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Meinald T. Thielsch, Julia Kirsch, Hannah Thölking, Lena Tangelder & Christoph Lamers. *Fight or flight? Behaviour and experiences of laypersons in the face of an incipient fire.* Pages: 149-170

Within minutes, an incipient fire can develop into a life-threatening full fire. Consequently, it should be fought as early as possible. But are laypersons capable of doing this? In such a situation, how do they behave and feel? These questions are addressed in the current study. Persons without any professional firefighting training ($N = 64$) were confronted in two experimental runs with a real incipient fire in the form of a burning pillow. The results show that most participants were motivated and able to extinguish the fire successfully. However, most of them made a number of mistakes. Of central importance for extinguishing the fire was self-efficacy. Furthermore, participants improved greatly in the second round, especially regarding reaction time span and various psychological variables (e.g. stress, mood). Particularly on the basis of these exercise effects, we can derive a number of practical implications. **Practitioner Summary:** Laypersons are willing and able to successfully fight an incipient fire. Yet, their behaviour is not optimal and could lead to self-endangerment. Thus, it is critically important that people perform practical exercises as part of fire safety trainings and repeat them after some time.

- **Keywords:** Firefighting, laypeople, attitudes, self-efficacy, training effects

Ari Antonovsky, Leon Straker & Clare Pollock. *Workforce perceptions of human factors as indicators of plant reliability and process safety*. Pages: 171-183.

Human factors, as perceived by the maintenance workforce, were used as the measure for comparing work areas within a petroleum company. These factors were then compared to an objective measure of reliability (Mean Time Between Failures) in order to determine which factors would be most predictive of plant reliability and process safety. Maintenance personnel were surveyed using scales based on *Problem-solving, Vigilance, Design and maintenance, Job-related feedback* and *Information about change.* Analysis of Variance was used to assess the strength of these variables in relation to *Reliability Level*. Significant differences were observed between different reliability levels based on

workforce perceptions of problem-solving requirements and the design and maintainability of plant. Conclusions were that perceptions of human factors in the workplace can be predictive of group-level performance, and that if issues relating to design and maintainability are not addressed at the design stage, greater problem-solving abilities will be required from maintenance personnel. **Practitioner summary**: Workforce perceptions of plant performance could provide a statistically valid measure of current and future reliability. A survey of perceptions of human factors was conducted with maintenance personnel in a petroleum company. Results indicated significant relationships between reliability and requirements for Problem-solving, as well as Design and Maintenance of equipment.

- **Keywords:** Reliability, leading indicator, human factors, maintenance, problem-solving

Chloe J. Robbins, James Rogers, Sophie Walton, Harriet A. Allen & Peter Chapman. *The effect of a secondary task on drivers' gap acceptance and situational awareness at junctions*. Pages: 184-198.

The current studies explored the roles of the visuospatial and phonological working memory subsystems on drivers' gap acceptance and memory for approaching vehicles at junctions. Drivers' behaviour was measured in a high-fidelity driving simulator when at a junction, with, and without a visuospatial or phonological load. When asked to judge when to advance across the junction, gap acceptance thresholds, memory for vehicles and eye movements were not different when there was a secondary task compared to control. However, drivers' secondary task performance was more impaired in the visuospatial than phonological domain. These findings suggest that drivers were able to accept impairment in the secondary task while maintaining appropriate safety margins and situational awareness. These findings can inform the development of in-car technologies, improving the safety of road users at junctions. **Practitioner summary:** Despite research indicating that concurrent performance on working memory tasks impairs driving, a matched visuospatial or phonological memory load did not change drivers' gap acceptance or situational awareness at junctions. Drivers displayed appropriate compensatory behaviour by prioritising the driving task over the visuospatial secondary task.

- **Keywords:** Driver behavior, mental workload, dual task, working memory

Weihua Zhang, Cheng Wang, Yanbin Shen, Jing Liu, Zhongxiang Feng, Kun Wang & Qian Chen. *Drivers' car-following behaviours in low-illumination conditions*. Pages: 199-211.

Low illumination is a special driving condition that negatively affects drivers' vision, information acquisition (IA) ability, distance recognition and risk perception. This study evaluated drivers' car-following behaviours and characteristics using questionnaire-based research conducted among 214 drivers in Hefei. In this study, exploratory factor analysis (EFA) was used to determine the factor structure of the scale, and the internal consistency of all factors was good. The results show that low illumination strongly influences drivers' following behaviour and that they tend to choose safe and conservative ways to follow leading vehicles. Street lights are beneficial, aiding drivers' IA and their grasp of surrounding or distant environments. Myopic drivers performed worse in car following when driving in a low illumination environment, regardless of the presence of street lights. Drivers with astigmatism performed worse when street lights were present. Drivers who reported more aberrant behaviours were more aggressive when driving and tended to adopt shorter following distances at night. **Practitioner summary:** This study developed two scales to evaluate drivers' car-following behaviours and characteristics. A total of 214 drivers participated in the survey. Low illumination strongly influences drivers' following behaviour. Drivers who reported more aberrant

behaviours were more aggressive when driving and tended to adopt shorter following distances at night.

- **Keywords:** Low illumination, car following, driving behaviour, questionnaire investigation

Rubén Molina, Beatríz Redondo, Leandro Luigi Di Stasi, Rosario G. Anera, Jesús Vera & Raimundo Jiménez. *The short-term effects of artificially-impaired binocular vision on driving performance*. Pages: 212-224.

Appropriate visual function is paramount to ensuring adequate driving performance and road safety. Here, we examined the influence of sudden artificially-impaired binocular vision on driving performance using a car simulator. Twenty-four young drivers (mean age 22.42 ± 3.19 years) drove under three different visual conditions (natural driving, monocular blur, and monocular occlusion) through three different traffic environments with low, medium, and high levels of complexity (highway, rural, and city, respectively). We assessed their driving performance, perceived level of task complexity, and subjectively-experienced road safety. Furthermore, as a manipulation check, we also evaluated the drivers' cardiac vagal responses, as a well-known index of task complexity. The sudden deterioration of binocular vision caused unsafe driving behaviours (distance out of the road and maximum breaking intensity) in the most complex traffic environments. Specific self-regulatory strategies (i.e. increased cardiac vagal responses) and subjective responses corroborated these results. **Practitioner summary**: This study provides evidence that the sudden deterioration of binocular vision has a detrimental effect on simulated driving performance. Our analysis of cardiovascular functioning shows that drivers adopt self-regulatory strategies when their binocular vision functioning is compromised.

- **Keywords:** Road safety, visual performance, cardiovascular response, heart rate variability, self-regulation

Christopher M. Durugbo. *Eye tracking for work-related visual search: a cognitive task analysis*. Pages: 225-240.

Cognitive Task Analysis (CTA) is an important methodology in ergonomics for studying workplaces and work patterns. Using eye tracking as a CTA methodology, this article explores visual search patterns in complex work environments and situations. It presents a simulated crime scene case study that applies eye tracking-based experiments in foraging and sense-making loops to elicit and represent knowledge on expert versus novice search patterns for complex work. The case probes the visual search task of preliminarily evaluating and documenting potential crime scene evidence. The experimental protocol relies on the ASL Mobile Eye and the analyses of experimental data include preliminary inspections of live-viewing data on eye-movements, precedence matrices detailing scan paths, and gaze charts that illustrate participants' attention based on fixation counts and durations. In line with the CTA methodology, the article uses concept maps to represent knowledge derived from different phases of the study. The article also discusses the research implications and methodologically reflects on the case study. **Practitioner summary:** This study offers valuable insights for work design. The use of eye tracking as a CTA methodology offers potentials for translating visual search tasks into defined visual search concepts for complex work environments and situations. The ability to model visual attention is valuable for work designs that improve complex work performance, reduce work stress, and promote work satisfaction.

- **Keywords:** Visual search, eye tracking, cognitive task analysis, complex workcrime scenes

Jonhatan Magno Norte Silva, Leila Amaral Gontijo, Antonio Cezar Bornia, Luiz Silva, Wilza Karla dos Santos Leite & Elamara Marama de Araujo Vieira. *Evaluation of musculoskeletal discomfort using item response theory: creation of a scale based on the self-reported pain symptoms*. Pages: 241-252.

This study aims to build a scale for musculoskeletal discomfort based on the self-reported musculoskeletal pain by individuals. For this, methods such as factorial analysis and item response theory were used. A sample of 1821 workers of a footwear industry participated in this study. The scale consists of four levels ranging from mild to maximum discomfort. In mild discomfort (level 60), pain symptoms are rare or frequent in regions such as cervical and trapezoidal area, low back, shoulders, wrists, ankles and feet. At level 70, rare or frequent symptoms affect regions of the upper and lower limbs. At level 80, frequent symptoms become common in the trunk and in most of the upper and lower limbs. At level 90, the symptoms become daily in elbows, thighs and knees. The scale showed signs of validity and proved useful for studies in ergonomics. **Practitioner Summary:** Methods such as factor analysis and item response theory were used to build a four-level musculoskeletal discomfort scale that can be useful to complement the screening process for workers with musculoskeletal pain. The scale shows signs of accuracy, in addition to validity and reliability.

- **Keywords:** Musculoskeletal discomfort, pain symptoms, scale, item response theory

E. Orantes-Gonzalez & J. Heredia-Jimenez. *Does a standard school trolley fit children of different heights? The fitting of a school trolley*. Pages: 253-258

Although school trolleys are an alternative to traditional backpacks, no studies have determined their suitability for children of different heights. This study aims to analyse the fit of a school trolley (0.89 m height from the top to the bottom of the handle) for children with different heights based on kinematic variables and the rate of perceived effort (RPE). A 3D motion capture system was used to analyse the kinematics of the thorax and hip during walking without load and when pulling a trolley loaded with 15% of the child's body weight (BW). The RPE was recorded at the end of each trial. The height of the subjects was clustered using Ward´s hierarchical cluster, and two groups were identified: Group 1: 120–139.9 cm; and Group 2: 140–160 cm. No differences were found between groups in the kinematics or RPE. In conclusion, a standard school trolley fits well to children with heights from 120 to 160 cm. **Practitioner Summary:** No studies have determined the suitability of school trolleys for children of different heights. This study aims to analyse the fit of a school trolley for children with different heights based on the kinematics and rate of perceived effort. The major finding is that a standard school trolley fits children with heights from 120 to 160 cm well and that the height of the school trolley was between 59% and 68% of the children's heights.

- **Keywords:** Wheeled backpack, walking, kinematice, perceived exertion

Xinyang Tan, Wei Chen, Jiangang Cao & Saeema Ahmed-Kristensen. *A preliminary study to identify data needs for improving fit of hand and wrist orthosis using verbal protocol analysis*. Pages: 259-272.

The delayed delivery, poor fitting and discomfort of customised orthoses are reported in rehabilitation clinics as resulting in more invasive interventions. The current practice of orthosis customisation relies heavily upon the experience and fabrication processes of therapists. In order to better understand the current practice, and thus identify data that is required for better comfort moving towards a data-driven customisation, this article

describes a study generating working models of therapists. Customisations of hand and wrist orthoses for 18 patients were observed. Verbal protocol analysis was employed to extend the current understanding of fabrication processes. Working models of four therapists were established with quantitative evaluation on major phases, interactive activities and iterations of performing tasks during fabrication, revealing different working models between in- and out-patient departments (e.g. fabrication for in-patients was more complex and focussed on ergonomic fitting whereas fabrication for out-patients paid attention to durability) which were qualitatively explained. **Practitioner summary:** Fit and comfort are imperative for orthosis design and fabrication, however the current practice of customisation of an orthosis relies upon the experience of individual hand therapist. The article presents working models of hand therapists, and relevant data that would enable customisation of orthosis for better fit.

- **Keywords:** Task analysis, verbal protocol analysis, comfort, working model, orthosis

Mohammad Fard, Jianchun Yao, Kazuhito Kato & John L. Davy. *The geometric mean is a superior frequency response averaging method for human body vibration*. Pages: 273-283.

The frequency response data of human body vibration are often used for standardisation, design of transport vehicles and occupational health and safety measures. This article shows that the commonly used methods of averaging frequency response spectra, such as arithmetic averaging in the complex or magnitude domain and median averaging, are not as suitable as the less commonly used geometric averaging in the complex domain. This is because it is necessary to minimise the deviation of the measured values about the mean value and to minimise the bias from the true mean value due to noise, distortion and nonlinearity. **Practitioner summary**: For averaging frequency response spectra, it is necessary to minimise the bias from the true mean value. This research shows that the commonly used averaging methods, such as arithmetic averaging in the complex or magnitude domain and the median, are not as suitable as geometric averaging in the complex domain.

- **Keywords:** Geometric mean, arithmetic mean, median, averaging method, human body vibration