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Wen-Ruey Chang, Sylvie Leclercq, Thurmon E. Lockhart & Roger Haslam.
[State of science: occupational slips, trips and falls on the same level.](#)
Pages 861-883.

Occupational slips, trips and falls on the same level (STFL) result in substantial injuries worldwide. This paper summarises the state of science regarding STFL, outlining relevant aspects of epidemiology, biomechanics, psychophysics, tribology, organisational influences and injury prevention. This review reaffirms that STFL remain a major cause of workplace injury and STFL prevention is a complex problem, requiring multi-disciplinary, multi-faceted approaches. Despite progress in recent decades in understanding the mechanisms involved in STFL, especially slipping, research leading to evidence-based prevention practices remains insufficient, given the problem scale. It is concluded that there is a pressing need to develop better fall prevention strategies using systems approaches conceptualising and addressing the factors involved in STFL, with considerations of the full range of factors and their interactions. There is also an urgent need for field trials of various fall prevention strategies to assess the effectiveness of different intervention components and their interactions. **Practitioner Summary:** Work-related slipping, tripping and falls on the same level are a major source of occupational injury. The causes are broadly understood, although more attention is needed from a systems perspective. Research has shown preventative action to be effective, but further studies are required to understand which aspects are most beneficial.

- **Keywords:** Slips, trips and falls, workplace falls, fall causation, fall prevention, occupational injury prevention

Richard J. Foster, John G. Buckley, David Whitaker & David B. Elliott. *The addition of stripes (a version of the 'horizontal-vertical illusion') increases foot clearance when crossing low-height obstacles. Pages 884-889.*

Trips over obstacles are one of the main causes of falling in older adults, with vision playing an important role in successful obstacle negotiation. We determined whether a horizontal-vertical illusion, superimposed onto low-height obstacles to create a perceived increase in obstacle height, increased foot clearances during obstacle negotiation thus

reducing the likelihood of tripping. Eleven adults (mean \pm 1 SD: age 27.3 \pm 5.1 years) negotiated obstacles of varying heights (3, 5, 7 cm) with four different appearance conditions; two were obstacles with a horizontal-vertical illusion (vertical stripes of different thickness) superimposed on the front, one was a plain obstacle and the fourth a plain obstacle with a horizontal black line painted on the top edge. Foot clearance parameters were compared across conditions. Both illusions led to a significant increase in foot clearance when crossing the obstacle, compared to the plain condition, irrespective of obstacle height. Superimposing a horizontal-vertical illusion onto low-height obstacles can increase foot clearance, and its use on the floor section of a double-glazing door frame for example may reduce the incidence of tripping in the home. **Practitioner Summary:** Low-height obstacles such as the floor section of a double-glazing door frame are potential tripping hazards. In a gait lab-based study we found that a horizontal-vertical illusion superimposed onto low-height obstacles led to significantly higher foot clearances; indicating their potential as a useful safety measure.

- **Keywords:** Tripping, obstacle crossing, horizontal-vertical illusion, toe clearance, door-frame

Kyung-Sun Lee & Myung-Chul Jung. *Three-dimensional finger joint angles by hand posture and object properties.* Pages 890-900.

The objective of this study was to identify three-dimensional finger joint angles for various hand postures and object properties. Finger joint angles were measured using a VICON system for 10 participants while they pinched objects with two, three, four and five fingers and grasped them with five fingers. The objects were cylinders and square pillars with diameters of 2, 4, 6 and 8 cm and weights of 400, 800, 1400 and 1800 g. Hand posture and object size more significantly affected the joint flexion angles than did object shape and weight. Object shape affected only the metacarpophalangeal (MCP) joint angle of the index finger and the flexion angle of the MCP joint of the little finger. Larger flexion angles resulted when the hand posture was grasping with five fingers. The joint angle increased linearly as the object size decreased. This report provides fundamental information about the specific joint angles of the thumb and fingers. **Practitioner Summary:** Three-dimensional finger joint angles are of special interest in ergonomics because of their importance in handheld devices and musculoskeletal hand disorders. In this study, the finger joint angles corresponding to various hand postures and objects with different properties were determined.

- **Keywords:** Pinching, grasping, object shape, object size, object weight

Tycho K. Fredericks, Steven E. Butt, Anil R. Kumar & Teresa Bellingar. *Do users desire symmetrical lumbar supports in task seating?* Pages 901-912.

This research was designed to objectively investigate the desired low back (lumbar) support in a task chair; specifically by allowing a user to self-select the magnitude and location of support. An experimental chair built specifically for this study allowed the users to remotely adjust 35 diodes to achieve their desired level of support. Pressure mapping was used to measure the interface pressure at the user-seat back interface. It was determined that 73.8% of the 201 participants in this study, self-selected asymmetrical lower back support that was at least 20% greater on one side vs. the other. Additionally, 16.9% of the participants self-selected support on one side which was at least twice that of the other side. Contrary to popular practice, participants were found to prefer asymmetric support in the lower back region. It is anticipated that the culmination of this research will aid chair manufacturers in designing adaptable back rests. **Practitioner Summary:** Most current lumbar supports are designed to move vertically and to symmetrically increase or decrease in firmness as per a user's adjustment. This investigation highlights that participants tended to select asymmetrical

lumbar support, and as such, designers should consider providing lumbar supports that provide the desired support at appropriate locations.

- **Keywords:** Low back support, lumbar comfort, seating, lumbar support design

Anna Ivarsson & Frida Eek. *The relationship between physical workload and quality within line-based assembly. Pages 913-923.*

Reducing costs and improvement of product quality are considered important to ensure productivity within a company. Quality deviations during production processes and ergonomics have previously shown to be associated. This study explored the relationship between physical workload and real (found during production processes) and potential (need of extra time and assistance to complete tasks) quality deviations in a line-based assembly plant. The physical workload on and the work rotation between 52 workstations were assessed. As the outcome, real and potential quality deviations were studied during 10 weeks. Results show that workstations with higher physical workload had significantly more real deviations compared to lower workload stations. Static work posture had significantly more potential deviations. Rotation between high and low workload was related to fewer quality deviations compared to rotation between only high workload stations. In conclusion, physical ergonomics seems to be related to real and potential quality deviation within line-based assembly. **Practitioner Summary:** To ensure good productivity in manufacturing industries, it is important to reduce costs and improve product quality. This study shows that high physical workload is associated with quality deviations and need of extra time and assistance to complete tasks within line-based assembly, which can be financially expensive for a company.

- **Keywords:** Physical workload, work rotation, assembly quality, stop time, extra assistance

Grace E. Vincent, Nicola D. Ridgers, Sally A. Ferguson & Brad Aisbett. *Associations between firefighters' physical activity across multiple shifts of wildfire suppression. Pages 924-931.*

The aim of this study was to examine the associations between firefighters' physical activity levels across consecutive wildfire suppression shifts and to determine whether sleep duration moderated these associations. Forty volunteer firefighters (31 males, 9 females) wore an activity monitor to concurrently measure physical activity and sleep duration. Sedentary time and time spent in light- (LPA), moderate- (MPA), and vigorous-intensity physical activity (VPA) during each shift were determined using monitor-specific cut points. During any given shift, every additional 60 min spent in LPA was associated with 7.2 min more LPA and 27.6 min MPA the following shift. There were no other significant positive or negative associations. No significant moderating effect of total sleep time was observed. Firefighters are able to maintain and/or increase their physical activity intensity between consecutive shifts. Further research is needed to understand firefighters pacing and energy conservation strategies during emergency wildfire deployments. **Practitioner Summary:** To examine associations between firefighters' physical activity levels across consecutive shifts during a multi-day emergency wildfire and determine whether sleep duration moderated these associations. Firefighters are able to maintain and/or increase their physical activity intensity between consecutive shifts. No significant moderating effect of total sleep time was observed.

- **Keywords:** Firefighting, occupational health, actigraphy

Grace E. Vincent, Brad Aisbett, Sarah J. Hall & Sally A. Ferguson. *Fighting fire and fatigue: sleep quantity and quality during multi-day wildfire suppression. Pages 932-940.*

This study examined firefighters' sleep quantity and quality throughout multi-day wildfire suppression, and assessed the impact of sleep location, shift length, shift start time and incident severity on these variables. For 4 weeks, 40 volunteer firefighters' sleep was assessed using wrist actigraphy. Analyses revealed that the quantity of sleep obtained on fire days was restricted, and pre- and post-sleep fatigue ratings were higher, compared to non-fire days. On fire days, total sleep time was less when: (i) sleep location was in a tent or vehicle, (ii) shifts were greater than 14 h and (iii) shifts started between 05:00 and 06:00 h. This is the first empirical investigation providing objective evidence that firefighters' sleep is restricted during wildfire suppression. Furthermore, sleep location, shift length and shift start time should be targeted when designing appropriate controls to manage fatigue-related risk and preserve firefighters' health and safety during wildfire events. **Practitioner Summary:** During multi-day wildfire suppression, firefighters' sleep quantity was restricted, and pre- and post-sleep fatigue ratings were higher, compared to non-fire days. Furthermore, total sleep time was less when: (i) sleep occurred in a tent/vehicle, (ii) shifts were >14 h and (iii) shifts started between 05:00 and 06:00 h.

- **Keywords:** Actigraphy, firefighting, occupational health, shift-work

Louisa D. Raisbeck, Joel Suss, Jed A. Diekfuss, Erich Petushek & Paul Ward. Skill-based changes in motor performance from attentional focus manipulations: a kinematic analysis. Pages 941-949.

In the present paper, expert and novice law enforcement officers performed a handgun shooting task under varied attention-demanding conditions; outcome (i.e. accuracy, consistency) and movement kinematics were measured (i.e. within and between-trial variability (BTV) of forearm and upper arm absolute angle). Using a dual-task paradigm, we directed participants' attention towards either a skill-relevant aspect of movement execution or to a skill-irrelevant distractor and compared their data to a single-task control condition. The results showed that experts' BTV in their upper arm increased during dual-tasks relative to control, but performance was similar across all three conditions. In contrast, novices' performance was poorer during both dual-tasks relative to control, but limited changes in movement kinematics were observed. This data suggests that attention demanding situations trigger experts' ability to adapt their movement pattern to maintain end-point control. The data for novices are less clear. Implications for future research are discussed. **Practitioner Summary:** Expert and novice law enforcement officials completed a shooting task under baseline and attention-demanding situations. Experts outperformed novices under all conditions, but exhibited increased variability in their upper arm position while shooting during attention-demanding compared to baseline conditions. Novices' movement data remained variable throughout all conditions. The data suggest that experts are able to maintain shooting performance during an attention-demanding situation by adopting a functional movement strategy.

- **Keywords:** Attentional focus, dual-task, skill, compensation, adaptation

Annemarie Landman, Arne Nieuwenhuys & Raoul R. D. Oudejans. The impact of personality traits and professional experience on police officers' shooting performance under pressure. Pages 950-961.

We explored the impact of professional experience and personality on police officers' shooting performance under pressure. We recruited: (1) regular officers, (2) officers wanting to join a specialised arrest unit (AU) (expected to possess more stress-resistant traits; pre-AU) and (3) officers from this unit (expected to also possess more professional experience; AU) (all male). In Phase 1, we determined personality traits and experience. In Phase 2, state anxiety, shot accuracy, decision-making (shoot/don't shoot), movement speed and gaze behaviour were measured while officers performed a shooting test under

low and high pressure. Results indicate minimal differences in personality among groups and superior performance of AU officers. Regression analyses showed that state anxiety and shooting performance under high pressure were first predicted by AU experience and second by certain personality traits. Results suggest that although personality traits attenuate the impact of high pressure, it is relevant experience that secures effective performance under pressure. **Practitioner Summary:** To obtain information for police selection and training purposes, we let officers who differed in personality and experience execute a shooting test under low and high pressure. Outcomes indicate that experience affected anxiety and performance most strongly, while personality traits of thrill- and adventure-seeking and self-control also had an effect.

- **Keywords:** Anxiety, experience, perceptual-motor performance, personality, stress

Timothy J. Neville & Paul M. Salmon. *Never blame the umpire – a review of Situation Awareness models and methods for examining the performance of officials in sport.* Pages 962-975.

As sport becomes more complex, there is potential for ergonomics concepts to help enhance the performance of sports officials. The concept of Situation Awareness (SA) appears pertinent given the requirement for officials to understand what is going on in order to make decisions. Although numerous models exist, none have been applied to examine officials, and only several recent examples have been applied to sport. This paper examines SA models and methods to identify if any have applicability to officials in sport (OoS). Evaluation of the models and methods identified potential applications of individual, team and systems models of SA. The paper further demonstrates that the Distributed Situation Awareness model is suitable for studying officials in fastball sports. It is concluded that the study of SA represents a key area of multidisciplinary research for both ergonomics and sports science in the context of OoS. **Practitioner Summary:** Despite obvious synergies, applications of cognitive ergonomics concepts in sport are sparse. This is especially so for Officials in Sport (OoS). This article presents an evaluation of Situation Awareness models and methods, providing practitioners with guidance on which are the most suitable for OoS system design and evaluation.

- **Keywords:** Situation Awareness, sociotechnical systems, cognitive ergonomics, sport, officials in sport, umpire, referee, naturalistic research

Nathan Lau, Greg A. Jamieson & Gyrd Skraaning Jr. *Situation awareness acquired from monitoring process plants – the Process Overview concept and measure.* Pages 976-988.

We introduce Process Overview, a situation awareness characterisation of the knowledge derived from monitoring process plants. Process Overview is based on observational studies of process control work in the literature. The characterisation is applied to develop a query-based measure called the Process Overview Measure. The goal of the measure is to improve coupling between situation and awareness according to process plant properties and operator cognitive work. A companion article presents the empirical evaluation of the Process Overview Measure in a realistic process control setting. The Process Overview Measure demonstrated sensitivity and validity by revealing significant effects of experimental manipulations that corroborated with other empirical results. The measure also demonstrated adequate inter-rater reliability and practicality for measuring SA based on data collected by process experts. **Practitioner Summary:** The Process Overview Measure is a query-based measure for assessing operator situation awareness from monitoring process plants in representative settings.

- **Keywords:** Situation awareness, process control, monitoring, domain-specific, measurement

Brett R. C. Molesworth, Dimuth Seneviratne & Marion Burgess. *Selling safety: the use of celebrities in improving awareness of safety in commercial aviation*. Pages 989-994.

The aim of this study was to investigate the influential power of a celebrity to convey key safety messages in commercial aviation using a pre-flight safety briefing video. In addition, the present research sought to examine the effectiveness of subtitles in aiding the recall of these important messages as well as how in-cabin aircraft noise affects recall of this information. A total of 101 participants were randomly divided into four groups (no noise without subtitles, no noise with subtitles, noise without subtitles and noise with subtitles) and following exposure to a pre-recorded pre-flight safety briefing video were tested for recall of key safety messages within that video. Participants who recognised and recalled the name of the celebrity in the safety briefing video recalled significantly more of the messages than participants who did not recognise the celebrity. Subtitles were also found to be effective, however, only in the presence of representative in-cabin aircraft noise. **Practitioner Summary:** Passenger attention to pre-flight safety briefings on commercial aircraft is poor. Utilising the celebrity status of a famous person may overcome this problem. Results suggest that celebrities do increase the recall of safety-related information.

- **Keywords:** Safety briefing, aviation, cabin safety, celebrity, noise, subtitles