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Maja Köpper, Susanne Mayr & Axel Buchner. *Reading from computer screen versus reading from paper: does it still make a difference?* Pages 615-632.

Four experiments were conducted to test whether recent developments in display technology would suffice to eliminate the well-known disadvantages in reading from screen as compared with paper. Proofreading speed and performance were equal for a TFT-LCD and a paper display, but there were more symptoms of eyestrain in the screen condition accompanied by a strong preference for paper (Experiment 1). These results were replicated using a longer reading duration (Experiment 2). Additional experiments were conducted to test hypotheses about the reasons for the higher amount of eyestrain associated with reading from screen. Reduced screen luminance did not change the pattern of results (Experiment 3), but positioning both displays in equal inclination angles eliminated the differences in eyestrain symptoms and increased proofreading speed in the screen condition (Experiment 4). A paper-like positioning of TFT-LCDs seems to enable unimpaired reading without evidence of increased physical strain. **Practitioner Summary:** Given the developments in screen technology, a re-assessment of the differences in proofreading speed and performance, well-being, and preference between computer screen and paper was conducted. State-of-the-art TFT-LCDs enable unimpaired reading, but a book-like positioning of screens seems necessary to minimise eyestrain symptoms.

- **Keywords:** TFT-LCD, iPad, proofreading, eyestrain, display inclination

Robert F. Lorch Jr., Hung-Tao Chen, Aqeel A. Jawahir & Julie Lemarié. *Communicating printed headings to the ear.* Pages 633-640.

Two experiments compared three methods of translating printed headings into an auditory format. In both experiments, college students listened to a text with instructions to stop the recording whenever they heard a heading and type the hierarchical level and exact wording of the heading. Listeners were poor at identifying headings and their levels if the headings were not distinguished from the rest of the text. However, listeners were very good at identifying headings if any method of signalling was used to distinguish headings and communicate their hierarchical level. The methods included: (1) tones

preceding headings, (2) changes of speaker to indicate headings or (3) verbal labels preceding headings. Although all three signalling methods improved identification of a heading's hierarchical level, the labelling method was the most effective means of communicating hierarchical level. Thus, the study identifies a simple method of effectively communicating headings in spoken text. **Practitioner Summary:** The study attempted to identify effective ways of communicating heading information in spoken text. College students listened to texts in order to detect headings and record their wording and hierarchical level. Performance was excellent when headings were preceded by verbal phrases that signalled the upcoming headings and their levels.

- **Keywords:** Text-to-speech software, text signalling devices, software design and valuation, human-computer interaction

Annette Kluge, Barbara Frank, Sanaz Maafi & Aleksandra Kuzmanovska. *Does skill retention benefit from retentivity and symbolic rehearsal? – two studies with a simulated process control task.* Pages 641-656.

Two experiments were designed to compare two symbolic rehearsal refresher interventions (imaginary practice, a hidden introspective process) and investigate the role of retentivity in skill retention. Retentivity is investigated as the ability to memorise and reproduce information and associations that were learned a short time ago. Both experiments comprised initial training (week 1), a symbolic rehearsal for the experimental group (week 2) and a retention assessment (week 3). In the first study, the experimental group received a symbolic rehearsal, while the control group received no rehearsal. In the second study, the experimental group received the same symbolic rehearsal used in study 1, enhanced with rehearsal tasks addressing human-computer interaction. The results showed that both symbolic rehearsal interventions were equally likely to mitigate skill decay. The retentivity showed medium to high correlations with skill retention in both studies, and the results suggest that subjects high in retentivity benefit more from a symbolic rehearsal refresher intervention. **Practitioner Summary:** Skill decay becomes a problem in situations in which jobs require the correct mastery of non-routine situations. Two experimental studies with simulated process control tasks showed that symbolic rehearsal and retentivity can significantly mitigate skill decay and that subjects higher in retentivity benefit more from refresher interventions.

- **Keywords:** Skill decay, process control, memory, individual differences, start-up mistakes

Nita Lewis Shattuck & Panagiotis Matsangas. *Operational assessment of the 5-h on/10-h off watchstanding schedule on a US Navy ship: sleep patterns, mood and psychomotor vigilance performance of crewmembers in the nuclear reactor department.* Pages 657-664.

We assessed sleep patterns, psychomotor vigilance performance, work demands and mood of 77 crewmembers of USS NIMITZ (CVN-68) on the rotating 5-h on/10-h off (5/10) watchstanding schedule. Within the 3-day cycle of the 5/10, sleep occurred at distinctly different times each day. On two of these days, sailors typically received only brief, 4-h sleep episodes followed by periods of sustained wakefulness (approximately 22 and 20 h). Crewmembers received approximately seven hours of sleep daily, but reported excessive fatigue and dissatisfaction with their schedule. Crewmembers' mood worsened significantly over the course of the underway phase. Psychomotor vigilance performance (reaction times, lapses) was significantly degraded compared to performance when working circadian-aligned schedules. Overall, standing watch on the 5/10 schedule, combined with other work duties, resulted in poor sleep hygiene. Crewmembers on the 5/10 experienced periodic bouts of sustained wakefulness and accrued a significant sleep debt due to extended workdays and circadian-misaligned

sleep. **Practitioner summary:** We assessed crewmembers' sleep patterns, psychomotor vigilance performance and work demands when working a rotating 5-h on/10-h off (5/10) watchstanding schedule. The 5/10, combined with other work duties, resulted in poor sleep hygiene. Crewmembers experienced periodic bouts of sustained wakefulness and accrued a significant sleep debt due to extended workdays and circadian-misaligned sleep.

- **Keywords:** Shiftwork, sleep deprivation, fatigue, shiftworking, watchstanding schedules, work scheduling, circadian misalignment

Andrea Biscarini, Paolo Benvenuti, Daniele Busti & Silvano Zanuso. A Scott bench with ergonomic thorax stabilisation pad improves body posture during preacher arm curl exercise. Pages 665-670.

We assessed whether the use of an ergonomic thorax stabilisation pad, during the preacher arm curl exercise, could significantly reduce the excessive shoulder protraction and thoracic kyphosis induced by the standard flat pad built into the existing preacher arm curl equipment. A 3D motion capture system and inclinometers were used to measure shoulder protraction and thoracic kyphosis in 15 subjects performing preacher arm curl with a plate-loaded machine provided with the standard flat pad. The same measures were repeated after replacing the flat pad with a new ergonomic pad, specifically designed to accommodate the thorax profile and improve body posture. Pad replacement significantly ($p < 0.001$) reduced shoulder protraction (from 12.0 ± 2.4 cm to 7.9 ± 2.6 cm) and thoracic kyphosis (from $35.5 \pm 8.2^\circ$ to $29.6 \pm 8.5^\circ$), enabling postural and functional improvements within the entire spine, shoulder girdle and rib cage. The ergonomic pad may potentially allow a more effective training, prevent musculoskeletal discomfort and reduce the risk of injury. **Practitioner summary:** We have designed an ergonomic thorax stabilisation pad for the preacher arm curl exercise. The new ergonomic pad improves the poor posture conditions induced by the standard flat pad and may potentially allow a more effective training, prevent musculoskeletal discomfort, improve the breathing function and reduce the risk of injury.

- **Keywords:** Kyphosis, shoulder protraction, exercise, equipment, motion analysis

Michiel P. de Looze, Tim Bosch, Frank Krause, Konrad S. Stadler & Leonard W. O'Sullivan. Exoskeletons for industrial application and their potential effects on physical work load. Pages 671-681.

The aim of this review was to provide an overview of assistive exoskeletons that have specifically been developed for industrial purposes and to assess the potential effect of these exoskeletons on reduction of physical loading on the body. The search resulted in 40 papers describing 26 different industrial exoskeletons, of which 19 were active (actuated) and 7 were passive (non-actuated). For 13 exoskeletons, the effect on physical loading has been evaluated, mainly in terms of muscle activity. All passive exoskeletons retrieved were aimed to support the low back. Ten-forty per cent reductions in back muscle activity during dynamic lifting and static holding have been reported. Both lower body, trunk and upper body regions could benefit from active exoskeletons. Muscle activity reductions up to 80% have been reported as an effect of active exoskeletons. Exoskeletons have the potential to considerably reduce the underlying factors associated with work-related musculoskeletal injury. **Practitioner Summary:** Worldwide, a significant interest in industrial exoskeletons does exist, but a lack of specific safety

standards and several technical issues hinder mainstay practical use of exoskeletons in industry. Specific issues include discomfort (for passive and active exoskeletons), weight of device, alignment with human anatomy and kinematics, and detection of human intention to enable smooth movement (for active exoskeletons).

- **Keywords:** Exoskeleton, industry, physical workload, discomfort

Megan P. Phillips, Robert Shapiro & Babak Bazrgari. *The effects of military body armour on the lower back and knee mechanics during box drop and prone to standing tasks.* Pages 682-691.

Modern day body armour (BA) has been successful at increasing survivability from previously lethal explosives; however, it has been suggested to reduce warfighter's performance and increase risk of injury. Joint biomechanics have a foremost impact on performance and risk of injury. The immediate and prolonged effects of wearing BA on biomechanics of the lower back and knee during box drop (BD) and prone to standing tasks were investigated. The immediate effects of BA on both tasks were an increase of $\geq 4\%$ ($p \leq 0.02$) in temporal task durations and a decrease of ~ 1.66 N/kg ($p = 0.03$) in normalised peak ground reaction force for the BD test. The prolonged duration of walking with BA (i.e. 45 min) was not found to cause more changes in our measures than walking without BA. Quantitative data related to the effects of BA are important for risk assessment and mission design such to reduce the risk of injury without compromising performance. **Practitioner Summary:** The effects of wearing military body armour (BA) on biomechanics of the lower back and knee were investigated. Though wearing BA was found to affect some biomechanical measures related to performance, the prolonged effects of exposure on our measures were the same whether or not the participants wore BA.

- **Keywords:** Military body armour, prolonged walking, performance, risk of injury

Nicola C. Armstrong & Louise A. Gay. *The effect of flexible body armour on pulmonary function.* Pages 692-696.

The additional mass and fit of current military in-service body armour (ISBA) can reduce pulmonary function in a way that is characteristic of a restrictive respiratory impairment. This could ultimately impair exercise capacity and military performance. This study compared pulmonary function (forced vital capacity [FVC] and forced expiratory volume in 1 s [FEV₁]) in UK ISBA (15.3 kg) and three flexible body armours (BAs) (FA1: 10 kg; FA2: 7.8 kg; FA3: 10 kg) in eight male soldiers. The design of the ballistic plates differed between the BAs to improve the flexibility. FVC and FEV₁ were reduced by 4–6%, without reduction in FEV₁/FVC for ISBA, FA2 and FA3, when compared to NoBA ($p < 0.05$). No difference was observed between FA1 and NoBA. As expected, wearing BA caused a mild restrictive ventilatory impairment; however, modifications to BA design can reduce the degree of this impairment. **Practitioner Summary:** This study showed that wearing body armour caused a mild restrictive ventilatory impairment. However, the design of the armour can be modified to reduce the degree of this impairment. This may lead to improvements in soldier performance during tasks that require body armour.

- **Keywords:** Protective armour, respiratory function, lung function, load carriage, chest wall restriction

Massimiliano Pau, Bruno Leban, Federica Corona, Sara Gioi & Maury A. Nussbaum. *School-based screening of plantar pressures during level walking with a backpack among overweight and obese schoolchildren.* Pages 697-703.

Among children, postural modifications due to backpack carriage have direct consequences on how forces are exchanged between body and ground and thus on plantar pressure distribution. However, it is unknown whether such alterations are influenced by the foot structure and functionality typical of obesity. In this study, we tested 65 overweight/obese primary schoolchildren using a pressure platform while walking with and without the backpack. Contact areas, arch index, peak and mean plantar pressures in the forefoot, midfoot and rearfoot were compared with those from an additional 65 age- and gender-matched group of normal-weight children. Backpack carriage modified pressure distribution similarly in both groups, with the exception of mean midfoot pressure, which increased significantly among normal-weight children but not in the overweight/obese group. Notably, the pressure values associated with mass excess and backpack carriage still raise some concerns regarding potential long-term adverse consequences on foot structure and functionality of overweight/obese children.

Practitioner summary: Backpack carriage by overweight/obese schoolchildren altered plantar pressures similar to what was observed in their normal-weight peers. Yet, high pressures were found among the overweight/obese children. This raises concerns regarding potential long-term adverse consequences on foot structure and functionality, and supports establishing more specific limits for the carried load.

- **Keywords:** Obesity, foot, backpack, pedobarography, gait

Mary F. Lesch, Chien-Chi Chang & Wen-Ruey Chang. *Prospective gait changes as a function of shifting perceptions of slipperiness: effects of visual and somatosensory cues.* Pages 704-716.

Forty participants, ages 18–45 years, rated perceived slipperiness before and after walking on five different floors under three different surface conditions. The before-ratings were taken as a proxy for visual cues to slipperiness, while after-ratings were taken as a proxy for somatosensory feedback received while walking on the surface. Before and after ratings of slipperiness were used to predict gait parameters, as a function of trial, during repeated walking. Effects of after-ratings of slipperiness were observed beginning on the second trial, and continued through the fifth trial, while effects of before-ratings of slipperiness were most apparent on the first trial. When perceived slipperiness increased (or decreased) from before to after walking on the surface, gait became more (or less) protective across trials. It is concluded that both visual cues, as well as somatosensory feedback, are used in the prospective control of gait. **Practitioner Summary:** Effects of visual and somatosensory cues to slipperiness on gait were disentangled using floor surfaces varying in the slipperiness suggested by those cues. Visually based ratings of slipperiness predicted gait parameters on earlier trials, while somatosensory-based ratings predicted gait parameters on subsequent trials. Flooring design should provide reliable information regarding slipperiness.

- **Keywords:** Gait, somatosensation, vision, prospective control

Jennifer Hsu, Robert Shaw, Alison Novak, Yue Li, Marcus Ormerod, Rita Newton, Tilak Dutta & Geoff Fernie. *Slip resistance of winter footwear on snow and ice measured using maximum achievable incline.* Pages 717-728.

Protective footwear is necessary for preventing injurious slips and falls in winter conditions. Valid methods for assessing footwear slip resistance on winter surfaces are needed in order to evaluate footwear and outsole designs. The purpose of this study was to utilise a method of testing winter footwear that was ecologically valid in terms of involving actual human testers walking on realistic winter surfaces to produce objective measures of slip resistance. During the experiment, eight participants tested six styles of footwear on wet ice, on dry ice, and on dry ice after walking over soft snow. Slip

resistance was measured by determining the maximum incline angles participants were able to walk up and down in each footwear–surface combination. The results indicated that testing on a variety of surfaces is necessary for establishing winter footwear performance and that standard mechanical bench tests for footwear slip resistance do not adequately reflect actual performance. **Practitioner Summary:** Existing standardised methods for measuring footwear slip resistance lack validation on winter surfaces. By determining the maximum inclines participants could walk up and down slopes of wet ice, dry ice, and ice with snow, in a range of footwear, an ecologically valid test for measuring winter footwear performance was established.

- **Keywords:** Slips and falls, gait kinematics, product safety, user testing, winter footwear

Yoshihiro Shimomura, Keita Minowa, Hiroshi Kawahira & Tetsuo Katsuura. *Ergonomic design and evaluation of the handle for an endoscopic dissector. Pages 729-734.*

The purpose of this study was to design an endoscopic dissector handle and objectively assess its usability. The handles were designed with increased contact area between the fingers and thumb and the eye rings, and the eye rings were modified to have a more perpendicular insertion angle to the finger midline. Four different handle models were compared, including a conventional product. Subjects performed dissection, exclusion, grasping, precision manipulation and precision handling tasks. Electromyography and subjective evaluations were measured. Compared to conventional handles, the designated handle reduced the muscle load in the extensor and flexor muscles of the forearm and increased subjective stability. The activity of the first dorsal interosseous muscle was sometimes influenced by the shape of the other parts. The ergonomically designed endoscopic dissector handle used in this study achieved high usability. Medical instrument designs based on ergonomic concepts should be assessed with objective indices. **Practitioner Summary:** The endoscopic dissector handles were designed with increased contact area and more suitable insertion angle between the fingers and thumb and the eye rings. Compared to conventional handles, the designated handle reduced the muscle load in the extensor and flexor muscles of the forearm and increased subjective stability.

- **Keywords:** Endoscopic dissector, surgical tool, usability, product design, electromyography