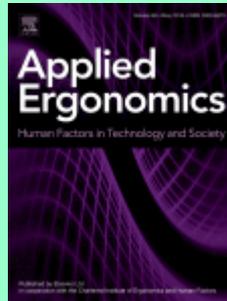


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Kyoung-Mi Jang, Moonyoung Kwon, Sun Gu Nam, DaMee Kim, Hyun Kyoon Lim. *Estimating objective (EEG) and subjective (SSQ) cybersickness in people with susceptibility to motion sickness. 103731.*

Cybersickness refers to the uncomfortable side effects, such as headaches, dizziness, and nausea, felt while experiencing virtual reality (VR). This study investigated cybersickness in people with sensitivity to motion sickness using electroencephalography (EEG), the Simulator Sickness Questionnaire (SSQ), and simple VR content. Based on the scores from the Motion Sickness Susceptibility Questionnaire (MSSQ), 40 males in their twenties were selected as the sensitive group ($n = 20$) and non-sensitive group ($n = 20$). The experiment contained two conditions: a baseline condition representing a resting state and a cybersickness condition in which watching VR content induced cybersickness. The SSQ score increased significantly after watching the VR content in both groups. The sensitive group showed significantly lower absolute power in the beta and gamma bands than the non-sensitive group. The cybersickness condition showed significantly increased delta and decreased alpha compared to the baseline condition. We evaluated EEG and SSQ to identify subjective symptoms and objective physiological changes associated with cybersickness.

- **Keywords:** Virtual reality; Cybersickness; Electroencephalography; Susceptibility to motion sickness

G. Cabour, É. Ledoux, S. Bassetto. *Aligning work analysis and modeling with the engineering goals of a Cyber-Physical-Social System for industrial inspection. 103703.*

Human inspectors rely on a significant number of macrocognitive functions, processes, and tacit knowledge to diagnose the condition of aircraft engine components. A deep understanding of inspectors' cognition and actions in the wild may establish the requirements to develop intelligent automation that truly enhances their perceptual, cognitive and social abilities. This paper takes a two-pronged approach to uncover and model the complexity of industrial inspection in a manner that aligns with the technical development stages of a Cyber-Physical-Social System. The findings offer thick descriptions accompanied by four descriptive empirical models that depict inspectors' meaning-making and decision-making processes. It includes how they gather, process, and apply domain-specific knowledge to diagnose a component's condition and how they deal with domain-related factors (norms, institution's rules, standard operating procedures). This study also highlights the support provided by empirical data/models in

designers' work packages. It concludes by presenting the design implications of these findings to envision future human-automation work situations.

- **Keywords:** Visual inspection; Cyber-physical system; Work analysis

Atiyeh Vaezipour, Nicole Andrews, Oscar Oviedo-Trespalacios, Fatima Amershi, Mark Horswill, Venerina Johnston, Patricia Delhomme. *Exploring driving behaviour from the perspectives of individuals with chronic pain and health professionals.* 103755.

Chronic pain affects one in five Australians, and this could impact daily activities such as driving. Driving is a complex task, which requires the cognitive and physical ability to predict, identify, and respond to hazards to avoid crashing. However, research exploring the factors that influence safe driving behaviour for chronic pain individuals is limited. A qualitative study was conducted which involved semi-structured interviews with 23 people who had experienced persistent pain for at least three months and 17 health professionals who had experience working with individuals with chronic pain. The aim of this study was to obtain a deeper understanding of the experiences and challenges that people with chronic pain may have in their day-to-day driving. Participants were also asked about currently available driving assessments and strategies for individuals with chronic pain in the Australian healthcare system. The themes emerging from the interviews highlighted the need for clearer guidelines and educational materials regarding the impact of chronic pain on an individual's ability to drive. These themes included the physical and cognitive challenges resulting from chronic pain, as well as the potential side effects of pain medications. In addition, participants identified a number of self-regulation strategies and driving assessments currently available for monitoring safe driving behaviour in Australia. This study improves our understanding of how chronic pain affects driving behaviour, as reported by individuals experiencing the pain and relevant health professionals. Recommendations for improving the safety of drivers with chronic pain are discussed, including possible technological interventions and better public education.

- **Keywords:** Chronic pain; Self-management; Driving behaviour; Self-regulation strategies; Driving assessment; Distracted driving

Federico Arippa, Athena Nguyen, Massimiliano Pau, Carisa Harris-Adamson. *Postural strategies among office workers during a prolonged sitting bout.* 103723.

Sedentary behavior has increased steadily over prior decades, primarily due to increased computer use at work and at home. The total sedentary time per day has been associated with increased risk of cardiometabolic diseases; increased sitting time at work has been associated with musculoskeletal discomfort particularly in the low back. Office workers spend many hours sitting, thus efforts to increase movement through changes of posture (sit to stand) or moving while sitting have been proposed as ways to mitigate the negative effects of prolonged sitting. Yet, few studies have investigated differences in the movement patterns of office workers while sitting performing their actual work. Therefore, the aim of this study was to characterize movement patterns during a prolonged sitting bout and to determine their association with musculoskeletal pain. Twenty-eight office workers participated in this field study that used a pressure sensitive mat to quantify seat pan pressure (4 regions) and trunk sway parameters over a 2-hour bout of computer work. Data were stratified by breakers who stood up at least once within the 2-hour test and prolongers who remained sitting throughout the test. Overall, there was a decreasing trend in trunk sway parameters (mean COP position, sway path, sway area, sway velocity, maximum displacement, and in-chair movements) over time ($p < 0.05$), with significant changes in sitting strategies. There were significant differences in trunk sway parameters and perceived musculoskeletal discomfort between

breakers and prolongers with breakers having more consistent movement while sitting over the prolonged sitting bout ($p < 0.05$) and lower discomfort ratings. This may indicate that interrupting prolonged bouts of sitting with short periods of standing can maintain sitting movement patterns and reduce the development of musculoskeletal discomfort. Trunk sway monitoring and promoting periodic standing may be useful tools for maintaining in chair movements that may reduce or prevent the onset of musculoskeletal discomfort during prolonged sitting.

- **Keywords:** Sitting posture; Trunk postural sway; Prolonged sitting; In-chair-movements

Michelle C. Léger, Michelle R. Cardoso, Cynthia Dion, Wayne J. Albert. *Does active sitting provide more physiological changes than traditional sitting and standing workstations?* 103741.

This cross-sectional study examined the physiological effects of two active chairs (AC1: had the feature to pedal and slide forward; AC2: was a multiaxial chair) compared to a traditional office chair and standing workstation. Twenty-four healthy participants computed at each of the workstations for 60 min. The active protocol was to alternate between a pedalling/side-to-side motion and sliding forward/front-to-back motion to the sound of a metronome operating at 40 bpm. The participants' physiological effects were recorded using near-infrared spectroscopy (NIRS); electrodermal activity (EDA) and a heart rate (HR) monitor for each collection period. Statistical analysis was conducted using a repeated measures analysis of variance for within-task and between-workstation comparisons. A Tukey's post hoc analysis was calculated for significant findings. Both active chairs significantly increased oxygenated blood in the gastrocnemius and participants' heart rate and EDA (stress) levels were affected slightly by task and time. However, participants felt more "productive" sitting in the control chair than in either of the active chairs.

- **Keywords:** Active chairs; Standing; Blood oxygenation; Heart rate; Electrodermal activity

Maja Goršič, Yu Song, Boyi Dai, Vesna D. Novak. *Short-term effects of the Auxivo LiftSuit during lifting and static leaning.* 103765.

Back support exosuits can support workers in physically demanding jobs by reducing muscle load, which could reduce risk of work-related musculoskeletal disorders. This paper presents a two-session evaluation of a commercial exosuit, the Auxivo LiftSuit 1.1. In session 1, 17 participants performed single repetitions of lifting and static leaning tasks with and without the LiftSuit. In session 2, 10 participants performed 50 box lifting repetitions with and without the LiftSuit. In session 1, the exosuit was considered mildly to moderately helpful, and reduced erector spinae and middle trapezius electromyograms. In session 2, the exosuit was not considered helpful, but reduced the middle trapezius electromyogram and trunk and thigh ranges of motion. These effects are likely due to placement of elastic elements and excessive stiffness at the hips. Overall, the LiftSuit appears suboptimal for long-term use, though elastic elements on the upper back may reduce muscle activation in future exosuit designs.

- **Keywords:** Exosuits; Exoskeletons; Back support

Abigail R. Wooldridge, Eva-Maria Carman, Anping Xie. *Human Factors and Ergonomics (HFE) applications in responses to the COVID-19 pandemic: Lessons learned and considerations for methods.* 103733.

Human Factors and Ergonomics (HFE), with the goal to support humans through system design, can contribute to responses to emergencies and crises, like the COVID-19 pandemic. In this paper, we describe three cases presented at the 21st Triennial Congress of the International Ergonomics Association to demonstrate how HFE has been applied during the COVID-19 pandemic, namely to (1) develop a mobile diagnostic testing system, (2) understand the changes within physiotherapy services, and (3) guide the transition of a perioperative pain program to telemedicine. We reflect on methodological choices and lessons learned from each case and discuss opportunities to expand the impact of HFE in responses to future emergencies. The HFE discipline should develop faster, less resource intensive but still rigorous, methods, increase available HFE expertise by growing the field, and proactively enhance individual and public perception of the importance of HFE in crisis response.

- **Keywords:** 1. COVID-19; 2. HFE in Public health crises; 3. SEIPS

Dan Basacik, Anisha Tailor. *A feast-and-famine pattern of sleep: Do railway staff get the sleep they need?* 103711.

The relationship between sleep and health and wellbeing is receiving increasing attention in our society, following decades of research that has demonstrated the impact of insufficient sleep on performance and health. Fatigue has been identified as a factor in 21% of high-risk incidents in the GB rail industry, and insufficient sleep and long periods of being awake are known to be two key contributors to fatigue. This paper presents evidence from a recent survey conducted in the GB rail industry, which enabled the sleep and wakefulness of railway workers to be quantified. There were 7807 responses to the survey, which represents a very large sample. Responses were primarily collected online, though paper copies were made available in some organisations. Respondents reported sleeping less when working nights, more when working days, and the most on days off, which suggests a feast-and-famine pattern of sleep. 41% were getting 6 h of sleep or less when working days, compared to 63% when working nights. Getting 6 h or less of sleep was associated with excessive daytime sleepiness. Although it is accepted that individuals' sleep requirements vary, the patterns that shift workers reported in this survey suggest that many are not achieving the amount of sleep they need. The findings of the survey presented in this paper highlight that there is work to be done to understand and address the causes of insufficient sleep in railway workers.

- **Keywords:** Fatigue risk management; Sleep; Shiftwork; Railway

Kathryn A. Feltman, Lance Randles, Claire Goldie, Kyle A. Bernhardt. *A new approach to manipulating aviator workload: A case for individualizing workload manipulations.* 103736.

The present study sought to manipulate workload individually for participants to evaluate whether individual manipulations of workload produces similar subjective ratings and performance changes across participants. Participants included eight Army-rated rotary-wing aviators who presented to the laboratory for two separate visits. During the first visit, individual responses to workload were determined, and during the second visit, individually manipulated high workload flights were completed. Outcome measures included flight performance and subjective workload ratings. Data were examined at the group and individual level. Subjective ratings of workload endorsed the individual workload manipulations, while performance data provided some additional support. By taking an individualized approach such as this, researchers and practitioners may be better able to control for individual differences influencing workload. This has important implications for system design and testing, development of new intervention technologies, and assessing methods for operator monitoring.

- **Keywords:** Workload; Aviation; Design and testing

Jessica Morton, Aleksandra Zheleva, Bram B. Van Acker, Wouter Durnez, Pieter Vanneste, Charlotte Larmuseau, Jonas De Bruyne, Annelies Raes, Frederik Cornillie, Jelle Saldien, Lieven De Marez, Klaas Bombeke. *Danger, high voltage! Using EEG and EOG measurements for cognitive overload detection in a simulated industrial context.* 103763.

Industrial settings will be characterized by far-reaching production automation brought about by advancements in robotics and artificial intelligence. As a consequence, human assembly workers will need to adapt quickly to new and more complex assembly procedures, which are most likely to increase cognitive workload, or potentially induce overload. Measurement and optimization protocols need to be developed in order to be able to monitor workers' cognitive load. Previous studies have used electroencephalographic (EEG, measuring brain activity) and electrooculographic (EOG, measuring eye movements) signals, using basic computer-based static tasks and without creating an experience of overload. In this study, EEG and EOG data was collected of 46 participants performing an ecologically valid assembly task while inducing three levels of cognitive load (low, high and overload). The lower individual alpha frequency (IAF) was identified as a promising marker for discriminating between different levels of cognitive load and overload.

- **Keywords:** Industrial setting; Assembly task; Cognitive workload; Cognitive ergonomics; Overload; EEG; EOG

Alison Cloet, Linsey Griffin, Minji Yu, William Durfee. *Design considerations for protective mask development: A remote mask usability Evaluation.* 103751.

The design of N95 filtering facepiece respirators (FFRs) continues to pose usability concerns for healthcare workers, which have been exacerbated by the COVID-19 pandemic. The aim of this study was to develop a holistic model to guide mask design improvement. Dental students ($n = 38$) with experience wearing N95 FFRs participated in a randomized wear trial of three alternative protective masks. A mixed methods survey was used to examine usability of individual mask design components, the relationship of facial/head area to mask features, and overall mask design. Survey results indicated MNmask v1 demonstrated higher usability in seal confidence ($M = 3.46$), while MNmask v2 performed higher in satisfactory fit ($M = 3.50$). Design components of nose wire and head/neck bands were the most problematic, while conditions of skin irritation and tight/loose fit created an unfavorable wear experience. To consider healthcare workers' needs in improving the usability of protective masks, a model is presented to consider characteristics of fit, comfort, material, and design.

- **Keywords:** Remote usability; Mask design improvement; Holistic mask design approach; N95 filtering facepiece respirators; Healthcare workers; COVID-19

Karla Beltran Martinez, Milad Nazarahari, Hossein Rouhani. *K-score: A novel scoring system to quantify fatigue-related ergonomic risk based on joint angle measurements via wearable inertial measurement units.* 103757.

Work-related musculoskeletal disorders have been recognized as a global problem that affects millions of people annually. Fatigue is one of the main contributors to musculoskeletal disorders. Thus, this study investigated fatigue detection based on the measured body motion by wearable inertial measurement units. We quantified the body motion during manual handling tasks using a novel kinematic score (i.e., K-score), and the Rapid Entire Body Assessment (REBA). K-score and REBA were calculated using joint angles. Nevertheless, unlike REBA, K-score showed a significant correlation (Spearman's

correlation coefficient of $p(302) = 0.21$, $p < 0.05$) with electromyography (EMG) signal amplitude, which was affected by muscle fatigue. Therefore, in-field measurement of K-score using inertial measurement units could detect the fatigue-induced change of body motion in long-duration manual handling tasks. Our proposed K-score can be used to assess fatigue-related ergonomic risk in long-term and real-world working conditions without the need for tedious EMG recording at workplaces.

- **Keywords:** Electromyography; Ergonomic risk assessment; Wearable inertial measurement units

Konstantin Wechsler, Otmar Bock, Torsten Schubert, Iring Koch. *Dual-task interference in simulated car driving: The psychological refractory period effect when not only the second, but also the first task is ecologically relevant.* 103722.

The psychological refractory period (PRP) effect denotes the finding that shortening the temporal interval between two tasks leads to increased reaction time in the second task. Earlier work in driving simulators confirmed the emergence of a PRP effect even if the second task (T2) was ecologically relevant, such as in a car-braking task. Here we evaluate the PRP effect if the first task (T1) is ecologically relevant as well. In a driving simulator, participants had to warn pedestrians against crossing the street (T1), and had to brake when the lead car braked (T2). As the temporal interval between tasks decreased, reaction time in T2 increased, confirming once more the emergence of a PRP effect. The PRP effect in our study was larger than in previous studies where T1 was artificial rather than ecologically relevant. This suggests that an ecologically relevant T1 is processed more elaborately, resulting in stronger interference with T2.

- **Keywords:** Ecological validity; Simulated car driving; Dual-task interference

Kristin Yeoman, Alyssa Weakley, Weston DuBose, Kimberly Honn, Timothy McMurry, Brianna Eiter, Brent Baker, Gerald Poplin. *Effects of heat strain on cognitive function among a sample of miners.* 103743.

Heat stress is associated with workplace injuries, likely through a combination of fatigue, reduced cognitive function, and thermal discomfort. The purpose of this study was to evaluate four cognitive tasks for sensitivity to heat stress. Eight participants performed treadmill exercise followed by assessments of serial reaction time (RT), Stroop effect, verbal delayed memory, and continuous performance working memory in an environmental chamber. A control (21.1 °C) trial, and "Hot 1" and "Hot 2" (both 37.8 °C) trials were run sequentially on two separate days to evaluate the four cognitive tasks. Heat strain (comparing Hot 1 and Hot 2 with the control trial) resulted in impairments in the serial RT test response and Stroop accuracy. Delayed memory was impacted only in the Hot 2 trial compared with the control trial. Given the demonstrated impact of heat on cognitive processes relevant to workers' real-world functioning in the workplace, understanding how to assess and monitor vigilant attention in the workplace is essential.

- **Keywords:** Heat stress; Cognitive

Megan J. McAllister, Patrick A. Costigan, Joshua P. Davies, Tara L. Diesbourg. *The effect of training and workstation adjustability on teleworker discomfort during the COVID-19 pandemic.* 103749.

Technological advancements have increased occupational flexibility for employees and employers alike. However, while effective telework requires planning, the COVID-19 pandemic required many employees to quickly shift to working from home without ensuring that the requirements for telework were in place. This study evaluated the

transition to telework on university faculty and staff and investigated the effect of one's telework setup and ergonomics training on work-related discomfort in the at-home environment. Fifty-one percent of respondents reported increases in their existing discomfort while 24% reported new discomfort since working from home. These results suggest a need for ergonomic interventions including ergonomic training and individual ergonomic assessments for those who work from home.

- **Keywords:** Working from home; Employee wellbeing; Office ergonomics; Remote assessment

Jessa M. Buchman-Pearle, Thomas Karakolis, Jack P. Callaghan. *Does sitting on a stability ball increase fall risk during ergonomic reaching tasks?* 103721.

is known about the increased potential for a fall on the deformable seat. This study examined differences in stability between sitting on a seat pan of a backless office chair and a stability ball during reaching tasks. Sixteen participants performed forward and lateral reaching tasks on a backless and armless office chair and stability ball while whole-body motion and force data under the seat were recorded. Even with participants placing their feet 16.5 cm wider when seated on the ball, the perceived fall risk was significantly greater. Centre of pressure displacement tended to be smaller under the ball for lateral reach directions, but larger during far anterior reaches. While not statistically significant, the medial-lateral margin of stability was on average 3.4 cm smaller on the ball. Despite attempts to increase stability by widening their stance, stability ball fall risk remained higher.

- **Keywords:** Exercise ball; Swiss ball; Seated balance

Jussi Onninen, Mia Pylkkönen, Tarja Hakola, Sampsa Puttonen, Jussi Virkkala, Asko Tolvanen, Mikael Sallinen. *The self-reported stress and stressors in tram and long-haul truck drivers.* 103761.

Work stress may compromise professional drivers' health and driving capacity. Differences between driver groups in terms of on-duty stress are understudied. Therefore, we examined self-reported stress (Stockholm University Stress Scale) of shift-working tram and long-haul truck drivers (n = 75) across 2–3 weeks. Furthermore, stressors were self-reported retrospectively and categorised as related to the job, driving conditions, personal, or other causes. Stress levels were generally low, but moderate to high stress (≥ 6) was more frequently reported among the tram drivers. Stressors related to the job (54%) and driving conditions (19% of all shifts) were frequently reported among the tram and truck drivers, respectively. Moderate to high stress was associated with categorised stressors related to the job and other causes among the tram drivers, and all categorised stressors among the truck drivers. Altogether, self-reported stress and stressors differ by driver group, but the role of shift type is less significant.

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

Yoshitaka Maeda, Yoshihiko Suzuki, Yoshikazu Asada, Shinichi Yamamoto, Masahisa Shimpo, Hiroshi Kawahira. *Training residents in medical incident report writing to improve incident investigation quality and efficiency enables accurate fact gathering.* 103770.

We assessed whether training on writing readable and accurate medical incident reports (IRs) improves the quality of fact description. In this training, 124 residents created fictional IRs. We provided tips, including using When, Where, Who, What, Why, How. We compared the fictional IRs with and without tips, and the trainees' and non-trainees' IRs

submitted in the first five months after training. Results indicated that the subject words in IRs were more clarified and the readability was improved. The fictional IRs using tips were more accurate, with increased descriptions of the patient's background, reporter's actions, team members' actions and conversations, safety check procedures, result of the error, and post-incident response. The reporter's actions, work procedures, and environment were more clarified in the trainees' IRs than in the non-trainees' IRs. This training may help analysts comprehend the sequence of and underlying factors for reporter's actions based on IRs.

- **Keywords:** Incident reporting; Accurate representation of facts; Patient safety education design

Una Geary, Marie E. Ward, Vincent Callan, Nick McDonald, Siobhán Corrigan. *A socio-technical systems analysis of the application of RFID-enabled technology to the transport of precious laboratory samples in a large acute teaching hospital.* 103759.

The scale and pace of improvement in patient safety in healthcare has been unacceptably slow. A paucity of research into the application of systems-thinking concepts and a failure to appreciate health systems complexity are cited as barriers to sustainable health systems improvement. This study reports on a socio-technical systems analysis, called the CUBE, of the characteristics of a large acute teaching hospital's system for the transport of precious specimens, a system enabled by radio-frequency identification tracking technology. The CUBE proved itself to be an effective analytic tool. The analysis provided a constructive framework to link diverse data and documentation; explicitly inviting consideration of the roles and understandings of different stakeholders; as well as broader cultural factors that could influence current or future activity. The analysis also supported recommendations to improve and extend operations. This study supports the argument for systems understanding and systems thinking being at the core of new approaches to patient safety.

- **Keywords:** Socio-technical systems analysis; RFID; Acute hospital

Jean Maillet, Jeremy Rossi, François Hug, Jean-Jacques Proquez, Antoine Nordez. *Influence of experience on kinematics of upper limbs during sewing gesture.* 103737.

To teach a skilled motor task, it is crucial to understand the characteristics of expertise. The aim of the present study was to compare the kinematics of the hand sewing task between novices ($n = 10$), intermediates ($n = 10$) and experts ($n = 10$). Compared to novices and intermediates, the proximal joint of expert participants was less involved in the task than their distal joints. The shoulder of experts stayed closer to the trunk, while the ranges of motion of the wrist and fingers were higher. This ability enabled them to avoid lifting the arm, which was resting on the table. We observed a low cycle-to-cycle variability of the movement pattern for experts, while it was more variable in novices. Moreover, experts shared similar joints synergies attesting of an "experts" common gesture. This knowledge gained about the hand sewing kinematics can be used to refine the training process of dressmakers.

- **Keywords:** Hand sewing; Kinematic analysis; Skill level

Adam C. Hayes, Herbert Groeller, Jace R. Drain, Kent Delbridge, Joanne N. Caldwell. *The physiological demand of a task simulation varies when developed by independent groups of experiential experts.* 103715.

Objective: To investigate the disparity in the specification and physiological demand of a task simulation when developed by two independent panels of experiential experts. **Design:** Independent groups design. **Methods:** Two groups of experiential experts from the Royal Australian Air Force (RAAF) worked independently to design, and then complete a simulation of a generic occupational task; the establishment of a security control point. Task duration, oxygen consumption, and cardiac frequency were measured whilst each panel completed the task simulation. Maximal acceptable work duration (MAWD) and the percentage of MAWD (%MAWD) were also calculated. Independent t-tests were used to determine differences ($P < 0.05$) between the measured variables. **Results:** No differences were observed in the average oxygen consumption ($1.26 \pm 0.25 \text{ L min}^{-1}$ and $1.28 \pm 0.29 \text{ L min}^{-1}$ respectively; $P = 0.84$), or cardiac frequency ($134 \pm 16.4 \text{ beats}\cdot\text{min}^{-1}$ and $125 \pm 8.5 \text{ beats}\cdot\text{min}^{-1}$ respectively; $P = 0.12$) between Panel 1 and Panel 2. However, there was a significant difference between panels with respect to task duration (Panel 1: $15.5 \pm 3.68 \text{ min}$; Panel 2: $34.20 \pm 9.60 \text{ min}$; $P < 0.01$), and the %MAWD (Panel 1: $5.32 \pm 3.17\%$, Panel 2: $12.15 \pm 9.40\%$, $P = 0.04$). **Conclusions:** The physiological demand of a task simulation is dependent upon the group of experts consulted to develop the simulation. It is critical that input from a wide representation of experiential experts is considered when developing task simulations to avoid bias towards the perceptions of the experts consulted.

- **Keywords:** Task; Physical requirements; Simulation; Employment standards; Health; Well-being

Savannah Bitzas, Shannon Ma, Kelly Pesanelli, Ann M. Zaia. *Risk factors and impacts of slips, trips, and falls in janitorial populations: A literature review.* 103745.

The objective of this paper is to analyze the existing literature to determine the scope and risk factors of slips, trips, and falls (STFs) within the janitorial population in order to make evidence-based recommendations to prevent these incidents in the future. Selected for review were published peer-reviewed articles, conference proceedings, and gray literature relating to STFs among janitors and cleaners. Individuals employed as janitors and cleaners, specifically those that were older than 45-years of age and/or female, represented the highest risk populations for STFs. These STFs result in injuries, such as sprains, strains, dislocations, and tears. Among janitors and cleaners, 30% of nonfatal incidents are attributed to STFs, resulting in a median of 11 days away from work. Both non-observable/human factors and observable/organizational factors contribute to STFs within this population and must be addressed to protect public health. Preventive interventions focused on comprehensive approaches that target observable and non-observable factors are needed to reduce STFs within the custodial population. More research is needed on STFs in the janitorial population to identify successful preventive STF interventions. Addressing the issue of STFs within this job classification will improve the overall health and well-being of janitors as well as reduce the indirect and direct economic burden placed on the employer organization.

- **Keywords:** Slips and falls; Trips; Occupational injury; Fall prevention; Cleaner; Janitor

Ying Zhou, Xinyue Cui, Weina Qu, Yan Ge. *The effect of automation trust tendency, system reliability and feedback on users' phishing detection.* 103754.

As a new intrusion method in the security field, phishing poses an enormous threat to network security and personal privacy. Thus, improving the level of network security and preventing phishing are a matter of great concern to both the state and researchers. A 2 (automation trust tendency) * 2 (system reliability level) * 2 (feedback) between-subjects design was adopted to study the impact of individual characteristics and system features

on phishing detection. Three hundred ninety-eight participants completed a phishing email task to identify whether 40 emails were legitimate or fraudulent. The results showed that systems with feedback and high reliability improve users' performance in email identification. Users with a high tendency towards automation trust have a higher risk of phishing. However, feedback from the system helps calibrate a high automation trust tendency. These research results can promote an understanding of phishing prevention mechanisms and provide support for the design of email defence systems.

- **Keywords:** Phishing detection; Automation trust; System reliability; Feedback

Saeb Ragani Lamooki, Sahand Hajifar, Jiyeon Kang, Hongyue Sun, Fadel M. Megahed, Lora A. Cavuoto. *A data analytic end-to-end framework for the automated quantification of ergonomic risk factors across multiple tasks using a single wearable sensor.* 103732.

Existing ergonomic risk assessment tools require monitoring of multiple risk factors. To eliminate the direct observation, we investigated the effectiveness of an end-to-end framework that works with the data from a single wearable sensor. The framework is used to identify the performed task as the major contextual risk factor, and then estimate the task duration and number of repetitions as two main indicators of task intensity. For evaluation of the framework, we recruited 37 participants to complete 10 simulated work tasks in a laboratory setting. In testing, we achieved an average accuracy of 92% for task identification, 7.3% error in estimation of task duration, and 7.1% error for counting the number of task repetitions. Moreover, we showed the utility of the framework outputs in two ergonomic tools to estimate the risk of injury. Overall, we indicated the feasibility of using data from wearable sensors to automate the ergonomic risk assessment in workplaces.

- **Keywords:** Human performance modeling; Ergonomic risk assessment; End-to-end learning; Change point detection; Wavelets; Wearable sensors

Lisa Klous, Femke van Diemen, Silke Ruijs, Nicola Gerrett, Hein Daanen, Marijne de Weerd, Bertil Veenstra, Koen Levels. *Efficiency of three cooling methods for hyperthermic military personnel linked to water availability.* 103700.

Purpose: Three feasible cooling methods for treatment of hyperthermic individuals in the military, that differed considerably in water volume needed (none to ~80 L), were evaluated. **Methods:** Ten male soldiers were cooled following exercise-induced hyperthermia (rectal temperature (T_{re}) ~39.5 °C) using ventilation by fanning (1.7 m s⁻¹), ventilation by fanning (1.7 m s⁻¹) while wearing a wet t-shirt (250 mL-27 °C water) and tarp assisted cooling with oscillations (80 L of 27.2 ± 0.5 °C water; TACO). **Results:** Cooling rates were higher using TACO (0.116 ± 0.032 °C min⁻¹) compared to ventilation (0.065 ± 0.011 °C min⁻¹, P<0.001) and ventilation in combination with a wet t-shirt (0.074 ± 0.020 °C min⁻¹, P=0.002). Time to cool (TTC) to T_{re} =38.2 °C for TACO was shorter (14 ± 4 min) compared to ventilation only (20 ± 5 min; P=0.018), but not to ventilation while wearing a wet t-shirt (18 ± 6 min; P=0.090). **Conclusions:** TACO may be an acceptable, efficient and feasible cooling method in case of exertional heat stroke. However, in case of limited water availability, transport should be prioritized, and cooling of any form should be implemented while waiting for and during transport.

- **Keywords:** Cooling; Exertional heat stroke; Military

Ying-Yin Huang, Marino Menozzi. *Effects of viewing distance and age on the performance and symptoms in a visual search task in augmented reality.* 103746.

In augmented reality (AR), virtual information is optically combined with the physical environment. In the most frequently used combination technique, optical settings in AR depart from the settings in natural viewing. Depending on the combination of viewing distances of the virtual task and its physical background, this deviation may lower visual performance and cause visual disturbance symptoms. The so-called vergence-accommodation conflict (VAC) has been identified as a cause for the visual disturbance symptoms in AR. In this study, for various distance combinations, the performance and symptoms when performing a search task displayed in a see-through head-mounted display (AR HMD, HoloLens 1st generation, Microsoft, USA) was investigated. The search task was displayed at a virtual distance of either 200 cm or 30 cm, and the real background was viewed either at a distance of 200 cm or 30 cm. Three combinations of viewing distances for the background and the virtual task were studied: 200 cm/200 cm, 200 cm/30 cm, and 30 cm/30 cm. Results revealed that both performance and visual disturbance symptoms depend on the combination of the viewing distances of the physical background and the virtual task. When the physical background was viewed at a distance of 200 cm, younger participants showed a significantly better search performance and reported stronger symptoms compared with older participants, no matter whether the virtual task was performed at 30 cm or at 200 cm. However, with the physical background at a distance of 30 cm, the performance of the younger group dropped to the level of the performance of the older group, and younger participants tended to report a stronger increase in visual disturbance symptoms compared with the older participants. From the AR HMD technology used in this study, it can be concluded that a near viewing distance of the virtual task does not cause a negative impact on performance and visual disturbance symptoms, provided any physical background seen through the AR HMD is not at a near viewing distance. The findings indicate that the VAC, which persists in augmented and virtual reality, depends, in addition to the physical component evaluating the optical distance, on a cognitive component evaluating the perceived distance. AR settings should therefore also be evaluated in terms of possible effects on perceived distance.

- **Keywords:** Augmented reality; Accommodation-vergence conflict; Viewing distance; Near work

Claire Bethel, Jessica G. Rainbow, Karen Johnson. *A qualitative descriptive study of the COVID-19 pandemic: Impacts on nursing care delivery in the critical care work system.* 103712.

The COVID-19 pandemic drastically changed the delivery of nursing care in U.S. critical care settings. The purpose of this study was to describe nurses' perceptions of the critical care work system during the COVID-19 pandemic in the U.S. We conducted interviews with experienced critical care nurses who worked during the pandemic and analyzed these data using deductive content analysis framed by the Systems Engineering Initiative for Patient Safety (SEIPS) 2.0 model. Concepts include the critical care work system structures, nursing care processes, outcomes, and adaptations during the pandemic. Our findings revealed a description of the critical care work system framed by the SEIPS 2.0 model. We suggest how human factors engineers can utilize a human factors and engineering approach to maximize the adaptations critical care nurses made to their work system during the pandemic.

- **Keywords:** Critical care; Nursing; Care delivery; Work system; COVID-19; Redesign

Yueyuan Chen, Weining Fang, Beiyuan Guo, Haifeng Bao. *The moderation effects of task attributes and mental fatigue on post-interruption task performance in a concurrent multitasking environment.* 103764.

In a concurrent multitasking environment, performing many types of tasks increases task complexity, and working long hours makes a person susceptible to mental fatigue. Emerging technologies may lead to more task interruptions. This study examines the effects of task attributes and mental fatigue on interrupted task performance in a concurrent multitasking environment. Thirty-four participants performed the MATB-II under eight conditions (two-level task interruption, two-level task complexity, two-level fatigue). The results revealed the significant interaction effects of interruption × task complexity and of interruption × fatigue state. The findings show that more time is required to return to a complex primary task, and there are differences among subtask types. Mental fatigue negatively affects primary task performance, workload, and the resumption lag after an interruption. The findings are explained by the increasing information cues needed to resume complex tasks and the negative effect of fatigue on memory activation.

- **Keywords:** Interruption; MATB-II; Multitasking environment

Jingyue Zheng, Liang Ma, Wei Zhang. *Promotion of cooperative lane changes by use of emotional vehicle-to-vehicle communication.* 103742.

This driving simulator study aimed to encourage cooperative lane changes through vehicle-to-vehicle (V2V) communication and explore whether emotional or rational communication content is better in promoting cooperative lane change. A total of 960 lane-changing datapoints from 30 participants in a driving simulation environment were collected. The participants' behavior, driving-related data, and emotional responses were recorded and analyzed. The results revealed that the trigger time to collision (TTC) between the lane changer and the following vehicle in the target lane and communication types were all important factors influencing the willingness of drivers to cooperate. V2V communication could significantly increase the willingness of the driver in the following vehicle to cooperate compared to the traditional method in which desire to change lanes is conveyed with only turn lights. The effect of different communication contents on willingness to cooperate did not vary significantly; however, emotional communication was superior to rational communication in some cases. This indicates that changing lanes owing to an emergency was more likely to be successful. The results of this study can provide a reference for V2V communication design for a safer and more comfortable driving experience.

- **Keywords:** Emotional; Rational; Communication; Cooperation; Lane change

Anne Silla. *Identifying measures with the highest potential to reduce suicides on Finnish railways.* 103748.

The purpose of this study was to work systematically through all known measures for preventing railway suicides and to consider their suitability for the Finnish railway environment. The research method included a selection and grouping of measures, definition of assessment criteria, a literature review and compilation of assessment forms, and a workshop for experts in the field. We assessed 21 measures based on 12 specified criteria. Specifically, the aim of these criteria was to support the identification and structuring of the available information on each measure to be in easily exploitable format for railway stakeholders. The measures were listed in order of priority in three categories based on final assessments from the workshop. The measures categorised as top priority with the highest potential to reduce suicides on Finnish railways included training of railway personnel to identify suicidal people (also called Gatekeeper training),

camera surveillance, detection systems (radar, movement sensors, etc.), collaboration between organisations, learning from international experience, cooperation between railway organisations, police and fire and rescue services, and training of mental health providers. This prioritisation, together with the information included in the assessment forms and expert's views related to each measure, support the Finnish railway stakeholders in selecting measures and defining implementation strategies to prevent railway suicides on Finnish railways. The insights of Finnish experts on the effectiveness and potential implementation of these different measures are valuable information also for railway stakeholders in other countries when selecting appropriate measures to prevent railway suicides. The results of this study support the safe and effective functioning of the railway system by adding knowledge that will help effectively prevent railway suicides and loss of life, delays to train traffic, and work-related stress and trauma to railway staff, rescue personnel and eyewitnesses.

- **Keywords:** Railway suicides; Prevention; Expert assessment

David Clusiaux, Justin B. Davidson, Daniel P. Armstrong, Steven L. Fischer *The influence of sex and strength capacity on normalized low-back exposure during lifting: Insights from a joint power analysis.* 103756.

Objective: Investigate the influence of sex, strength capacity, and relative load mass on low-back exposure and lower extremity joint power generation in backboard lifting. **Background:** Sex and strength have been shown to influence lifting strategy, but without load mass being scaled to strength it is unknown which factor influences low-back exposures, and whether there are interactions with load mass. **Methods:** Motion capture and force plate data from 28 participants were collected during backboard lifting at load masses scaled to strength capacity. Differences in normalized peak low-back moment, peak knee-to-hip power magnitude ratio and timing were tested as a function of sex, strength, and load mass. **Results:** Stronger participants had lower normalized peak low-back moments (average 32% change from low-capacity across all load masses), with no significant sex effect ($p = 0.582$). As load mass increased, normalized peak low-back moment, peak knee-to-hip power magnitude and synchronicity decreased. **Conclusion:** Training to both increase strength capacity and hip-joint power generation may be a strategy to reduce low-back exposure in backboard lifting.

- **Keywords:** Strength capacity; Energetics; Paramedics

Peter JH. Beliveau, Heather Johnston, Dwayne Van Eerd, Steven L. Fischer. *Musculoskeletal disorder risk assessment tool use: A Canadian perspective.* 103740.

Canadian ergonomics professionals from the Association of Canadian Ergonomists (ACE) and Board of Canadian Registered Safety Professionals (BCRSP) participated in a web-based survey of their awareness, use, and factors influencing use of ergonomics musculoskeletal disorder (MSD) risk assessment tools. A total of 791 respondents (21.0% response rate) participated in the survey. Certified ergonomics professionals represented an important subpopulation of MSD risk assessment tool users, however; the vast majority (86.4%) of users within Canada were certified safety professionals. Average tool use varied between ACE and BCRSP groups, where ACE respondents on average use more tools than BCRSP respondents, however the top 10 tools used were similar between the groups. Over 45% of assessment tools were learned at school and average tool use was not influenced by years of experience or continuing education.

- **Keywords:** Ergonomics; Musculoskeletal disorders; Risk assessment

Jeyeon Jo, Susan Sokolowski, Meredith McQuerry, Linsey Griffin, Huiju Park. *Firefighters' feet: Differences by sex and weight-bearing.* 103753.

Firefighters have reported their protective boots to be bulky and ill-fitting, which they believe restrict the lower body movement on the unpredictable fireground. This study used 3D foot scanning to compare the shape of firefighters' feet to the general population, the shape of female firefighters' feet to males, and the impact of the heavy fire gear on foot shape. The results found the foot breadth of firefighters was larger than the general population and the feet of female firefighters were slimmer than males. Furthermore, it revealed that the feet of firefighters became longer, wider, and flatter when bearing the weight of fire gear. Protective boots should be designed based on the foot shape and dimensions of the actual population, with consideration of sex differences and the impact of weight-bearing for their safety.

- **Keywords:** Firefighter; Foot; Fire boots; 3D scan; Sex difference; Weight-bearing

Grigore M. Havârneanu, Laura Petersen, Andreas Arnold, Danielle Carbon, Thomas Görden. *Preparing railway stakeholders against CBRNe threats through better cooperation with security practitioners.* 103752.

This paper presents partial results from the Horizon2020 PROACTIVE project, following a set of literature reviews and surveys conducted with first responder organisations and rail security experts. Qualitative and quantitative data from two surveys are being presented. The results provide an overview of the CBRNe (Chemical, Biological, Radiological, Nuclear and explosive) preparedness and response capabilities of railway stakeholders and how these relate to a wider context represented by CBRNe first responders. The results highlight a set of challenges as well as five core skills that railway staff need to develop or improve: 1) understand the specific characteristics of the CBRNe threat, 2) develop basic response measures, 3) cooperate with authorities and train with specialised first responders, 4) improve public awareness about this threat, and 5) optimise crisis communication. In line with these, project PROACTIVE will further help update rail crisis management plans with practical recommendations concerning the CBRNe threat.

- **Keywords:** Rail security; Capacity building; Emergency response; Transport; Terrorism

Paul Rothmore, Susan Williams. *Maintaining work ability in outdoor workers – A long-term Evaluation.* 103758.

In this three-year study we examined the effect on work ability in a cohort of workers before and after the implementation of a workplace intervention based on the APHIRM (A Participative Hazard Identification and Risk Management) toolkit. Primary analysis was conducted to detect changes in mean work ability scores between baseline and three-year follow-up for all workers who completed the surveys (matched and unmatched), and all workers who were ≥ 50 years of age (matched and unmatched). There were no significant differences between the two time periods. A secondary analysis was undertaken to examine associations between risk factors and work ability scores. This identified that six of the 18 psychosocial risk factors, and three of the eight physical risk factors associated with reduced work ability at baseline were no longer significant. These results indicate that the APHIRM toolkit may be effective in identifying hazards which, if addressed, could contribute to the maintenance of work ability over time.

- **Keywords:** Older workers; Work ability; Aging; APHIRM

Matthew Ward, William S. Helton. *More or less? Improving monocular head mounted display assisted visual search by reducing guidance precision.* 103720.

Objective To test six different methods of directing a user's attention in a peripheral head mounted display assisted visual search task. **Background:** Each time a user needs to shift their attention between virtual information and their environment has a cost. The faster a user can process a guiding cue and the fewer times they need to return to it, the more efficient that cue will be at directing a user's attention. The most effective method, creating a visual effect at the location of the target, is not suitable for peripheral head mounted displays. This study tests alternative guiding cues better suited to these devices. **Method:** Participants searched for a singleton target hidden among 299 distractors while directed with one of six device-delivered guiding cues. Search times were recorded. **Results:** A static region map was the most efficient and most preferred cue. Static and dynamic directional cues were also effective in comparison to non-guided search. Cues designed to work solely within the participants' peripheral vision were relatively ineffective. **Conclusion:** Guidance cues that direct a user's attention to targets within the real environment do not need to precisely lead to the target. It is instead more efficient to lead a user to the general vicinity of the target quickly and then have the user revert to their natural visual search behaviour. **Application:** This finding is broadly useful when assisting visual search tasks with handheld or worn devices which do not cover the user's full field of view. **Précis:** This study tested six different methods of guiding attention in a peripheral head-mounted display assisted visual search task. This study compared static, dynamic and peripheral-vision endogenous cues to targets and found a static simple map cue both fastest and most preferred by users.

- **Keywords:** Attention; Head-mounted display; Mobile devices; Visual search; Wearable devices

Sanjay Veerasammy, Justin B. Davidson, Steven L. Fischer. *Multi-task exposure assessment to infer musculoskeletal disorder risk: A scoping review of injury causation theories and tools available to assess exposures.* 103766.

Exposure assessment is critical for understanding musculoskeletal disorder (MSD) risk. Previous reviews summarized the tools available for single-task exposure assessment, however no reviews summarize tools available to assess the accumulation or aggregation of exposure associated with the performance of multiple tasks (i.e., multi-task assessment). We address this gap by using a scoping review methodology to: 1) summarize the theories explaining how multi-task exposures may lead to MSDs, and 2) summarize the models and tools available to assess multi-task exposures, stratified based on prevailing theories. Using a systematic search strategy, 3230 articles were identified, of which 34 were retained for data extraction. Of the retained articles, 13 described MSD causation theories, 12 described mathematical models (not yet accessible as tools), six described readily accessible tools, and three described both theories and a model or tool. We summarized the state-of-the-art in multi-task exposure assessment and highlight the need for more tools that assess muscle fatigue and inform on recovery.

- **Keywords:** Fatigue-failure; Muscle fatigue; Cumulative loading; MSD prevention

Wenbi Wang, Henry Peng, Fethi Bouak. *Measuring sleep parameters of naval sailors: A comparison between subjective self-report and wrist actigraphy.* 103744.

Wrist actigraph and self-report activity logs were used in a Royal Canadian Navy's at-sea exercise to track sleep patterns of naval personnel. In this study, we compared sleep

parameters obtained from two measurement methods and investigated their intrinsic biases. The results revealed a strong agreement between two methods for recording sleep offset times, but a relatively poor agreement for parameters that include substantial periods of transition between sleep and wake states. Overall, self-reported sleep durations were substantially longer than actigraphic estimates (mean bias of -30.6 min; limits of agreement -95.9 to 34.8 min), and the discrepancy was mainly caused by differences in two methods to track sleep onset latency and Wake-up After Sleep Onset (WASO). Based on a customised activity log, a strong positive correlation ($\rho = 0.75$, $p < .001$) between self-report and actigraphy was observed for sleep duration estimates, which confirmed the effectiveness of the activity log in field studies. Between two participant groups with different work schedules, the agreement between self-report and actigraphy was consistently better for day workers than watch keepers. The findings inform future sleep research planning that involves naval personnel in field settings.

- **Keywords:** Sleep parameter estimate; Actigraphy; Self-report

Azin Setayesh, Valentina Di Pasquale, W. Patrick Neumann. *An inter-method comparison of four Human Reliability Assessment models.* 103750.

This paper presents a comparison of four common Human Reliability Assessment (HRA) models through a scoping literature review and sensitivity analysis. The scoping literature review identified 72 relevant studies which formed the basis of the comparison. Studies reported the four selected models have similarities in terms of the sector of origin, applied sectors, output calculation, and a lack of clear guidelines on Performance Influencing Factors (PIFs) selection and risk level allocation. The studied models have differences in the number and type of PIF inputs and Human Error Probability (HEP) calculation procedures. The One Factor At a Time (OFAT) and "combined" sensitivity analysis were conducted to examine the HRA models' responses to systematic risk level changes when each of 8 matching PIFs were systematically set to "high" and then "low" levels individually and simultaneously. The OFAT analysis showed coefficients of variation (CV) in HEP varying from 9% for skills/training up to 94% for work procedure when the PIFs are assigned to a "low" risk level individually. The combined analysis showed the median HEP value close to 97% and 1% when PIFs are assigned to "high" and "low" risk levels respectively. Although the selected HRA models were reported to be validated in high-risk domains there was no study found that validated these models in low-risk domains such as manual order picking, or manual assembly lines. The HRA models examined here are disconnected from specific system design elements which can inhibit design improvement efforts. The study outcome suggests the need for clear guidelines for PIFs selection and risk level allocation. Future research should address both the connection of error assessment to the design of the system and the features of new HRA models that affect its reliability and validity in a variety of industrial contexts.

- **Keywords:** Human error; Human error probability; Performance shaping factors; Human factors; Ergonomics

Fernanda Cabegi de Barros, Cristiane Shinohara Moriguchi, Tatiana de Oliveira Sato. *Effects of workstation adjustment to reduce postural exposure and perceived discomfort among office workers - A cluster randomized controlled trial.* 103738.

This study aimed to evaluate the effects of workstation adjustment to reduce postural exposure and perceived discomfort among office workers in a cluster randomized controlled trial. Experimental (EG, $n = 31$) and control groups (CG, $n = 30$) were compared before (pre-intervention), immediately (post-intervention), and 3 months after

(follow up) the intervention. EG received workstation adjustments and CG did not receive the intervention. Postural exposure of head, upper back and upper arms was objectively measured by inclinometers. Overall level of perceived discomfort for the whole body was evaluated using a visual analogue scale (0–100 mm). EG showed a statistically significant reduction on the head (pre: 10.1°, SD 5.7°; post: 6.6°, SD 4.7°) and upper back flexion (pre: 15.4°, SD 10.7°; post: 10.4°, SD 8.4°) from pre to post-intervention. EG also showed a statistically significant reduction from pre (50.7°, SD 9.5°) to post-intervention (42.1°, SD 7.6°) and from pre to follow up (41.6°, SD 6.5°) on upper arm elevation. CG did not show any difference between evaluations. Perceived discomfort increased 7.2 (SD 2.0) mm in CG and decreased 22.1 (SD 2.2) mm in EG between pre and post intervention. The variation between pre intervention and follow up was 4.5 (SD 1.2) mm increase for the CG and 24.1 (SD 1.5) mm of reduction for the EG ($P < 0.01$). There was no significant difference for the post intervention and follow up for both groups ($P > 0.05$). The results show evidence of the workstation adjustment to reduce postural exposure and perceived discomfort among office workers.

- **Keywords:** Musculoskeletal disorders; Neck; Shoulder; Inclinometer; Ergonomics

Sebastian Pütz, Vera Rick, Alexander Mertens, Verena Nitsch. *Using IoT devices for sensor-based monitoring of employees' mental workload: Investigating managers' expectations and concerns.* 103739.

Although the objective assessment of mental workload has been a focus of human factors research, few studies have investigated stakeholders' attitudes towards its implementation in real workplaces. The present study addresses this research gap by surveying $N = 702$ managers in three European countries (Germany, United Kingdom, Spain) about their expectations and concerns regarding sensor-based monitoring of employee mental workload. The data confirm the relevance of expectations regarding improvements of workplace design and employee well-being, as well as concerns about restrictions of employees' privacy and sovereignty, for the implementation of workload monitoring. Furthermore, Bayesian regression models show that the examined expectations have a substantial positive association with managers' willingness to support workload monitoring in their company. Privacy concerns are identified as a significant barrier to the acceptance of workload monitoring, both in terms of their prevalence among managers and their strong negative relationship with monitoring support.

- **Keywords:** Mental workload; Monitoring; Privacy concerns

Da Tao, Kunhua Yang, Tingru Zhang, Xingda Qu. *Typing with mobile devices: A comparison of upper limb and shoulder muscle activities, typing performance and perceived workload under varied body postures, typing styles and device types.* 103760.

This study aimed to examine the effects of body posture, typing style and device type on upper limb and shoulder muscle activities, typing performance and perceived workload while typing with mobile devices. Participants were asked to type with two mobile devices (i.e., a tablet and a smartphone) under three postures and in two typing styles. Muscle activity was recorded for four upper limb and shoulder muscles on both sides with surface electromyography. Results showed that body posture and typing style yielded significant effects on typing performance, perceived workload, and muscle activities in the forearm, upper arm and shoulder. Typing with a tablet was more accurate and had greater muscle activities in the upper arm and forearm on both sides than typing with a smartphone. The findings may be useful in developing evidence-based guidelines for the wise use of mobile devices and for the prevention of risks for musculoskeletal disorders.

- **Keywords:** Mobile device; Body posture; Typing style; Muscle activity; Musculoskeletal disorder

Megan J. Blakely, Samantha L. Smith, Paul N. Russell, William S. Helton. *The impact of cognitive load on kayaking and kayaking on cognitive performance.* 103747.

Objective: We examined the impact of performing a cognitive task of varying loads and kayaking simultaneously, compared to performance on the same tasks individually. **Background:** When two tasks are performed together, performance often suffers compared to performance on either task alone. Interference not only occurs in competing cognitive tasks, but has also been found with certain physically demanding activities, such as climbing. **Method:** Skilled kayakers performed a kayak course on open water, performed a high and a low cognitive load tone counting task, and also performed the kayak and counting tasks simultaneously. **Results:** Despite some past research finding dual task facilitation with laboratory aerobic activities, simultaneous kayaking and tone counting led to dual-task interference. **Conclusion:** Concurrent counting and kayaking led to performance impairments in both tasks, relative to single task performance. **Application:** The present results are applicable to occupations involving concurrent demanding physical activity and cognitive task performance, such as the work of first responders and military operators. **Précis:** Kayaking, like climbing, appears to hinder cognitive performance more than the low-risk physical tasks carried out in laboratory conditions.

- **Keywords:** Kayaking; Dual task; Exercise; Tone counting

Anne Skov Oestergaard, Nidhi Gupta, Trine Fernando Smidt, Louise Fleng Sandal, Karen Søgaaard. *The objectively measured physical work demands and physical capacity of offshore wind technicians: An observational field study.* 103716.

We aimed to assess the physical capacity and physical work demands of wind service technicians (WT) in different field conditions (onshore and offshore workdays). We recruited 27 male WTs (mean age of 31 years (SD: ± 7), VO₂max of 46 mL O₂/kg/min (SD: ± 7)) and assessed their physical work demands for a total of 110 workdays using heart rate monitors and accelerometers at five body placements. On average, each day, sitting was the most recorded activity (43%), followed by standing (19%), lying (13%) moving (9%), walking (8%) and high intensity physical activities (1%). Additionally, 1 minute was spent on vertical climbing, 20 minutes on work with forward bent trunk, 13 minutes on work with elevated arms and 6 minutes kneeling. The average cardiovascular load was 22% and 4 minutes per day were spent at high cardiovascular intensities. We found significantly higher demands on offshore compared with onshore workdays.

- **Keywords:** Wind technician; Physical work demands; Physical capacity; Offshore wind industry

David Golightly, Mark S. Young. *Local knowledge in rail signalling and balancing trade-offs.* 103714.

The control of rail signalling is known to be highly dependent on local knowledge and local factors. It is also known to be highly cognitive in its nature involving a constant balancing of system performance within the constraints of safety. In the current paper, data generated through field work with signallers were used to understand the role of local knowledge, set against the background of an existing Local Knowledge Framework (Pickup et al., 2013) that was proposed to help determine the contents and mechanisms

behind local knowledge in rail signalling. The field work included interviews with signallers and operations managers along with observations of signaller work. The results showed that the local knowledge framework needs to be expanded to include aspects related to the general public at user worked crossings and level crossings. In addition, the analysis highlights some of the issues with the transmission of local knowledge. The paper then discusses some of the gaps in the current framework, highlighting the importance not only of local knowledge for specific functions of signalling, but how these interact to support trade-offs to balance performance with safety. The implications for the design of signaller work are discussed.

- **Keywords:** Signalling; Rail control; Local knowledge