

Applied Ergonomics - rok 2007, ročník 38

Číslo 3 (May 2007)



Kai Way Li, Rui-feng Yu and Xiao L. Han. *Physiological and psychophysical responses in handling maximum acceptable weights under different footwear–floor friction conditions.* Pages 259-265.

A study on combined manual materials-handling tasks performed on floors under three friction levels was conducted. Eight male subjects participated in the study. The maximum acceptable weight of handling, including lifting, carrying for 3 m, lowering, and walking 3 m back at twice per minute was determined. The subject then performed the same tasks for 10 min. Heart rate, Vo_2 , energy efficiency, perceived sense of slip, and rating of perceived exertion for whole body strain were measured. The results showed that the effects of friction level on the maximum acceptable weights of handling, perceived sense of slip, Vo_2 , and energy efficiency were statistically significant ($p \leq 0.0006$). As the friction level increased from low to high, the maximum acceptable weights of handling increased from 8.15 to 9.34 kg. The energy efficiency on the low friction condition (12.58 kg/L/min) was significantly lower than those of the medium (15.73 kg/L/min) and high (15.38 kg/L/min) friction conditions. The perceived sense of slip was the highest (5.44) on the low-friction condition, followed by the medium-friction condition (3.58), and last the high-friction condition (1.84). The implication of this study was that friction level should be regarded as one of the major environmental factors in designing MMH tasks as it affected both physiological and psychophysical responses of the subjects. Low-friction footwear–floor interface should be avoided as it resulted in not only high scores of perceived sense of slip but also in low-energy efficiency utilized in the body.

Chris Fullwood. *The effect of mediation on impression formation : a comparison of face-to-face and video-mediated conditions.* Pages 267-273.

It is suggested that communication mediated by video may have an important impact on the way in which individuals are perceived and this might be a result of an attenuation or distortion of visual signals. The current study aimed to test this further by employing a simple mind-reading task, which gave participants an opportunity to interact with one another. Participants completed the task in pairs either face-to-face or via video-mediated technologies. After completing the task, participants filled in a questionnaire which was designed to assess perceptions of how much they liked and how intelligent they believed their partner in the task to be. Results indicate that participants were regarded as significantly less likeable and intelligent in the video-mediated condition. This is probably a consequence of the attenuation of visual signals, in particular eye

gaze, which has been shown to be important in impression formation. Findings from this study have practical implications for using this type of technology to assess performance, for example in interviews, especially if comparisons are made with face-to-face interviewees.

Hsieh-Ching Chen, Yung-Ping Liu, Chia-Ling Chen and Chih-Yong Chen. *Design and feasibility study of an integrated pointing device apparatus for individuals with spinal cord injury. Pages 275-283.*

Despite the commercial availability of numerous computer-pointing devices, many severely disabled individuals still rely on customized equipment to operate computers. This study presents a novel Integrated Pointing Device Apparatus (IPDA) that integrates numerous commercial pointing devices. The novel IPDA, which complies with a standard USB 1.1 interface, is compatible with most tested computer-pointing devices and flexibly integrates commercial computer devices, tailoring them to suit individual needs. By using simple integrated circuit design and low-cost electronic components, this low-cost apparatus is easily maintained. The feasibility of the IPDA was evaluated by four subjects with high-level cervical (C4-5) spinal cord injury (SCI). Participants performed normal move-and-click and drag-and-drop tasks typically performed by computer pointing devices. Each participant not able to use a traditional computer mouse or trackball were able to operate a computer adequately with the IPDA and three including one operating a trackball with his chin, operated computers easily and smoothly. This feasibility study showed that the IPDA effectively integrates commercial pointing devices, thereby providing the possibility for some people with SCI to obtain computer operability. This study demonstrated the advantages of flexibility, low cost, and acceptable efficiency of the novel IPDA.

Nancy L. Black and Biman Das. *A three-dimensional computerized isometric strength measurement system. Pages 285-292.*

The three-dimensional Computerized Isometric Strength Measurement System (CISMS) reliably and accurately measures isometric pull and push strengths in workspaces of paraplegic populations while anticipating comparative studies with other populations. The main elements of the system were: an extendable arm, a vertical supporting track, a rotating platform, a force transducer, stability sensors and a computerized data collection interface. The CISMS with minor modification was successfully used to measure isometric push-up and pull-down strengths of paraplegics and isometric push, pull, push-up and pull-down strength in workspaces for seated and standing able-bodied populations. The instrument has satisfied criteria of versatility, safety and comfort, ease of operation, and durability. Results are accurate within 2 N for aligned forces. Costing approximately \$1,500 (US) including computer, the system is affordable and accurate for aligned isometric strength measurements.

David Rempel, Alan Barr, David Brafman and Ed Young. *The effect of six keyboard designs on wrist and forearm postures. Pages 293-298.*

There is increasing evidence that alternative geometry keyboards may prevent or reduce arm pain or disorders, and presumably the mechanism is by reducing awkward arm postures. However, the effect of alternative keyboards, especially the new designs, on wrist and arm postures are not well known. In this laboratory study, the wrist and forearm postures of 100 subjects were measured with a motion analysis system while they typed on 6 different keyboard configurations. There were significant differences in wrist extension, ulnar deviation, and forearm pronation between keyboards. When

considering all 6 wrists and forearm postures together, the keyboard with an opening angle of 12°, a gable angle of 14°, and a slope of 0° appears to provide the most neutral posture among the keyboards tested. Subjects most preferred this keyboard or a similar keyboard with a gable angle of 8° and they least preferred the keyboard on a conventional laptop computer. These findings may assist in recommendations regarding the selection of keyboards for computer usage.

Stephan Milosavljevic, Allan B. Carman, Anthony G. Schneiders, Peter D. Milburn and Barry D. Wilson. *Three-dimensional spinal motion and risk of low back injury during sheep shearing*. Pages 299-306.

Sheep shearers are known to work in sustained flexed postures and have a high prevalence of low back pain (LBP). As sustained posture and spinal movement asymmetry under substantial loads are known risk factors for back injury our aim was to describe the 3D spinal movement of shearers while working. We hypothesised that thoraco-lumbar and lumbo-sacral movement would be tri-axial, asymmetric, and task specific.

Sufficient retro-reflective markers were placed on the trunk of 12 shearers to define thoraco-lumbar and lumbo-sacral 3D motion during three tasks. Thoraco-lumbar movement consistently involved flexion, left lateral flexion, and right rotation. Lumbo-sacral movement consistently involved right lateral flexion in flexion with minimal rotation.

Shearers therefore work in sustained spinal flexion where concurrent, asymmetric spinal movements into both lateral flexion and rotation occur. These asymmetric movements combined with repetitive loading may be risk factors leading to the high incidence of LBP in this occupational group.

Christian Korunka, Dieter Scharitzer, Pascale Carayon, Peter Hoonakker, Angelika Sonnek and Francois Sainfort. *Customer orientation among employees in public administration: A transnational, longitudinal study*. Pages 307-315.

The relation between ergonomic principles and quality management initiatives, both, in the private and public sector, has received increasing attention in the recent years. Customer orientation among employees is not only an important quality principle, but also an essential prerequisite for customer satisfaction, especially in service organizations. In this context, the objective of introducing new public management (NPM) in public-service organizations is to increase customer orientation among employees who are at the forefront of service providing.

In this study, we developed a short scale to measure perceived customer orientation. In two separate longitudinal studies carried out in Austria and the US, we analyzed changes in customer orientation resulting from the introduction of NPM. In both organizations, we observed a significant increase in customer orientation. Perceived customer orientation was related to job characteristics, organizational characteristics and employee quality of working life. Creating positive influences on these characteristics within the framework of an organizational change process has positive effects on employee customer orientation.

Chih-Hung Chang and Yuh-Chuan Shih. *The effects of glove thickness and work load on female hand performance and fatigue during a infrequent high-intensity gripping task. Pages 317-324.*

In various workplaces, gloves are commonly employed to protect the hands with the design rationale of 'the thicker the gloves, the better the protection'. Therefore, the present paper investigated the effects of glove thickness on hand performance and fatigue during two infrequent high-intensity gripping tasks, such as 5-s and sustained tasks. The hand performance was evaluated by maximum volitional contraction (MVC) and its associated time needed to reach the MVC (T_{MVC}), and the total force generation (TFG) during the sustained task. The hand fatigue was assessed by MVC degeneration (ΔMVC), the shift in time needed to reach the MVC (ΔT_{MVC}), and the maximal endurance time (MET) associated with the sustained task. Ten female subjects took part in the experiment voluntarily. The four-gloved conditions included bare hand, wearing one layer (Cotton-1), wearing two layers of cotton gloves (Cotton-2), and covering the handle with two layers of cotton glove and exerting with the bare hand (Covered-2). The results indicates that wearing gloves decreased the grip MVC, and the thicker the gloves, the less the grip MVC, but the wearing style did not change the MVC (Cotton-2 MVC was indifferent from Covered-2 MVC). As to muscular fatigue, on the other hand, wearing gloves did not affect ΔMVC , MET, T_{MVC} , or ΔT_{MVC} . Due to the greater bare-hand MVC and indifferent MET, bare-hand TFG was better than those conditions with gloves. Finally, the load specified here did not alter T_{MVC} or ΔT_{MVC} , but the greater the load, the more strength degeneration (ΔMVC) was induced.

Shih-Kai Chang and Colin G. Drury. *Task demands and human capabilities in door use. Pages 325-335.*

Doors are ubiquitous in the built environment, but despite their frequent use by people and their involvement in over 300,000 injuries per year (USA), they are little studied from a human factors perspective. This paper provides a classification scheme for doors based on human/door interaction and a prototypical task analysis of door use. Two observational studies were performed on a particular type of door. The first observed 1600 human/door interactions and found that people's use of force-enhancing strategies increased for larger doors, particularly for people of smaller stature. The second observed 800 interactions with push doors and found that the point where force is exerted is higher for taller individuals and closer to the center of the door than is typically assumed for placing handles. The second study was partly corroborated by measuring the position of wear patterns on doors. As is expected in human factors, the way people used doors was a function of both task demands and human capabilities. These results suggests that those specifying doors for buildings use a restoring torque below 30 Nm and site the handle or push plate 250–350 mm from the door edge and 1000–1500 mm above the floor.

Tülin Gündüz Cengiz and Fatih C. Babalık. *An on-the-road experiment into the thermal comfort of car seats. Pages 337-347.*

This paper presents an evaluation of thermal comfort in an extended road trial study. Automobile seats play an important role in improving the thermal comfort. In the assessment of thermal comfort in autos, in general subjective and objective measurements are used. Testing on the road is very difficult but real traffic conditions affect the comfort level directly, as well as the driver's experience to real conditions. Thus, for such cases real traffic situations should not be neglected in the evaluation of comfort. The aim of this study was to carry out, on an extended road trial study, an evaluation of thermal comfort using human subjects. In the experiments used, the 100%

polyester seat cover had three different cover materials, which were velvet, jacquard and micro fiber. All experiments were carried out on a sunny day with ten participants over 1 h. They were carried out at air temperatures of 25 °C in a Fiat Marea 2004, which had an automatic climate function. Skin temperature at eight points and skin wettedness at two points on the human body were measured during the trials. Participants were required to complete a questionnaire of 15 questions, every 5 min.

It can be concluded that there was negligible difference in participants' reported thermal sensation between the three seats. According to objective measurement results, all seat cover materials have the same degree of thermal comfort. On the road the participants feel warmer around their waist than any other area of the body. It was suggested that the effects of real traffic conditions must be accounted for in comfort predictions.

Yejin Lee, Kyunghi Hong and Sung-Ae Hong. *3D quantification of microclimate volume in layered clothing for the prediction of clothing insulation*. Pages 349-355.

Garment fit and resultant air volume is a crucial factor in thermal insulation, and yet, it has been difficult to quantify the air volume of clothing microclimate and relate it to the thermal insulation value just using the information on the size of clothing pattern without actual 3D volume measurement in wear condition. As earlier methods for the computation of air volume in clothing microclimate, vacuum over suit and circumference model have been used. However, these methods have inevitable disadvantages in terms of cost or accuracy due to the limitations of measurement equipments. In this paper, the phase-shifting moiré topography was introduced as one of the 3D scanning tools to measure the air volume of clothing microclimate quantitatively. The purpose of this research is to adopt a non-contact image scanning technology, phase-shifting moiré topography, to ascertain relationship between air volume and insulation value of layered clothing systems in wear situations where the 2D fabric creates new conditions in 3D spaces. The insulation of vests over shirts as a layered clothing system was measured with a thermal manikin in the environmental condition of 20 °C, 65% RH and air velocity of 0.79 m/s. As the pattern size increased, the insulation of the clothing system was increased. But beyond a certain limit, the insulation started to decrease due to convection and ventilation, which is more apparent when only the vest was worn over the torso of manikin. The relationship between clothing air volume and insulation was difficult to predict with a single vest due to the extreme openings which induced active ventilation. But when the vest was worn over the shirt, the effects of thickness of the fabrics on insulations were less pronounced compared with that of air volume. In conclusion, phase-shifting moiré topography was one of the efficient and accurate ways of quantifying air volume and its distribution across the clothing microclimate. It is also noted that air volume becomes more crucial factor in predicting thermal insulation when clothing is layered.

Christina Stave, Marianne Törner and Mats Eklöf. *An intervention method for occupational safety in farming : evaluation of the effect and process*. Pages 357-368.

In order to increase safety in Swedish farming an intervention methodology to influence attitudes and behaviour was tested. Eighty-eight farmers and farm workers in nine groups gathered on seven occasions during 1 year. The basic concept was to create socially supportive networks and encourage discussions and reflection, focusing on risk manageability. Six of the groups made structured incident/accident analyses. Three of the latter groups also received information on risks and accident consequences. Effects were evaluated in a pre-post questionnaire using six-graded scales. A significant increase in safety activity and significant reduction in stress and risk acceptance was observed in the total sample. Risk perception and perceived risk manageability did not change.

Analysing incidents/accidents, but not receiving information, showed a more positive outcome. Qualitative data indicated good feasibility and that the long duration of the intervention was perceived as necessary. The socially supportive network was reported as beneficial for the change process.

Raymond W. McGorry, Angela DiDomenico and Chien-Chi Chang. *The use of a heel-mounted accelerometer as an adjunct measure of slip distance.* Pages 369-376.

A human-centered measure of floor slipperiness could be useful as an adjunct to conventional tribologic measures. This paper reports on the development and evaluation of a measure of slip distance based on variables derived from the signal of a heel-mounted accelerometer. Twenty-one participants walked on a laboratory runway under several surface slipperiness conditions at three walking speeds during a protocol designed to produce a wide range of slip distances at heel strike. Analysis of variance showed significant effects of slip distance (no-slip, micro-slip and slide), walking speed (1.52, 1.78 and 2.13 m/s) and their interactions on peak forward acceleration, peak vertical acceleration and deceleration time of the heel following heel strike in 704 trials. Regression analysis of slip distance and deceleration time showed the strongest relationship with $R^2=0.511$. Large individual variation in the strength of this relationship was observed. The heel-mounted accelerometer may have utility as an adjunct measure in the evaluation of floor slipperiness, particularly for field applications where direct measurement may not be feasible.

Hyun-Young Lee and Kyunghi Hong. *Optimal brassiere wire based on the 3D anthropometric measurements of under breast curve.* Pages 377-384.

It has been difficult to quantify the fit of brassiere wire to the natural nude under breast line due to the difficulty of obtaining women's nude under breast line in 3D image. The objectives of this study are firstly to design the ergonomic brassiere wire that should fit to the curve of under breast and thorax and secondly to apply the 3D measurement of human body structure to the product design and evaluation using phase shifting moiré topography. Eight brassiere wires were evaluated and key factors of comfortable wires were selected depending on the types of women's under breast those are considered as backbones of the brassiere structure. Twenty-one middle-aged women participated in the subjective wear test, and 17 volunteers of them continued to participate in the 3D image recording. 3D morphological data of the breast before and after wearing experimental brassieres was examined by phase shifting moiré topography. As results, it was found that the fitting of the global average radius of curvature of wire to that of the bodyline of the under breast curve was an important variable for the design of wires. Conventional shape of brassiere wire was suitable to the majority of the subjects. However, for those who have skewed under breast lines, the wire of larger global average radius of curvature along the inner part of the under breast line was rated higher in terms of wear comfort and appearance. The recommended magnitude of the torsional rigidity of the brassiere wire was about $0.015 \text{ N/mm}^2 \text{ mm}$. The observation on women's under breast curve and their comfortable breast wire as discussed in this paper would provide with comfortable and stable fit for women in special needs such as soldiers, athletes and actress.

Bao-Chi Chang, Biing-Shiun Huang, Ching-Kong Chen and Shyh-Jen Wang. *The pincer chopsticks : the investigation of a new utensil in pinching function.* Pages 385-390.

The manipulation of chopsticks requires skillful motions of fingers. Therefore, it would be difficult to manipulate chopsticks for people with hand dysfunction. We designed a simple and convenient utensil, the pincer chopsticks, to simulate the pincers-pinching operation of traditional chopsticks. To compare the performance of the new device with that of traditional chopsticks and spoons, 32 volunteers applied these utensils to pick up four kinds of food with either hand. For dominant hands, the manipulation time of both pincer and traditional chopsticks was shorter than that of spoons, while using pincer chopsticks with non-dominant hands revealed the best performance among the three experimental utensils for users without experience. In this study, the newly designed pincer chopsticks demonstrated advantages for operation and performance. It has the potential to benefit patients with impaired hands.