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Annu Haapakangas, Pia Sirola & Virpi Ruohomäki. [Understanding user behaviour in activity-based offices.](#) Pages: 419-431.

Little is known about the factors that explain the differences in the ways that individuals use activity-based offices (ABOs). This study aimed to investigate whether person-related and situational factors are associated with self-reported use of workspaces and the perceived person-environment (P-E) fit in ABOs, independently of the job profile. Survey data were gathered in one organisation ($N = 332$) 7–11 months after an office re-design. Younger age, male gender, managerial position, and better work ability were associated with more frequent use of different workspaces. Workspace switching was perceived as more time-consuming by employees who worked at the office less, had a high workload, and were dissatisfied with ergonomics. All variables except gender were associated with the P-E fit. Person-related and situational factors appear relevant to workspace use and P-E fit, independently of job contents. Contextual, cultural, and office design differences should be considered when generalising these results. **Practitioner summary:** This case study investigated individual differences in how activity-based offices are used. Being younger, male, a manager, or having good work ability were associated with using workspaces more actively. Person-related and situational factors appear relevant to how offices are used and perceived, in addition to job characteristics.

- **Keywords:** Individual differences, office ergonomics, user needs analysis, workplace design, organisational ergonomics

Sungho Kim, May Jorella Lazaro & Yohan Kang. [Galvanic vestibular stimulation to counteract leans illusion: comparing step and ramped waveforms.](#) Pages: 432-442.

Leans is a common type of Spatial Disorientation (SD) illusion that causes pilots to be confused about the position of the aircraft during a flight. This illusion could lead to serious adverse effects and even flight mishaps. Therefore, an effective means to deal with leans is crucial for flight safety. This study aims to investigate the effects of Galvanic Vestibular Stimulation (GVS) technology with different waveforms as a tool to mitigate the negative effects of leans. 20 Air Force pilots participated in leans-induced flight simulation experiment with three GVS conditions (without-GVS, step-GVS, ramped-GVS).

Bank angle error, subjective SD, perceived strength, and annoyance were measured as the dependent variables. Analysis revealed that step-GVS and ramped-GVS yielded lower bank angle errors and subjective SD than without-GVS. In addition, annoyance ratings were lower for ramped-GVS than step-GVS. This study suggests that GVS has the potential to be utilised as a counteracting tool to cope with leans. **Practitioner summary:** Galvanic Vestibular Stimulation (GVS) can be utilised as a tool to counteract the detrimental effects of leans illusion, specifically the ramped style GVS, considering that it is less annoying and distracting for the pilots. In general, GVS induces a roll sensation that can offset the false sensation caused by the leans, which can potentially help maintain flight safety and avoid spatial disorientation-related accidents.

- **Keywords:** Leans illusion, spatial disorientation, galvanic vestibular stimulation, flight safety, transportation safety, military ergonomics

Mark Cropley, Linda Weidenstedt, Birgit Leick & Stefan Sütterlin. [*Working from home during lockdown: the association between rest breaks and well-being.*](#) **Pages: 443-453.**

One of the challenges with working from home (WFH) is the question of its effect on health and well-being. The impact of home working on health has so far not been studied extensively. We address this gap by investigating the association between internal recovery, operationalised as rest break frequency (low, medium, and high) during the working day, on self-reported musculoskeletal pain, and post-work recovery symptoms in WFH knowledge workers ($n = 382$). The analysis showed that failing to take frequent breaks was associated with a dose-response increased risk of reporting headaches. For post-work recovery symptoms, failing to take rest breaks throughout the day was associated with an increased risk of reporting psychological fatigue, physical fatigue, and sleep problems, and a decreased risk of psychologically detaching from work and experiencing adequate rest. Our findings emphasise the importance of remote workers taking recovery breaks from work demands in the maintenance of health and well-being. **Practitioner Summary:** For the foreseeable future, many knowledge workers will be obliged to work from home for at least, some days of the week. It is therefore important for workers to learn to regulate their behaviour, and workers need to be educated about the value of taking regular rest breaks throughout the working day.

- **Keywords:** Remote working, recovery from workrest breaks, musculoskeletal pain, well-being

P. A. Hancock. *Reacting and responding to rare, uncertain and unprecedented events.* **Pages: 454-478.**

This work examines how we may be able to anticipate, respond to, and train for the occurrence of rare, uncertain, and unexpected events in human-machine systems operations. In particular, it uses a foundational matrix which describes the combinations of the state-of-the-world and the state-of-the-respondent, to formulate preferred response strategies, contingent upon what is knowable and actionable in each circumstance. It employs the dichotomy of System I and System II forms of cognitive response and augments these perspectives with a further form of decision-making, namely Systems III. The latter is predicated upon reactions to novel, unprecedented, and even 'unthinkable' events. The degree to which any human operator, the associated automation and/or the autonomy of a system, or each of these acting in concert, can best deal with these 'blue swan' events is explored. Potential forms of remediation, especially featuring training, are discussed, and evaluated in light of the skills needed to respond to even prohibitive degrees of situational uncertainty. **Practitioners summary:** Practitioners are liable to witness a growing spectrum of unusual and, on occasion, even unprecedented events in the operation of systems for which they are responsible. They will be required to account for their response to these circumstances to

a spectrum of involved constituencies to whom they answer. This work aids them in succeeding to bring clarity to such difficult and challenging processes.

- **Keywords:** Rare and unanticipated events, decision-making, response strategies

Salam Rahmatalla, Guandong Qiao, Jonathan DeShaw & Rachel Kinsler. *Quantifying supine human discomfort in off-road whole-body vibration*. Pages: 479-491.

This work presents a new methodology to quantify supine human discomfort during transport when multi-axis whole-body vibration (WBV) and shocks are present. The methodology employs a new scheme to normalise the reported discomfort. Twenty-six human subjects were tested under different off-road conditions and their reported discomforts collected. The paired Wilcoxon signed-rank method was used to investigate the significant differences ($p < 0.01$) between different track sections on the normalised reported discomfort from the subjects. Analyses based on ISO 2631-1 showed weak correlation with the reported discomfort when significant lateral motions existed. The results with the new formulation showed that discomfort is highly correlated with the vibration dose value at the head of the supine human during WBV ($p < 0.001$). These results are consistent with previous published work showing that discomfort based on motion at the head-neck region comprises more than 70% of the reported discomfort during supine transport under multiple-axis WBV. **Practitioner summary:** There are shortcomings in the current approaches to quantifying discomfort of supine humans in multi-axis whole-body vibration where lateral motions are excessive. This study revealed that reported discomfort is strongly related to the vibration dose value at the head of supine subjects rather than the input motion to the body.

- **Keywords:** Vibration dose value, predictive discomfort, field study, lateral motion, reported discomfort

Alexandre Moreira, Luciane Moscaleski, Daniel Gomes da Silva Machado, Marom Bikson, Gozde Unal, Paul S. Bradley, Thais Cevada, Fabiana Tenório Gomes da Silva, Abrahão F. Baptista, Edgard Morya & Alexandre Hideki Okano. *Transcranial direct current stimulation during a prolonged cognitive task: the effect on cognitive and shooting performances in professional female basketball players*. Pages: 492-505.

The negative effect of prolonged cognitive demands on psychomotor skills in athletes has been demonstrated. Transcranial direct current stimulation (tDCS) could be used to mitigate this effect. This study examined the effects of tDCS over the left dorsolateral prefrontal cortex (DLPFC) during a 30-min inhibitory Stroop task on cognitive and shooting performances of professional female basketball players. Following a randomised, double-blinded, sham-controlled, cross-over design, players were assigned to receive anodal tDCS (a-tDCS, 2 mA for 20 min) or sham-tDCS in two different sessions. Data from 8 players were retained for analysis. Response Time decreased significantly over time ($p < 0.001$; partial $\eta^2 = 0.44$; no effect of condition, or condition vs. time interaction). No difference in mean accuracy and shooting performance was observed between tDCS conditions. The results suggest that a-tDCS exert no additional benefits in reducing the negative effects of prolonged cognitive demands on technical performance compared to sham (placebo). **Practitioner summary:** Prolonged cognitive demands can negatively affect the athletes' performance. We tested whether transcranial direct current stimulation (tDCS) over the left dorsolateral prefrontal cortex (DLPFC) could attenuate these effects on cognitive and shooting performance in professional female basketball players. However, tDCS did not exert any additional benefits compared to sham.

- **Keywords:** Fatigue, athletic, neuromodulation, inhibition, sports

Yubin Xie, Ronggang Zhou & Jianhong Qu. *Fitts' law on the flight deck: evaluating touchscreens for aircraft tasks in actual flight scenarios.* Pages: 506-523.

This research investigated the effects of an abnormal flight environment using touch-based navigation displays (TNDs). Fitts' law was used to compare the performance of TNDs with control display units (CDUs) and mode control panel (MCPs) under three different flight scenarios (normal, turbulence and startled). A within-subjects design involving 15 male participants was used. Data were collected in respect to accuracy, movement time, subjective feelings, choices and comments. The results showed that under abnormal conditions, TNDs showed worse operation performance and stability than CDUs and MCPs; however, it was easy to learn from TNDs, and they provided a good user experience. Moreover, this research demonstrated the application of Fitts' law to describe pilot behaviours in interactive flight devices, particularly for tasks involving real flight operations. TND designs for aviation could be developed based on these findings to improve flight crew performance when using new technology. **Practitioner summary:** This research built a Fitts' law model to evaluate the performance of aircraft cockpit touchscreens under normal, turbulence and startled scenarios. We compared the different touchscreens (TNDs) with other traditional interactive devices, such as CDUs and MCPs. The results have implications for the design of aircraft cockpit touchscreens and define the task scenario. Furthermore, the results contribute to the development of scenes utilising Fitts' law.

- **Keywords:** Fitts' Law, aviation cockpit touch, screens, interface evaluation, turbulence, startle and surprise

Yu Huang & Jingdong Li. *Effects of vertical vibration on sitting comfort in civil aviation during the cruising flight.* Pages: 524-535.

This paper investigated the effects of vertical vibration on sitting comfort in civil aviation, with particular attention to high-frequency components (i.e. 30–100 Hz). We generated 24 vibration stimuli at four positions (i.e. the co-pilot, front, middle, and rear seat positions) in the aircraft cabin, with magnitudes ranging from 0.05 to 2 ms⁻² r.m.s. and durations of 10 s. Twenty-four subjects (12 males and 12 females) judged the vibration discomfort using a category-ratio method. We found a significant effect of high-frequency vibration on comfort: vibration stimuli at the middle and rear seats contained more energy at high frequencies and caused significantly greater discomfort than those at the co-pilot and the front seats. However, this effect became less significant with increasing magnitudes of vibration stimuli. The discomfort predicting models provided more accurate results by amplifying weighting factors for high-frequency vibration than those using standardised weightings (i.e. W_b and W_k weightings). **Practitioner summary:** The severity of high-frequency vibration for sitting comfort was usually underestimated. We investigated vibration discomfort at various seat positions in an aircraft cabin. Vibration at the middle and rear seats contained more high-frequency components and caused more discomfort. This work provided accurate predicting models of discomfort using the modified weighting.

- **Keywords:** Vibration discomfort, whole-body vibration, aircraft cabin, vibration standards, high frequency

Dario Lampe & Barbara Deml. *Increasing physical activity in the vehicle with an interactive seating system in a male sample.* Pages: 536-553.

An interactive seating system (IASS) was compared to a state-of-the-art massage seating system (MS) regarding the potential of reducing health risks from prolonged sitting in the vehicle. The study investigated if the systems (1) increase heart rate, which

is associated with reduced metabolic and cardiovascular risks; (2) activate muscles with the potential to reduce musculoskeletal pain; (3) influence seating comfort and discomfort. The systems were compared in a passenger scenario in a laboratory study (30 male subjects). Only the use of the IASS significantly elevated the heart rate. Muscle activity showed tendencies to increase in the lower back only while using the MS. In comparison, the IASS activated all six captured muscles. Significantly less discomfort was found for the IASS compared to the MS. In comparison to the MS, the IASS showed a substantially higher potential for reducing health risks from static sitting in the vehicle. **Practitioner summary:** This laboratory study compared the effects of a novel automotive interactive seating system with those of a state-of-the-art massage seating system. Muscle activity, heart rate and discomfort indicated that the IASS has a significantly higher potential to reduce health risks associated with static seating in a vehicle.

- **Keywords:** Active seating, static sitting, prolonged sitting, musculoskeletal pain, sedentariness

Peter Hoppe, Harald Reibnegger, Emmerich Boxhofer, Astrid Leeb, Iris Frenner & Bernhard Schwartz. [*Physical and psychological strain in upper Austrian elementary school teachers – an observational study.*](#) **Pages: 554-568.**

Musculoskeletal disorders (MSDs) are the main cause of pain leading to high economic burden and psychosocial disadvantages. In addition, psychological stress impacts the overall health as well as the quality of life. Elementary school teachers clearly are a cohort with a high risk of MSDs and stress. The 'BelaPrim' study was conducted to determine the physical and psychological conditions of elementary school teachers in Upper Austria and to investigate the influence of physical and psychological parameters on MSDs. Physical and mental strain was determined with the Nordic Musculoskeletal Questionnaire (NMQ) and the 11-item short version of a German work-related behaviour and experience assessment (AVEM), respectively. Despite a high prevalence of MSDs, high scores were found on personality dimensions. Furthermore, qualitative results indicated the need of administrative/pedagogical support. A linear regression model showed that body height (+), work engagement (+), and emotions (–) are predictors for the occurrence of back pain. **Practitioner summary:** Despite a high proportion of physical complaints, Upper Austrian elementary school teachers show good mental health. Body height, a high work engagement, and low level of emotions are predictors for the occurrence of back pain. Health initiatives for elementary schools should have a multifactorial view to improve teachers' health.

- **Keywords:** Musculoskeletal disorders, stress, elementary school, pain, mental health