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M.F. Lesch, W.J. Horrey, M.S. Wogalter & W.R. Powell. *Age-related differences in warning symbol comprehension and training effectiveness : effects of familiarity, complexity, and comprehensibility. Pages 879-890.*

Age-related changes in selective attention, inhibitory efficiency, and the ability to form new associations suggest that older adults may have greater difficulty with more complex and less comprehensible symbols. We examined comprehension of symbols varying in terms of ratings of familiarity, complexity, and comprehensibility, by younger (aged 18–35) and older (aged 55–70) adults. It was found that older adults have greater difficulty than younger adults in comprehending warning symbols and that accident scenario training improves comprehension. Regression analyses indicated that familiarity and comprehensibility were important in determining performance on the pre-training comprehension test by both younger and older adults. However, training eliminated the effects of stimulus characteristics for younger adults, while older adults' comprehension continued to be significantly influenced by comprehensibility. We suggest that symbol design incorporates cues to knowledge to facilitate the linkage between new knowledge (i.e. the warning symbol) and relevant knowledge in long-term memory. **Statement of Relevance:** Symbol characteristics play an important role in age-related differences in warning symbol comprehension. To optimise comprehension by older adults, symbols should have a clear relationship with areal-world referent. Alternatively, symbol design could incorporate cues to knowledge to facilitate the linkage between new knowledge and relevant knowledge in long-term memory.

- **Keywords:** warnings, safety symbols, ageing, training

S. Shirren & J.G. Phillips. *Decisional style, mood and work communication : email diaries. Pages 891-903.*

To understand the use of technology to support interpersonal interaction, a theory of decisional style was applied to email use within the workplace. Previous research has used self-report and rating scales to address employee email behaviours, but this falls short of management's capability to monitor the actual behaviour. Thirty-nine employed individuals completed a five-day communication diary recording their actual behaviour upon receiving personal and work-related emails as well as the Melbourne Decision Making Questionnaire and the Depression Anxiety Stress Scales. It was found that

vigilant individuals were more likely to use email in an efficient manner by deleting personal email and being less likely to open email later. Procrastinators, buckpassers and people experiencing high levels of negative affect were all more likely to delay dealing with email, which could be viewed as dealing with email in a less efficient manner.

Statement of Relevance: This work offers insights as to how people receive and process emails and is thus relevant to the development and implementation of collaborative technologies. Whilst other studies use individual's self-reports, this study uses a more accurate communication diary. Decisional style can predict the monitoring and response to electronic communication.

- **Keywords:** operator workload, decision making, organisational communication, distributed cooperative work, human-computer interaction

M.-A. Sanda, J. Johansson, B. Johansson & L. Abrahamsson.
Understanding social collaboration between actors and technology in an automated and digitised deep mining environment. Pages 904-916.

The purpose of this article is to develop knowledge and learning on the best way to automate organisational activities in deep mines that could lead to the creation of harmony between the human, technical and the social system, towards increased productivity. The findings showed that though the introduction of high-level technological tools in the work environment disrupted the social relations developed over time amongst the employees in most situations, the technological tools themselves became substitute social collaborative partners to the employees. It is concluded that, in developing a digitised mining production system, knowledge of the social collaboration between the humans (miners) and the technology they use for their work must be developed. By implication, knowledge of the human's subject-oriented and object-oriented activities should be considered as an important integral resource for developing a better technological, organisational and human interactive subsystem when designing the intelligent automation and digitisation systems for deep mines. **Statement of Relevance:** This study focused on understanding the social collaboration between humans and the technologies they use to work in underground mines. The learning provides an added knowledge in designing technologies and work organisations that could better enhance the human-technology interactive and collaborative system in the automation and digitisation of underground mines.

- **Keywords:** human's subject-oriented activity, psychosocial environment, social collaboration, automated and digitised deep mine

A.K. Pradhan , G. Divekar, K. Masserang, M. Romoser, T. Zafian, R.D. Blomberg, F.D. Thomas, I. Reagan, M. Knodler, A. Pollatsek & D.L. Fisher.
The effects of focused attention training on the duration of novice drivers' glances inside the vehicle. Pages 917-931.

Several studies have documented that the failure of drivers to attend to the forward roadway for a period lasting longer than 2–3 s is a major cause of highway crashes. Moreover, several studies have demonstrated that novice drivers are more likely to glance away from the roadway than the experienced drivers for extended periods when attempting to do a task inside the vehicle. The present study examines the efficacy of a PC-based training programme (*FORward Concentration and Attention Learning, FOCAL*) designed to teach novice drivers not to glance away for these extended periods of time. A FOCAL-trained group was compared with a placebo-trained group in an on-road test, and the FOCAL-trained group made significantly fewer glances away from the roadway that were more than 2 s than the placebo-trained group. Other measures indicated an advantage for the FOCAL-trained group as well. **Statement of relevance:** Distracted driving is increasingly a problem, as cell phones, navigation systems, and other in-vehicle

devices are introduced into the cabin of the automobile. A training programme is described that has been tested on the open road and can reduce the behaviours that lead to crashes caused by the distracted driving.

- **Keywords:** novice drivers, attention, training, distraction, eye movements, field driving study

Bryan Reimer & Bruce Mehler. *The impact of cognitive workload on physiological arousal in young adult drivers : a field study and simulation validation.* Pages 932-942.

Physiological measures provide a continuous and relatively non-invasive method of characterising workload. The extent to which such measures provide sensitivity beyond that provided by driving performance metrics is more open to question. Heart rate and skin conductance were monitored during actual highway driving in response to systematically increased levels of cognitive demand using an auditory delayed digit recall task. The protocol was consistent with an earlier simulator study, providing an opportunity to assess the validity of physiological measures recorded during driving simulation. The pattern of change in heart rate with increased cognitive demand was highly consistent between field and simulator. The findings meet statistical criteria for both relative and absolute validity, although there was a trend for absolute levels to be higher under actual driving conditions. For skin conductance level, the pattern in both environments was also quite similar and a reasonable case for overall relative validity can be made. **Statement of Relevance:** Growing complexity and multiple demands on modern drivers' attention highlight the significance of determining whether physiological measures provide increased sensitivity in workload detection. Better understanding, including whether simulator assessments provide valid measures of real-world response patterns, has implications in evaluating and refining interface designs and for developing advanced workload managers.

- **Keywords:** cognitive workload, driver state, heart rate, skin conductance, simulator validity

I. Zoer, M.M. Ruitenburt, D. Botje, M.H.W. Frings-Dresen & J.K. Sluiter. *The associations between psychosocial workload and mental health complaints in different age groups.* Pages 943-952.

The objective of the present study was to explore associations between psychosocial workload and mental health complaints in different age groups. A questionnaire was sent to 2021 employees of a Dutch railway company. Six aspects of psychosocial workload (work pressure, mental workload, emotional workload, autonomy, social support from colleagues and social support from supervisors) and three mental health outcomes (work-related fatigue, stress and burnout) were assessed. Associations between the aspects of psychosocial workload (distributed into tertiles) and health complaints were analysed by logistic regression analysis in four age groups (22–35, 36–45, 46–55 and 56–66 years old). In all age groups, worse work pressure was a significant risk factor for having mental health complaints. Worse emotional load in the younger employees and lack of social support in older employees were associated with a higher risk of having mental health complaints. Age-specific preventive measures should be implemented on both individual and group levels. **Statement of Relevance:** With an ageing workforce, understanding relationships between age and work-related health ailments is increasingly important. This study found that emotional workload in younger and lack of social support in older employees were associated with a higher risk of mental health complaints. Work pressure was a risk factor in all age groups.

- **Keywords:** age, mental disorders, mental health complaints, psychosocial workload

D. Jonker, B. Rolander, I. Balogh, L. Sandsjö, K. Ekberg & J. Winkel. *Mechanical exposure among general practice dentists in Sweden and possible implications of rationalisation.* Pages 953-960.

The present study investigates the dental work in terms of time distribution and mechanical exposure in value-adding work (VAW) and non-VAW. Further rationalisation of dental work would typically involve an increase in the proportion of VAW. Information on mechanical exposure within the classes of VAW and non-VAW may be used to predict possible implications of rationalisation. Sixteen dentists were investigated. Using a data logger, postures and movements were continuously recorded for each subject during the 4 h of work, which included the 45 min of video recording. Time distribution and mechanical exposure for the six different work activities identified were evaluated from the video recordings, using a loss analysis technique. VAW, which comprised 54% of the total working time, generally implied significantly more constrained mechanical exposures as compared with non-VAW. The results suggest that future rationalisation of dental work, involving a reduction of non-VAW, may increase the risk of developing musculoskeletal disorders. **Statement of Relevance:** The present study illustrates the potential effects of rationalisation on biomechanical exposures for dentists. The results highlight the significance of integrating ergonomic issues into the rationalisation process in dentistry in addition to ordinary workstation and tool design improvements performed by ergonomists.

- **Keywords:** dentistry, efficiency, value-adding, workload

N.J. Seo & T.J. Armstrong. *Effect of elliptic handle shape on grasping strategies, grip force distribution, and twisting ability.* Pages 961-970.

A generic torque model for various handle shapes has been developed and evaluated using experimental data. Twelve subjects performed maximum isometric torques using circular and elliptic cylinders in medium and large sizes (circular: $r = 25.4, 38.1$ mm; elliptic: semi-major/minor axes = 30.9/19.3, 47.1/27.8 mm) finished with aluminium and rubber, in two opposite directions. Torque, grip force distribution, and finger position were recorded. Maximum torques were 25%, 7%, and 31% greater for the elliptic, large-size, and rubber-finished cylinders than for the circular, medium-size, and aluminium-finished cylinders, respectively. Greater torque for the elliptic cylinders was associated with 58% greater normal force that the subjects could generate for the elliptic than circular cylinders. The model suggests that greater torques for the large-size and rubber cylinders are related to long moment arms and greater frictional coupling at the hand-cylinder interface, respectively. Subjects positioned their hands differently depending on torque direction to maximise their normal force and torque generation. **Statement of Relevance:** Desirable handle features for torque generation may be different from those for grip only. Design of handles per advantageous handle features (e.g., shape, size, and surface) may help increase people's torque strength and contribute to increased physical capacity of people.

- **Keywords:** friction, torque direction, normal force distribution, moment arm

Yun-Ju Lee, Marco J.M. Hoozemans & Jaap H. van Dieën. *Handle height and expectation of cart movement affect the control of trunk motion at movement onset in cart pushing.* Pages 971-982.

As unexpected sudden unloading of the trunk may cause low-back injury, the objective of the present study was to investigate whether handle height and the expectation of cart movement in pushing affect trunk control at movement onset. Eleven healthy male participants pushed a 200-kg cart with handles at shoulder and hip heights. The cart would suddenly move when externally released (externally triggered condition) or when

static friction was overcome (self-initiated condition). Before self-initiated cart movement, trunk stiffness and muscle activity were significantly higher than before an externally triggered onset at comparable pushing force. Lower muscle activity and trunk stiffness at shoulder height compared with the hip height before the onset resulted in higher trunk inclination after the onset. In conclusion, higher preparatory activation of trunk muscles serves to increase trunk stiffness in anticipation of cart movement and may reduce the impact of the perturbation associated with the onset of cart movement.

Statement of Relevance: Sudden cart movement in pushing causes an unexpected unloading perturbation to the trunk. This perturbation was shown to cause uncontrolled trunk movement, which may explain how pushing tasks can be associated with low-back injury. Effects of handle height and awareness of the subjects of the possible cart movement suggest directions for prevention.

- **Keywords:** spine, occupational biomechanics, low-back pain, manual material handling