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Alan H. S. Chan; Errol R. Hoffmann. Movement compatibility for frontal controls with displays located in four cardinal orientations. Pages 1403 – 1419.

Strength and reversibility of direction-of-motion stereotypes and response times are presented for different configurations of horizontal, vertical and rotary controls with horizontal, vertical and circular displays. Measures of the strength and reversibility of stereotypes were used to analyse the effects of direction of turn instruction (clockwise/anticlockwise; up/down; left/right), display orientation (North; East; South; West) and hand side (left/right) on movement compatibility. A number of acceptable display/control arrangements were identified for displays in each of the North, East, South and West orientations relative to the operator. For the horizontally moving control, the Worryingham and Beringer principle was found to identify display/control arrangements having both high stereotype strength and high reversibility. Vertically moving controls are excellent with vertical displays but poor with horizontal and circular displays. Rotary controls have high stereotype strength and reversibility with both horizontal and circular displays (with the indicator at the 12 o'clock position). **Statement of Relevance:** Design of display/control arrangements requires a strong relationship between operator's expectancies and the response of a device to control inputs. The present research fills in gaps for stereotypes where data are not available, in particular where the operator is not seated facing a display directly to the front.

- **Keywords:** movement compatibility; display orientation; stereotype reversability; control and display

Lisa Dorn; Lucy Stephen; Anders af Wåhlberg; Julie Gandolfi. Development and validation of a self-report measure of bus driver behaviour. Pages 1420 – 1433.

There are likely to be individual differences in bus driver behaviour when adhering to strict schedules under time pressure. A reliable and valid assessment of these individual differences would be useful for bus companies keen to mitigate risk of crash involvement. This paper reports on three studies to develop and validate a self-report measure of bus driver behaviour. For study 1, two principal components analyses of a pilot questionnaire revealed six components describing bus driver behaviour and four bus driver coping components. In study 2, test-retest reliability of the components were tested in a sub-

sample and found to be adequate. Further, the 10 components were used to predict bus crash involvement at three levels of culpability with consistently significant associations found for two components. For study 3, avoidance coping was consistently associated with acceleration variables in a bus simulator, especially for a time-pressured drive. **Statement of Relevance:**The instrument can be used by bus companies for driver stress and fatigue management training to identify at-risk bus driver behaviour. Training to reduce the tendency to engage in avoidance coping strategies, improve evaluative coping strategies and hazard monitoring when under stress may improve bus driver safety.

- **Keywords:** bus driver; crash; driver behaviour; traffic safety

Camilo Charron; Jean-Michel Hoc; Isabelle Milleville-Pennel. *Cognitive control by brain-injured car drivers: an exploratory study.* Pages 1434 – 1445.

Cognitive control is a key tool for adaptation in dynamic situations. The aim of the study is to assess the relevance of a theoretical framework for cognitive control in dynamic situations, in order to understand brain-injured (BI) car drivers' cognitive impairment. The framework supports a cognitive control multimodality based on the crossing of two orthogonal dimensions: symbolic/subsymbolic; anticipative/reactive control. BI car drivers' behaviour was compared with that of a control group (CTRL) during driving simulator scenarios. Eye movement analysis, among other variables, revealed that BI car drivers made use of a more symbolic and reactive control than did CTRL drivers. CTRL drivers showed a more stable cognitive compromise than BI drivers. The latter became less symbolic and more reactive in the case of difficult scenarios. In addition, BI drivers focused on the main task of trajectory management, with fewer resources devoted to traffic interaction management. **Statement of Relevance:**An explanation of differences between BI and CTRL drivers in terms of cognitive control requirements, attention and processing speed is put forward. From this, it is possible to derive some implications in terms of driver assistance (e.g. lane keeping or a warning assistance device) and rehabilitation.

- **Keywords:** anticipative and reactive behaviour; brain-injured car driver; cognitive control; symbolic and subsymbolic processing

J. AbouHassan; S. Milosavljevic; A. Carman. *Can postural modification reduce kinetic and kinematic loading during the bowing postures of Islamic prayer?* Pages 1446 – 1454.

As stooped postures are known to increase kinematic and kinetic loading on the lumbar spine they can be problematic for people with low back pain and postural task modification is often recommended. For the Muslim with low back pain, the bowing postures during prayer can aggravate low back symptoms. The aims of this study were to describe lumbo-sacral and pelvic tilt kinematics and lumbo-sacral kinetics during the standard bowing postures of Islam and to compare these to kinematic and kinetic data gathered during a clinically recommended modified bowing posture. The study was a repeated measures within subject cross-over design with 33 healthy male Muslim participants. 3-D motion analysis data were gathered to calculate body joint angles during the two bowing postures. A 3-D biomechanical model was then used to calculate spinal loads. Paired t-test analyses showed that the use of the modified posture resulted in significantly less pelvic tilt range of motion and anterior shear force and compressive force L5/S1, at stages 1 and 5 of bowing. Although this study was conducted with healthy young Muslim males, the use of this modified bent knee posture is recommended for all Muslims with low back pain. Clinical trials are being considered to determine the clinical utility of this postural manoeuvre as an intervention. **Statement of Relevance:**The presence of low back pain may hinder a Muslim's ability to use the

traditional Islamic bowing posture. Muslims who have low back pain may benefit from adopting a modification to the traditional bowing posture, which has been found to reduce the loads and postural demands on the lower back.

- **Keywords:** bowing posture; kinematics; kinetics; low back pain; Muslims; range of movement

Fiona C. Trevelyan; Stephen J. Legg. Prevalence and characteristics of back pain among school children in New Zealand. Pages 1455 – 1460.

A cross-sectional survey among 245 children was conducted to establish the prevalence and characteristics of back pain in school children aged 11-14 years. A self-complete questionnaire was used to ascertain demographic details, pain prevalence, psychosocial parameters, school and leisure activities and family characteristics. In the last month, 58% of children had experienced spinal pain. In total, 31% of children reported that pain occurred in one part of the back, while 28% stated that pain presented in more than one spinal region. Pain in the last month was found to be equally prevalent in the low back (35%) and neck (36%) regions. Low back pain was associated with the most severe pain and pain lasting for the longest duration when compared with the upper back and neck regions. Further research should be directed towards investigating pain in the neck region and understanding the characteristics of symptom co-occurrence. **Statement of Relevance:** A survey was conducted to establish the prevalence and characteristics of back pain in school children. The results provide additional evidence that back pain is a serious problem in children aged 11-14 years, whilst also indicating widespread co-occurrence of pain in the neck, upper back and lower back spinal regions.

- **Keywords:** back pain; epidemiology; prevalence; school children

Xingda Qu. Physical load handling and listening comprehension effects on balance control. Pages 1461 – 1467.

The purpose of this study was to determine the physical load handling and listening comprehension effects on balance control. A total of 16 young and 16 elderly participants were recruited in this study. The physical load handling task required holding a 5-kg load in each hand with arms at sides. The listening comprehension task involved attentive listening to a short conversation. Three short questions were asked regarding the conversation right after the testing trial to test the participants' attentiveness during the experiment. Balance control was assessed by centre of pressure-based measures, which were calculated from the force platform data when the participants were quietly standing upright on a force platform. Results from this study showed that both physical load handling and listening comprehension adversely affected balance control. Physical load handling had a more deleterious effect on balance control under the listening comprehension condition vs. no-listening comprehension condition. Based on the findings from this study, interventions for the improvement of balance could be focused on avoiding exposures to physically demanding tasks and cognitively demanding tasks simultaneously. **Statement of Relevance:** Findings from this study can aid in better understanding how humans maintain balance, especially when physical and cognitive loads are applied. Such information is useful for developing interventions to prevent fall incidents and injuries in occupational settings and daily activities.

- **Keywords:** age; balance control; falls; listening comprehension; physical load handling

Iman Dianat; Christine M. Haslegrave; Alex W. Stedmon. Short and longer duration effects of protective gloves on hand performance

capabilities and subjective assessments in a screw-driving task. Pages 1468 – 1483.

The study investigated short and longer duration effects of gloves on hand performance capabilities (muscle activity, dexterity, touch sensitivity, finger pinch and forearm torque strength) and subjective assessments of discomfort and ease of manipulation when performing a light assembly task. The independent variables were hand condition with four levels (wearing cotton, nylon or nitrile gloves as well as barehanded) and point of time within the 2 h duration of the task (with measurements taken at 0, 30, 60, 90 and 120 min). Participants worked with a screwdriver to fit two components together using screws. Wearing gloves significantly increased the muscle activity, pinch strength and discomfort but reduced the dexterity and touch sensitivity. There was also a significant effect of task time on the muscle activity, dexterity, forearm torque strength and touch sensitivity, which indicates that the duration of the task should be an important consideration in glove evaluation studies and in the selection of work gloves. **Statement of Relevance:** It is important to evaluate the effects of gloves on hand performance capabilities in a working context so that job demands can be taken into account and the most appropriate type of glove be chosen for each task. This study gives recommendations regarding the evaluation and use of gloves for screw-driving tasks.

- **Keywords:** assembly task; glove; hand performance capability; screwdriver; work durativ

Peter I. Brown; Tom M. McLellan; Denise M. Linnane; David M. Wilkinson; Victoria L. Richmond; Fleur E. Horner; Sam D. Blacker; Mark P. Rayson. Influence of hydration volume and ambient temperature on physiological responses while wearing CBRN protective clothing. Pages 1484 – 1499.

This study examined a low (L; 5 ml/kg per h) and high (H, 10 ml/kg per h) rate of fluid replacement in moderate (18°C) and hot (30°C) conditions on physiological responses while wearing personal protective equipment (PPE). PPE included the gas-tight suit (GTS), the powered respirator protective suit (PRPS) and the civil responder 1 (CR1). Relative to the moderate condition, physiological responses were greater in the hot condition. The percentage change in body mass was different ($p < 0.05$) between L and H in the hot (L vs. H, GTS: -0.83 vs. -0.38%; PRPS: -1.18 vs. -0.71%; CR1: -1.62 vs. -0.57%) and moderate conditions, although in GTS and CR1 body mass increased (L vs. H, GTS: -0.48 vs. 0.06%; PRPS: -0.66 vs. -0.11%; CR1: -0.18 vs. 0.67%). Fluid replacement strategies for PPE should be adjusted for environmental conditions in order to avoid >1% body mass loss and/or net body mass gain. **Statement of Relevance:** Currently, the UK Emergency Services do not have specific evidence-based fluid replacement guidelines to follow when wearing chemical, biological, radiological and/or nuclear (CBRN) PPE. Although *ad libitum* fluid replacement is encouraged (when breathing apparatus permits), recommendations from evidence-based findings specific to different PPE and to different environmental conditions are lacking. This study provides novel evidence supporting the need to develop fluid replacement strategies during CBRN deployments in both moderate and hot environmental conditions for CBRN PPE.

- **Keywords:** ambient temperature; fluid replacement; protective clothing; rectal temperature

SHORT COMMUNICATION

Ray Lloyd; Karen Hind; Bridget Parr; Simeon Davies; Carlton Cooke. The Extra Load Index as a method for comparing the relative economy of load carriage systems. Pages 1500 – 1504.

The Extra Load Index (ELI) has been proposed as a suitable method of assessing the relative economy of load carriage systems. The purpose of this study was to determine, based on empirical evidence, that the ELI can accommodate variations in both body composition and added load. In total, 30 women walked carrying loads of up to 70% body mass at self-selected walking speeds whilst expired air was collected. In addition, each of the women had body composition assessed via dual energy X-ray absorptiometry. Results show that the ELI is independent of body composition variables, the magnitude of additional loads and the speed of progression. Consequently, it is suggested that it represents an appropriate method of comparing load carriage systems in both scientific and commercial arenas. **Statement of Relevance:** This paper demonstrates that ELI is independent of body composition, added load and speed and is therefore an appropriate method to generalise comparisons of load carriage systems. It has the advantage of being easily understood by manufacturers and consumers whilst retaining appropriate scientific precision.

- **Keywords:** anthropometry; ergonomics tools and methods; physiology; product design