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J. P. Biéchy, C. Charissou, S. Gobert, J. C. Verdier, E. Castel-Lacanal, D. Amarantini & L. Fautrelle. *The combination of deep breathing and mental imagery promotes cardiovascular recovery in firefighters.* Pages: 1231-1242

Firefighters' rescue operations involve intense physical activity associated with a high level of cardiovascular stress. To sustain such intense physical performance whilst maintaining a healthy heart, it is crucial that they benefit from rapid recovery between each intervention. This study aimed at investigating the impacts of a recovery protocol combining deep breathing and mental imagery. Forty firefighters were divided into two experimental groups which undertook two maximum fitness tests separated by either the control recovery protocol (30 min reading time; $n = 20$) or the experimental recovery protocol (30 min of deep breathing and mental imagery; $n = 20$). When compared to the pre-tests, the percentage evolution ratios in the post-tests for the Cooper performance, the heart rate recovery and the parasympathetic reactivation were promoted by the experimental protocol, compared to simple reading. In light of these results, we propose the use of practices of deep-breathing combined with mental imagery to improve firefighters' recovery. **Practitioner summary:** Firefighters' activities involve intense physical activities associated with a high level of psychological stress. Enhancing their recovery after each rescue intervention appears crucial. The results of this study showed that a recovery protocol combining deep breathing and mental imagery promotes heart rate recovery and better maintenance of physical fitness.

- **Keywords:** Firefighter physical performance, heart rate variability, autonomic nervous system, cardiovascular recovery, Cooper test

Ben Meadley, Ella Horton, David B. Pyne, Luke Perraton, Karen Smith, Kelly-Ann Bowles & Joanne Caldwell. *Comparison of swimming versus running maximal aerobic capacity in helicopter rescue paramedics.* Pages: 1243-1254

Swimming is a critical task for helicopter rescue paramedics and aerobic capacity is assessed in this occupation to determine job suitability. We evaluated one treadmill-

based and one pool-based assessment of maximal aerobic capacity ($\text{VO}_{2\text{peak}}$) in 14 helicopter rescue paramedics. There was a small absolute difference ($p = 0.11$, $d = 0.46$) between $\text{VO}_{2\text{peak}}$ in the swim ($45.5 \pm 7.8 \text{ ml.kg}^{-1}.\text{min}^{-1}$) compared to the run ($48.5 \pm 5.5 \text{ ml.kg}^{-1}.\text{min}^{-1}$), with a moderate relationship noted ($r = 0.74$, 95% CI [0.35–, 0.91], $p = 0.0023$). Whilst not interchangeable, run $\text{VO}_{2\text{peak}}$ was a predictor of swim $\text{VO}_{2\text{peak}}$. Maximal blood lactate was similar ($p = 0.93$) in swim ($13.4 \pm 3.8 \text{ mmol.L}^{-1}$) and run ($12.2 \pm 3.0 \text{ mmol.L}^{-1}$), and maximal heart rate 13% lower ($p < 0.0001$) in the swim ($162 \pm 11 \text{ bpm}$) versus the run ($186 \pm 10 \text{ bpm}$). To estimate swimming $\text{VO}_{2\text{peak}}$ in paramedics a treadmill test is sufficient but does not replace assessment of swimming proficiency. **Practitioner Summary:** We developed a swim protocol to assess maximal aerobic capacity in helicopter rescue paramedics. Compared to a treadmill-based test, our swim protocol generated 20% lower submaximal VO_2 and 6% lower $\text{VO}_{2\text{peak}}$. Although not interchangeable, a treadmill $\text{VO}_{2\text{peak}}$ test is indicative of maximal aerobic capacity in rescue paramedics whilst swimming.

- **Keywords:** Human performance, aerobic capacity, exercise performance, emergency medical services

Mansour Ziae, Alireza Choobineh, Haleh Ghaem & Mohammad Abdoli-Eramaki. Evaluation of a passive low-back support exoskeleton (Ergo-Vest) for manual waste collection. Pages: 1255-1270

The purpose of study was to determine the biomechanical, physiological, and subjective effect of a Passive Exoskeleton device (called Ergo-Vest) among 20 waste collectors in the working environment. Compression force and moment on L4/L5 related to 400 critical postures of the participants were estimated using the 3DSSPP software. The heart rate and energy expenditure are measured as the physiological strain using the Polar RS400 Heart Rate Monitor. Borg scale perceived exertion, system usability scale, and ergonomic design indicators of the device were collected as the subjective parameters. Compression force and moment on L4/L5 disc were decreased when the Ergo-Vest was utilised. There was no significant difference in energy expenditure and heart rate with and without the device. The workers' perceived physical exertion was decreased while using the Ergo-Vest. From the perspective of end users, the usability and ergonomic design features of the Ergo-Vest was acceptable. **Practitioner summary:** The prevalence of musculoskeletal disorders is high among the Iranian waste collectors. To mitigate this occupational problem, the effect of a passive exoskeleton for lower-back support (Ergo-Vest) was investigated on the workers' spine loading, physiological parameters, and perceived physical exertion. The result shows spine force reduction and lower subjective responses.

- **Keywords:** Compression force on L4/L5 disc, energy expenditur, passive exoskeleton, perceived physical exertion, waste collector

Hanatsu Nagano & Rezaul Begg. A shoe-insole to improve ankle joint mechanics for injury prevention among older adults. Pages: 1271-1280

Technologies to assist senior individuals with active walking are important. This experiment aimed to investigate whether a customised insole geometry would reduce the risk of falls and locomotive injuries. The tested insole incorporated a built-in inclination to assist ankle dorsiflexion (2.2°) and eversion (4.5°). Twenty-six older adults and 30 younger counterparts undertook gait assessment with and without the experimental insole while 3D motion capture and force plates recorded gait. The insole increased swing foot-ground clearance, with .43 cm for the older adults' dominant foot. The insole also prevented excessive lateral centre of pressure movement. The main insole effects on foot contact mechanics were (i) prolonged time to foot-flat (.015 s) and (ii) improved energy efficiency (2%). Reduced knee adduction moment (>15%) was observed in the older group. Shoe insoles to provide dorsiflexion and eversion support may have the

potential to reduce the risk of falls and locomotion-related injuries for older adults. **Practitioner Summary:** Using 3D gait assessment techniques this research investigated shoe-insoles incorporating ankle dorsiflexion and eversion support features. It was shown that falls risk and locomotive injuries could be reduced by the application of orthotics to support ankle dorsiflexion and eversion. Shoe-orthotics may provide practical low-cost solutions to correcting gait impairments.

- **Keywords:** Walking, falls prevention, shoe-insole, ageing

Alexander J. Nolan, Megan E. Govers & Michele L. Oliver. *Effect of fatigue on muscle latency, muscle activation and perceived discomfort when exposed to whole-body vibration.* Pages: 1281-1296

Whole-body vibration and muscle fatigue have both been shown to delay the trunk muscle reflex response and increase trunk muscle activation, leading to an increased risk of low back injuries. However, the effects of whole-body vibration on previously fatigued trunk muscles have never been tested, despite studies showing that prolonged exposure to whole-body vibration can lead to muscle fatigue. The purpose of this research was to investigate the effects of muscle fatigue on muscle latency, muscle activation and perceived discomfort when exposed to whole-body vibration. The results showed that a fatigued muscle state resulted in increased muscle latency, muscle activation and perceived discomfort, which all escalate the risk of low back injuries. Additionally, the ISO 2631-1 comfort ratings did not increase with fatigue, showing a disconnect between these comfort ratings and the perceived discomfort ratings in a fatigued muscle state. **Practitioner summary:** When exposed to whole-body vibration, fatigued back muscles result in delayed muscle contraction, higher overall muscle activation and increased perceived discomfort, all of which are known to increase low back injury risk. ISO 2631-1 comfort ratings are unable to increase with fatigue, showing a disconnect with perceived discomfort ratings.

- **Keywords:** Vibration training, surface electromyography, low back injuries, trunk muscle activity

Francois Denquin, Jamilah Foucher, Simon Pla, Jean-Christophe Sarrazin & Benoit G. Bardy. *Optical and gravito-inertial contributions to the perception and control of height in a simulated Low-Altitude Flight context.* Pages: 1297-1309

Low-Altitude Flight (LAF) is a flight formation consisting of rapid close ground flight. Perception and control of self-motion, allowing for optimal information collection and rapid adaptation, are of fundamental importance during LAF, but remain largely unexplored. This study aimed to analyse the impact of visuo-vestibular stimuli on the monitoring of height in a motion-based simulated LAF context. Thirteen non-pilots were tested in different environmental conditions, in which optical and gravito-inertial (GI) information were manipulated. The visual environment, displayed with a VR headset, was a low-textured landscape with identical and equally spaced trees throughout the trials. The GI environment was designed thanks to a motion-based simulator. Results showed that participants had better performances in a visuo-vestibular environment than in a visual-only setting, indicating that multi-sensory information was picked-up faster than a mono-sensory structure. Additionally, we found differences in the contribution of vestibular inputs depending on the kind of task. **Practitioner summary:** Low-Altitude-Flight (LAF) manoeuvres require delicate aircraft control. Two experiments using a large flight simulator investigated how visual and vestibular stimulation contribute to LAF perception and control. Results suggest that both sources of stimulation need to be combined for accurate performance, with consequences for simulator-based training scenarios.

- **Keywords:** Aeronautics, Low-Altitude Flight, motion simulator, perception, control

Yanjun Zhang, Tian Yang, Xia Zhang, Yongjin Zhang & Youchao Sun.
Effects of full windshield head-up display on visual attention allocation.
Pages: 1310-1321

This study explores the impact of full windshield head-up display (HUD) cues on the visual attention allocation of drivers under different scenarios. Forty-eight participants with driving experience were randomly divided into two groups and asked to drive on a preset route in various virtual driving scenarios created in advance. The full windshield highlights situational cues related to the driving task, such as lane lines, safe vehicle distance warnings, navigation guidance and pedestrian cues. Regarding the perception of situational cues, the number of fixations and mean fixation duration with HUD were lower than those without HUD. Furthermore, the dwell time percentage of the driver's forward view with HUD was larger than that without HUD, and the dwell time percentage on both sides was smaller than that without HUD. In conclusion, HUD may help drivers more effectively perceive cues and improve drivers' visual attention allocation. **Practitioner summary:** HUD may affect drivers' attention while driving. We examined the effect of HUD on number of fixations, fixation duration and dwell time percentage in the area of interest under different weather scenarios. Experimental results indicated that HUD could improve drivers' visual attention allocation and help drivers more effectively perceive cues.

- **Keywords:** Full windshield head-up display, visual attention allocation, number of fixations, mean fixation durations, dwell time percentage

A.G Leeftink, J. Visser, J.M de Laat, N.T.M. van der Meij, J.B.H Vos & G.D Valk.
Reducing failures in daily medical practice: Healthcare failure mode and effect analysis combined with computer simulation.
Pages: 1322-1332

This study proposes a risk analysis approach for complex healthcare processes that combines qualitative and quantitative methods to improve patient safety. We combine Healthcare Failure Mode and Effect Analysis with Computer Simulation (HFMEA-CS), to overcome widely recognised HFMEA drawbacks regarding the reproducibility and validity of the outcomes due to human interpretation, and show the application of this methodology in a complex healthcare setting. HFMEA-CS is applied to analyse drug adherence performance in the surgical admission to discharge process of pheochromocytoma patients. The multidisciplinary team identified and scored the failure modes, and the simulation model supported in prioritisation of failure modes, uncovered dependencies between failure modes, and predicted the impact of measures on system behaviour. The results show that drug adherence, defined as the percentage of required drugs received at the right time, can be significantly improved with 12%, to reach a drug adherence of 99%. We conclude that HFMEA-CS is both a viable and effective risk analysis approach, combining strengths of expert opinion and quantitative analysis, for analysing human-system interactions in socio-technical systems. **Practitioner summary:** We propose combining Healthcare Failure Mode and Effects Analysis with Computer Simulation (HFMEA-CS) for prospective risk analysis of complex and potentially harmful processes, to prevent critical incidents from occurring. HFMEA-CS combines expert opinions with quantitative analyses, such that the results are more reliable, reproducible, and fitting for complex healthcare settings.

- **Keywords:** Patient safety, system failure modelling, risk assessment and management, human reliability, system performance modelling

Till Saßmannshausen, Peter Burggräf, Johannes Wagner, Marc Hassenzahl, Thomas Heupel & Fabian Steinberg. Trust in artificial intelligence within production management – an exploration of antecedents. Pages: 1333-1350

Industry 4.0, big data, predictive analytics, and robotics are leading to a paradigm shift on the shop floor of industrial production. However, complex, cognitive tasks are also subject of change, due to the development of artificial intelligence (AI). Smart assistants are finding their way into the world of knowledge work and require cooperation with humans. Here, trust is an essential factor that determines the success of human-AI cooperation. Within this article, an analysis within production management identifies possible antecedent variables on trust in AI and evaluates these due to interaction scenarios with AI. The results of this research are five antecedents for human trust in AI within production management. From these results, preliminary design guidelines are derived for a socially sustainable human-AI interaction in future production management systems. **Practitioner summary:** In the future, artificial intelligence will assist cognitive tasks in production management. In order to make good decisions, humans trust in AI has to be well calibrated. For trustful human-AI interactions, it is beneficial that humans subjectively perceive AI as capable and comprehensible and that they themselves are digitally competent.

- **Keywords:** Production management, cyber production management, trust, artificial intelligence, machine learning

Brid Karacan, Olga Kombeiz & Anna Steidle. Powered by virtual realities: promoting emotional recovery through technology-based recovery interventions. Pages: 1351-1366

Previous research indicates that short work breaks in nature can facilitate emotional recovery, but during a workday nature is not always accessible. We conducted two intervention studies ($N = 51$; $N = 101$) applying virtual reality technology in a short work break and examined the effect of the degree of immersion into nature and the type of nature (stimulating vs. calming) on the restorative experience and, in turn, on affective states. The results revealed that high immersion promotes being away and perceived fascination. Being away mediated the effect of high immersion on increased positive and decreased negative affect. Perceived fascination mediated the effect of stimulating nature on increased positive affect in both studies and decreased negative affect in Study 2. The present research highlights the unique benefits of virtual realities, degrees of immersion and different types of nature for recovery interventions in organisations. **Practitioner Summary:** Integrating virtual realities into the work environment is an emerging topic. The present research demonstrates that a short technology-based intervention via virtual reality enhances emotional recovery. The results provide interesting possibilities for the design of work breaks in situations where nature is not within reach or not accessible.

- **Keywords:** Positive affect, negative affect, virtual realities, recovery, restorativeness