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Xiaohan He, Xiaofei Nie, Ronggang Zhou, Jiazhong Yang & Ruilin Wu. *The risk-taking behavioural intentions of pilots in adverse weather conditions: an application of the theory of planned behaviour*. Pages: 1043-1056.

This paper examined pilots' risk-taking behavioural intentions based on the theory of planned behaviour, as well as the impact of experience on behavioural intentions in adverse weather conditions. Two hundred and seventy-three airline pilots and flying cadets were divided into two groups and asked to complete a questionnaire based on two decision-making scenarios. This questionnaire measured pilots' intentions to take risks, along with the attitude towards the behaviour, subjective norms, perceived behavioural control (PBC), risk perception, and self-identity. The results showed that attitude, subjective norm, PBC, and risk perception explained 52% of the variance in behavioural intentions. Additionally, pilots' risk-taking decisions can be influenced by experience. Inexperienced pilots had a relatively stronger intention to take risks and a more favourable attitude towards risky behaviour. Moreover, pilots were more likely to rely on their own direct experience in the decision-making process. **Practitioner summary:** This study examined the pilots' risk-taking intentions under adverse weather conditions using a questionnaire based on the TPB theory. Results demonstrated that the TPB model can be applied to the risk-taking scenario and that experience can influence pilots' decisions. These findings have implications for improving flight safety and lowering accident rates.

- **Keywords:** Aviation safety, the theory of planned behaviour (TPB), risk perception, risk-taking behaviour

Dominik Bonin, Alexander Ackermann, Dörte Radke, Markus Peters & Sascha Wischniewski. *Anthropometric dataset for the German working-age population using 3D body scans from a regional epidemiological health study and a weighting algorithm*. Pages: 1057-1071.

For the ergonomic design of workplaces and products, a representative anthropometric dataset of the working-age population is needed. As body proportions are constantly

changing and the latest publicly available dataset for Germany was published in 2004 (data collection period 1999–2002), the aim of this study was to create and publish an updated anthropometric dataset of the German working-age population. Within a regional epidemiological health study, 3D body scan data from 2313 subjects were collected and used to create an anthropometric dataset with a total of 39 ISO 7250-1 measures. To approximate the goal of generating representative values for Germany, the collected regional dataset was weighted with an algorithm, using values from a known nationally representative survey. Based on the weighted dataset, a gender stratified percentile table with values for the 5th, 50th, and 95th percentile was calculated. **Practitioner summary:** Body proportions are constantly changing and the latest publicly available anthropometric dataset for Germany was published in 2004. A new dataset was created, using 3D body scans from an epidemiological health study and a weighting algorithm. Ultimately, percentile tables with values for the 5th, 50th, and 95th percentile are published.

- **Keywords:** Anthropometry, data weighting, survey methodology, occupational safety and health

Michelle C. Léger, Cynthia Dion, Wayne J. Albert & Michelle R. Cardoso. *The biomechanical benefits of active sitting*. Pages: 1072-1089.

This cross-sectional study examined the biomechanical effects of two active chairs (AC1: had the feature to pedal and slide forward on the seat pan; AC2: a multiaxial motion seat pan) compared to a traditional office chair and standing workstation. Twenty-four healthy participants worked at each of the workstations for 60-min. The following equipment was used: Motion Capture, Electromyography, Ratings of Perceived Discomfort Questionnaire, and Exit Survey. The active protocol had positive effects on the body, including increased neuromuscular activity in the gastrocnemius, increased overall movement, and a more open trunk–thigh angle. Greater discomfort in the buttocks due to the lack of seat pan contour was reported for the AC1 which identified a need for a design modification. While standing, participants' shoulders were less flexed than when sitting in any of the three seats, however, greater discomfort was reported in the lower legs after 1 h of computer work. **Practitioner summary:** A comparison of four different workstations was conducted to further understand the use of active workstations. Active sitting was found to have positive effects on the body, such as allowing sitters to increase movement while sitting without the high activation of muscular activity. Standing can also provide a positive break from sitting.

- **Keywords:** Active chairs, standing, joint angles, electromyography, discomfort

Chao Shi & Ling Rothrock. *Using eye movements to evaluate the effectiveness of the situation awareness rating technique scale in measuring situation awareness for smart manufacturing*. Pages: 1090-1098.

Physiological indicators, including eye-tracking measures, may provide insight into human internal states in many domains, such as smart manufacturing. The Situation Awareness Rating Technique (SART) scale has been criticised for not assessing situation awareness (SA) accurately. In this study, we investigated the precision of the SART scale for assessing SA by comparing the scores to eye movement data. Thirty participants were recruited to complete a process plant monitoring task. Participants' eye movements and SART scores were recorded and analysed. Our results moderately supported the idea that the SART scale did not accurately measure SA. We found that four dimensions in the SART scale need to be revised to reflect real SA, which may partially solve the divergence between objective and subjective SA measurements. Moreover, these findings provided solutions for designing a revised SART scale to measure the internal states of operators for smart manufacturing. **Practitioner summary:** Situation awareness (SA) is a critical

component of decision-making and performance for smart manufacturing. The present study examines the relationships among eye movement, the SART scale, and SA for smart manufacturing in a refinery control room.

- **Keywords:** Eye-tracking, SA, smart manufacturing, SART

Wenzhe Tang, Shanguang Chen, Chengqi Xue, Yafeng Niu, Junkai Shao & Yanfei Zhu. *Influence of nuclear power plant interface complexity on user decision-making: an ERP study.* Pages: 1099-1117.

User decision-making concerning critical operations is very important to nuclear power plant (NPP) safety. The NPP interface is the main information source that guides decision-making; thus, a good interface design is essential. Among the interface design factors such as interface complexity, layout and colour, interface complexity (the amount of information in the interface) has the greatest impact on NPP operator decision-making. This paper used the event-related potential (ERP) to evaluate the impact of interface complexity on user decision-making and found interface complexity has a specific range suitable for decision-making. Based on this important finding, a fast and economical method of evaluating NPP interfaces in all design phases was proposed. This method compensates for the shortcomings of traditional methods, such as heuristic evaluation and experimental evaluation, which are inconvenient for evaluating interfaces in initial design phase; it can also be applied to interfaces with similar features in other industrial fields. **Practitioner summary:** Evaluation of the impact of NPP interface complexity on user decision-making through an ERP experiment revealed a specific range of interface complexity that facilitates user decision-making. Based on this finding, a new, fast and inexpensive interface evaluation method was proposed.

- **Keywords:** Nuclear power plant, interface complexity, decision-making, ERP, evaluation method

Amelie Koch, Boris Schlenker, Armin Becker & Matthias Weigl. *Operating room team strategies to reduce flow disruptions in high-risk task episodes: resilience in robot-assisted surgery.* Pages: 1118-1131.

In healthcare work settings, flow disruptions (FDs) pose a potential threat to patient safety. Resilience research suggests that adaptive behavioural strategies contribute to preventing cognitive overload through FDs at crucial moments. We aimed to explore the nature and efficacy of operating room (OR) team strategies to prevent FDs in robot-assisted surgery. Within a mixed-methods design, we first asked surgical professionals, which strategies they apply, and secondly, identified behavioural strategies through direct observations. Findings were analysed using content analysis. Additionally, FDs were assessed through live observations in the OR. The sample included four interviewed experts and 15 observed surgical cases. Sixty originally received strategies were synthesised into 17 final OR team strategies. Overall, 658 FDs were observed with external FDs being the most frequent. During high-risk episodes, FDs were significantly reduced ($p < 0.0001$). The identified strategies reveal how OR teams deliberately and dynamically manage and mitigate FDs during critical tasks. Our findings contribute to a nuanced understanding of adaptive strategies to safeguard performance in robot surgery services. **Practitioner Summary:** Flow disruptions (FDs) in surgical work may become a severe safety threat during high-risk situations. With interviews and observations, we explored team strategies applied to prevent FDs in critical moments. We obtained a comprehensive list of behavioural strategies and found that FDs were significantly reduced during a specific high-risk surgical task. Our findings emphasise the role of providers' and teams' adaptive capabilities to manage workflow in high-technology care environments.

- **Keywords:** Flow disruptions, OR team, patient safety, resilience

Robert G. Radwin, Yu Hen Hu, Oguz Akkas, Stephen Bao, Carisa Harris-Adamson, Jia-Hua Lin, Alysha R. Meyers & David Rempel. *Comparison of the observer, single-frame video and computer vision hand activity levels.* Pages: 1132-1141.

Observer, manual single-frame video, and automated computer vision measures of the Hand Activity Level (HAL) were compared. HAL can be measured three ways: (1) observer rating (HAL_o), (2) calculated from single-frame multimedia video task analysis for measuring frequency (F) and duty cycle (D) (HAL_f), or (3) from automated computer vision (HAL_c). This study analysed videos collected from three prospective cohort studies to ascertain HAL_o , HAL_f , and HAL_c for 419 industrial videos. Although the differences for the three methods were relatively small on average (<1), they were statistically significant ($p < .001$). A difference between the HAL_c and HAL_f ratings within ± 1 point on the HAL scale was the most consistent, where more than two thirds (68%) of all the cases were within that range and had a linear regression through the mean coefficient of 1.03 ($R^2 = 0.89$). The results suggest that the computer vision methodology yields comparable results as single-frame video analysis. **Practitioner summary:** The ACGIH Hand Activity Level (HAL) was obtained for 419 industrial tasks using three methods: observation, calculated using single-frame video analysis and computer vision. The computer vision methodology produced results that were comparable to single-frame video analysis.

- **Keywords:** Hand activity level, repetitive motion, computer vision

Mickaël J. R. Perrier, Tyron L. Louw & Oliver M. J. Carsten. *Usability testing of three visual HMIs for assisted driving: How design impacts driver distraction and mental models.* Pages: 1142-1163.

There is a variety of visual human-machine interfaces (HMI) designed across vehicle manufacturers that support drivers while supervising driving automation features, such as adaptive cruise control (ACC). These various designs communicate the same limited amount of information to drivers about their ACC system and it is unclear which HMI designs impact driver distraction the least or how their design could be modified to help drivers develop more accurate mental models of their ACC system. Using a user-centred design (UCD) approach, we designed a speedometer to inform drivers about some of the system's capabilities and then invited 23 drivers to use ACC in a low-fidelity driving simulator to compare the usability of three HMIs using eye-tracking, response times, and qualitative data. Our attempt at designing an intuitive and more informative speedometer received mixed results, but design recommendations are given regarding the indication of the set target speed, set time gap between vehicles (headway distance), and system mode (conventional or adaptive cruise). **Practitioner summary:** Manufacturers' heterogeneous designs of their visual HMIs for the ACC systems may impact driver distraction in different ways. We used usability testing to compare three HMIs in a driving simulator and make several design recommendations to indicate speed, time gap, and system mode in a more efficient way.

- **Keywords:** Adaptive cruise control, human-machine interface, User-centred design, Eye-tracking, Visual attention

Yang Jiao, Sašo Džeroski & Ales Jurca. *Analysis of hallux valgus angles automatically extracted from 3D foot scans taken in North America, Europe, and Asia.* Pages: 1164-1175.

The forefoot is the foot part most affected by ill-fitting shoes. Footwear fitting considers the measurements of length, width, and arch length. Toe shape has not yet been used in sizing feet and fitting shoes. This study aims to investigate the variation in toe shape, as

measured by the hallux valgus angle. An automatic and reproducible hallux valgus angle measuring method using 3D foot scans with no palpation markers is proposed and applied to about half a million samples collected across North America, Europe, and Asia. The measuring method is robust and can detect the medial contour along the proximal phalanx even in extreme cases. The hallux valgus angle has a normal distribution with long tails on both sides in the general population. Large dispersions of HVA values were observed for both genders and in all three geographical regions. **Practitioner summary:** The hallux valgus angle has a broad distribution in the general population. Females have larger hallux valgus angles than males, and people from Asia have larger hallux valgus angles than people from North America and Europe. Shoe toe boxes should be designed to fit the actual shapes of shoppers' toes. The proposed method for measuring HVA opens a new opportunity to study the causal relationship between shoe wearing habits and HVA on a large scale.

- **Keywords:** Hallux valgus angle, 3D scans, foot, wearfoot, wear fit, hallux valgus

Wen-Chin Li, Jingyi Zhang, Graham Braithwaite & Peter Kearney. *Quick coherence technique facilitating commercial pilots' psychophysiological resilience to the impact of COVID-19*. Pages: 1176-1189.

This study investigates the effect of quick coherence technique (QCT) on commercial pilots' resilience to the unprecedented impact of a pandemic. Eighteen commercial pilots voluntarily participated in a 2-day training course on QCT followed by 2 months of self-regulated QCT practicing during controlled rest in the flight deck and day-to-day life. There are subjective and objective assessments to evaluate the effects of QCT on commercial pilots' psychophysiological resilience. Results demonstrated that QCT training can significantly increase pilots' psychophysiological resilience thereby improving their mental/physical health, cognitive functions, emotional stability and wellness on both subjective (PSS & AWSA) and objective measures (coherence scores). Moreover, pilots who continued practicing self-regulated QCT gained the maximum benefits. Current research has identified great potential to enhance pilots' mental/physical health via QCT training. Operators can develop peer support programs for pilots to increase resilience and maintain mental and physical health using the QCT technique. **Practitioner summary:** QCT breathing has been proven to increase commercial pilots' resilience by moderating psychophysiological coherence, strengthening mental/physical capacity and sustaining positive emotions to deal with the challenges both on the flight deck and in everyday life.

HIGHLIGHTS:

- Pilots have suffered from the impact of the Covid-19 pandemic across many factors including social, economic, mental, physical, emotional, and operational issues
- Biofeedback training can increase commercial pilots' resilience by moderating psychophysiological coherence, strengthening mental and physical capacity
- Self-regulated practicing QCT to form a habitual behaviour is required to sustain the maximum benefits either in the flight or day-to-day life
- QCT is an effective intervention for aviation authorities and airline operators to develop peer support programs to increase pilots' fatigue resilience
- **Keywords:** Aviation safety, biofeedback training, controlled rest, psychophysiological resilience, quick coherence technique

Elizaveta Mojaeva, Mike McAlonan & Alex Scott. *The effect of rigid tape on wrist postures during tree planting*. Pages: 1190-1201.

Taping has been suggested to reduce the incidence of tendinopathy in tree planters. However, the ability of taping to reduce wrist postures during planting has not yet been formally evaluated. The primary aim was to test the effect of rigid taping on wrist postures during tree planting tasks. Eleven tree planters planted up to 50 trees in three conditions: no-tape (NT), tape-on-the-dorsum-of-the-hand (T1) and tape-on-the-thumb (T2) in a randomised cross-over, within-participant, repeat-measures design. Electrogoniometers (EG) recorded continuous wrist postures. Digital video recordings were used to segment EG traces of each planting cycle (one planted tree) into 4 kinematically distinct Phases. The tree and shovel wrist were analysed separately. Tree-wrist peak ulnar deviation and frequency of shovel-wrist awkward frontal plane postures were significantly reduced in the T2 condition. Taping may be effective at reducing non-neutral postures and should be researched further to determine its effectiveness in reducing tree planting injuries. **Practitioner summary:** The effect of rigid taping on wrist postures during tree planting has not yet been formally evaluated. A randomised cross-over, within-participant, repeat measures design was used to evaluate the effect of rigid taping on wrist postures during planting. Thumb rigid taping appeared to reduce wrist range of motion during planting.

KEY POINTS:

- Taping of the thumb reduced peak ulnar deviation of the tree wrist and frequency of awkward frontal plane postures of the shovel wrist.
- While taping of the dorsum of the hand appeared to be more restrictive, it did not significantly reduce wrist movement; this is likely because only its effect on sagittal plane posture was assessed which had a higher variance.
- Upon application, tape appeared to restrict voluntary movement patterns, decreased voluntary grip force exertion and physically restrain wrist movement.
- Overall, rigid tape was found to be an acceptable intervention for the tree planting occupation, with financial costs and perceived effort identified as the primary barriers to acceptability.
- **Keywords:** Tendinopathy, injury prevention, upper extremity, kinematic, Leukotape™