



**E. Galy; C. Mélan; M. Cariou. *Investigation of task performance variations according to task requirements and alertness across the 24-h day in shift workers.* S. 1338–1351.**

**Abstract:** The study investigated time-of-day effects on task performance in shift workers in different tasks (reaction time, discrimination, probe recognition, free recall), by varying task-specific features. On each of six recordings, each programmed on a different day and in a randomised order, operators rated alertness and performed different tasks. Self-rated alertness varied according to a typical diurnal trend. Time of day also affected reaction time (slower responses at 03:00 hours), discrimination performance (lower accuracy at 03:00 hours in the most difficult condition) and recall (superior recall at 07:00 and 11:00 hours following deeper processing at encoding). The data demonstrated time-of-day effects on cognitive processes also involved in many real-job activities, despite the lack of control for a number of exogenous factors known to interfere with performance in work settings. Since in the cognitively more loaded tasks, time-of-day effects depended on task conditions, the findings are of operational concern in shift-work situations involving differential task requirements. In a real-job setting, performance variations were observed according to time of day and task requirements in a set of cognitively more or less demanding tasks. Task-specific research across the 24-h day enables a better understanding of operators' tasks and the development of supporting technology.

- **Keywords:** shift-workers; alertness; reaction time; non-verbal discrimination; memory tasks

**Jan M. Noyes; Kate J. Garland. *Computer- vs. paper-based tasks : are they equivalent?* S. 1352–1375.**

**Abstract:** In 1992, Dillon published his critical review of the empirical literature on reading from paper vs. screen. However, the debate concerning the equivalence of computer- and paper-based tasks continues, especially with the growing interest in online assessment. The current paper reviews the literature over the last 15 years and contrasts the results of these more recent studies with Dillon's findings. It is concluded that total equivalence is not possible to achieve, although developments in computer technology, more sophisticated comparative measures and more positive user attitudes have resulted in a continuing move towards achieving this goal. Many paper-based tasks used for assessment or evaluation have been transferred directly onto computers with little regard for any implications. This paper considers equivalence issues between the media by reviewing performance measures. While equivalence seems impossible, the importance of any differences appears specific to the task and required outcomes.

- **Keywords:** computer vs. paper; NASA-TLX workload measure; online assessment; performance indices

**S. S. Ho; W. Yu; T. T. Lao; D. H. K. Chow; J. W. Chung; Y. Li. *Comfort evaluation of maternity support garments in a wear trial.* S. 1376–1393.**

**Abstract:** This study aims to evaluate the wear comfort of eight commercially available maternity support garments. The thermophysiological, sensory/tactile and movement comfort were assessed in a wear trial using a 19-item questionnaire. Fourteen pregnant Chinese women aged  $32.3 \pm 4.2$  years were recruited from a local obstetric clinic. The results show that the tested garments generally provided greater sensory comfort than thermophysiological comfort. The thermophysiological comfort was mainly influenced by the fibre contents and breathability. Significant linear relationships were found between material appearance and hand feel ( $r = 0.86, p < 0.001$ ), and between non-itchiness and no red mark ( $r = 0.78, p < 0.001$ ). Movement comfort was influenced by the garment type and style features. Overall, the soft, good-fit, cotton/elastane maternity brief was

perceived as the best product. The findings of comfort needs in pregnant women and the effects of various garment attributes would be helpful for the development of maternity support garment design criteria that are required to satisfy critical ergonomic needs. Low back pain during pregnancy is a common and significant health problem. A maternity support garment is regarded as a convenient and safe device to stabilise the lumbar spine so as to relieve pain. However, patient compliance is likely to be affected by discomfort and inconvenience. The results of this study provide guidance for the optimal design of maternity support clothing.

- **Keywords:** maternity; garment; comfort; thermophysiological; sensory; movement

**Michael A. Cornell; Mohammad T. Khasawneh. *An ergonomic comparison of firearm safety mechanisms.* S. 1394–1406.**

**Abstract:** As with most machines, the integral safety mechanism on firearms is vital to injury or fatality free operation. Presently, there is little or no standardisation in the design of these mechanisms. In this investigation, five existing designs found on both military and commercial rifles were evaluated ergonomically to determine the most effective characteristics for incorporation into future designs. The designs were evaluated experimentally on ease of use, visual effectiveness and operational impact. Three groups, representing a total of 30 subjects with widely varying experience, were selected. Results strongly suggest that safeties whose actuators are mounted within easy reach of the trigger finger are preferred and have the least operational impact. Subjects also preferred and were more adept at recognising safety status when the indicator was located on the receiver/barrel along the normal line of sight. Subjects more often correctly identified safety status when the indicator utilised colouring, was clearly marked and/or was in the normal line of sight. The results of this research prove that ergonomics can contribute to the understanding of firearm safety dynamics. The two essential components of safety mechanism design identified in this investigation, unambiguous status visibility and impact-free operation, are also likely to have implications in non-firearm safety mechanism design. This is particularly true for devices whose inadvertent operation can cause injury, as well as systems in which operational effectiveness can be jeopardised when attentiveness or operational control are lost in the process of actuating a poorly designed safety mechanism.

- **Keywords:** firearm safety; ergonomic evaluation; safety mechanism design

**Chandan K. Pradhan; Sridhar Thakur; Ajay K. Mukherjee; Amal Roychowdhury. *Energy expenditure of cycle rickshaw pullers in different places in India.* S. 1407–1417.**

**Abstract:** The cycle rickshaw is a popular transportation device. The aim of the study was to assess workload of cycle rickshaw pullers-physiological and subjective at four different places in India. Subjects were instructed to pull a cycle rickshaw with two passengers, for 20 min. Working and recovery heart rates were recorded. The mean values of energy expenditure of pulling a cycle rickshaw varied from  $23.5 \pm 2.66$  to  $25.35 \pm 1.51$  kJ/min. Relative cardiac strain and cardiac cost indicated that the job is 'heavy' to 'very heavy'. Subjective assessment of workload was 'heavy' to 'very heavy'. The combined workload assessed from physiological parameters and subjective assessment indicated that the job could be categorised as 'heavy' to 'very heavy' at all the places studied and needs to be reduced by redesigning the structural and functional components of the cycle rickshaw. The rickshaw pullers carry out the jobs many times per day, sometimes without proper rest pauses between trips. The outcome of the research project is beneficial for cycle rickshaw pullers, health administrators as well as manufacturers of cycle rickshaws. Primarily, the manufacturers would be able to use the data for producing a newer model of cycle rickshaw, which would require less energy to

drive. The health administrators would be able to take policy decisions for administering better health care for the unorganised and underprivileged workers. The pullers could be guided into taking care of their health by improving their work practice, i.e. taking a sufficient rest pause between trips.

- **Keywords:** cycle rickshaw pulling; heart rate; energy expenditure; subjective assessment

**Kimberly L. Elsner; Fred W. Kolkhorst. *Metabolic demands of simulated firefighting tasks.* S. 1418–1425.**

**Abstract:** Firefighters having higher cardiovascular fitness completed a series of simulated firefighting tasks more quickly than those having lower fitness. These results support the need of a high level of cardiovascular fitness for firefighters to ensure not only their safety, but that of fellow firefighters and rescue victims.

- **Keywords:** energy expenditure; cardiovascular fitness; oxygen uptake; firefighters

**Gert S. Faber; Idsart Kingma; Nico J. Delleman; Jaap H. van Dieën. *Effect of ship motion on spinal loading during manual lifting.* S. 1426–1440.**

**Abstract:** This study investigated the effects of ship motion on peak spinal loading during lifting. All measurements were done on a ship at sea. In 1-min trials, which were repeated over a wide range of sailing conditions, subjects lifted an 18 kg box five times. Ship motion, whole body kinematics, ground reaction forces and electromyography were measured and the effect of ship motion on peak spinal moments and compression forces was investigated. To investigate whether people time their lifts in order to reduce the effect of ship motion on back loading, trials were performed at a free and at a constrained (lifting every 10s) work pace. With increase of the (local) vertical ship acceleration, increased moments and compression forces were found. Furthermore, lifting at a free work pace did not result in smaller effects of ship motion on spinal moments and compression forces than working at a constrained work pace.

- **Keywords:** low back; spinal loading; ship motion; ship acceleration; lifting

**M. Domalain; L. Vigouroux; F. Danion; V. Sevrez; E. Berton. *Effect of object width on precision grip force and finger posture.* S. 1441–1453.**

**Abstract:** This study aimed to define the effect of object width on spontaneous grasp. Participants held objects of various masses (0.75 to 2.25 kg) and widths (3.5 to 9.5 cm) between thumb and index finger. Grip force, maximal grip force and corresponding finger postures were recorded using an embedded force sensor and an optoelectronic system, respectively. Results showed that index finger joints varied to accommodate the object width, whereas thumb posture remained constant across conditions. For a given object mass, grip force increased as a function of object width, although this result is not dictated by the laws of mechanics. Because maximal grip force also increased with object width, we hypothesise that participants maintain a constant ratio between grip force and their maximal grip force at each given width. Altogether we conclude that when the task consists in manipulating objects/tools, the optimal width is different than when maximal force exertions are required.

- **Keywords:** precision grip; object shape; pinch force; finger joint angle; hand-held object; optimal width