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Juergen Sauer, Andreas Sonderegger & Sven Schmutz. *Usability, user experience and accessibility: towards an integrative model*. Pages: 1207-1220.

Within the field of ergonomics, the concepts of usability, user experience and accessibility have played an increasingly important role. The present paper examined the meaning of these concepts and their relationship to each other, which included an analysis of the definitions, methods, and typical outcome measures employed. Despite some concerns in the literature about the utility of usability, user experience and accessibility as umbrella terms, we provide arguments for their continued use. The article proposes how the three concepts and their different perspectives can be integrated. We propose the term 'interaction experience' (IX) as a higher-level concept. Due to the multi-faceted nature of umbrella concepts, we suggest using spider charts as a means to report the results of evaluating artefacts with regard to usability, user experience and accessibility. **Practitioner Summary:** A better integration of the concepts of usability, user experience and accessibility is expected to provide some benefits to practitioners. We propose employing spider charts for reporting the outcome of artefact evaluations regarding the three concepts. This may help practitioners interpret the characteristics of a device at a glance.

- **Keywords:** Usability, user experience, accessibility, interaction experience, method, ergonomics

Gemma J. M. Read, Paul M. Salmon, Natassia Goode, Michelle van Mulken, Michael G. Lenné, Nicholas Stevens & Guy H. Walker. *Interaction-centred design: an end user evaluation of road intersection concepts developed using the cognitive work analysis design toolkit (CWA-DT)*. Pages: 1221-1239.

Crashes at intersections represent an important road safety problem. Interactions between different road user types, such as between vehicles and vulnerable road users, are a particular concern. It has been suggested driver-centric road design plays a role in crashes. A multi-road user evaluation of three novel intersection designs is described.

The designs were generated using the Cognitive Work Analysis Design Toolkit, underpinned by sociotechnical systems theory. The desktop evaluation involved drivers, motorcyclists, cyclists and pedestrians rating the design concepts against alignment with design goals, sociotechnical systems theory and usability, and providing feedback on the positive and negative aspects. Two concepts received more positive ratings and feedback in comparison to a concept that provided more user autonomy. The evaluation results also highlight clear differences in needs across road user groups. The design and evaluation process demonstrates how sociotechnical systems values and principles can be applied in the design of public spaces. **Practitioner Summary:** This study involved a participatory evaluation of novel road intersection designs, based on sociotechnical systems theory. The results identified important differences in needs and preferences across road user groups and demonstrate the value of sociotechnical systems theory and user participation in road transport design and evaluation processes.

- **Keywords:** Sociotechnical systems theory, design, road safety, intersections, end user evaluation

Jukrin Moon, Farzan Sasangohar, Changwon Son & S. Camille Peres. *Cognition in crisis management teams: an integrative analysis of definitions*. Pages: 1240-1256.

In large-scale extreme events, multidisciplinary crisis management teams (CMTs) are required to function together cognitively. Despite theoretical maturity in team cognition and recurrent emphasis on cognition in the crisis management practices, no synthesis of theoretical and practical discourses is currently available, limiting empirical investigations of cognition in CMTs. To address this gap, this paper aims to review the definitions of cognition in CMTs, with a particular focus on examining if and to what extent they are diversified. Through a systematic process to search peer-reviewed journal articles published in English from 1990 to 2019, 59 articles were selected with 62 coded definitions of 11 different constructs. The similarities and variabilities of the definitions were examined in terms of their theoretical and practical emphases and then synthesised into an integrative definition expected to serve as a general guide of reference for future researchers seeking an operational definition of cognition in CMTs. **Practitioner summary:** Understanding of cognition in CMTs is grounded in various theories and models with varying assumptions. An integrative conceptualisation of such cognition as interaction within and across CMTs to perceive, diagnose, and adapt to the crisis may facilitate the accumulation of knowledge and future operationalisations.

- **Keywords:** Team cognition, crisis management, multi-team, common operating picture, collective sensemaking

Aude Villemain & Patrice Godon. *Logistic transport in extreme environments: the evolution of risk and safety management over 27 years of the polar traverse*. Pages: 1257-1270.

In this article we seek to explain how safety mechanisms and risks evolve over time. The article focuses on a sociotechnical system, that of a polar traverse (a transport operation in a polar environment). In the study spanning a period of 27 years data were collected with ethnographic participative observations on three of the 56 traverses already achieved. Activities were traced from the whole 1398 daily reports and scale models of the convoy vehicles were used to reconstruct events during the traverses. Self-confrontation interviews were also conducted. A traverse feedback process was carried out which revealed that (1) whereas proactive safety is aimed at maintaining the continuous improvement of a system, reactive safety makes it possible to maintain the system's level of safety; (2) the development of redundancy and mixed technology contribute positively to the safety system. Improvements made to the safety system, its dynamics, and embodied resilience are discussed as well as the study limitations and

implications. **Practitioner summary:** This article seeks to understand how safety has been ensured in logistical transport in extreme conditions in a case study extending over a period of more than 27 years. The study investigates how risks and safety mechanisms have evolved and the benefits of developing a traverse feedback process to improve safety.

- **Keywords:** Proactive-reactive safety, extreme situations, dynamics, risks, system improvement

Magnus Liebherr, Stephan Schweig, Annika Brandtner, Heike Aeverbeck, Niko Maas, Dieter Schramm & Matthias Brand. *When virtuality becomes real: Relevance of mental abilities and age in simulator adaptation and dropouts.* Pages: 1271-1280.

Previous studies increasingly report problems with simulator adaptation as well as dropouts. Therefore, the present study aims at better understanding these aspects by considering individual factors, such as age and mental abilities. 414 people were tested with commonly used neuropsychological measures as well as within a driving simulator which consists of a close-to-production vehicle of the compact class. In contrast to previous findings, neither a significant relationship between age and the time of adaptation nor an interaction between age and mental abilities on adaptation time could be identified. However, the time participants spent in the simulator (simulator dropout) significantly correlated with age but not with mental abilities. People who showed no adaptation spent significantly less time in the simulator, because of the occurrence of simulator sickness. Although attention was only mildly associated with the time of simulator adaptation, further research on this linkage is suggested. **Practitioner summary:** The study at hand clarifies the relevance of considering the process of simulator adaptation within simulator studies. However, the present findings suggest no relation between age and the time of adaptation but with simulator dropouts.

- **Keywords:** Simulator, adaptation, age, mental abilities

Camila Pizarro-Montaner, Jorge Cancino-Lopez, Alvaro Reyes-Ponce & Marcelo Flores-Opazo. *Interplay between rotational work shift and high altitude-related chronic intermittent hypobaric hypoxia on cardiovascular health and sleep quality in Chilean miners.* Pages: 1281-1292.

Mining activities expose workers to diverse working conditions, rotational shifts and high altitude-related hypobaric hypoxia. Separately, each condition has been reported having a negative impact on miners' health risk; however, the combination of both stressors has been poorly explored. The present study aimed to analyse the effects of exposure to rotational work shift (RWS) alone or in combination with high altitude-related chronic intermittent hypobaric hypoxia (CIHH) on cardiometabolic, physical activity and sleep quality related markers in copper miners from Los Pelambres mine in Chile. One hundred and eleven male miners working in RWS with or without CIHH were included. Anthropometrics measures, sleep quality assessment, physical activity level (PAL) and handgrip strength were evaluated. Exposure to CIHH exacerbated the detrimental effects of RWS as miners exposed to the combination of RWS and CIHH were more obese and had a wider neck circumference, reduced PAL at work and worsened sleep quality. **Practitioner summary:** The purpose was to assess cardiometabolic health and sleep quality markers associated with the combined effects of rotational shift work and high altitude-related intermittent hypobaric hypoxia in miners. Findings showed a wider neck circumference, lower physical activity level and higher prevalence of poor sleep quality in exposed miners.

- **Keywords:** High altitude, chronic intermittent hypobaric hypoxia, rotational shift work, cardiovascular risk

Enrique Riesco & Juan Manuel Munoz-Guijosa. *An enhanced whole-body vibration emission index for railway vehicles. Pages: 1293-1303.*

Whole-body vibration (WBV) is a concept that is gaining importance in the railway sector. Occupational disorders, such as back pain and sciatica, frequently cause sick leave and have resulted in lawsuits against employers. Railway operators require a clear procedure for specification and purchase of certified rail vehicles that evaluate the vehicle from the point of view of the effect of WBV. However, a review of current standards and studies shows no clear and simple method for defining a vibration emission value, such as that defined in EN 1032 for mobile machinery. This study proposes a systematic and robust railway driver-related vibration index and describes the methodology for its determination. The proposed index, based on current WBV standards, is robust and allows comparisons between vehicles. For index validation, we used experimental results as well as results from a neural network using the cabin floor data. **Practitioner summary:** A new vibration emission index is proposed for the certification of railway vehicles, using whole-body vibration, based on current standards. It could be used as a criterion when purchasing a vehicle and as a design specification for manufacturers, thereby improving the ergonomics of drivers' working environment.

- **Keywords:** Railroad engineer ergonomics, railway vibration exposure metrics, Vibration emission index, whole-body vibrations in railway

Dennis J. Larson, Patricia G. Menezes & Stephen H.M. Brown. *Influence of creep deformation on sub-regional lumbar spine motion during manual lifting. Pages: 1304-1311.*

Prolonged or repetitive spine flexion induces creep deformation of posterior spine tissues allowing for increased intervertebral motion beyond 'normal' limits, which may influence sub-regional (intersegmental) spine motion during subsequent manual lifting tasks. Using spine skin-surface kinematics, intersegmental lumbar spine motion was recorded over 20 minutes of prolonged static spine flexion and a subsequent manual lifting task (2 lifts every 3 minutes, 30 minutes total) in 14 participants. Results demonstrated that mid to lower lumbar intersegmental levels (i.e. L2/L3 to L4/L5) experienced the greatest overall creep deformation and range of motion during both prolonged flexion and manual lifting; however, overall range of motion during manual lifting was unaffected. Additionally, creep deformation did not completely recover within 30 minutes. Future work should continue to investigate the influence of this residual creep, as well as how overall creep deformation impacts spine neuromuscular control and stability, and ultimately the development of low back disorders. **Practitioner summary:** Mid to lower lumbar spine levels (i.e. L2/L3 to L4/L5) experienced the greatest creep deformation and range of motion during both prolonged flexion and manual lifting. Repeated lifting following prolonged flexion may limit creep recovery; however, overall lifting kinematic motion remained unchanged.

- **Keywords:** Creep, prolonged flexion, intersegmental motion, lumbar spine, lifting

Ming-I Brandon Lin, Ruei-Hong Hong & Yu-Ping Huang. *Influence of virtual keyboard design and usage posture on typing performance and muscle activity during tablet interaction. Pages: 1312-1328.*

This study aimed to determine the effects of virtual keyboard designs and postures on task performance and muscle activity during tablet use. Eighteen healthy adults were randomly assigned to one of three postures (DESK, LAP, BED) to complete six sessions of

60-minute typing on a tablet with three virtual keyboards (STD, WIDE, SPLIT) twice in an experimental laboratory. Keystroke dynamics and muscle activity of the forearm and neck-shoulder regions were measured by electromyography. The split virtual keyboard was found to be associated with faster typing speed (SPLIT vs STD, $p = .015$; SPLIT vs WIDE, $p < .001$) and decreased muscle activity of extensor digitorum communis (SPLIT vs STD, $p = .021$). Lap posture was associated with faster typing speed ($p = .018$) and higher forearm muscle activity ($p < .05$). Typing performance decreased ($p < .001$) with elevated neck extensor muscle activity ($p = .042$) when the task duration prolonged. The split virtual keyboard showed potential to improve tablet ergonomics under various postures. **Practitioner Summary:** Tablets have become widely used for a variety of tasks and have gradually expanded into the realm of mobile productivity and education. Adequate designs of virtual keyboards for tablets show the potential for increased task performance and decreased muscle activity pertinent to typing activity and posture constraints imposed by non-traditional work positions.

- **Keywords:** Tablet, virtual keyboard, usage posture, muscle activity, typing

M. T Pace, J. M Green, L. G Killen, J. C Swain, H. Chander, J. D Simpson & E. K O'Neal. *Minimalist style boot improves running but not walking economy in trained men. Pages: 1329-1335.*

This study examined movement economy under load with 1000 g minimalist (MIN) vs. 1600 g traditional (TRD) style boots. Fourteen trained, male participants completed a VO_{2peak} test (46.6 ± 7.3 ml/kg/min) while wearing a 16 kg external load. Treadmill speeds for the running economy (RE) trials were determined by the slowest pace in which participants completed a full stage with a running gait pattern during the VO_{2peak} test. Walking economy (WE) pace was 1.6 km/h slower than RE pace. During the second session, participants completed 5-min exercise bouts at WE and RE pace under load wearing MIN and TRD. There were no differences for any measured variables during WE trials. In contrast, RE (MIN = 2.95 ± 0.28 vs. TRD = 3.04 ± 0.30 L/min; $p = .003$; Cohen's $d = 0.32$), respiratory exchange ratio ($p < .001$), and perceptual measures ($p < .05$) were all improved while wearing MIN. **Practitioner summary:** In trained men, 1000 g/pair minimalist style boots (MIN) resulted in improvements of approximately 3% and 5% for running economy and respiratory exchange ratio versus 1600 g/pair traditional boots while wearing a 16 kg kit. Perceptual responses, including comfort, also favoured MIN. These effects were not found at walking pace.

- **Keywords:** Military footwear, tactical athlete, oxygen uptake, energy cost, military workload