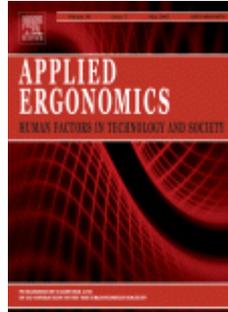


## **Applied Ergonomics - rok 2007, ročník 38**

### **Číslo 6 (November 2007)**



#### **Emily Yim Lee Au and Ravindra S. Goonetilleke. *A qualitative study on the comfort and fit of ladies' dress shoes.* Pages 687-696.**

The perceived differences between comfortable and uncomfortable shoes and the fit preferences in the different regions of ladies' shoes were explored. Twenty Hong Kong Chinese females participated in the study. Each participant wore and rated the different aspects of their own comfortable and uncomfortable shoes. The Wilcoxon signed rank tests showed significant differences in ten perceived characteristics between the comfortable and uncomfortable shoes. Among the ten were tactile, auditory and olfactory sensations. The ten items reliably (Cronbach alpha > 0.9) distinguished between comfortable and uncomfortable shoes. There were no significant differences between comfortable and uncomfortable shoes for aesthetic-related characteristics. Further analysis on the fit ratings showed a significant impact on the fit preferences in the *Toe region* ( $p < 0.0001$ ), *Metatarsophalangeal (MPJ) region* ( $p < 0.0001$ ), *Arch region* ( $p = 0.002$ ) and *Ingress/egress opening* ( $p < 0.001$ ). Knowing the preferred type of fit can help establish a specification for comfortable shoes and also brings out the criteria that a comfortable shoe does not necessarily have the same perceived fit in every region of a shoe.

- **Keywords:** Footwear; Fit; Comfort; Perception

#### **A. Plamondon, A. Delisle, C. Larue, D. Brouillette, D. McFadden, P. Desjardins and C. Larivière. *Evaluation of a hybrid system for three-dimensional measurement of trunk posture in motion.* Pages 697-712.**

Ambulatory assessment of trunk posture is important in improving our understanding of the risk of low back injury. Recently, small inertial sensors combining accelerometers, gyroscopes and magnetometers were developed and appear to be promising for measuring human movement. However, the validity of such sensors for assessing three-dimensional (3D) trunk posture in motion has not been documented. The purpose of this study was to evaluate a hybrid system (HS) composed of two inertial sensors for the 3D measurement of trunk posture. A secondary purpose was to explore the utility of adding another source of information, a potentiometer, to measure the relative rotation between both sensors in order to improve the validity of the system. The first sensor was placed over the sacrum and the second on the upper part of the thorax. Both sensors were linked by a flexible rod with a potentiometer. A complementary quaternion filter algorithm was used to estimate trunk orientation by taking advantage of the nine components of each sensor and the potentiometer. The HS's orientations were compared

to those obtained from a 3D optoelectronic system. Validation of the HS was performed in three steps in which six subjects had to perform manual handling tasks in: (1) static postures; (2) dynamic motions of short duration (30 s); and (3) dynamic motions of long duration (30 min). The results showed that the root mean square (RMS) error of the HS was generally below 3° for the flexion and lateral bending axes, and less than 6° for the torsion axis, and that this error was lower for the short-duration tests compared to the long-duration one. The potentiometer proved to be an essential addition, particularly when the magnetometer signals were corrupted and only the gyroscope and accelerometer could be combined. It is concluded that the HS can be a useful tool for quantifying 3D trunk posture in motion.

- **Keywords:** Inertial tracking device; Accelerometers; Gyroscopes

**Dan Lämkuil, Lars Hanson and Roland Örtengren. *The influence of virtual human model appearance on visual ergonomics posture evaluation.* Pages 713-722.**

The objective of this study was to investigate whether the appearance of virtual human models influences observers when judging a working posture. A task in which a manikin is manually assembling a car battery was used in the experiment. In total, 16 different pictures were presented to the subjects. All pictures had the same background, but included a unique posture and manikin appearance combination. 24 subjects consisting of manufacturing managers, simulation engineers and ergonomists were asked to rate and rank the pictures. The results showed that the virtual human model appearance influenced subjects when they rated pictures one by one: a more realistic manikin was rated higher than the identical posture visualized with a less natural appearance. This appearance effect was not seen when subjects ranked the pictures while looking at all of them at the same time. The study demonstrates that the human modelling tool used when showing and visually evaluating results makes a difference. To minimize subjective effects, a combination of visualizations and objective ergonomic assessment methods is recommended.

- **Keywords:** Manikin appearance; Ergonomics visualization; Virtual manufacturing

**Rosemary R. Seva, Henry Been-Lirn Duh and Martin G. Helander. *The marketing implications of affective product design.* Pages 723-731.**

Emotions are compelling human experiences and product designers can take advantage of this by conceptualizing emotion-engendering products that sell well in the market. This study hypothesized that product attributes influence users' emotions and that the relationship is moderated by the adherence of these product attributes to purchase criteria. It was further hypothesized that the emotional experience of the user influences purchase intention. A laboratory study was conducted to validate the hypotheses using mobile phones as test products. Sixty-two participants were asked to assess eight phones from a display of 10 phones and indicate their emotional experiences after assessment. Results suggest that some product attributes can cause intense emotional experience. The attributes relate to the phone's dimensions and the relationship between these dimensions. The study validated the notion of integrating affect in designing products that convey users' personalities.

- **Keywords:** Affective product design; Product design; Multilevel modelling; Phone design

**Richard Wells, Svend Erik Mathiassen, Lars Medbo and Jørgen Winkel. *Time : A key issue for musculoskeletal health and manufacturing.* Pages 733-744.**

Time is a key issue for both ergonomists and engineers when they engage in production system interventions. While not their primary purpose, the actions of engineers have major effects on biomechanical exposure; possibly of much greater magnitude than many ergonomics interventions. This paper summarises the aims, actions and tools of engineers and ergonomists, emphasising time-related outcomes. Activities of the two groups when attempting to manipulate time aspects of work may be contradictory; engineers wishing to improve production and ergonomists aiming at better health as well as contributing to production. Consequently, tools developed by ergonomists for assessing time aspects of work describe rest patterns, movement velocities or daily duration of exposures, while engineering tools emphasise time-efficient production. The paper identifies measures that could be used to communicate time-relevant information between engineers and ergonomists. Further cooperation between these two stakeholders as well as research on the topic are needed to enable ergonomists to have a larger impact on the design of production systems.

- **Keywords:** Mechanical exposure; Time variation; Risk factors; Ergonomists; Engineers; Production system; Design

**Adriana Trejo, Myung-Chul Jung, Dmitry Oleynikov and M. Susan Hallbeck. *Effect of handle design and target location on insertion and aim with a laparoscopic surgical tool. Pages 745-753.***

Two laparoscopic tools, a scissor-type grasper and an ergonomically designed grasper, were compared in terms of operation efficiency and physical workload while inserting into a simulated abdomen and aiming five cross-shaped targets. Thirty right-handed novice participants performed the tasks with five tool-grasping hand postures at two computer monitor angles that simulated reaching an organ during laparoscopic surgery. When comparing the two free style hand postures used, there was a significant improvement in operation efficiency. This demonstrated that the participants quickly became familiar with the Intuitool by finding new hand postures that will significantly help them reach the target faster and more accurately. The 45° monitor angle showed the worst accuracy and deviation, the 0° monitor angle showed the best accuracy and smallest deviation with the upper target. Thus it is recommended that the camera trocar be placed directly above the organ of interest, and the part of the organ to be reached should be displayed slightly above the center of the feedback monitor. For physical workload, the method of gripping the tools was the most important factor. The scissors-type tool caused the largest wrist flexion, in contrast both free styles hand postures with the Intuitool showed the least wrist flexion.

- **Keywords:** Laparoscopy; Ergonomic tool design; Insertion of tool; Aiming with long stylus

**Steven M. Carcone and Peter J. Keir. *Effects of backrest design on biomechanics and comfort during seated work. Pages 755-764.***

The purpose of this study was to examine the effects of backrest configuration on seatpan and backrest pressure, spinal posture, and comfort. Thirty volunteers (15 male, 15 female) typed a standardized text passage while seated at a computer workstation in five backrest configurations: chair only, chair with a supplementary backrest, and with each of three lumbar pad thicknesses. Pressure, lumbar and cervical angles were collected during 15-min trials. Subjective data were collected during each trial and at the end of the entire protocol. The addition of a supplementary backrest to a standard chair reduced peak and average pressure on the back by 35% and 20%, respectively ( $P < 0.02$ ). Lumbar lordosis was observed only when lumbar pads were used, being greatest with the large pad. Participants preferred backrest configurations that had lower pressure on the back and less lordotic lumbar posture (backrest only or 3 cm lumbar pad), regardless of anthropometrics. Comfort was rated highest in conditions that would

not necessarily be considered biomechanically ideal. Further delineation between specific comfort and objective seating variables is required to effectively reduce and prevent low back pain.

- **Keywords:** Seating; Backrest; Pressure; Comfort; Spine; Posture

**Stephanie A. Reid and Gary A. Mirka. *Learning curve analysis of a patient lift-assist device.* Pages 765-771.**

One of the challenges facing ergonomists in the implementation of an ergonomic solution is addressing the concerns related to their impact on productivity. The focus of the current study was to (1) apply standard learning curve analysis to the learning that takes place as an individual works with a patient handling device and (2) compare the effects of two different training protocols on measures of learning. Eighteen subjects completed 11 replications of a patient transfer task after participating in either an "interactive" training protocol or "see-one-do-one" training protocol. The results show that the learning rate for this task was 83% with no difference as a function of training protocol. The results do indicate that the effect of Training Method was significant ( $p < 0.05$ ) for time to complete the first patient lift task (370 s for the interactive training vs. 475 s for see-one-do-one training). The results of the analysis of the survey data supported the objective results in that the only measure that was responsive to training type ( $p < 0.05$ ) was related to comfort level in performing the patient lift task for the first time. The results emphasize the importance in considering learning when introducing an intervention in the workplace, and showed that in this instance, training type had an immediate impact on productivity, but that this effect diminished over time.

- **Keywords:** Intervention; Learning; Musculoskeletal

**Kurt E. Beschorner, Mark S. Redfern, William L. Porter and Richard E. Debski. *Effects of slip testing parameters on measured coefficient of friction.* Pages 773-780.**

Slips and falls are a major cause of injuries in the workplace. Devices that measure coefficient of friction (COF) of the shoe-floor-contaminant interface are used to evaluate slip resistance in various environments. Testing conditions (e.g. loading rate, timing, normal force, speed, shoe angle) are believed to affect COF measurements; however, the nature of that relationship is not well understood. This study examines the effects of normal force (NF), speed, and shoe angle on COF within physiologically relevant ranges. A polyvinyl chloride shoe was tested using a modified industrial robot that could attain high vertical loads and relatively high speeds. Ground reaction forces were measured with a loadcell to compute COF. Experiment #1 measured COF over a range of NF (~100–500 N) for two shoe angles (10° and 20°), four speeds (0.05, 0.20, 0.35, and 0.50 m/s), and two contaminants (diluted detergent and diluted glycerol). Experiment #2 further explored speed effect by testing seven speeds (0.01, 0.05, 0.20, 0.35, 0.50, 0.75, and 1.00 m/s) at a given NF (350 N) and shoe angle (20°) using the same two contaminants. Experiment #1 showed that faster speeds significantly decreased COF, and that a complex interaction existed between NF and shoe angle. Experiment #2 showed that increasing speed decreased COF asymptotically. The results imply that COF is dependent on film thickness separating the shoe and the heel, which is dependent on speed, shoe angle, and NF, consistent with tribological theory.

- **Keywords:** Slip; Footwear; Tribometry; Floor; Contaminant

**Spyros Margaritis and Nicolas Marmaras. *Supporting the design of office layout meeting ergonomics requirements.* Pages 781-790.**

This paper proposes a method and an information technology tool aiming to support the ergonomics layout design of individual workstations in a given space (building). The proposed method shares common ideas with previous generic methods for office layout. However, it goes a step forward and focuses on the cognitive tasks which have to be carried out by the designer or the design team trying to alleviate them. This is achieved in two ways: (i) by decomposing the layout design problem to six main stages, during which only a limited number of variables and requirements are considered and (ii) by converting the ergonomics requirements to functional design guidelines. The information technology tool (ErgoOffice 0.1) automates certain phases of the layout design process, and supports the design team either by its editing and graphical facilities or by providing adequate memory support.

**Tim A. Bentley, Stephen J. Page and Keith A. Macky. *Adventure tourism and adventure sports injury : The New Zealand experience. Pages 791-796.***

The primary aims of this study were to establish a client injury baseline for the New Zealand adventure tourism and adventure sport sector, and to examine patterns and trends in claims for injury during participation in adventure activities. Content analysis of narrative text data for compensated injuries occurring in a place for recreation and sport over a 12-month period produced over 15,000 cases involving adventure tourism and adventure sport. As found in previous studies in New Zealand, highest claim counts were observed for activities that are often undertaken independently, rather than commercially. Horse riding, tramping, surfing and mountain biking were found to have highest claim counts, while hang gliding/paragliding/parasailing and jet boating injuries had highest claim costs, suggesting greatest injury severity. Highest claim incidence was observed for horse riding, with female claimants over-represented for this activity. Younger male claimants comprised the largest proportion of adventure injuries, and falls were the most common injury mechanism.

- **Keywords:** Adventure tourism; Adventure sport; Unintentional injury; Injury compensation claims; Injury epidemiology

**Sam Murphy, Peter Buckle and David Stubbs. *A cross-sectional study of self-reported back and neck pain among English schoolchildren and associated physical and psychological risk factors. Pages 797-804.***

This study set out to identify the associations between ergonomics and other factors with back and neck pain among schoolchildren. Self-reported questionnaires were used to record health outcomes and potential risk factors in state schools. Six hundred and seventy-nine schoolchildren from Surrey in the United Kingdom aged 11–14 years took part. Twenty-seven percent of children reported having neck pain, 18% reported having upper back pain, and 22% reported having low back pain. A forward stepwise logistic regression was performed with pain categories the dependent variables. Neck pain was significantly associated with school furniture features, emotional and conduct problems, family history of low back pain and previous treatment for musculoskeletal disorders. Upper back pain was associated with school bag weight (3.4–4.45 kg), school furniture features, emotional problems and previous treatment for musculoskeletal disorders. Low back pain was associated with school furniture features, emotional problems, family history and previous injury or accident. It is important to recognise the influence of physical, psychological and family factors in children's pain.

**Keywords:** Musculoskeletal disorders; Back pain; Physical and psychological risk factors

**Brendan Ryan and Christine M. Haslegrave. *Developing a verbal protocol method for collecting and analysing reports of workers' thoughts during manual handling tasks*. Pages 805-819.**

Concurrent and retrospective verbal protocol methods were used to collect thoughts from 18 participants during a manual handling task involving the repeated transfer of loads between locations at two tables. The effectiveness of qualitative and quantitative methods of analysing the reported information was tested in the study. A simple taxonomy was developed to investigate the content of the reports (including reports on postures and loads) and determine how the participants approached the task (whether they made plans, described actions or evaluated their completion of the task). References to posture were obtained in the verbal protocol reports, indicating that the participants had some awareness of their postures during parts of the task. There were similarities in the content of the concurrent and retrospective reports, but there were differences in the amount of detail between the methods and differences in the way the reports were constructed. There could be some scope for developing the quantitative analysis of the frequencies of references to classes of information, though this can only be recommended for concurrent reports on tasks of short duration. The analyses of qualitative data gave a deeper insight into the reports, such as identifying factors that can be important when planning to handle a load, or illustrating how participants can change their focus of attention periodically throughout the task. The relative strengths of the concurrent and retrospective methods are described, along with ideas for improving the quality of information collected in future studies. A number of potential problems with the interpretation of the reported information are explained.

- **Keywords:** Self reports; Verbal protocol methods; Manual handling tasks