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Christopher Durugbo. *Work domain analysis for enhancing collaborations: a study of the management of microsystems design.* Pages 603-620.

Collaboration is an important process that enables organisations to achieve goals or solve problems and, in design processes, is an important factor for accomplishing interdisciplinary and multidisciplinary tasks. An understanding of the functional configuration of organisations could therefore offer a useful insight into collaborations of designers. This study makes use of work domain analysis (WDA) to analyse the management of design by organisations within the microsystems technology (MST) domain. The WDA considers the functional configuration of MST companies in terms of management constraints and boundaries. This study also makes use of the WDA to suggest ways of establishing collaborative design and enhancing collaboration between organisations.

Practitioner Summary: The results of this methodical analysis offer useful insights for managing design functions. This study also presents recommendations for enhancing collaboration in organisations. The ability to manage and collaborate in design functions is valuable for improving the productivity, cost-effectiveness and time-to-market systems.

- **Keywords:** work domain analysis, cognitive work analysis, collaborative working, organisational design

Peter Kolb, Christine Gockel & Lioba Werth. *The effects of temperature on service employees' customer orientation: an experimental approach.* Pages 621-635.

Numerous studies have demonstrated how temperature can affect perceptual, cognitive and psychomotor performance (e.g. Hancock, P.A., Ross, J., and Szalma, J., 2007. A meta-analysis of performance response under thermal stressors. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 49 (5), 851–877). We extend this research to interpersonal aspects of performance, namely service employees' and salespeople's customer orientation. We combine ergonomics with recent research on social cognition linking physical with interpersonal warmth/coldness. In Experiment 1, a scenario study in the lab, we demonstrate that student participants in rooms with a low temperature showed more customer-oriented behaviour and gave higher customer discounts than participants in rooms with a high temperature – even in zones of thermal

comfort. In Experiment 2, we show the existence of alternative possibilities to evoke positive temperature effects on customer orientation in a sample of 126 service and sales employees using a semantic priming procedure. Overall, our results confirm the existence of temperature effects on customer orientation. Furthermore, important implications for services, retail and other settings of interpersonal interactions are discussed.

Practitioner Summary: Temperature effects on performance have emerged as a vital research topic. Owing to services' increasing economic importance, we transferred this research to the construct of customer orientation, focusing on performance in service and retail settings. The demonstrated temperature effects are transferable to services, retail and other settings of interpersonal interactions.

- **Keywords:** temperature, customer orientation, interpersonal performance, helping behaviour

P.J. Pisula, C.H. Lewis & R.S. Bridger. *Vessel motion thresholds for maintaining physical and cognitive performance: a study of naval personnel at sea.* Pages 636-649.

Methods and results are reported from a study of ships companies' exposure to low-frequency motions on three vessels of the Royal Navy. The aim of the study was to investigate relationships between deck accelerations and the incidence of problems such as difficulties with physical tasks, cognitive activities, motion sickness, and work effort. Ship motions were recorded continuously during sea patrols of 10–14 days. The data collected from the three vessels comprised 105 days of ship motions over 12 patrols, with 779 associated daily diaries from 78 participants. Problems most strongly associated with vessel motions were related to the difficulties with physical tasks. Some cognitive aspects of task performance and motion sickness were associated with vertical acceleration magnitudes, but the correlations were less strong than with physical tasks.

Practitioner Summary: Little is known about the severity of ship motions that degrade physical and mental performance. The paper offers preliminary estimates of the motion threshold values below which the performance will not be degraded by motion.

- **Keywords:** ship motion, physical effects, cognitive effects

Francesco Draicchio, Martina Trebbi, Silvia Mari, Federico Forzano, Mariano Serrao, Andreas Sicklinger, Alessio Silvetti, Sergio Iavicoli & Alberto Ranavolo. *Biomechanical evaluation of supermarket cashiers before and after a redesign of the checkout counter.* Pages 650-669.

An experiment was carried out on supermarket cashiers to evaluate the time, kinematic and electromyographic changes, in both sitting and standing positions, following the redesign of a checkout counter. The novelty of the prototype checkout counter is a disk wheel placed in the bagging area, which is designed to avoid the cashier having to manually push products along the bagging area. The kinematic evaluation was based on the upper limb and trunk range of motions (RoM). The electromyographic parameters assessed were mean and maximum muscular activations. Three factors were taken into account: design (before and after redesign), posture (standing or sitting) and bagging area (anterior or posterior). The results show that the RoM values are lowest after the intervention and in the standing position. Mean and maximum muscular activation patterns are similar. Differences related to the bagging area in which the goods were released also emerged. The disk wheel represents a valid aid for reducing biomechanical overload in cashiers; the standing position is biomechanically more advantageous.

Practitioner Summary: EMG and optoelectronic motion analysis systems are useful for the quantitative assessment of the effects of the redesign of the workplace biomechanical risk. Our results suggest that a disk wheel positioned in the bagging area reduces the biomechanical risk for cashiers and increases time spent resting.

- **Keywords:** ergonomic redesign, work posture, motion analysis, electromyography, checkout counter

J.L. Bruno Garza, B.H.W. Eijkelhof, P.W. Johnson, S.M. Raina, P.W. Rynell, M.A. Huysmans, J.H. van Dieën, A.J. van der Beek, B.M. Blatter & J.T. Dennerlein. *Observed differences in upper extremity forces, muscle efforts, postures, velocities and accelerations across computer activities in a field study of office workers. Pages 670-681.*

This study, a part of the PRedicting Occupational biomechanics in Office workers (PROOF) study, investigated whether there are differences in field-measured forces, muscle efforts, postures, velocities and accelerations across computer activities. These parameters were measured continuously for 120 office workers performing their own work for two hours each. There were differences in nearly all forces, muscle efforts, postures, velocities and accelerations across keyboard, mouse and idle activities. Keyboard activities showed a 50% increase in the median right trapezius muscle effort when compared to mouse activities. Median shoulder rotation changed from 25 degrees internal rotation during keyboard use to 15 degrees external rotation during mouse use. Only keyboard use was associated with median ulnar deviations greater than 5 degrees. Idle activities led to the greatest variability observed in all muscle efforts and postures measured. In future studies, measurements of computer activities could be used to provide information on the physical exposures experienced during computer use.

Practitioner Summary: Computer users may develop musculoskeletal disorders due to their force, muscle effort, posture and wrist velocity and acceleration exposures during computer use. We report that many physical exposures are different across computer activities. This information may be used to estimate physical exposures based on patterns of computer activities over time.

- **Keywords:** office ergonomics, biomechanics, task analysis, human-computer interaction

Jérémy Rossi, Eric Berton, Laurent Grélot, Charlie Barla & Laurent Vigouroux. *Characterisation of forces exerted by the entire hand during the power grip: effect of the handle diameter. Pages 682-692.*

The objective of this study was to analyse the effect of the handle diameter on the grip forces exerted by the hand during a maximal power grip task. A handle ergometer, combining six instrumented beams and a pressure map, was used to determine the forces exerted by the palm side of the hand regrouping data from 10 anatomical sites (fingertips, phalanges, thumb, palm...). This methodology provided results giving new insight into the effect of the handle diameter on the forces exerted by the hand. First, it appeared that the relationship between the hand length/handle diameter ratio and the maximal grip force fit a U-inverted curve with maximal values observed for a handle diameter measuring 17.9% of the hand length. Second, it was showed that the handle diameter influenced the forces exerted on the anatomical sites of the hand. Finally, it was showed that the handle diameter influenced the finger force sharing particularly for the index and the little fingers.

Practitioner Summary: This study analysed the effect of the handle diameter on the grip forces exerted by the hand during a maximal power grip force. This study showed

that measurement of the totality of the forces exerted at the hand/handle interface is needed to better understand the ergonomics of handle tools. Our results could be re-used by designers and clinicians in order to develop handle tools which prevent hand pathologies.

- **Keywords:** power grip, force distribution, handle diameter, ergonomics, maximal force

Pattanasin Areeudomwong, Rungthip Puntumetakul, David B. Kaber, Sawitri Wanpen, Naruemon Leelayuwat & Uraiwan Chatchawan. *Effects of handicraft sitting postures on lower trunk muscle fatigue. Pages 693-703.*

The purpose of this study was to assess trunk muscle fatigue in seated handicraft tasks using surface electromyography (sEMG) and visual analogue scale (VAS) ratings for trunk discomfort, and to assess the relationship of these responses. Twenty-three participants were randomly assigned to assumed crossed-leg and heel sitting postures for 30 min. Normalised median frequency (NMF) slopes for lumbar multifidus (LM) and internal oblique (IO) muscles and VAS ratings were recorded. Results revealed that the crossed-leg posture produced significantly steeper NMF slopes for both sides of the LM and IO muscles than heel sitting. Greater VAS ratings were found in crossed-leg sitting posture than the heel sitting posture. The NMF slopes and the VAS ratings had significant negative correlations for both postures. Findings support heel sitting in handicraft tasks over crossed-leg sitting due to greater trunk muscle fatigue and discomfort during the latter posture. Results support VAS ratings as a complementary method to sEMG for identifying trunk muscle fatigue.

Practitioner Summary: Trunk muscle fatigue in handicraft work is a potential risk for low back pain. Based on EMG and discomfort analyses, heel sitting is preferred to crossed-leg posture. Discomfort ratings are consistent with EMG measures in identifying trunk muscle fatigue in such postures.

- **Keywords:** trunk muscle fatigue, body discomfort, surface electromyography, visual analogue scale, normalised median frequency slope

J. White & J. Scurr. *Evaluation of professional bra fitting criteria for bra selection and fitting in the UK. Pages 704-711.*

A correctly fitting bra is essential for good health; this study investigates the use of professional bra fitting criteria to establish best-fit in an underwire bra commonly sold in the UK. A comparison was made between women's bra size as measured by the traditional bra fitting method with their recommended bra size based on professional bra fitting criteria. Forty-five female participants were recruited; their mode self-reported bra size was 34DD. Participants were measured in their own bra using the traditional bra-fitting method to establish their 'traditional size'. A 'best-fit' bra size was recorded for participants based on professional bra fitting criteria. Significant differences were found between traditional and best-fit cup and band sizes ($p < 0.001$); the traditional method of bra fitting overestimated band size and underestimated cup size. As band size increased the traditional method also became more inaccurate ($p < 0.001$). It is recommended that women are educated in assessing their own bra fit using professional bra fitting criteria and less emphasis placed on determining absolute bra size.

Practitioner Summary: This is the first study to investigate using professional bra fitting criteria to establish best-fit in an underwired bra commonly sold in the UK. The traditional method of bra fitting was found to be inadequate, especially for larger-breasted women; the use of professional bra fitting criteria should be encouraged.

- **Keywords:** sizing, fit, bra, women, education