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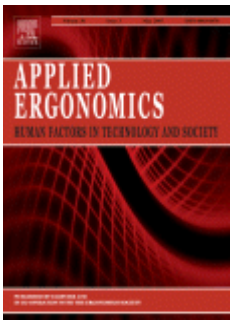

Thorsten Baldus, Patrick Patterson. *Usability of pointing devices for office applications in a moving off-road environment*. Pages 671-677.

Three pointing devices (mouse, touch pad, touch screen) were evaluated for usability with a Windows™-style menu selection task while in a moving off-road environment. A pilot study determined which commercially available devices had the potential to promote good performance in the environment. Eighteen subjects performed a series of complex pointing tasks that simulated the use of a standard application in a moving tractor. The devices were also rated for subjective usability. The mouse and the touch screen produced the best performances, with the mouse receiving the best subjective usability ratings. The participants had a significantly lower performance with the touch pad, which also received lower ratings in the subjective usability ratings.

- **Keywords:** Pointing devices; Off road; Office applications

Raymond W. McGorry, Chien-Chi Chang, Angela DiDomenico. *Rearward movement of the heel at heel strike*. Pages 678-684.

This paper describes the observation of rearward movement (RM) of the heel following heel strike occurring during normal gait. Thirty-one participants recruited as part of a larger study on slip kinematics walked the length of an 8-m runway at a speed of 1.5 m/s. Several floor surfaces, presented dry and with contaminant, were used for the purpose of eliciting a wide range of small slip distances. The normal force applied to a forceplate mounted in the runway was used to identify heel strike, as well as to calculate the utilized coefficient of friction during early stance phase. A motion analysis system tracked the displacement of two heel-mounted markers, and the data were used to derive kinematic variables related to the heel strike event. Results showed that RMs occurred in 18.1% of 494 trials, with a mean rearward displacement of 5.02 (±3.68) mm. When present, RMs occurred in close temporal proximity to heel strike, typically completing RM within 40 ms of the heel strike event. When divided into groups by age, older participants (>40 years) were more than twice as likely to have RMs as younger participants. When grouped by height or weight, differences in the proportion of trials with RMs were small. In trials where RMs were observed, forward slip distances were significantly less than for trials with no RMs, 2.17 (±3.87) mm vs. 12.58 (±10.71) mm, respectively. The time until the heel stopped moving during the post-heel strike period was not significantly different between RM and non-RM trials. Further investigation of this gait feature may improve understanding of normal gait patterns and may have implications for future slipmeter development.

- **Keywords:** Backswing; Gait; Kinematics; Micro-slip; Slip distance; Aging

Stefan IJmker, Janneke Mikkers, Birgitte M. Blatter, Allard J. van der Beek, Willem van Mechelen, Paulien M. Bongers. *Test–retest reliability and concurrent validity of a web-based questionnaire measuring workstation and individual correlates of work postures during computer work*. Pages 685-696.

Introduction: "Ergonomic" questionnaires are widely used in epidemiological field studies to study the association between workstation characteristics, work posture and musculoskeletal disorders among office workers. Findings have been inconsistent regarding the putative adverse effect of work postures. Underestimation of the true association might be present in studies due to misclassification of subjects to risk (i.e. exposed to non-neutral working postures) and no-risk categories (i.e. *not* exposed to non-neutral working postures) based on questionnaire responses. The objective of this study was to estimate the amount of misclassification resulting from the use of questionnaires. **Methods:** Test–retest reliability and concurrent validity of a newly developed questionnaire was assessed. This questionnaire collects data on workstation characteristics and on individual characteristics during computer work (i.e. work postures, movements and habits). Pictures were added where possible to provide visual guidance. The study population consisted of 84 office workers of a research department. They filled out the questionnaire on the Internet twice, with an in-between period of 2 weeks. For a subgroup of workers (n=38), additional on-site observations and multiple manual goniometer measurements were performed. **Results:** Percentage agreement ranged between 71% and 100% for the test–retest analysis, between 31% and 100% for the comparison between questionnaire and on-site observation, and between 26% and 71% for the comparison between questionnaire and manual goniometer measurements. For 9 out of 12 tested items, the percentage agreement between questionnaire and manual goniometer measurements was below 50%. **Conclusions:** The questionnaire collects reliable data on workstation characteristics and some individual characteristics during computer work (i.e. work movements and habits), but does not seem to be useful to collect data on work postures during computer work in epidemiological field studies among office workers.

- **Keywords:** Work postures; Reliability; Validity

Midori Mori, Sadao Horino, Sou Kitajima, Masaru Ueyama, Takeshi Ebara, Toru Itani. *Ergonomics solution for crossing collisions based on field assessment of visual environment at urban intersections in Japan*. Pages 697-709.

This paper aims to assess quantitatively the actual visual environment of uncontrolled urban downtown intersections in Japan in relation to frequently occurring crossing collisions and to discuss the safety countermeasures for them. In Field Study 1 dealing with direct visibility, our ultra-wide-angle photograph analysis revealed that most of the right/left-ward visible range at 11 intersections were insufficient to check safety, and the quality of direct visibility was closely associated with causing crossing collisions. The countermeasures to reduce a blind area were determined to be a top priority. In Field Study 2 dealing with indirect visibility, more than half of the 25 traffic convex mirrors had marked shortcomings for preventive safety, and ergonomics guidelines ensuring indirect visibility were proposed for installing traffic convex mirrors. Low-cost/low-technology-oriented countermeasures are highly recommended to obtain clear/sufficient images of crucial information satisfying drivers' requirements on traffic convex mirrors in accordance with those ergonomics guidelines was highly recommended. Crossing collisions could be prevented by improvement of poor direct and indirect visibility.

- **Keywords:** Crossing collision; Visual environment; Traffic convex mirror

Jerker Sundström, Shafiquzzaman Khan. *Influence of stationary lateral vibrations on train passengers' difficulty to read and write*. Pages 710-718.

Recent studies on train passengers' activities found that many passengers were engaged in some form of work, e.g. reading and writing, while traveling by train. A majority of the passengers reported that they were disturbed by vibrations or motions during their journey. A laboratory study was therefore set up to study how stationary low-frequency lateral vibrations influence the difficulty to read and write. The study involved 48 subjects (24f+24m) divided into three age groups. Two levels of sinusoidal vibrations were applied at nine discrete frequencies (0.8–8.0 Hz). Subjects performed both reading and writing tasks under two sitting positions (leaning against the backrest and leaning over a table). The judgments of perceived difficulty to read and write were rated using Borg's CR-100 scale. The results showed significant differences between the tasks and postural conditions. The subjects reported greater difficulty while reading and writing on the table than while leaning back. The frequencies up to 5 Hz had a particular influence on the perceived difficulty.

- **Keywords:** Lateral vibration; Reading; Writing; Difficulty

Georg Hoffmann, Veronika Gufler, Andrea Griesmacher, Christian Bartenbach, Markus Canazei, Siegmund Staggl, Wolfgang Schobersberger. *Effects of variable lighting intensities and colour temperatures on sulphatoxymelatonin and subjective mood in an experimental office workplace*. Pages 719-728.

Workplace illumination is of paramount importance in determining the employee's productivity and well-being. Moreover, light exerts non-visual effects with respect to biological rhythms. In this study, we investigated the impact of different lighting conditions (500–1800 lx, 6500 K; 500 lx, 4000 K) on sulphatoxymelatonin (aMT6-s) and subjective mood in an experimental office accommodation. Urinary aMT6-s concentrations were significantly decreased at all days of the experiment in both lights. On day 3, differences between aMT6-s concentrations in specimen collected at 05:00 p.m. and at 09:00 a.m. were significantly higher under variable lighting conditions. Analyses of a mood rating inventory revealed a benefit of variable light with respect to the dimensions of "Activity", while "Deactivation" and "Fatigue" were increased in regular light on day 1. "Activity", "Concentration", and "Deactivation" changed in opposite directions when comparing variable with regular illumination on two consecutive days. In conclusion, variable light exerts a potential advantage in indoor office accommodations with respect to subjective mood, although no unequivocal differences in the profile of aMT6-s were found as compared to regular light.

- **Keywords:** Lighting; Neopterin; Office workplace; Subjective mood; Sulphatoxymelatonin

Suzy Ngomo, Karen Messing, Hélène Perrault, Alain Comtois. *Orthostatic symptoms, blood pressure and working postures of factory and service workers over an observed workday*. Pages 729-736.

North American workers usually stand while working, and prolonged standing is associated with discomfort and cardiovascular problems. Moving may alleviate the problems, but optimum mobility is unknown. The effects of variations in mobility were explored among (1) 34 health care workers whose symptoms of orthostatic intolerance (OI) were recorded after work; (2) 45 factory and laundry workers. Postures were

observed over a workday and blood pressure (BP) and heart rate (HR) of both groups were recorded before and after work. Among health care workers, 65% manifested OI symptoms. In a multiple logistic regression, presence of ⩾1 symptom of OI was associated with static postures and being female (p=0.001). More static standing was associated with a larger drop in BP (p=0.04) in both populations. The results suggest that more static standing postures are associated with OI and musculoskeletal symptoms and with a subclinical drop in BP.

- **Keywords:** Standing; Orthostatic intolerance; Blood pressure

Yu-Chi Lee, Yi-Lang Chen. *An auxiliary device for chopsticks operation to improve the food-serving performance*.Pages 737-742.

Chopsticks are popular dining utensils in many Asian countries. It is well recognized that the pincers-pinching mode has been recommended for chopsticks operation for Chinese dining. The objective of this study was to propose an auxiliary device for transferring the subjects who had experienced scissors pinching to that of pincers pinching. A total of 30 male university students who used scissors pinching daily were recruited for the experiment. Subjects were requested to perform four simulated food-serving tasks under four different pinching stages. An additional testing was also performed for validation purpose. Results showed that the subjects had a better performance of food serving by the pincers-pinching method than by the scissors-pinching method, after familiarizing themselves with pincers pinching with the assistance of an auxiliary for 1 h. Because of the relatively shorter transferring time (1 h), the subjects still evaluated scissors pinching as their preferable ones. We suggested that this new auxiliary device could be used to teach or correct the chopsticks operation of people who are naïve/children and are interested in chopsticks use or experienced in chopsticks scissors pinching.

- **Keywords:** Pincers pinching; Scissors pinching; Auxiliary device

Gerlienke E. Voerman, Miriam M.R. Vollenbroek-Hutten, Leif Sandsjö, Roland Kadefors, Hermie J. Hermens. *Prognostic factors for the effects of two interventions for work-related neck–shoulder complaints : myofeedback training and ergonomic counselling*. Pages 743-753.

Aim: To explore prognostic factors for the effects of two interventions (myofeedback training in combination with ergonomic counselling (Mfb/EC) and ergonomic counselling alone (EC)) on discomfort and disability in work-related neck–shoulder complaints. **Methods:** Thirty-six females completed the interventions. Discomfort and disability were assessed at baseline, immediately after the intervention, and at 3-month follow-up. Potential sociodemographic and psychological prognostic factors were assessed using questionnaires. Data were analysed using multiple regression and general linear modelling. **Results:** Changes in discomfort were best predicted by baseline discomfort levels. Changes in disability were predicted by baseline disability levels, patient profile, and coping strategy 'ignoring sensations'. A significant difference between the Mfb/EC and EC group was found for coping strategy 'ignoring sensations', which appeared to be a predictor for changes in disability at 3-month follow-up in the Mfb/EC group only. **Conclusions:** Subjects with high levels of initial discomfort and disability and specific psychological patient profiles benefit most from interventions. Myofeedback training contributes a specific quality to those who ignore pain sensations.

- **Keywords:** Work-related; Myofeedback; Prognostic factors

Rina Maiti. *Workload assessment in building construction related activities in India*. Pages 754-765.

A field study was conducted to highlight the occupational risk factors related to building construction activities in India among female workers. These workers were engaged in eight different types of activities and related work parameters were studied in detail. From field environmental parameters, the calculated WBGT was obtained as 30.26±1.52 °C, indicated that these workers worked under a positive heat load condition. Whole day work study was conducted on 11 adult female workers performing concreting operation. They were having age of 28–32 years with 5–7 years of work experience. These workers were mainly performing two types of operations in the field: (A) asymmetric lifting during concreting a boundary wall formwork of a lift unit and (B) carrying the concrete mixture. During asymmetric lifting, the average field working heart rate (HR) was calculated as 124.1±12.5 beats min^{-1}, equivalent to 45.03±6.93% of VO_2 max level. These working heart rates (HRs) were significantly ($p \leqslant 0.005$) correlated with pause time (P.T.) and lifting frequency, but not with lifting time. A method was proposed to determine the average steady P.T. from fluctuating working HR and the lifting frequency was calculated as 6.1 lifts min^{-1}. This type of load handling task showed lower work efficiency and higher relative HR (%RHR). The required resting time was calculated as 61.47%, whereas the actual rest time (R.T.) in the field was 23.56±10.28%. Using Neibel and Frivalds equation, the rest allowance (RA) due to muscular fatigue and environmental load were calculated as 50.46% and 45.02 min/h, respectively. These results showed that the workers were not getting sufficient rest in the field. With work parameter modification, in optimum condition, the RWL value could be achieved as 7.19 kg, which was much lesser than the actual lifted load of 12.02 kg. Therefore, modification of workplace and work methods was suggested to compensate the health hazard conditions.

- **Keywords:** Work–rest schedule; Workload assessment; Relative heart rate; Indian building construction workers

Wen-Ruey Chang, Chien-Chi Chang, Simon Matz, Mary F. Lesch. *A methodology to quantify the stochastic distribution of friction coefficient required for level walking*. Pages 766-771.

The required friction coefficient is defined as the minimum friction needed at the shoe and floor interface to support human locomotion. The available friction is the maximum friction coefficient that can be supported without a slip at the shoe and floor interface. A statistical model was recently introduced to estimate the probability of slip and fall incidents by comparing the available friction with the required friction, assuming that both the available and required friction coefficients have stochastic distributions. This paper presents a methodology to investigate the stochastic distributions of the required friction coefficient for level walking. In this experiment, a walkway with a layout of three force plates was specially designed in order to capture a large number of successful strikes without causing fatigue in participants. The required coefficient of friction data of one participant, who repeatedly walked on this walkway under four different walking conditions, is presented as an example of the readiness of the methodology examined in this paper. The results of the Kolmogorov–Smirnov goodness-of-fit test indicated that the required friction coefficient generated from each foot and walking condition by this participant appears to fit the normal, log-normal or Weibull distributions with few exceptions. Among these three distributions, the normal distribution appears to fit all the data generated with this participant. The average of successful strikes for each walk achieved with three force plates in this experiment was 2.49, ranging from 2.14 to 2.95 for each walking condition. The methodology and layout of the experimental apparatus presented in this paper are suitable for being applied to a full-scale study.

- **Keywords:** Friction requirement; Statistical distribution; Human locomotion

Janneke M. Richter, Harm P. Slijper, Eelco A.B. Over, Maarten A. Frens. *Computer work duration and its dependence on the used pause definition*. Pages 772-778.

Several ergonomic studies have estimated computer work duration using registration software. In these studies, an arbitrary pause definition (Pd; the minimal time between two computer events to constitute a pause) is chosen and the resulting duration of computer work is estimated. In order to uncover the relationship between the used pause definition and the computer work duration (PWT), we used registration software to record usage patterns of 571 computer users across almost 60,000 working days. For a large range of Pds (1–120 s), we found a shallow, log-linear relationship between PWT and Pds. For keyboard and mouse use, a second-order function fitted the data best. We found that these relationships were dependent on the amount of computer work and subject characteristics. Comparison of exposure duration from studies using different pause definitions should take this into account, since it could lead to misclassification. Software manufacturers and ergonomists assessing computer work duration could use the found relationships for software design and study comparison.

- **Keywords:** Computer use; Work duration; Software

Daniëlle Noorloos, Linda Tersteeg, Ivo J.H. Tiemessen, Carel T.J. Hulshof, Monique H.W. Frings-Dresen. *Does body mass index increase the risk of low back pain in a population exposed to whole body vibration?* Pages 779-785.

The aim of this study was to determine whether body mass index (BMI) influences the risk of low back pain (LBP) in a population exposed to whole body vibration (WBV). For this a self-administered questionnaire was sent to 467 participants, driving occupational vehicles. Vibration measurements were performed according to ISO 2631–1 on a representative sample (n=30) of this population. For each participant, we calculated the current root mean square (r.m.s.) over an 8 h (A(8)) working day. The questionnaire response rate was 47% (n=221). We did not find a significant correlation between BMI and the onset of LBP in the last 7 days (r=0.07, p=0.34) nor for LBP in past 12 months (r=−0.30, p=0.63). No significant increased risk was found for the onset of LBP with the increase of BMI, neither for the last 7 days (OR 1.02; 95% CI: 0.93–1.23) nor for the past 12 months LBP (OR 0.98; 95% CI: 0.89–1.09). Introducing the interaction with WBV exposure in the logistic regression model, did not result a significant increased risk in the onset of LBP—7 days (OR 0.97; 95% CI: 0.92–1.01) nor in the onset of LBP 12 months (OR 0.97; 95% CI: 0.93–1.01) either. Occupational participants exposed to WBV, with a high BMI do not have an increased risk for the development of LBP.

- **Keywords:** Low back pain; Whole body vibration; Body mass index

Lars E. Sörensen, Mika M. Pekkonen, Kaisa H. Männikkö, Veikko A. Louhevaara, Juhani Smolander, Markku J. Alén. *Associations between work ability, health-related quality of life, physical activity and fitness among middle-aged men*. Pages 786-791.

The Work ability of ageing work force is a matter of major concern in many countries. The aim of this study was to examine the relationship between perceived work ability and health-related quality of life (HRQoL), and to investigate their associations with age, physical activity and physical fitness in middle-aged men working in blue-collar occupations. The study population consisted of 196 middle-aged (aged 40–60 years) men (construction and industrial work) attending occupationally orientated early medical rehabilitation. They were mostly healthy having only symptoms of musculoskeletal or psychological strain. Perceived work ability was assessed with the work ability index

(WAI) and HRQoL with the Rand, 36-item health survey (Rand-36). Information on physical activity was obtained with a structured questionnaire. Cardiorespiratory fitness was estimated with a submaximal exercise test on a cycle-ergometer. The WAI was significantly (p<0.001) associated with the total score of Rand-36, and with all its domains. Age, physical activity and cardiorespiratory fitness were neither associated with the WAI, nor did physical activity predict any of the dimensions of Rand-36. Cardiorespiratory fitness was associated with the physical functioning dimension of the Rand-36 whilst age was positively associated with the dimensions of the energy, emotional well being and social functioning of the Rand-36. The present study on middle-aged men showed a close relationship between perceived work ability and the HRQoL. It is suggested that the promotion of work ability may have beneficial effects on quality of life.

- **Keywords:** Work ability; Quality of life; Ageing

Karen M. Conrad, Paul A. Reichelt, Steven A. Lavender, Jessica Gacki-Smith, Sally Hattle. *Designing ergonomic interventions for EMS workers : concept generation of patient-handling devices*. Pages 792-802.

Fire service personnel and private ambulance paramedics suffer musculoskeletal injuries as they lift and carry patients while performing emergency medical services (EMS). Engineering changes, such as the design of new EMS patient-handling devices, offer a potential intervention opportunity for combating this problem. The purpose of this qualitative descriptive study was to generate beginning ideas for the design of new EMS patient-handling devices that were framed within the contextual reality of the end user firefighter/paramedics. Guided by an ecological model of musculoskeletal injuries in the fire service, focus groups were conducted with 25 firefighter/paramedics from 13 suburban fire departments. Based on their availability, participants were assigned to one of three groups with each group focusing on a different EMS patient-handling scenario. Each group participated in two focus group sessions: one session to brainstorm ideas for devices and a second session to validate sketches of their design ideas. The sketches were professionally drawn by an industrial designer who attended all focus group sessions. Sketches, photos, videotapes, and written transcripts were content analyzed to describe the phenomena of interest. The ideas centered on EMS devices for lateral transfers, bed-to-stairchair transfers, and stair descent transport, and served as the starting point for the development of EMS devices in subsequent phases of a mixed method research study. The outcomes of this study were an improved understanding of the contextual issues that need to be considered in designing EMS patient handing devices and a set of industrial design sketches that served as a starting point for subsequent development of the devices. End user acceptance criteria for the devices included: affordability, portability/compactness, durability, operability including being quickly ready for use, and cleanability.

- **Keywords:** Emergency medical services (EMS); Firefighter; Paramedic; EMS patient-handling devices; Concept development; Low back disorder (LBD); Focus group

Katrin Skagert, Lotta Dellve, Mats Eklöf, Anders Pousette, Gunnar Ahlborg Jr. *Leaders' strategies for dealing with own and their subordinates' stress in public human service organisations*. Pages 803-811.

Despite the acknowledged key role of leaders for psychosocial work environment, few studies focus on *how* leaders can decrease work-related stress. To gain deeper knowledge of leaders' perceptions and strategies for dealing with their own and their subordinates' stress in public human service organisations (HSO), qualitative interviews were made with leaders from hospitals and regional social insurance offices (n=21), and

analysed in line with grounded theory method. The leaders handled subordinates' stress and perceived leadership demands by *acting as shock absorber* (core category) and used strategies characterised as *leading in continuous change whilst maintaining trustworthiness*. To cope with their own stress from perceived leadership demands, they tried to *sustain their own integrity* (core category) by either *identifying* with or *distancing* themselves from the leader role. The strategies for dealing with leaders' own and subordinates' exposures to stressors was pervaded by perceived leadership demands and are probably influencing each other. Supportive structures and improved communication about everyday dilemmas seem to be needed in order, not just to prevent stress reactions, but to improve the basic conditions for practicing leadership in HSO.

- **Keywords:** Coping behaviour; Social support; Role ambiguity

Kai Way Li, Chien-Chi Chang, Wen-Ruey Chang. *Slipping of the foot on the floor when pulling a pallet truck*. Pages 812-819.

Workers pulling pallet trucks are likely to slip when pulling and stepping on a low-friction floor. This study investigated the slipping of male participants when pulling a pallet truck, walking backward, and stepping on either a dry, wet, or glycerol-contaminated vinyl surface. The weight of the load on the truck was either low (0 kg), medium (295 kg), or high (568 kg). A motion-tracking system was used to collect the three-dimensional coordinates of the markers on the shoes. It was found that subjects might slip either upon landing of the leading foot on the toe (slip I) or before taking off of the lagging foot on the heel (slip II). The results indicated that the slip distances for both types of slip were significantly affected by the load and surface conditions and their interactions. Micro-slips (slips between 0.1 and 3 cm) and midi-slips (slips between 3 and 10 cm) were more common in slip I than in slip II. On glycerol-contaminated surfaces, the probabilities of a slide, or a slip more than 10 cm, for both slips I and II were over 40%. The implications of the results were discussed.

- **Keywords:** Slips and falls; Pulling; Pallet truck; Slippery and non-slippery floors