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Kate S. Brasher ; Angela B. C. Dew ; Shaun G. Kilminster ; Robert S. Bridger. *Occupational stress in submariners : the impact of isolated and confined work on psychological well-being.* Pages 305 – 313.

This study aimed to identify work-related and personal factors associated with occupational stress in submariners. Work and well-being questionnaires were distributed to 219 male submariners (mean age 34 years), as part of a larger cohort study involving a stratified sample of 4951 Royal Navy (RN) personnel. The stress rate in submariners was 40%; significantly higher than the stress rate in the general RN, although once demographic factors were controlled for in a matched control sample, this difference was no longer significant. A summary model accounted for 49% of the variance in submariner stress, with key differences emerging between the occupational factors associated with stress in submariners and in the general RN. The longitudinal nature of this study permits stress in submariners to be monitored over 5 years, which will provide valuable insights into the chronicity of stress in this specialised occupational group. **Statement of Relevance:** This paper contributes to the current literature on the negative impact of working in isolated conditions. It is demonstrated that occupational stress in submarines can be partially explained using current theories of stress in the workplace. However, the constraints of a restricted environment introduce additional factors which can also be associated with occupational stress.

- **Keywords:** occupational stress; submariners; extreme environment; isolated environment

R. Wells ; K. McFall ; C. R. Dickerson. *Task selection for increased mechanical exposure variation : relevance to job rotation.* Pages 314 – 323.

It is generally considered that variation in mechanical exposure is beneficial from the viewpoint of preventing musculoskeletal disorders. An approach to quantifying the functional similarity of manual tasks was developed and tested by using three handgrips: power grip (PG); pulp pinch (PP); lateral pinch (LP). Changes in maximal voluntary contraction (MVC) forces were measured during 15 combinations of 2-min duration, 30% MVC isometric contraction in 25 participants. Strength changes in PG were found to be substantially different from LP; when the two grips were alternated, strength dropped to 85.1% MVC whereas after PG alone, strength dropped to 59.3% MVC. The findings

suggest that PG and LP are functionally different enough for their alternating use to contribute to increased exposure variation during manual activities. **Statement of Relevance:** The paper describes how to determine if two tasks, when performed alternately, are different enough to reduce fatigue, increase work capacity and potentially prevent musculoskeletal disorders. Better understanding of the differences between tasks has the potential to improve job design by allowing better choice of tasks that combine to define a job.

- **Keywords:** working rest; hand grip; pinch; fatigue; mechanical exposure

So Young Lee ;J. L. Brand. *Can personal control over the physical environment ease distractions in office workplaces?* Pages 324 – 335.

The purpose of this study was to investigate whether perception of control over aspects of the physical environment reduces the previously documented negative effects of distraction in office workplaces on perceived job performance. This study analysed 384 questionnaires collected from employees in the corporate offices of three manufacturing companies in Michigan, USA. The role of a sense of personal control over physical environment features as a mediating influence between work attitudes and work outcomes was explored using structural equations modelling. The results showed that workers' sense of control over physical aspects of their work environment mediated the relationship between perceived distractions and perceived job performance. These results suggest that increasing perceptions of personal control over features of the physical work environment may serve to link work attitudes and work outcomes. Open-plan offices are common throughout the world, making this study relevant for researchers and practitioners alike. These results suggest that if employees can adjust aspects of their office work environment, this may increase their sense of personal control, reducing the effects of distractions, a frequent complaint in open offices.

- **Keywords:** mediating variable; personal control; distraction; workplace; perceived performance

Jennifer Di Domizio ;Peter J. Keir. *Forearm posture and grip effects during push and pull tasks.* Pages 336 – 343.

Direction of loading and performance of multiple tasks have been shown to elevate muscle activity in the upper extremity. The purpose of this study was to evaluate the effects of gripping on muscle activity and applied force during pushing and pulling tasks with three forearm postures. Twelve volunteers performed five hand-based tasks in supinated, neutral and pronated forearm postures with the elbow at 90° and upper arm vertical. All tasks were performed with the right (dominant) hand and included hand grip alone, push and pull with and without hand grip. Surface EMG from eight upper extremity muscles, hand grip force, tri-axial push and pull forces and wrist angles were recorded during the 10 s trials. The addition of a pull force to hand grip elevated activity in all forearm muscles (all $p < 0.017$). During all push with grip tasks, forearm extensor muscle activity tended to increase when compared with grip only while flexor activity tended to decrease. Forearm extensor muscle activity was higher with the forearm pronated compared with neutral and supinated postures during most isolated grip tasks and push or pull with grip tasks (all $p < 0.017$). When the grip dynamometer was rotated so that the push and pull forces could act to assist in creating grip force, forearm muscle activity generally decreased. These results provide strategies for reducing forearm muscle loading in the workplace. **Statement of Relevance:** Tools and tasks designed to take advantage of coupling grip with push or pull actions may be beneficial in reducing stress and injury in the muscles of the forearm. These factors should be considered in assessing the workplace in terms of acute and cumulative loading.

- **Keywords:** EMG; forearm; posture; force coupling; force; grip; upper extremity; push; pull

Salah R. Agha. *School furniture match to students' anthropometry in the Gaza Strip.* Pages 344 – 354.

This study aimed at comparing primary school students' anthropometry to the dimensions of school furniture and determining whether the furniture used matches the students' anthropometry. A sample of 600 male students, whose ages were between 6 and 11 years, from five primary schools in the Gaza Strip governorates participated in the study. Several students' body dimensions were measured. The dimensions measured included elbow-seat height, shoulder height, knee height, popliteal height and buttock-popliteal length. Measurements of the dimensions of the classroom furniture indicated that there was a considerable mismatch between the students' body dimensions and the classroom furniture. The mismatches in seat height, seat depth and desk height occurred for 99% of the students, while the mismatch for the back rest height was only 35%. Two design specifications were proposed in order to decrease the mismatch percentage based on the data obtained. The two proposed designs showed a considerable improvement in the match percentages as compared to the existing design. **Statement of Relevance:** Having identified mismatches between the dimensions of the school furniture used in primary schools in the Gaza Strip, two new design specifications are proposed and shown to improve match with the students' anthropometric dimensions. The findings of the study are also an important addition to local knowledge on school children's anthropometry.

- **Keywords:** anthropometry, school furniture; students

Jason C. Gillette ; Catherine A. Stevermer ; Ross H. Miller ; Stacey A. Meardon ; Charles V. Schwab. *The effects of age and type of carrying task on lower extremity kinematics.* Pages 355 – 364.

The purpose of this study was to determine the effects of age, load amount and load symmetry on lower extremity kinematics during carrying tasks. Forty-two participants in four age groups (8-10 years, 12-14 years, 15-17 years and adults) carried loads of 0%, 10% and 20% body weight (BW) in large or small buckets unilaterally and bilaterally. Reflective markers were tracked to determine total joint range of motion and maximum joint angles during the stance phase of walking. Maximum hip extension, hip adduction and hip internal rotation angles were significantly greater for each of the child/adolescent age groups as compared with adults. In addition, maximum hip internal rotation angles significantly increased when carrying a 20% BW load. The observation that the 8-10-year-old age group carried the lightest absolute loads and still displayed the highest maximum hip internal rotation angles suggests a particular necessity in setting carrying guidelines for the youngest children. **Statement of Relevance:** Bucket-carrying tasks were analysed as a function of age group, load amount and load symmetry. Hip joint rotations significantly increased when carrying 20% BW loads and in children as compared to adults, which suggests a particular necessity in setting carrying guidelines for the youngest age group (8-10 year olds).

- **Keywords:** biomechanics; gait; load carriage; youth

William D. R. Baker ; Neil J. Mansfield. *Effects of horizontal whole-body vibration and standing posture on activity interference .* Pages 365 – 374.

Standing people are exposed to whole-body vibration in many environments. This paper investigates the effects of horizontal whole-body vibration and standing posture on task

performance. Sixteen participants were exposed to random vibration (up to 4 Hz) whilst performing a timed pegboard task in two standing postures. Objective and subjective indicators of performance were used. Time taken to complete the task increased progressively with increases in vibration magnitude. The fore-and-aft posture generally showed greater performance decrements and postural interruptions ($>1.0 \text{ ms}^{-2}$ root mean square) than the lateral. For both postures, performance was better during y-axis vibration than during x-axis vibration. Subjective ratings showed similar trends to time data. Impairments due to dual axis exposure were well predicted using root sum of squares calculations based on single axis components. These results indicate that best performance for those standing in moving environments will be achieved if individuals adopt a lateral posture with the most severe vibration in the y-axis. **Statement of Relevance:** People have a need to work during transportation, either working for the transport provider or as a passenger. All modes of transport result in travellers being exposed to horizontal motion. This study demonstrates that task disturbance is affected by the orientation of the standing person to the vibration and, therefore, vehicle layouts can be optimised.

- **Keywords:** manual dexterity; pegboard; performance; standing posture; whole-body vibration

Gyouhyung Kyung ; Maury A. Nussbaum ;Kari L. Babski-Reeves. *Enhancing digital driver models : identification of distinct postural strategies used by drivers. Pages 375 – 384.*

Driver workspace design and evaluation is, in part, based on assumed driving postures of users and determines several ergonomic aspects of a vehicle, such as reach, visibility and postural comfort. Accurately predicting and specifying standard driving postures, hence, are necessary to improve the ergonomic quality of the driver workspace. In this study, a statistical clustering approach was employed to reduce driving posture simulation/prediction errors, assuming that drivers use several distinct postural strategies when interacting with automobiles. 2-D driving postures, described by 16 joint angles, were obtained from 38 participants with diverse demographics (age, gender) and anthropometrics (stature, body mass) and in two vehicle classes (sedans and SUVs). Based on the proximity of joint angle sets, cluster analysis yielded three predominant postural strategies in each vehicle class (i.e. 'lower limb flexed', 'upper limb flexed' and 'extended'). Mean angular differences between clusters ranged from 3.8 to 52.4° for the majority of joints, supporting the practical relevance of the distinct clusters. The existence of such postural strategies should be considered when utilising digital human models (DHMs) to enhance and evaluate driver workspace design ergonomically and proactively. **Statement of Relevance:** This study identified drivers' distinct postural strategies, based on actual drivers' behaviours. Such strategies can facilitate accurate positioning of DHMs and hence help design ergonomic driver workspaces.

- **Keywords:** asymmetric driving posture; cluster analysis; comfortable driving posture; preferred driving posture; postural strategies

Eric M. Lamberg ;Marshall Hagins. *Breath control during manual free-style lifting of a maximally tolerated load. Pages 385 – 392.*

Clear evidence links voluntary breath control, intra-abdominal pressure and lumbar stability. However, little is known regarding optimal breath control during manual materials handling. No studies have examined natural breath control while lifting a maximal load. Fourteen healthy subjects lifted a loaded crate from the floor to a table while respiratory flow data were collected. The loads lifted began at 10% of body weight and increased up to 50% (if tolerated) by 5% increments. Data from the minimum, moderate and maximum loads were analysed. Uniform and consistent breath holding during lifting of a maximally tolerated load did not occur. Across all three loads,

frequency of inspiration was highest immediately prior to lift-off and significantly higher inspired volume occurred at lift-off of the load compared with preparation for lifting. Holding the breath does not appear to be related to lifting of a maximally tolerated load from floor to table. **Statement of Relevance:** The findings demonstrate that consistent patterns of naturally occurring breath control during lifting of a maximal load can be identified and do not include uniform breath holding. The findings may assist in creating models for optimal breath control, which will minimise risk of injury during manual material handling tasks.

- **Keywords:** breathing; intra-abdominal pressure; lifting; lumbar stability; respiration

Denham L. Phipps ; Dianne Parker ; George H. Meakin ; Paul C. W. Beatty. *Determinants of intention to deviate from clinical practice guidelines.* Pages 393 – 403.

The volitional nature of procedural violations in work systems creates a challenge for human factors research and practice. In order to understand how violations are caused and what can be done to mitigate them, there is a need to determine the influence of workers' beliefs about rules and guidelines. This study demonstrates the use of a social psychological approach to investigate the beliefs of anaesthetists about clinical practice guidelines. A survey was completed by 629 consultant anaesthetists, who rated their beliefs about deviation from three guidelines (performing pre-operative visits; checking anaesthetic equipment; handling intravenous fluid bags). Regression analysis indicated that the belief ratings predicted self-rated intention to deviate from the guidelines. Implications for understanding anaesthetists' adherence to guidelines are discussed. **Statement of Relevance:** This study builds upon previous work by the authors, presenting a more detailed insight into potential causes of procedural violations in healthcare. The study also demonstrates the use of a social psychological method to the investigation of violations. Hence, it is of interest to researchers and practitioners interested in human reliability, especially in healthcare.

- **Keywords:** anaesthesia; patient safety; psychology; theory of planned behaviour; violations

Ying Wang ; Bruce Mehler ; Bryan Reimer ; Vincent Lammers ; Lisa A. D'Ambrosio ; Joseph F. Coughlin. *The validity of driving simulation for assessing differences between in-vehicle informational interfaces : a comparison with field testing.* Pages 404 – 420.

Data from on-road and simulation studies were compared to assess the validity of measures generated in the simulator. In the on-road study, driver interaction with three manual address entry methods (keypad, touch screen and rotational controller) was assessed in an instrumented vehicle to evaluate relative usability and safety implications. A separate group of participants drove a similar protocol in a medium fidelity, fixed-base driving simulator to assess the extent to which simulator measures mirrored those obtained in the field. Visual attention and task measures mapped very closely between the two environments. In general, however, driving performance measures did not differentiate among devices at the level of demand employed in this study. The findings obtained for visual attention and task engagement suggest that medium fidelity simulation provides a safe and effective means to evaluate the effects of in-vehicle information systems (IVIS) designs on these categories of driver behaviour. **Statement of Relevance:** Realistic evaluation of the user interface of IVIS has significant implications for both user acceptance and safety. This study addresses the validity of driving simulation for accurately modelling differences between interface methodologies

by comparing results from the field with those from a medium fidelity, fixed-base simulator.

- **Keywords:** destination entry; driving simulator; in-vehicle information system; validity; visual attention

A. H. Wertheim. *Visual conspicuity : a new simple standard, its reliability, validity and applicability.* Pages 421 – 442.

A general standard for quantifying conspicuity is described. It derives from a simple and easy method to quantitatively measure the visual conspicuity of an object. The method stems from the theoretical view that the conspicuity of an object is not a property of that object, but describes the degree to which the object is perceptually embedded in, i.e. laterally masked by, its visual environment. First, three variations of a simple method to measure the strength of such lateral masking are described and empirical evidence for its reliability and its validity is presented, as are several tests of predictions concerning the effects of viewing distance and ambient light. It is then shown how this method yields a conspicuity standard, expressed as a number, which can be made part of a rule of law, and which can be used to test whether or not, and to what extent, the conspicuity of a particular object, e.g. a traffic sign, meets a predetermined criterion. An additional feature is that, when used under different ambient light conditions, the method may also yield an index of the amount of visual clutter in the environment. Taken together the evidence illustrates the methods' applicability in both the laboratory and in real-life situations. Statement of Relevance: This paper concerns a proposal for a new method to measure visual conspicuity, yielding a numerical index that can be used in a rule of law. It is of importance to ergonomists and human factor specialists who are asked to measure the conspicuity of an object, such as a traffic or rail-road sign, or any other object. The new method is simple and circumvents the need to perform elaborate (search) experiments and thus has great relevance as a simple tool for applied research.

- **Keywords:** conspicuity; crowding; lateral masking; visibility; visual clutter; visual search