VIMS) is a common discomfort response associated with vection-provoking stimuli. It has been suggested that susceptibility to VIMS depends on the ability to regulate visual performance during vection. To test this, 29 participants, with VIMS susceptibility assessed by Motion Sickness Susceptibility Questionnaire, were recruited to undergo three series of sustained attention to response tests (SARTs) while watching dot pattern stimuli known to provoke roll-vection. In general, SARTs performance was impaired in the central visual field (CVF), but improved in peripheral visual field (PVF), suggesting the reallocation of attention during vection. Moreover, VIMS susceptibility was negatively correlated with the effect sizes, suggesting that participants who were less susceptible to VIMS showed better performance in attention re-allocation. Finally, when trained to re-allocation attention from the CVF to the PVF, participants experienced more stable vection. Findings provide a better understanding of VIMS and shed light on possible preventive measures. **Practitioner Summary:** Allocating less visual attention to central visual field during visual motion stimulation is associated with stronger vection and higher resistance to motion sickness. Virtual reality application designers may utilise the location of visual tasks to strengthen and stabilise vection, while reducing the potential of visually induced motion sickness.

- **Keywords:** Visually induced motion sickness, motion sickness susceptibility, vection, visual attention

Andreas Gregoriades & Alistair Sutcliffe. *Simulation-based evaluation of an in-vehicle smart situation awareness enhancement system*. Pages: 947-965.

Situation awareness (SA) constitutes a critical factor in road safety, strongly related to accidents. This paper describes the evaluation of a proposed SA enhancement system (SAES) that exploits augmented reality through a head-up display (HUD). Two SAES designs were evaluated (information rich vs. minimal information) using a custom-made simulator and the Situation Awareness Global Assessment Technique with performance and EEG measures. The paper describes the process of assessing the SA of drivers using the SAES, through a series of experiments with participants in a Cave Automatic Virtual Environment. The effectiveness of the SAES was tested in a within-group research design. The results showed that the information rich (radar-style display) was superior to the minimal (arrow hazard indicator) design and that both SAES improved drivers' SA and performance compared to the control (no HUD) design. **Practitioner Summary:** Even though driver situation awareness is considered as one of the leading causes of road accidents, little has been done to enhance it. The current study demonstrates the positive effect of a proposed situation awareness enhancement system on driver situation awareness, through an experiment using virtual prototyping in a simulator.

- **Keywords:** Situation awareness, driving simulation, virtual reality, head-up display

Timo Melman, David A. Abbink, Marinus M. van Paassen, Erwin R. Boer & Joost C. F. de Winter. [What determines drivers' speed? A replication of three behavioural adaptation experiments in a single driving simulator study](#). Pages: 966-987.

We conceptually replicated three highly cited experiments on speed adaptation, by measuring drivers' experienced risk (galvanic skin response; GSR), experienced task difficulty (self-reported task effort; SRTE) and safety margins (time-to-line-crossing; TLC) in a single experiment. The three measures were compared using a nonparametric index that captures the criteria of constancy during self-paced driving and sensitivity during forced-paced driving. In a driving simulator, 24 participants completed two forced-paced and one self-paced run. Each run held four different lane width conditions. Results showed that participants drove faster on wider lanes, thus confirming the expected speed adaptation. None of the three measures offered persuasive evidence for speed adaptation because they failed either the sensitivity criterion (GSR) or the constancy criterion (TLC, SRTE). An additional measure, steering reversal rate, outperformed the other three measures regarding sensitivity and constancy, prompting a further evaluation of the role of control activity in speed adaptation. **Practitioner Summary:** Results from a driving simulator experiment suggest that it is not experienced risk, experienced effort or safety margins that govern drivers' choice of speed. Rather, our findings suggest that steering reversal rate has an explanatory role in speed adaptation.

- **Keywords:** Behavioural adaptation, risk homeostasis, driving simulator, psychophysiology, safety margins

Henry T. Peng, Fethi Bouak, Wenbi Wang, Renee Chow & Oshin Vartanian. *An improved model to predict performance under mental fatigue*. Pages: 988-1003.

Fatigue has become an increasing problem in our modern society. Using MATLAB as a generic modelling tool, a fatigue model was developed based on an existing one and compared with a commercial fatigue software for prediction of cognitive performance

under total and partial sleep deprivation. The flexibility of our fatigue model allowed additions of new algorithms and mechanisms for non-sleep factors and countermeasures and thus improved model predictions and usability for both civilian and military applications. This was demonstrated by model simulations of various scenarios and comparison with experimental studies. Our future work will be focused on model validation and integration with other modelling tools. **Practitioner Summary:** Mental fatigue affects health, safety and quality of life in our modern society. In this paper, we reported a cognitive fatigue model based on existing models with newly incorporated components taking both the operator's state of alertness and task demand into account. The model provided the additional capability for prediction of cognitive performance in scenarios involving pharmaceutical countermeasures, different task demands and shift work.

- **Keywords:** Bio-mathematical model, mental fatigue, cognitive performance, sleep, shift work

Nataly Zion, Anat Drach-Zahavy & Tamar Shochat. *Who is sleepier on the night shift? The influence of bio-psycho-social factors on subjective sleepiness of female nurses during the night shift.* Pages: 1004-1014.

Sleepiness is a common complaint during the night shift and may impair performance. The current study aims to identify bio-psycho-social factors associated with subjective sleepiness during the night shift. Ninety-two female nurses working rotating shifts completed a sociodemographic questionnaire, the Munich ChronoType Questionnaire for shift workers, the Pittsburg Sleep Quality Index, and the Pre-sleep Arousal Scale. Subjective sleepiness was measured hourly during two night shifts using the Karolinska Sleepiness Scale, and activity monitors assessed sleep duration 24-h before each shift. Findings showed that increased sleepiness was associated with increased age in nurses with early chronotypes and with more children. High cognitive pre-sleep arousal, but not sleep, was associated with increased sleepiness, especially in late chronotypes. The impact of bio-psycho-social factors on night shift sleepiness is complex, and depends on mutual interactions between these factors. Nurses most prone to increased sleepiness must develop personal strategies for maintaining vigilance on the night shift. **Practitioner Summary:** This study aims to identify bio-psycho-social factors associated with subjective sleepiness of female nurses during the night shift. Increasing sleepiness was associated with increased age in nurses with early chronotypes and with more children. Increased cognitive pre-sleep arousal, but not sleep, was associated with increased sleepiness, especially in late chronotypes.

- **Keywords:** Subjective sleepiness, age, chronotype, cognitive pre-sleep arousal