

## **Ergonomics– rok 2022, ročník 65**

### **Číslo 7**



**Christoph Bernhard, Aljoscha Klem, Elias C. Altuntas & Heiko Hecht. *Wider is better but sharper is not: optimizing the image of camera-monitor systems*. Pages: 899-914.**

The replacement of rear-view mirrors with camera-monitor systems introduces new opportunities for design, such as altering the image quality and the rearward field-of-view. We investigated how the image quality and field-of-view might affect the distance and time-to-contact estimation of other vehicles. Eighty-six subjects estimated either their egocentric distance to a stationary vehicle (Experiment I) or the time-to-contact to an approaching vehicle (Experiment II). Throughout the experiments, the pixel density and either the field-of-view or the viewing condition varied. A larger field-of-view increased distance estimation accuracy and confidence. Reduced pixel density led to larger estimates. In contrast, reduced pixel density and simulated dirt shortened time-to-contact estimates. This is compatible with a safety strategy applied under conditions of impaired vision. Moreover, a limited benefit was observed for higher pixel densities. Therefore, camera-monitor systems with large field-of-view and a pixel density of around 300 ppi could ensure accurate TTC and distance estimation. **Practitioner summary:** A camera's field-of-view and image quality are important parameters for camera-monitor systems. In two experiments, we investigated the effects of these two parameters on rearward distance and time-to-contact estimation. Whereas a larger field-of-view improved distance estimation accuracy, increasing the pixel density had a limited effect in the estimation of time-to-contact.

- **Keywords:** Camera-monitor systems camera resolution field-of-view design recommendation time-to-contact estimation

**Costas I. Karageorghis, Garry Kuan, Elias Mouchlianitis, William Payre, Luke W. Howard, Nick Reed & Andrew M. Parkes. [Interactive effects of task load and music tempo on psychological, psychophysiological, and behavioural outcomes during simulated driving](#). Pages: 915-932.**

We examined the interactive effects of task load and music tempo on cognition, affect, cardiac response, and safety-relevant behaviour during simulated driving. Using a counterbalanced, within-subjects design, participants (N = 46) were exposed to fast-,

slow-, and no-music conditions at high and low loads in a high-grade simulator. Task load had the most salient effect across a broad swath of variables. For core affect, the Load × Music Condition interaction showed that, under high load, affective arousal scores were higher in the fast-tempo condition vs. slow. A main effect of tempo emerged for the HRV index of SDNN, with fast-tempo music eliciting lower scores than both slow- and no-music conditions. Behavioural data showed a main effect of tempo for risk ratings, with fast-tempo music eliciting the highest scores for a traffic-light trigger. Our findings indicate that drivers in high-load, urban environments should exercise caution in their use of fast-tempo music. **Practitioner summary:** We examined the interactive effects of task load and music tempo in simulated driving (urban and highway). Cognition, mood, cardiac response, and driving behaviour were assessed. Participants exhibited more risky behaviours in response to fast-tempo music. Drivers should exercise caution in their use of up-tempo music in urban settings.

- **Keywords:** Affect, cognitive load, distraction, personality, road safety

**Preyen Archary & Andrew Thatcher. *Affective and cognitive restoration: comparing the restorative role of indoor plants and guided meditation.* Pages: 933-942**

This study investigated whether indoor plants were as effective as a guided meditation for enabling psychological recovery after fatigue induced by the abbreviated vigilance task. Sixty students were randomly assigned to an indoor plant, guided meditation, or control rest-break condition. The psychological processes most in need of recovery were identified as cognitive and affective restoration. Measures of affect, stress, and working memory were taken before and after the vigilance task, and again after a rest intervention. The vigilance task-induced fatigue as shown by a significant vigilance decrement and also significantly lowered positive affect and cognitive engagement, and significantly increased distress across all three conditions. After exposure to the break interventions, distress significantly decreased for participants in the indoor plant break condition while distress significantly decreased and engagement significantly increased in the guided meditation break condition. Indoor plants and guided meditation had a small, but significant positive impact on affective restoration and no significant impact on cognitive restoration. **Practitioner summary:** Indoor plants are a cost-effective green ergonomics intervention in offices. This study found that a rest break with indoor plants was as effective as a rest break with guided meditation for affective restoration after fatigue from a vigilance task.

- **Keywords:** Green ergonomics, rest breaks, fatigue, restoration

**Finian Ralph, David R. Large, Gary Burnett, Alexandra Lang & Andrew Morris. *U can't touch this! Face touching behaviour whilst driving: implications for health, hygiene and human factors.* Pages: 943-959.**

Analysis of thirty-one hours of video-data documenting 36 experienced drivers highlighted the prevalence of face-touching, with 819 contacts identified (mean frequency: 26.4 face touches/hour (FT/h); mean duration: 3.9-seconds). Fewer face-touches occurred in high primary workload conditions (where additional physical/cognitive demands were placed on drivers), compared to low workload (4.4 and 26.1 FT/h, respectively). In 42.5% of touches (or 11.2 FT/h), mucous membrane contact was made, with fingertips (33.1%) and thumbs (35.6%) most commonly employed. Individual behaviours differed (ranging from 5.1 to 90.7 FT/h), but there were no significant differences identified between genders, age-groups or hand used. Results are of relevance from an epidemiological/hygiene perspective within the context of the COVID-19 pandemic (and can therefore inform the design of practical solutions and encourage behavioural change to reduce the risk of self-inoculation while driving), but they also help to elucidate how habitual human behaviours are imbricated with the

routine accomplishment of tasks. **Practitioner summary:** The study highlights the propensity of face touching whilst driving through the analysis of on-road video datasets. Results have implications for the design of technological interventions (such as touchless interfaces and driver monitoring systems) and can inform awareness campaigns to reduce the risk of self-inoculation and infection transmission while driving.

- **Keywords:** Face-touching driving COVID-19 hand hygiene self-inoculation infection transmission

**Raymond Hernandez, Shawn C. Roll, Haomiao Jin, Stefan Schneider & Elizabeth A. Pyatak. *Validation of the National Aeronautics and Space Administration Task Load Index (NASA-TLX) adapted for the whole day repeated measures context.* Pages: 960-975.**

Our objective was to investigate the validity of four-item and six-item versions of the National Aeronautics and Space Administration Task Load Index (NASA-TLX, or TLX for short) for measuring workload over a *whole day* in the *repeated measures* context. We analysed data on 51 people with type 1 diabetes from whom we collected ecological momentary assessment and daily diary data over 14 days. The TLX was administered at the last survey of every day. Confirmatory factor analysis fit statistics indicated that neither the TLX-6 nor TLX-4 were a unidimensional representation of whole day workload. In exploratory analyses, another set of TLX items we refer to as TLX-4v2 was sufficiently unidimensional. Raw sum scores from the TLX-6 and TLX-4v2 had plausible relationships with other measures, as evidenced by intra-person correlations and mixed-effects models. TLX-6 appears to capture multiple factors contributing to workload, while TLX-4v2 assesses the single factor of 'mental strain'. **Practitioner Summary:** Using within-person longitudinal data, we found evidence supporting the validity of a measure evaluating whole-day workload (i.e. workload derived from all sources, not only paid employment) derived from the NASA-TLX. This measure may be useful to assess how day-to-day variations in workload impact quality of life among adults.

- **Keywords:** Task load, mental strain, workload, patient ergonomics, type 1 diabetes

**Mona Frey, Adam Blanchard, Ian Skinner & Diana De Carvalho. *Effect of a 'spine offloading' chair design on seated height and posture.* Pages: 976-986.**

A prototype chair with anterior chest and arm supports has been designed to reduce compressive spine loads. The purpose of this study was to compare the effects of this offloading design on seated height compared to a control configuration of the same chair. 20 males sat on each configuration for 1 hour. Seated height, perceived pain, spine angles, seat pressure, and participant experience were measured. Spine height loss was significantly reduced in the offloading ( $-0.75 \pm 3.79$  mm) compared to the control configuration ( $-6.16 \pm 4.27$  mm,  $p < 0.001$ ), and participants sat significantly more anterior on the seat pan in the offloading ( $20.56 \pm 1.67$  cm) compared to control configuration ( $18.03 \pm 1.92$  cm,  $p < 0.001$ ). There were no differences in spine angles or perceived back and gluteal pain between configurations. This design appears to be a promising approach to protecting the back during sitting when engaging in forward leaning tasks where the offloading effect of a backrest may be minimised. **Practitioner summary:** A prototype chair with anterior chest and arm supports designed to offload the spine was shown to significantly reduce seated height loss during 1-hour of sitting compared to a control configuration. While participants perceived the offloading design to be more supportive, no differences in perceived pain or posture were found.

- **Keywords:** Seated height, chair design, spinal offloading, prolonged sitting, posture

**Mohan Gawande, Peng Wang, Graham Arnold, Sadiq Nasir, Rami Abboud & Weijie Wang. [Effect of wheelchair configurations on shoulder movements, push rim kinetics and upper limb kinematics while negotiating a speed bump](#). Pages: 987-998.**

This study aimed to provide a comprehensive assessment of upper limb kinetics and kinematics and shoulder movements during wheelchair propulsion while negotiating a speed bump of 6 cm height using four different wheelchair configurations. 16 healthy males aged  $30.8 \pm 5.7$  years participated in the experiment. The kinetic and kinematic data during wheelchair propulsion were recorded. A smart system was used to collect the push forces and a motion capture system was used to collect upper limb movements. The results show that approximately 50% more pushing force was required to negotiate the speed bump than that of level ground propulsion. At the upward-forward axle position, peak total forces were  $95.17 \pm 5.70$  N which resulted in significantly improved propulsion ergonomics, but  $129.36 \pm 6.68$  N was required at the upward-back axle position at the speed bump push. The findings could help manufactures to design protective gloves for wheelchair users and provide useful rehabilitation information to clinicians and patients. **Practitioner summary:** This study investigated pushing forces and movements during wheelchair propulsion over a speed bump. Approximately 50% more pushing force was required to negotiate the bump than a level surface propulsion. The upper-forward axle position was found to be reasonably better than other positions during wheelchair propulsion.

- **Keywords:** Wheelchair, speed bump, push force, chair position, upper limb

**Karol Stasiak, Małgorzata Zyskowska, Ilona Głowinkowska, Krzysztof Kowalczyk & Rafał Lewkowicz. *Influence of night vision goggles with white and green phosphor screens on selected parameters of the eye and fatigue*. Pages: 999-1014.**

In modern aviation, in particular in the military context, increasingly many aviation tasks are performed at night. To improve the safety of night flights, night vision goggles (NVGs) are commonly used. This study aimed to examine whether changes in ophthalmic parameters during NVGs use vary depending on phosphor screen type (green or white coded as P43 and P45 respectively). Thirteen participants were studied during a 2-h visual task in a night vision laboratory. Before and after NVGs use, we examined visual acuity, pachymetry, critical flicker-frequency thresholds, stereoscopic and contrast vision. During the use of NVGs, visual acuity, intra-ocular pressure and eye refraction were measured. We found no difference in visual performance between NVGs with green and white phosphor screens; however, NVGs use in general may lead to subjective eye fatigue, neck pain and headaches associated with the time of wearing and the weight of the helmet with additional equipment attached. **Practitioner summary** Night vision goggles (NVGs), widely used to improve the safety of night flights, were examined according to the applied type of the phosphor screen. There was no difference in visual performance between a white and green phosphor screens; however, NVGs and helmet manufacturers should strive to design these devices to be as lightweight as possible.

- **Keywords:** Military ergonomics, wearable device, NVG, vision and lighting, sensory impairment, physical fatigue

**Ming-I Brandon Lin, Yi-Ting Yen & Chun Han Chang. *Use of an inflatable mat to reduce body discomfort development when performing computer work at a standing desk*. Pages: 1015-1034.**

This study aimed to determine the effects of inflatable mat design on body discomfort, task performance, and musculoskeletal exposures during standing computer work. Twenty-seven healthy adults completed three 2-hour standing trials on different mediums (concrete floor, foam mat, and inflatable mat) on different days in an experimental laboratory. Both mats were associated with reduced discomfort in all lower-body regions and increased typing performance compared to the concrete floor. Perceived discomfort in lower extremities (except thighs) was further alleviated while standing on the inflatable mat than on the foam mat. Use of the inflatable mat led to increased lower-body muscle activity, a flexed lower back, and a wide range of sagittal knee movements. As standing time increased, body discomfort increased, typing accuracy decreased, and there were increased variations in muscle activity and postural movements in the lower body. The inflatable mat shows potential to improve the ergonomic experience during prolonged standing. **Practitioner summary:** Incorporating standing postures in office-based workplaces can reduce sitting time and may mitigate the health hazards associated with sedentary behaviour. With adequate weight-shifting movements, using an inflatable mat for standing could be an effective way to lessen discomfort and accumulated musculoskeletal strain due to constrained standing, without jeopardising task productivity.

- **Keywords:** Standing, electromyography, joint angle, typing performance