

## **Ergonomics– rok 2020, ročník 63**

### **Číslo 12**



#### ***Ke Chen. Why do older people love and hate assistive technology? – an emotional experience perspective. Pages: 1463-1474.***

Assistive technology is increasingly valued to support older people with functional decline and disabilities. Inspired by classical theories on technology acceptance, emotional experience, and psychological needs, this study aimed to better understand the use of assistive technology by older people. Qualitative semi-structured interviews were conducted with 50 community-dwelling older adults in Hong Kong (mean age = 67.47, standard deviation = 7.96). Thematic analysis was used to generate themes. Positive and negative emotional experiences emerged as two themes. The theme of positive emotional experiences is associated with enhanced security, independence, and relativeness. However, assistive technology may also produce anxiety, frustration, stigma, isolation, and risks that induce negative emotional experiences. These findings indicate that older users' emotional and psychological concerns should be addressed and reflected in the process of assistive technology product design and implementation.

**Practitioner summary:** To enhance the well-being of older people through the application of assistive technology, it is necessary to maximise autonomy or independence, enhance social relativeness, and lift self-competence to evoke positive emotional experiences.

- **Keywords:** Product emotion, ageism, emotional experience, qualitative methodology

#### ***Kuang-Chin Tai. Using a ripple wall to help blind people measure the water level in a container. Pages: 1475-1484.***

The aim of this study is to determine whether swiping the ripple wall of a container can help blind people to measure the water level in it. Swiping the ripples on the wall of a container above the water level produces a different sound from doing so below the water level, and this difference in sound may be able to indicate the level of water in the container. Such sound differences associated with 27 3D-printed containers with a capacity of 500 ml and various forms were recorded. One of the printed containers and a commercially available beverage container were tested by blind people to measure water levels in three operations. The experimental results reveal that the thickness of the wall

affected the sound most strongly. The errors in the estimated water levels were significantly smaller when the containers was lifted and swiped than when it was lifted only. **Practitioner summary:** Lifting only is used by blind people to judge the fullness of a container. The experimental results reveal that the errors in the estimated water levels were significantly smaller when blind people lifted and swiped a 500 ml container with a ripple wall than when it was lifted only.

- **Keywords:** Blind people, water level measurement, ripple wall container

**Martina Lorenzino, Flavia D'Agostin, Sara Rigutti, Massimo Bovenzi, Carlo Fantoni & Luigi Bregant. *Acoustic comfort depends on the psychological state of the individual.* Pages: 1485-1501.**

Recent studies have shown that comfort can be influenced more by psychological processes than from the characteristics of environmental stimulation. This is relevant for different industrial sectors, where comfort is defined only as a function of the intensity of external stimuli. In the present study, we measured physiological and psychological comfort during the exposure to four levels of acoustic noise [from 45 to 55 dB(A)] corresponding to different comfort classes inside a full-scale mock-up of a cruise ship cabin. We found an increase of psychological and physiological discomfort for higher noise intensities, but not for all the intensities defining the comfort classes. Furthermore, we found that negative psychological states determine a lower physiological sensitivity to acoustic noise variations compared to positive states. Our results show that, at normal/low intensities, psychological processes have a greater role in determining acoustic comfort when compared to the stimulus intensity. **Practitioner summary:** This study shows that psychological factors can be more relevant in determining acoustic comfort inside a ship cabin than the intensity of acoustic stimulus itself. This finding suggests that the cruise industry should consider not only the engineering measurements when evaluating comfort on board, but also the passenger' psychological state.

- **Keywords:** Acoustic noiseheart rate variabilitycomfortmoodWeber's law

**Christopher Curry, Nicolette Peterson, Ruixuan Li & Thomas A. Stoffregen. *Postural precursors of motion sickness in head-mounted displays: drivers and passengers, women and men.* Pages: 1502-1511.**

Motion sickness is preceded by distinctive patterns of postural activity that differ between the sexes. We asked whether such postural precursors of motion sickness might exist before participants were exposed to a virtual driving game presented via a head-mounted display. Men and women either controlled a virtual vehicle (drivers), or viewed a recording of virtual vehicle motion (passengers). Before exposure to the game, we recorded standing body sway while participants performed simple visual tasks (staring at a blank page vs. counting target letters in a block of text). Following game exposure, participants were classified into Well and Sick groups. In a statistically significant interaction, the multifractality of body sway varied as a function of sex, vehicle control, and motion sickness status. The results confirm that postural precursors of motion sickness differ between the sexes, and extend these to the control of virtual vehicles in head-mounted displays. **Practitioner summary:** We asked whether postural sway might predict motion sickness during exposure to a driving game via a head-mounted display. Participants drove a virtual car (drivers), or watched recorded car motion (passengers). Beforehand, we measured standing body sway. Postural precursors of motion sickness differed between the sexes and drivers and passengers.

- **Keywords:** Motion sickness,posture, balance, visual performance, virtual environments

**Omar Faruque Hamim, Md. Shamsul Hoque, Rich C. McIlroy, Katherine L. Plant & Neville A. Stanton. *Representing two road traffic collisions in one Accimap: highlighting the importance of emergency response and enforcement in a low-income country.* Pages: 1512-1524.**

Seemingly erratic pedestrian crossing has become a major source of vehicle-pedestrian collisions on highways in Bangladesh, and across other low- and middle-income countries (LMICs). In this article, we approach the challenge from a sociotechnical systems perspective by using the Accimap method to analyse a pair of time-separated yet interconnected road traffic collisions. The first event involved a truck colliding with a road divider; in the second, fatal incident, a bus hit a university student. The traditional-style investigation conducted immediately after the collision apportioned blame to end users, that is, drivers and pedestrian; however, application of sociotechnical systems thinking revealed the contribution from lack of emergency response and enforcement among many other important factors. Results and recommendations are discussed in terms of reducing the chance and severity of such collisions across LMICs, and in terms of the need to look beyond the end-user, a focus that remains dominant in such settings.

**Practitioner summary:** This paper applies sociotechnical systems thinking to pedestrian safety in Bangladesh by analysing two inter-connected road traffic collisions using a single Accimap. The findings emphasise the importance of implementing road safety interventions that target all system levels, and draw attention to the importance of post-collision response in low-income settings.

- **Keywords:** Sociotechnical systems, road safety, Accimap low-income country, vehicle-pedestrian collision

**Stephanie E. Chappel, Brad Aisbett, Julie Considine & Nicola D. Ridgers. *The accumulation of, and associations between, nurses' activity levels within their shift in the emergency department.* Pages: 1525-1534.**

The aim of this study was to examine emergency nurses' activity levels and associations between hourly activity levels within-shifts. Fifty emergency nurses (45 females, 5 males) wore ActiGraph accelerometers and completed work diaries for up to 4 weeks. A sub-group (n=42) also wore activPALs. Multilevel analyses examined temporal associations between hourly periods. In any hourly period, increased time spent in moderate- to vigorous-intensity physical activity (MVPA) was associated with less time spent in MVPA in the following hourly period. In any afternoon hourly period, increased time spent in MVPA was associated with more time spent in light-intensity physical activity in the following hourly period. No other associations were significant. Emergency nurses maintain activity levels within-shifts, except when more time spent in MVPA was associated with less time spent in MVPA in the following hour; a potential recovery strategy. Future research should determine how emergency nurses maintain their activity levels within-shifts. **Practitioner summary:** Emergency nursing is physically demanding; however, it is unknown how active they are during hourly periods within-shifts. Emergency nurses' activity levels were maintained within hourly periods of a shift. Except for an increase in MVPA in 1 h was associated with a decrease in MVPA in the following hour.

- **Keywords:** Nursing emergency nursing physical activity sitting time shift work

**Jing Li, Carolyn M. Sommerich, Esther Chipps, Steven A. Lavender & Elizabeth A. Stasny. [\*A framework for studying risk factors for lower extremity musculoskeletal discomfort in nurses.\*](#) Pages: 1535-1550.**

Lower extremity musculoskeletal discomfort (MSD) is prevalent, but understudied, in nurses. A comprehensive, theoretical, aetiological model of lower extremity work-related

MSD in hospital in-patient staff nurses was developed through a review of the literature to provide a framework for aetiological and intervention research. The framework informed the design of a survey of 502 hospital staff nurses. Symptom prevalence ranged from 32% in hip/thigh to 59% in ankle/foot regions. Logistic regression modelling using survey data showed that different work and personal factors were associated with discomfort in different regions of the lower extremity. Individual factors (e.g. older age, higher BMI or having any foot condition), physical factors (e.g. higher frequency of patient handling), psychosocial factors (e.g. lower job satisfaction) were associated with discomfort in one or more parts of the lower extremity. Future research should target these factors for intervention, to attempt to reduce occurrence of lower extremity discomfort in nurses. **Practitioner summary:** Practitioners may find useful the illustrated, theoretical aetiological model of factors that could influence the prevalence of lower extremity discomfort in nurses. The model could guide conversations with nurses and observational analyses of nursing work. The model and survey results may provide ideas for intervention exploration.

- **Keywords:** Lower extremity, logistic regression modelling, nursing, discomfort, hospital, psychosocial work factors

**Gillian L. Hatfield & Iris A. Lesser. *Does body size impact muscle recruitment during law enforcement physical control simulator use?* Pages: 1551-1560.**

This study examined muscle activation during the 'push-pull' component of law enforcement physical abilities testing and assessed activation differences based on sex, height, and body mass index. Fifty participants (40 male) completed the 'push-pull' task while surface electromyograms were recorded from ten upper and lower extremity muscles, and six trunk muscles. Muscle activation was amplitude-normalized to maximum voluntary isometric contraction and compared between sexes and tertiles of height and body mass index (BMI). Women had significantly higher activation of anterior deltoid and pectoralis major on the pull, and posterior deltoid and triceps on the push. Significant differences largely remained after controlling for body size in regression analyses. The lowest tertile of height had significantly higher triceps activity on the push. The highest tertile of BMI had significantly higher rectus abdominus and external obliques activity on the pull, and external obliques activation on the push. **Practitioner summary:** Muscle activation during the 'push-pull' component of law enforcement standardised testing was examined, including differences based on sex, height, and BMI. Minimal differences existed between sexes (females had higher deltoid, pectoralis major, triceps activity), height (shorter people had higher triceps activity) and BMI tertiles (larger people had more abdominal activity).

- **Keywords:** Electromyography, law enforcement, occupational fitness screening, muscle activation

**Johan Merbah, Philippe Gorce & Julien Jacquier-Bret. *Effects of environmental illumination and screen brightness settings on upper limb and axial skeleton parameters: how do users adapt postures?* Pages: 1561-1570.**

79% of smartphone users carry their phone 22 hours a day. In this context, the main task worldwide, texting, is performed under a wide range of light and position conditions. The aim of this study was to test the effects of environmental illumination and screen brightness settings on upper limb and axial skeleton parameters. Twelve subjects performed three trials of texting under three experimental positions, two screen luminance settings and three environmental light conditions. 3D axial skeleton and upper limb angles, smartphone orientation and face-to-smartphone distance were used as

dependent variables. High environmental illumination and/or low screen brightness resulted in an increase in interaction time and a reduction in the face-to-smartphone distance by approximately 10%. Subjects attempted to compensate for the unfavourable effects of such light conditions by adopting postures rated 5 in the Rapid Upper Limb Assessment, indicating an increased risk of developing musculoskeletal disorders. **Practitioner's summary:** The purpose of the study was to quantify the joint angles of the upper body in experimental conditions that represent daily life. Postures were influenced by ambient illumination and display brightness. The most harmful postures were observed when the display brightness was minimum, and the ambient light was similar to a sunny day.

- **Keywords:** Smartphones, light effects, biomechanics, upper limb, musculoskeletal disorders, users' posture, environmental conditions

**Liangjie Guo & Shuping Xiong. *Effects of working posture, lifting load, and standing surface on postural instability during simulated lifting tasks in construction.* Pages: 1571-1583.**

Postural instability is a major contributor to fatal and nonfatal falls in the construction industry. This study investigated the effects of working posture, lifting load and standing surface on perceived postural instability. Thirty young males performed simulated lifting tasks in construction using six different postures under four experimental conditions (2 loads × 2 surfaces). Results showed working postures with bending at the waist and overhead carrying were associated with high postural instability. With lifting load and inclined standing surface both significantly increased postural instability for all working postures except the full squatting. Full squatting with lifting load was more stable than without load for the flat surface, but opposite for the inclined surface. These findings indicate three investigated factors had not only significant main effects, but also complicated interaction effects on postural instability, implying that all three factors should be considered simultaneously for the real practice on fall prevention in construction. **Practitioner summary:** The leading causes of worker deaths in the construction industry were falls. This study showed that working postures with waist bending and overhead carrying were associated with high postural instability. With lifting load and inclined standing surface both significantly increased postural instability for all working postures except the full squatting.

- **Keywords:** Postural instability, balance and falls, construction safety

**K. L. Hinde, C. Low, R. Lloyd & C. B. Cooke. *Inspiratory muscle training at sea level improves the strength of inspiratory muscles during load carriage in cold-hypoxia.* Pages: 1584-1598.**

Inspiratory muscle training (IMT) and functional IMT (IMTF: exercise-specific IMT activities) has been unsuccessful in reducing respiratory muscle fatigue following load carriage. IMTF did not include load carriage specific exercises. Fifteen participants split into two groups (training and control) walked 6 km loaded (18.2 kg) at speeds representing ~50%VO<sub>2</sub>max in cold-hypoxia. The walk was completed at baseline; post 4 weeks IMT and 4 weeks IMTF (five exercises engaging core muscles, three involved load). The training group completed IMT and IMTF at a higher maximal inspiratory pressure (P<sub>imax</sub>) than controls. Improvements in P<sub>imax</sub> were greater in the training group post-IMT (20.4%, p = .025) and post-IMTF (29.1%, p = .050) compared to controls. Respiratory muscle fatigue was unchanged (p = .643). No other physiological or subjective measures were improved by IMT or IMTF. Both IMT and IMTF increased the strength of respiratory muscles pre-and-post a 6 km loaded walk in cold-hypoxia. **Practitioner summary:** To explore the interaction between inspiratory muscle training (IMT), load carriage and environment, this study investigated 4 weeks IMT and 4 weeks functional IMT on respiratory muscle strength and fatigue. Functional IMT improved

inspiratory muscle strength pre-and-post a loaded walk in cold-hypoxia but had no more effect than IMT alone.

- **Keywords:** Environmental physiology, respiratory muscle fatigue, functional training, inspiratory muscle training