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J. C. Marquié; L. Rico Duarte; P. Bessières; C. Dalm; C. Gentil; J. B. Ruidavets. *Higher mental stimulation at work is associated with improved cognitive functioning in both young and older workers. Pages 1287 – 1301.*

The study examined whether mental stimulation received in the workplace positively affects cognitive functioning and rate of cognitive change. Data taken from the VISAT (ageing, health and work) longitudinal study concerned 3237 workers who were seen three times (in 1996, 2001 and 2006) and who were aged between 32 and 62 years at baseline. Measures of cognitive stimulation both at work and outside work were available at baseline. Cognitive efficiency was assessed on the three occasions through episodic verbal memory, attention and processing speed tests. Greater cognitive stimulation (at work and outside work) was associated with higher levels of cognitive functioning and a more favourable change over the 10-year follow-up. These results were obtained after adjustment for age, education, sex and a variety of medical, physical and psychosocial confounders. The study thus supports the hypothesis that exposure to jobs that are mentally demanding and that offer learning opportunities increases the level of cognitive functioning and possibly attenuates age-related decline. **Statement of Relevance:** The effect of occupational activity on cognitive functioning is under-researched. This paper reports results from a substantive longitudinal study, with findings indicating that exposure to jobs that are mentally demanding are beneficial in increasing levels of cognitive functioning and possibly attenuating age-related decline.

- **Keywords:** ageing; cognitive performance; cognitive stimulation; longitudinal study; mental demand; work

Enid Montague. *Patient source of learning about health technologies and ratings of trust in technologies used in their care. Pages 1302 – 1310.*

In order to design effective health technologies and systems, it is important to understand how patients learn and make decisions about health technologies used in their care. The objective of this study was to examine patients' source of learning about technologies used in their care and how the source related to their trust in the technology was used. Individual face-to-face and telephone interviews were conducted with 24 patients. Altogether, 13 unique sources of information about technology were identified and three major themes emerged: outside of the work system vs. inside the work

system; when the health information was provided; the medium used. Patients used multiple sources outside of the healthcare work system to learn about technologies that will be used in their care. Results showed a relationship between learning about technologies from web sources and trust in technologies but no relationship between learning about technologies from healthcare providers and trust in technologies. **Statement of Relevance:** The value of considering human attitudes about elements in health systems has been illustrated. This research shows a relationship between patient attitudes about medical technologies used in their care and healthcare work system design. Results show that patient attitudes are formed about technologies used in their care by sources within and outside of the sociotechnical work system.

- **Keywords:** consumer health informatics; education; health systems; patient-provider relationship; sociotechnical systems

J. Sauer; A. Darioly; M. Schmid Mast; P. C. Schmid; N. Bischof. *A multi-level approach of evaluating crew resource management training : a laboratory-based study examining communication skills as a function of team congruence.* Pages 1311 – 1324.

The article proposes a multi-level approach for evaluating communication skills training (CST) as an important element of crew resource management (CRM) training. Within this methodological framework, the present work examined the effectiveness of CST in matching or mismatching team compositions with regard to hierarchical status and competence. There is little experimental research that evaluated the effectiveness of CRM training at multiple levels (i.e. reaction, learning, behaviour) and in teams composed of members of different status and competence. An experiment with a two (CST: with vs. without) by two (competence/hierarchical status: congruent vs. incongruent) design was carried out. A total of 64 participants were trained for 2.5 h on a simulated process control environment, with the experimental group being given 45 min of training on receptiveness and influencing skills. Prior to the 1-h experimental session, participants were assigned to two-person teams. The results showed overall support for the use of such a multi-level approach of training evaluation. Stronger positive effects of CST were found for subjective measures than for objective performance measures. **Statement of Relevance:** This work provides some guidance for the use of a multi-level evaluation of CRM training. It also emphasises the need to collect objective performance data for training evaluation in addition to subjective measures with a view to gain a more accurate picture of the benefits of such training approaches.

- **Keywords:** communication skills; crew resource management training; performance; team composition

Alan H. S. Chan; Annie W. Y. Ng. *Effects of sign characteristics and training methods on safety sign training effectiveness.* Pages 1325 – 1346.

This study investigated whether or not training methods affected the effectiveness of symbol training and if there were any relationships between sign symbol characteristics and training effectiveness. Altogether, 26 Mainland China industrial safety signs were used and 60 participants were randomly assigned into four equal-sized groups of control, paired-associate learning, recall training and recognition training. The result was that participants from all the training groups showed significantly greater improvement in comprehension performance than those in the control group, indicating that the training methods improved comprehension of the meaning of safety signs. Participants from the recall training group performed better in the post-training test than those from other training groups. It seems that the recall task elicited a deeper level of learning than the recognition task and that questioning and feedback had a positive effect on training

effectiveness. The results also showed that sign characteristics had no significant influence on training effectiveness. It was concluded that recall training is more effective in enhancing comprehension of industrial safety signs than paired-associate learning or recognition training. The findings of this study provide a basis for useful guidelines for designing symbol-training programmes and for designing more user-friendly safety signs. **Statement of Relevance:** The present study shows that recall training was more effective in improving comprehension of industrial safety signs than paired-associate learning or recognition training and cognitive sign features did not influence training effectiveness. They provide a basis for useful guidelines for designing symbol-training programmes and for designing more user-friendly safety signs.

- **Keywords:** safety signs; training; sign features; recall; recognition; paired associate training

Patrick G. Dempsey; Svend Erik Mathiassen; Jennie A. Jackson; Niall V. O'Brien. *Influence of three principles of pacing on the temporal organisation of work during cyclic assembly and disassembly tasks.* Pages 1347 – 1358.

A study was conducted to investigate the influence of different approaches to arranging the pace and temporal organisation of repetitive assembly and disassembly tasks on both average performance and its variability and to compare assembly and disassembly times derived with psychophysical methods to a more traditional methods-time measurement (MTM) approach. The conditions studied were a traditional assembly line arrangement, where assemblies were started at a pace of 110 MTM (repeated on two occasions), a batch condition, where subjects were required to complete 36 assemblies within the total amount of time allowed at 110, MTM and a psychophysical condition, where subjects were allowed to choose their pace (repeated on two occasions). Overall, the results suggest that the mean time spent working in each cycle (the 'on-time') remained fairly constant across conditions, while the idle 'off-time' in between on-times was shorter and of less varied duration in the more autonomous batch and psychophysical conditions. During the second psychophysical (self-paced) condition, subjects completed a significantly higher number of assemblies than during the 110 MTM line condition. The higher pace was achieved through reduction in mean off-times and the potential implications for musculoskeletal risk are discussed. **Statement of Relevance:** Higher levels of autonomy over work pace, which intuitively would be beneficial from an ergonomics standpoint, actually led to subjects selecting to organise work such that off-times (idle times) were reduced. In contrast, active 'on' times were not affected much by autonomy. These results point to a reason that piecework would be associated with increased risk for musculoskeletal disorders.

- **Keywords:** laboratory study; management of production; work organisation

Robert D. Catena; Angela DiDomenico; Jacob J. Banks; Jack T. Dennerlein. *The effect of load weight on balance control during lateral box transfers.* Pages 1359 – 1367.

Few studies have endeavoured to measure balance control during manual material handling. This study examined the effects of load weight during a stationary manual material handling task. In total, 36 healthy participants completed 180° lateral transfer tasks of a loaded (5% of body weight) and an unloaded box. The projection of the centre of mass onto the base of support, as measured via a passive-marker 3-D motion analysis system, was used to quantify balance control. Muscle activities of lower extremity muscles were also measured. When moving the loaded box, individuals ventured ≥ 1 cm closer to the edges of the base of support and increased centre of mass movement up to 14%. In addition, muscle electromyographic activity on both sides of the shank

increased. In summary, during loaded configurations, vulnerability to loss of balance was increased and individuals appeared to adapt by increasing co-contraction of the shank muscles suggesting increased ankle stiffness. **Statement of Relevance:** Industries requiring manual material handling have a particularly high rate of injuries due to falls. This study suggests that larger load weights during lateral material handling tasks adversely affect balance control and may create a vulnerability to imbalance throughout the entire manoeuvre.

- **Keywords:** balance control; falls; load weight; manual material handling

David W. Wagner; Matthew P. Reed; Don B. Chaffin. *The development of a model to predict the effects of worker and task factors on foot placements in manual material handling tasks. Pages 1368 – 1384.*

Accurate prediction of foot placements in relation to hand locations during manual materials handling tasks is critical for prospective biomechanical analysis. To address this need, the effects of lifting task conditions and anthropometric variables on foot placements were studied in a laboratory experiment. In total, 20 men and women performed two-handed object transfers that required them to walk to a shelf, lift an object from the shelf at waist height and carry the object to a variety of locations. Five different changes in the direction of progression following the object pickup were used, ranging from 45° to 180° relative to the approach direction. Object weights of 1.0 kg, 4.5 kg, 13.6 kg were used. Whole-body motions were recorded using a 3-D optical retro-reflective marker-based camera system. A new parametric system for describing foot placements, the Quantitative Transition Classification System, was developed to facilitate the parameterisation of foot placement data. Foot placements chosen by the subjects during the transfer tasks appeared to facilitate a change in the whole-body direction of progression, in addition to aiding in performing the lift. Further analysis revealed that five different stepping behaviours accounted for 71% of the stepping patterns observed. More specifically, the most frequently observed behaviour revealed that the orientation of the lead foot during the actual lifting task was primarily affected by the amount of turn angle required after the lift ($R^2 = 0.53$). One surprising result was that the object mass (scaled by participant body mass) was not found to significantly affect any of the individual step placement parameters. Regression models were developed to predict the most prevalent step placements and are included in this paper to facilitate more accurate human motion simulations and ergonomics analyses of manual material lifting tasks. **Statement of Relevance:** This study proposes a method for parameterising the steps (foot placements) associated with manual material handling tasks. The influence of task conditions and subject anthropometry on the foot placements of the most frequently observed stepping pattern during a laboratory study is discussed. For prospective postural analyses conducted using digital human models, accurate prediction of the foot placements is critical to realistic postural analyses and improved biomechanical job evaluations.

- **Keywords:** lifting; manual material handling; parameterisation; step; transfer

Ryan P. Blood; James D. Ploger; Peter W. Johnson. *Whole body vibration exposures in forklift operators : comparison of a mechanical and air suspension seat. Pages 1385 – 1394.*

Using a repeated measures design, this study compared differences in whole body vibration (WBV) exposures when 12 forklift operators drove the same forklift with a mechanical suspension and an air suspension seat. A portable PDA-based WBV data acquisition system collected and analysed time-weighted and raw WBV data per ISO 2631-1 and 2631-5 WBV measurement standards. Tri-axial measurements of weighted vibration (A_w), crest factor, vibration dose values, time-weighted average-peak, raw (+) peak, raw (-) peak and static compression dose (S_{ed}) were compared between seats.

There were significant differences in z-axis WBV exposures with the air suspension seat, yielding lower WBV exposures. In addition, there were differences between seats in how they attenuated WBV exposures based on the driver's weight. In the mechanical suspension seat, WBV exposures were weight-dependent, with lighter drivers having higher WBV exposures, whereas with the air suspension seat, the same trends were not as prevalent. **Statement of Relevance:** This study contributes to the understanding of how different seat suspensions can influence WBV transmission and how some components of vibration transmission are dependent on the weight of the driver. Additional systematic studies are needed to quantify how various factors can influence WBV exposures.

- **Keywords:** back pain; injury risks; intervention effectiveness; musculoskeletal disorders; vehicle ergonomics

Charles K. Anderson. *Relationship between aerobic capacity, injury risk and tenure for new-hire delivery drivers.* Pages 1395 – 1401.

Over a 2-year study period, aerobic capacity was measured at time of hire for 1419 delivery drivers. Injury experience and tenure were then monitored for these new-hires during that same period. Number of strain injuries, time to first strain and time to termination were regressed on aerobic capacity adjusting for tenure. Statistically significant, monotonically changing relationships were found for all three outcome variables. A unit increase in aerobic capacity was predicted to result in a 3.7% decrease in injury rate and a 1.1% decrease in risk of termination. When age was included in the model for time to termination, aerobic capacity was no longer a significant predictor. The findings regarding injury experience and aerobic capacity support National Institute for Occupational Safety and Health recommendations that individuals should work at no more than 21-30% of their aerobic capacity. **Statement of Relevance:** Knowledge of the nature of the relationship between aerobic capacity, injury experience and retention allows the ergonomist to determine whether there is a point of diminishing returns in intervention effectiveness for higher levels of aerobic capacity.

- **Keywords:** injury risk; musculoskeletal disorders; NIOSH lifting equation; personnel selection; physical work capacity