
In industrially developing countries (IDC), small and medium enterprises (SMEs) account for the highest proportion of employment. Unfortunately, the working conditions in SMEs are often very poor and expose employees to a potentially wide range of health and safety risks. This paper presents a comprehensive review of 161 articles related to ergonomics application in SMEs, using Indonesia as a case study. The aim of this paper is to investigate the extent of ergonomics application and identify areas that can be improved to promote effective ergonomics for SMEs in IDC. The most urgent issue found is the need for adopting participatory approach in contrast to the commonly implemented top-down approach. Some good practices in ergonomics application were also revealed from the review, e.g. a multidisciplinary approach, unsophisticated and low-cost solutions, and recognising the importance of productivity. The review also found that more work is still required to achieve appropriate cross-cultural adaptation of ergonomics application. **Practitioner Summary:** Despite continuous efforts in addressing ergonomics issues in SMEs of IDC, workers are still exposed to poor work conditions. We reviewed factual-based evidence of current ergonomics application to inform future strategies of ergonomics in IDC, using Indonesia as a case study.

- **Keywords:** industrial ergonomics, health and safety, small and medium enterprises, industrially developing countries, intervention effectiveness


Social interactions with other road users are an essential component of the driving activity and may prove critical in view of future automation systems; still up to now they have received only limited attention in the scientific literature. In this paper, it is argued that drivers base their anticipations about the traffic scene to a large extent on observations of social behaviour of other ‘animate human-vehicles’. It is further argued that in cases of uncertainty, drivers seek to establish a mutual situational awareness.
through deliberate communicative interactions. A linguistic model is proposed for modelling these communicative interactions. Empirical evidence from on-road observations and analysis of concurrent running commentary by 25 experienced drivers support the proposed model. It is suggested that the integration of a social interactions layer based on illocutionary acts in future driving support and automation systems will improve their performance towards matching human driver’s expectations. **Practitioner Summary:** Interactions between drivers on the road may play a significant role in traffic coordination. On-road observations and running commentaries are presented as empirical evidence to support a model of such interactions; incorporation of drivers’ interactions in future driving support and automation systems may improve their performance towards matching driver’s expectations.

- **Keywords:** drivers’ interactions, linguistic model, anticipation of intent, driving support and automation systems

**Sibylle Pennig, Julia Quehl & Martin Wittkowski. Speech intelligibility and speech quality of modified loudspeaker announcements examined in a simulated aircraft cabin. pages 1806-1816.**

Acoustic modifications of loudspeaker announcements were investigated in a simulated aircraft cabin to improve passengers’ speech intelligibility and quality of communication in this specific setting. Four experiments with 278 participants in total were conducted in an acoustic laboratory using a standardised speech test and subjective rating scales. In experiments 1 and 2 the sound pressure level (SPL) of the announcements was varied (ranging from 70 to 85 dB(A)). Experiments 3 and 4 focused on frequency modification (octave bands) of the announcements. All studies used a background noise with the same SPL (74 dB(A)), but recorded at different seat positions in the aircraft cabin (front, rear). The results quantify speech intelligibility improvements with increasing signal-to-noise ratio and amplification of particular octave bands, especially the 2 kHz and the 4 kHz band. Thus, loudspeaker power in an aircraft cabin can be reduced by using appropriate filter settings in the loudspeaker system. **Practitioner Summary:** Acoustic modifications of loudspeaker announcements were examined in a simulated aircraft cabin via psychological methods with the aim of improving speech intelligibility and subjective speech quality. The findings led to recommendations for improvements of announcement systems concerning sound pressure level and frequencies according to the noise in different cabin sections.

- **Keywords:** speech intelligibility, sound design, loudspeaker announcements, aircraft cabi

**Jean-Paul Imbert, Helen M. Hodgetts, Robert Parise, François Vachon, Frédéric Dehais & Sébastien Tremblay. Attentional costs and failures in air traffic control notifications. pages 1817-1832.**

Large display screens are common in supervisory tasks, meaning that alerts are often perceived in peripheral vision. Five air traffic control notification designs were evaluated in their ability to capture attention during an ongoing supervisory task, as well as their impact on the primary task. A range of performance measures, eye-tracking and subjective reports showed that colour, even animated, was less effective than movement, and notifications sometimes went unnoticed. Designs that drew attention to the notified aircraft by a pulsating box, concentric circles or the opacity of the background resulted in faster perception and no missed notifications. However, the latter two designs were intrusive and impaired primary task performance, while the simpler animated box captured attention without an overhead cognitive cost. These results highlight the need for a holistic approach to evaluation, achieving a balance between the
benefits for one aspect of performance against the potential costs for another.

**Practitioner summary:** We performed a holistic examination of air traffic control notification designs regarding their ability to capture attention during an ongoing supervisory task. The combination of performance, eye-tracking and subjective measurements demonstrated that the best design achieved a balance between attentional power and the overhead cognitive cost to primary task performance.

- **Keywords:** air traffic control, visual notifications, attentional capture, detection, eye movement

**Dietrich Manzey, Nina Gérard & Rebecca Wiczorek. Decision-making and response strategies in interaction with alarms: the impact of alarm reliability, availability of alarm validity information and workload. pages 1833-1855.**

Responding to alarm systems which usually commit a number of false alarms and/or misses involves decision-making under uncertainty. Four laboratory experiments including a total of 256 participants were conducted to gain comprehensive insight into humans' dealing with this uncertainty. Specifically, it was investigated how responses to alarms/non-alarms are affected by the predictive validities of these events, and to what extent response strategies depend on whether or not the validity of alarms/non-alarms can be cross-checked against other data. Among others, the results suggest that, without cross-check possibility (experiment 1), low levels of predictive validity of alarms (≤0.5) led most participants to use one of two different strategies which both involved non-responding to a significant number of alarms (cry-wolf effect). Yet, providing access to alarm validity information reduced this effect dramatically (experiment 2). This latter result emerged independent of the effort needed for cross-checkings of alarms (experiment 3), but was affected by the workload imposed by concurrent tasks (experiment 4). Theoretical and practical consequences of these results for decision-making and response selection in interaction with alarm systems, as well as the design of effective alarm systems, are discussed. **Practitioner Summary:** Four laboratory experiments were performed to investigate the effects of false alarms and misses on the behavioural effectiveness of alarm systems. The results provide insight in determinants of compliance with alarms, dependent on the alarm system's reliability, the possibility to cross-check the validity of alarms and the workload imposed by concurrent tasks.

- **Keywords:** decision-making, alarm system, compliance, reliance, cry-wolf effect

**Yafa Levanon, Yehuda Lerman, Amit Gefen & Navah Z. Ratzon. Validity of the modified RULA for computer workers and reliability of one observation compared to six. pages 1856-1863.**

Awkward body posture while typing is associated with musculoskeletal disorders (MSDs). Valid rapid assessment of computer workers' body posture is essential for the prevention of MSD among this large population. This study aimed to examine the validity of the modified rapid upper limb assessment (mRULA) which adjusted the rapid upper limb assessment (RULA) for computer workers. Moreover, this study examines whether one observation during a working day is sufficient or more observations are needed. A total of 29 right-handed computer workers were recruited. RULA and mRULA were conducted. The observations were then repeated six times at one-hour intervals. A significant moderate correlation (r = 0.6 and r = 0.7 for mouse and keyboard, respectively) was found between the assessments. No significant differences were found between one observation and six observations per working day. The mRULA was found to be valid for the assessment of computer workers, and one observation was sufficient to assess the work-related risk factor. **Practitioner Summary:** This study approved the validity of the
mRULA for assessing computer workers and the reliability of one observation in comparison with six. This version identified a greater percentage of computer workers at a higher ergonomic risk level and therefore may encourage clinicians to use the mRULA for assessment.

- **Keywords:** human-computer interaction, musculoskeletal disorders, upper limb disorders, office ergonom

**Ehsan Rashedi, Sunwook Kim, Maury A. Nussbaum & Michael J. Agnew. Ergonomic evaluation of a wearable assistive device for overhead work. pages 1864-1874.**

Overhead work is an important risk factor for upper extremity (UE) musculoskeletal disorders. We examined the potential of a mechanical arm and an exoskeletal vest as a wearable assistive device (WADE) for overhead work. Twelve participants completed 10 minutes of simulated, intermittent overhead work, using each of three payloads (1.1, 3.4 and 8.1 kg) and with/without the WADE. Ratings of perceived discomfort (RPDs) and electromyography (EMG) were obtained for the upper arms, shoulders and low back. Using the WADE, UE RPDs decreased by \( \sim 50\% \) with the heavier payloads, whereas smaller (\( \sim 25\% \)) and non-significant increases in low-back RPDs were found and were relatively independent of payload. Changes in RPDs with WADE use were consistent with physical demands indicated by EMG, though EMG-based differences in fatigue were less apparent. Participants generally preferred using the WADE, particularly with heavier payloads. These results supported the potential utility of a WADE as an intervention for overhead work. **Practitioner Summary:** A wearable assistive device for overhead work reduced physical demands on the upper extremity and had high acceptance, though some evidence suggested increased demands at the low back. While some design needs were found and field-testing is needed, this may be a useful practical intervention.

- **Keywords:** shoulder, overhead work, wearable assistive device, exoskeleton

**Jungyong Lee, Maury A. Nussbaum & Gyouhyung Kyung. Effects of work experience on fatigue-induced biomechanical changes during repetitive asymmetric lifts/lowers. pages 1875-1885.**

Repetitive lifting/lowering is associated with an increased risk of work-related low back disorders (WRLBDs), and fatigue may exacerbate such risk. Work methods used by experienced workers are potential models for developing worker training to reduce WRLBDs, though whether experience modifies the effects of fatigue on WRLBD risk is largely unknown. Here, six novices and six experienced workers completed 185 cycles of repetitive, asymmetric lifts/lowers. Physical demands, whole-body balance and torso movement stability were assessed using torso kinematics/kinetics, linear/angular momenta and Lyapunov exponents, respectively. Several fatigue-induced changes in movement strategies were evident. Novices decreased and experienced workers increased peak lumbar moments post-fatigue, suggesting lower WRLBD risks among the former in terms of torso kinetics. Other than lumbar moments, though, fatigue substantially reduced group-level differences in torso twisting velocities and accelerations. Post-fatigue movement strategies of experienced workers thus did not appear to be advantageous in terms of WRLBD risk. **Practitioner Summary:** Fatigue induced changes in movement strategies during a repetitive, asymmetric lifting/lowering task. Novices and experienced workers adapted to fatigue differently, with diminished post-fatigue differences in lifting strategies. Regarding work-related low back disorder risks, the post-fatigue movement strategies of experienced workers did not appear superior to those of novices.

- **Keywords:** work experience, low back disorders, fatigue, repetitive lifting, asymmetric lifting, biomechanics

This study evaluated the accuracy of self-reported body weight and height compared to measured values among firefighters and identified factors associated with reporting error. A total of 863 male and 88 female firefighters in four US regions participated in the study. The results showed that both men and women underestimated their body weight (−0.4 ± 4.1, −1.1 ± 3.6 kg) and overestimated their height (29 ± 18, 17 ± 16 mm). Women underestimated more than men on weight (p = 0.022) and men overestimated more than women on height (p < 0.001). Reporting errors on weight were increased with overweight status (p < 0.001) and were disproportionate among subgroups. About 27% men and 24% women had reporting errors on weight greater than ±2.2 kg, and 59% men and 28% women had reporting errors on height greater than 25 mm. **Practitioner Summary:** This study along with literature revealed that the self-reported approach is not a sustainable option for anthropometric surveys, even for gathering data from physically active professional groups, such as firefighters, who presumably are knowledgeable of their body dimensions. Self-reported anthropometric information is unpredictable in important population subgroups.

- **Keywords:** weight, height, self-reported, firefighter, anthropometry, obesity


In order to safely and effectively extinguish fires and rescue life, firefighters are required to routinely wear self-contained breathing apparatus (SCBA), yet little is known about the specific physiological and psychological demands associated with repeated exposure to tasks that require SCBA. A total of 12 experienced firefighters took part in a series of commonly encountered SCBA activities: free search, guideline search and live firefighting tasks under room temperature (∼20°C) and extreme heat (∼180°C) conditions to assess changes in heart rate, blood pressure, mood, perceived workload and air usage. Findings demonstrate that live firefighting is associated with greater perceived exhaustion than free search or guideline exercises; however, all tasks lead to high cardiovascular demand regardless of the presence of heat. No significant impact of task upon mood and no significant differences between the perceived demands of guideline, free search and live firefighting exercises were found. **Practitioner Summary:** This study considered the physiological and psychological responses of firefighters undertaking SCBA exercises. Although live firefighting is associated with greater perceived exertion, the absence of differences in psychological domains between exercises demonstrates that task demands are not always dependent upon the presence of fire and that all tasks are mentally challenging.

- **Keywords:** firefighters, demand, mood, breathing apparatus


The involvement of otolith organs in motion sickness has long been debated; however, equivocal findings exist in literature. The present study thus aimed at evaluating the otolith functioning in individuals with motion sickness. Cervical and ocular vestibular evoked myogenic potentials were recorded from 30 individuals with motion sickness, 30
professional drivers and 30 healthy individuals. The results revealed no significant difference in latencies and amplitudes between the groups (p>0.05). Nonetheless, thresholds were significantly elevated and inter-aural asymmetry ratio significantly higher in motion sickness susceptible group (p < 0.001) for both the potentials. All the individuals in the motion sickness group had high asymmetry ratio at least on one of the two potentials. Thus, reduced response and/or asymmetric otolithic function seem the likely reasons behind motion sickness susceptibility. **Practitioner Summary:** Motion sickness is among the most rampant conditions affecting travellers across the globe. Otolith abnormality has been floated as a possible pathologic factor for motion sickness but has not been authenticated as yet. This study explores otolith functionality in individuals with motion sickness in order to evaluate this theory.

- **Keywords:** motion sickness, otolith, cervical vestibular evoked myogenic potential, ocular vestibular evoked myogenic potential


Several studies have indicated that slip-resistant shoes may have a positive effect on reducing the risk of slips and falls, a leading cause of injury at work. Few studies, however, have examined how duration of shoe usage affects their slip-resistance properties. This study examined the association between the duration of slip-resistant shoes usage and the self-reported rate of slipping in limited-service restaurant workers. A total of 475 workers from 36 limited-service restaurants in the USA were recruited to participate in a 12-week prospective study of workplace slipping. Of the 475 participants, 83 reported changing to a new pair of shoes at least once during the 12-week follow-up. The results show that slip-resistant shoes worn for less than six months were moderately more effective than those worn for more than six months. Changing to a new pair of shoes among those wearing slip-resistant shoes at baseline was associated with a 55% reduction in the rate of slipping (RR = 0.45, 95% CI = 0.23–0.89). Further research is needed to develop criteria for the replacement of slip-resistant shoes. **Practitioner Summary:** The duration of usage impacts the slip-resistance properties of slip-resistant shoes. Slip-resistant shoes worn for less than six months were moderately more effective in reducing slips than slip-resistant shoes worn for more than six months. Shoe use policies should not only encourage or require their use but also include guidance on replacing slip-resistant shoes at regular intervals.

- **Keywords:** slips, falls, injury, restaurants, slip-resistant shoes, shoe wear, shoe usage, personal protective equipment, safety


The objective of this study was to investigate the effects of mental fatigue on biomechanics of slips. A total of 44 healthy young participants were evenly categorised into two groups: no fatigue and mental fatigue. Mental fatigue was induced by performing an AX-continuous performance test. The participants in both groups were instructed to walk on a linear walkway, and slips were induced unexpectedly during walking. We found that mental fatigue has adverse effects in all the three phases of slips. In particular, it leads to increased likelihood of slip initiation, poorer slip detection and a more insufficient reactive recovery response to slips. Based on the findings from the present study, we can conclude that mental fatigue is a risk factor for slips and falls. In order to prevent slip-induced falls, interventions, such as providing frequent rest breaks,
could be applied in the workplace to avoid prolonged exposures to cognitively demanding activities. **Practitioner Summary:** Slips are a common external perturbation initiating accidental falls. Recognising risk factors is typically the first step in accident prevention. We found that mental fatigue is a risk factor for slips and falls. Thus, exposures to mental fatigue should be avoided in order to reduce the risk of slip-induced falls.

- **Keywords:** falls, slips, mental fatigue, biomechanics