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Olga Menoni, Marco Tasso, Giulia Stucchi, Rosa Manno, Silvia Cairolì, Luca Galinotti, Stefano Basilico & Natale Battevi. *Application of MAPO (movement and assistance of hospitalized patients) method in hospitals and nursing homes: 20 years of experience and evolution – part 1. Pages: 1035-1045.*

This article illustrates the evolution of the MAPO method for quantifying the risk of musculoskeletal disorders associated with patient handling. The main factors that have influenced MAPO risk determinants include the rising number of disabled patients (D), growing understaffing, and the increased availability of equipment and training. Hospital wards and especially nursing homes have been provided with lifting equipment since 2008; however, 73.8% of the workforce in nursing homes is exposed to a high level of MAPO risk versus only 8.1% of hospital workers. This study presents organisational data in hospital wards (no.=528) and nursing homes (no.=214) involving 14,246 caregivers: the D/Op ratio in nursing homes is significantly higher compared to the corresponding ratio in hospital wards (p -value < 0.001). Moreover, the number of healthcare workers involved in manual patient handling activities over the night shift in nursing homes is much lower than the corresponding number in hospital wards. **Practitioner summary:** The purpose of this article is to illustrate organisational data from hospital wards and nursing homes, gathered over 20 years of implementing the MAPO method. The protocols for adapting the method to recent changes in care delivery are also presented.

- **Keywords:** Manual patient lifting, nurses, risk assessment, nursing homes, organisational aspects

Yibin Li, Yanqun Huang, Xu Li, Jian Ma, Jie Zhang & Jutao Li. *The influence of brightness combinations and background colour on legibility and subjective preference under negative polarity. Pages: 1046-1056.*

This study explores the influence of colour combinations on legibility and aesthetic feelings for the currently popular negative polarity interface design. Legibility was measured in two different ways in two tasks: time threshold (Task I) and a 9-point subjective rating (Task II). In Task I, we combined an adaptive program to measure 37

participants' recognition thresholds and online pseudo-word recognition tasks; in Task II, 44 participants' subjective preferences were measured using a scale. We found that higher brightness contrasts led to better legibility; different background colours with identical brightness and saturation did not cause significant differences; brighter texts produced better subjective preference for aesthetic appearance, legibility, and visual comfort; and different background colours had no significant effect on subjective preference. These findings have implications for digital interface design. **Practitioner summary:** In display design under negative polarity, experimental results show that higher brightness contrast leads to higher legibility, while background colour has no such significant effect; background brightness and hue have no significant effect on subjective preference, but text brightness and background colour have significant interaction effect on subjective preference.

- **Keywords:** Negative polarity, background colour, legibility, subjective preference, digital display interface

Maryam Zahabi, Vanessa Nasr, Ashiq Mohammed Abdul Razak, Logan McCanless, Azima Maredia, Ben Patranella, David Wozniak & Farzaneh Shahini. *Effect of variable priority training on police officer driving performance and workload.* Pages: 1057-1070.

Motor vehicle crashes are a leading cause of police injuries and deaths in line of duty. These crashes have been mainly attributed to the use of in-vehicle technologies while driving. Police officers receive extensive training on driving skills; however, limited training is provided on the use of in-vehicle technologies. Variable priority training (VPT) is a computer-based training that has shown promising results in improving multi-tasking performance. Eighteen police officers participated in a driving simulation study to assess the effect of VPT on officers' performance and workload. Findings suggested that although VPT was effective in improving officers' performance in dual and multi-task simulations across the training sessions, this effect was not generally transferred to driving. However, the VPT might be effective for training of high-demand situations involving pursuit driving and multiple secondary tasks. The findings can be beneficial for police agencies to improve training protocols. **Practitioner summary:** A driving simulation study was conducted to assess the effect of a computer-based training approach on police officers' driving performance and cognitive workload. The findings suggested that the proposed training approach might be effective for training of high-demand situations involving pursuit driving and multi-tasking.

- **Keywords:** Training, driving, police, workload, multi-tasking

Jessica A. Dobson, Diane L. Riddiford-Harland, Alison F. Bell, Caleb Wegener & Julie R. Steele. *Effect of work boot shaft stiffness and sole flexibility on boot clearance and shank muscle activity when walking on simulated coal mining surfaces: implications for reducing trip risk.* Pages: 1071-1085.

Mining work boot shaft stiffness and sole flexibility variations are likely to affect how a miner moves their foot to clear the ground thus influencing their risk of tripping. Despite the potential negative consequences associated with tripping, limited research has investigated how these boot design features might contribute to a miner's trip risk. Therefore, this study aimed to investigate the effects of systematic variations to boot shaft stiffness and sole flexibility on lower limb alignment and shank muscle activity at toe off and boot clearance during initial swing when 20 males walked across two simulated coal mining surfaces. Although knee and hip alignment remained constant, changes to boot shaft stiffness and sole flexibility significantly interacted to influence the shank muscle activity and ankle alignment displayed at toe off. To reduce the risk of

tripping, underground coal miners should avoid a boot with a stiff shaft, regardless of the sole flexibility. **Practitioner summary:** Underground coal miners experience a high incidence of work-related lower limb injuries, with tripping a main cause. This study systematically investigated two boot design features that are likely to influence a miner's risk of tripping. To reduce trip risk, coal miners should avoid a boot with a stiff shaft.

- **Keywords:** Boot design, mining, uneven terrain, electromyography, kinematic, lower limb injuries

Gena R. Gerstner, Jacob A. Mota, Hayden K. Giuliani, Mark A. Weaver, Nicholas W. Shea & Eric D. Ryan. *The impact of repeated bouts of shiftwork on rapid strength and reaction time in career firefighters.* Pages: 1086-1094

The purpose of this study was to examine the influence of repeated bouts of shiftwork on lower extremity maximal and rapid strength and reaction time in career firefighters. Thirty-five firefighters (3 females; 34.3 ± 9.1 years) performed a psychomotor vigilance test (PVT) and reactive maximal isometric strength assessment prior to and following a full shift rotation (three 24-hr on-off shifts). Reaction time (RT), maximal, absolute and normalised rapid strength (50, 100, 150, 200 ms), and PVT measures were assessed on-site. Separate linear regression models were used to evaluate the POST-PRE change in variables adjusted for BMI, age, sleep, and call duration. Early (50 ms) absolute rapid strength was the only variable significantly reduced (-25.9% ; $p = 0.031$) following the full shift rotation. Our findings indicate that early rapid strength may be a sensitive measure in detecting work-related fatigue, despite minimal changes in sleep between work and non-work nights and a low call duration. **Practitioner summary:** We examined the impact of repeated shiftwork on changes in reaction time and neuromuscular function. Early rapid strength was a sensitive, portable lab assessment that feasibly measured work-related fatigue in career firefighters. Interventions that mitigate work-related fatigue may be impactful at preventing falls and/or risk of musculoskeletal injury.

- **Keywords:** Occupational health, work-related fatigue, neuromuscular function, explosive force

Murillo Pagnotta, David M. Jacobs, Patricia L. de Frutos, Ruben Rodríguez, Jorge Ibáñez-Gijón & David Travieso. *Task difficulty and physiological measures of mental workload in air traffic control: a scoping review.* Pages: 1095-1118.

This study provides a systematic synthesis of empirical research on mental workload (MWL) in air traffic control (ATC). MWL is a key concept in research on innovative technologies, because the assessment of MWL is crucial to the evaluation of such technologies. Our specific focus was on physiological measures of MWL. The used search strategy identified 39 peer-reviewed publications that analysed ATC tasks, examined different levels of difficulty of the ATC task, and considered at least one physiological measure of MWL. Positive relations between measures of MWL and task difficulty were observed most frequently, indicating that the measures indeed allowed the assessment of MWL. The most commonly used physiological measures were brain measures (EEG and fNIR) and heart rate measures. The review revealed a need for more precise descriptions of crucial experimental parameters in order to permit a transition of the field towards more interactive and dynamic types of analysis.

Practitioner summary: Research on innovative technology in air traffic control (ATC) depends on assessments of mental workload (MWL). We reviewed empirical research on MWL in ATC. Brain and heart measures often allow assessments of MWL. Better descriptions of experiments are needed to allow comparisons among studies and more dynamic and interactive analyses.

- **Keywords:** ATC, complexity, EEG, innovative technology, performance

Petya Ventsislavova, Tova Rosenbloom, Joost Leunissen, Yishai Spivak & David Crundall. [An online hazard prediction test demonstrates differences in the ability to identify hazardous situations between different driving groups](#). Pages: 1119-1137.

Previous research has found that the traditional approach to measuring hazard perception, as used by the UK Government, does not necessarily transfer well to other countries. The speeded response times of a hazard perception test were susceptible to threshold bias, differentiating drivers according to cultural background more than driving experience. An alternative method – the hazard prediction test – appears to mitigate these problems when used across different countries. The current study applies the hazard prediction methodology to a new cultural context (Israel), delivered via an online platform. A further innovation was to include both hazardous and non-hazardous trials allowing measures of criterion and sensitivity parameters of the Signal Detection Theory to be calculated. In total, 74 participants (43 experienced and 31 novices) watched 26 hazard prediction clips that had been filmed in Tel Aviv (Israel), 13 of which contained cues to genuine hazards. Each hazardous clip was occluded prior to the hazardous situation fully materialising, though with sufficient evidence that any participant who was looking in the right place at the right time would be able to correctly identify the unfolding hazard. Participants were first asked to identify whether there was a hazard (a binary decision), and then to predict how the traffic situation was going to develop by choosing one of four options provided after each video. As hypothesised, experienced drivers outperformed novices in the multiple-choice prediction question, provided that they had correctly identified that the clip contained a hazard in the first question. Novices were poor at selecting the correct multiple-choice option, regardless of whether they correctly identified that the clip contained a hazard. Both driving experience and hazard sensitivity significantly predicted multiple-choice accuracy, though criterion did not. The newly developed online test was successful in differentiating between experienced and novice driver groups for accuracy in prediction. These results support the roll-out of the hazard prediction methodology across different countries. **Practitioner summary:** This study provides new insights into how to develop an online hazard prediction test suitable for international export. The results suggest that this newly developed test is successful in differentiating between experienced and novice drivers. This raises the possibility of assessing and training drivers on a global scale.

- **Keywords:** Hazard prediction online assessment driving experience Signal Detection Theory

Elizabeth H. Lazzara, Richard J. Simonson, Logan M. Gisick, Andrew C. Griggs, Emily A. Rickel, Joyce Wahr, Meghan B. Lane-Fall & Joseph R. Keebler. *Does standardisation improve post-operative anaesthesia handoffs? Meta-analyses on provider, patient, organisational, and handoff outcomes*. Pages: 1138-1153.

Anaesthesia handoffs are associated with negative outcomes (e.g. inappropriate treatments, post-operative complications, and in-hospital mortality). To minimise these adverse outcomes, federal bodies (e.g. Joint Commission) have mandated handoff standardisation. Due to the proliferation of handoff interventions and research, there is a

need to meta-analyze anaesthesia handoffs. Therefore, we performed meta-analyses on the provider, patient, organisational, and handoff outcomes related to post-operative anaesthesia handoff protocols. We meta-analysed 41 articles with post-operative anaesthesia handoffs that implemented a standardised handoff protocol. Compared to no standardisation, a standardised post-operative anaesthesia handoff changed provider outcomes with an OR of 4.03 (95% CI 3.20–5.08), patient outcomes with an OR of 1.49 (95% CI 1.32–1.69), organisational outcomes with an OR of 4.25 (95% CI 2.51–7.19), handoff outcomes with an OR of 8.52 (95% CI 7.05–10.31). Our meta-analyses demonstrate that standardised post-operative anaesthesia handoffs altered patient, provider, organisational, and handoff outcomes. **Practitioner Summary:** We conducted meta-analyses to assess the effects of post-operative anaesthesia handoff standardisation on provider, patient, organisational, and handoff outcomes. Our findings suggest that standardised post-operative anaesthesia handoffs changed all listed outcomes in a positive direction. We discuss the implications of these findings as well as notable limitations in this literature base.

- **Keywords:** Patient safety, safety culture, socio-technical systems, team working

Xin Zhou, Liang Ma & Wei Zhang. *Event-related driver stress detection with smartphones among young novice drivers*. Pages: 1154-1172.

Complex and diverse driving situations can pose short-term stressors to novice drivers. Continuously detecting stress is essential for driver training, stress intervention, and the design of in-vehicle information systems. This study designed and validated a driver stress detection method at the event level based on machine learning algorithms and facial features captured with smartphones. Thirty young novice drivers completed two driving tasks containing eight events of two versions (neutral and stressful), with psychological, physiological, and facial data collected. Four combinations of input data types and six machine learning algorithms were used to detect stressful events. The KNN algorithm with facial plus individual profile features yielded the highest accuracy of 89.2%. Adding individual profile features can improve classification performance. Facial areas such as brow, eye, jaw, nose, and mouth were most sensitive to stress. This approach could provide more temporal-spatial information about the driver's stress levels during the whole driving process. **Practitioner Summary:** This paper proposed a method to detect driver stress at the event level with smartphones. Models with facial plus individual profile features and the KNN algorithm had the most outstanding classification performance. The presented approach can serve as a tool for improving in-vehicle interaction system design when considering driver stress.

- **Keywords:** Driver stress, driving event., facial expression, classification, smartphone