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Kristi E. Schmidt; Yili Liu; Srivatsan Sridharan. *Webpage aesthetics, performance and usability : design variables and their effects.* Pages 631–643.

The primary objectives of this research are to identify the underlying clusters of design variables affecting the perceived usability of a webpage and to examine the effects of webpage design variables on webpage performance. Fifty-seven design variables and 10 underlying clusters that conceptualise the structure of user webpage judgement are identified through content analysis on literature and structured interviews, balanced incomplete block user survey administration and cluster analysis. Five clusters are selected to conduct three experiments that quantify the change in user aesthetic preference, perceived ease of interaction and interaction speed as a function of loading speed, image colour, image size, font size, link style, and column width. Results show that user performance alone is not a good indicator of aesthetic judgement and overall effectiveness of a webpage. The value of integrating global construct analysis processes and local controlled experimentation processes in ergonomic interface research is illustrated. Fifty-seven webpage design variables are defined, ranked and clustered according to perceived importance and overall preference. Experimental results illustrate that both technical performance and aesthetic factors are important webpage design considerations.

- **Keywords:** webpage usability; webpage performance; webpage aesthetics; human performance

Saskia M. Koller; Colin G. Drury; Adrian Schwaninger. *Change of search time and non-search time in X-ray baggage screening due to training.* S. 644–656.

As found in studies of aircraft structural inspection, the time used for judging if a part of an aircraft shows tiny cracks is composed of search time, used for actively scanning, and non-search time, used for matching and decision while fixating a region of interest (Drury *et al.* 1997). These findings can be applied to detection of threats by X-ray screening of passenger bags at airports. To investigate whether search time and non-search time change when an experienced screener is given additional training in recognising threat objects in passenger bags, data from a European airport were analysed. A comparison of detection performance and reaction time between two large groups of screeners, one trained for 6 months, shows a large impact of training on overall performance and on both search and non-search components of the task. There was also a small but

consistent decline in performance measures with screener age. This study shows a way to localise the effect of training on threat detection performance for aviation security screening. Analysis of the time needed for screening each passenger bag showed that training had a significant effect, particularly on the non-search part of the searching process (i.e. identification, recognition, decision, response execution, etc.).

- **Keywords:** aviation security; X-ray baggage screening; search time; non-search time; training effect; visual search

A. K. Pradhan; A. Pollatsek; M. Knodler; D. L. Fisher. *Can younger drivers be trained to scan for information that will reduce their risk in roadway traffic scenarios that are hard to identify as hazardous?* S. 657–673.

Younger drivers (18-21 years) are over-involved in crashes. Research suggests that one of the reasons for this over-involvement is their failure to scan areas of the roadway for information about potential risks in situations that are hazardous, but not obviously so. The primary objective of the present study is to develop and evaluate a training program that addresses this failure. It was hypothesised that PC-based hazard anticipation training would increase the likelihood that younger drivers would scan for potential hazards on the open road. In order to test this hypothesis, 12 trained and 12 untrained drivers' eye movements were measured as they drove a vehicle on local residential, feeder and arterial roads. Overall, the trained drivers were significantly more likely to gaze at areas of the roadway that contained information relevant to the reduction of risks (64.4%) than were the untrained drivers (37.4%). Significant training effects were observed even in situations on the road that were quite different from those shown in training. These findings have clear implications for the type of training of teen drivers that is necessary in order to increase their anticipation of hazards.

- **Keywords:** younger drivers; hazard anticipation; driver training; eye movements; driving simulators

David Crundall. *The Deceleration Detection Flicker Test : a measure of experience?* S. 674–684.

A new driving-related test is described, which provides a simple procedure to investigate a wide range of distraction and visual attention issues in driving. It requires participants to divide attention between multiple sources of potential hazard within a driving scene. The primary task requires a response when the perceived headway to a car ahead diminishes across a series of static images. Two experiments used different secondary tasks to demonstrate that central task performance is sensitive to driver experience, with highly experienced drivers better able to notice a change in apparent headway to the lead vehicle. Furthermore, background visual complexity, such as visually cluttered urban roads compared to sparser rural roads, exacerbates the experiential differences. The results suggest that the Deceleration Detection Flicker Test taps into a real driving-related skill and may provide a useful methodology for future investigation of a wide range of visual processing issues in driving research.

- **Keywords:** driving; attention; experience; headway

F. A. Fathallah; J. H. Chang; W. Pickett; B. Marlenga. *Ability of youth operators to reach farm tractor controls.* S. 685–694.

Farm tractor work is commonly assigned to young people on North American farms, where tractors account for the majority of deaths and major portions of non-fatal trauma to working youths. However, little is known about the potential mismatch between the

anthropometric and physical characteristics of children and tractor characteristics. The purpose of this study was to evaluate the ability of children of varying ages and percentiles to reach major controls on 45 tractors in common use in the US. The main study finding was that many tractor controls, especially those that are hand-operated, may not be effectively reached by the majority of youth operators aged 12 to 16 years. The study raises further serious questions about the ability of children to safely operate tractors in common use on US farms and calls for reconsideration of age guidelines for the assignment of children to tractor work on farms. This study provides novel ergonomic evidence about the ability of children to reach controls inside agricultural tractor cabins. The approach could be applied in similar situations where youths may operate other vehicles or machines. Study findings support the establishment and refinement of policies and guidelines related to youth tractor operation.

- **Keywords:** agriculture; children; safety; reach; photogrammetr

Álvaro Page; Helios de Rosario; Vicente Mata; Rosa Porcar; José Solaz; María José Such. *Kinematics of the trunk in sitting posture : an analysis based on the instantaneous axis of rotation. S. 695 – 706.*

This paper presents a new approach for analysing trunk kinematics in sitting posture based on the characterisation of thorax and pelvis motion by means of ranges of motion and instantaneous axes of rotation (IAR). These variables are estimated from videophotogrammetric data. An experiment was carried out in order to analyse three motions associated with the flexion-extension movement: the absolute motions of the pelvis and thorax and the relative motion between the thorax and pelvis. The results obtained suggest a sequential activation of lumbar vertebrae in the flexion-extension motion. On the other hand, the location of the pelvis IAR shows that the movement of the pelvis on the seat is not just a rolling motion but a rolling with some level of sliding. Finally, the location of the IAR in the thorax-pelvis relative motion shows a mismatch between the trunk IAR and the backrest axis of rotation in several office chairs. The proposed technique provides a new approach for the kinematic analysis of sitting posture. The results can be applied to the improvement of biomechanical models of seated posture as well as to define some design criteria of work seats based on the fit between the trunk and backrest movements.

- **Keywords:** human motion analysis; instantaneous axis of rotation; sitting posture; seat design

R. Olson; D. I. Hahn; A. Buckert. *Predictors of severe trunk postures among short-haul truck drivers during non-driving tasks : an exploratory investigation involving video-assessment and driver behavioural self-monitoring. S. 707–722.*

Short-haul truck (lorry) drivers are particularly vulnerable to back pain and injury due to exposure to whole body vibration, prolonged sitting and demanding material handling tasks. The current project reports the results of video-based assessments (711 stops) and driver behavioural self-monitoring (BSM) (385 stops) of injury hazards during non-driving work. Participants ($n = 3$) worked in a trailer fitted with a camera system during baseline and BSM phases. Descriptive analyses showed that challenging customer environments and non-standard ingress/egress were prevalent. Statistical modelling of video-assessment results showed that each instance of manual material handling increased the predicted mean for severe trunk postures by 7%, while customer use of a forklift, moving standard pallets and moving non-standard pallets decreased predicted means by 12%, 20% and 22% respectively. Video and BSM comparisons showed that drivers were accurate at self-monitoring frequent environmental conditions, but less accurate at monitoring trunk postures and rare work events. The current study identified

four predictors of severe trunk postures that can be modified to reduce risk of injury among truck drivers and showed that workers can produce reliable self-assessment data with BSM methods for frequent and easily discriminated events environmental.

- **Keywords:** truck drivers; musculoskeletal disorders; self-assessment; self-monitoring; trunk postures

J. Village; M. Koehoorn; S. Hossain; A. Ostry. *Quantifying tasks, ergonomic exposures and injury rates among school custodial workers.* S. 723–734.

A job exposure matrix of ergonomics risk factors was constructed for school custodial workers in one large school district in the province of British Columbia using 100 h of 1-min fixed-interval observations, participatory worker consensus on task durations and existing employment and school characteristic data. Significant differences in ergonomics risk factors were found by tasks and occupations. Cleaning and moving furniture, handling garbage, cleaning washrooms and cleaning floors were associated with the most physical risks and the exposure was often higher during the summer vs. the school year. Injury rates over a 4-year period showed the custodian injury rate was four times higher than the overall injury rate across all occupations in the school district. Injury rates were significantly higher in the school year compared with summer (12.2 vs. 7.0 per 100 full-time equivalents per year, $p < 0.05$). Custodial workers represent a considerable proportion of the labour force and have high injury rates, yet ergonomic studies are disproportionately few. Previous studies that quantified risk factors in custodial workers tended to focus on a few tasks or specific risk factors. This study, using participatory ergonomics and observational methods, systematically quantifies the broad range of musculoskeletal risk factors across multiple tasks performed by custodial workers in schools, adding considerably to the methodological literature.

- **Keywords:** cleaning; ergonomics assessment; observational analysis; custodian; school

Rammohan V. Maikala; Patrick G. Dempsey; Vincent M. Ciriello; Niall V. O'Brien. *Dynamic pushing on three frictional surfaces : maximum acceptable forces, cardiopulmonary and calf muscle metabolic responses in healthy men.* S. 735–746.

Pushing is an important materials handling activity in many occupations; however, pushing-related physiological investigations are still in infancy. The purpose was to evaluate maximum acceptable forces and physiological responses while pushing on: treadmill (TREAD); plywood floor (PLY); and Teflon floor (TEF). Acceptable forces, cardiopulmonary and calf muscle oxygenation and blood volume responses were collected simultaneously while 12 men (age 39 ± 13 years; height 178 ± 6 cm; and body mass 91.5 ± 16 kg) pushed for 2 h on each surface at their psychophysical workload. Participants selected higher forces on the PLY, resulting in higher pulmonary oxygen uptake compared to that of TEF (by $\square 9\%$) and TREAD (by $\square 18\%$). Pushing on the TEF demonstrated 50-56% lower blood volume changes and 1.5-1.8 times more oxygenation-force ratio than that for other surfaces. It is concluded that, to avoid a potential slip, participants were conservative in selecting acceptable forces to push on the slippery TEF. Part of this compensatory strategy on the TEF resulted in less muscle activity and, therefore, less demand for oxygen delivery to the calf muscle than for other surfaces. The present findings of significant force- and physiological-related differences in treadmill vs. high inertia pushcart clearly demonstrate that pushing experiments are essential to evaluate functional abilities of the workers.

- **Keywords:** cart pushing; muscle blood volume; tissue oxygenation index; near-infrared spectroscopy; oxygen uptake; slips and falls

S. J. Petruzzello; J. I. Gapin; E. Snook; D. L. Smith. *Perceptual and physiological heat strain : examination in firefighters in laboratory- and field-based studies.* S. 747–754.

Firefighting demands performing heavy muscular work under adverse and potentially dangerous conditions. Although the physiological and psychological responses to simulated firefighting activities have been described, the heat strain has not been characterised using standardised indices of exercise-heat strain. The purpose of the study is to describe the physiological and perceptual strain associated with working in personal protective equipment and performing simulated firefighting activities in a hot environment using recently developed strain indices (Physiological Strain Index (PhSI); Perceptual Strain Index (PeSI)). Data from two previously published studies (Smith *et al.* 1995, 2001) - one a laboratory-based study and one a field-based study - were re-analysed incorporating the strain indices. The laboratory study involved walking on a treadmill for 15 min while wearing three different clothing and equipment configurations. The field study involved three trials of standardised firefighting tasks in a live-fire training structure (mean trial length = 5.76 min). Heart rate, rectal temperature, thermal sensations and ratings of perceived exertion were collected in each study. PhSI and PeSI values were calculated using the formulae developed by Moran *et al.* (1998b) and Tikuisis *et al.* (2002), respectively. PhSI and PeSI increased significantly over time in both studies. Even relatively brief bouts of exercise while wearing heavy impermeable clothing or simulated firefighting activity in the heat results in moderate to high levels of heat strain as assessed by PhSI and PeSI.

- **Keywords:** physiological strain index; psychological strain index; firefighting; personal protective equipment