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Zhiying Cui, Jintu Fan & Yuenshing Wu. *A comparative study on the effects of air gap wind and walking motion on the thermal properties of Arabian Thawbs and Chinese Cheongsams*. Pages 999-1008.

This paper reports on an experimental investigation on the effects of air gap, wind and walking motion on the thermal properties of traditional Arabian thawbs and Chinese cheongsams. Total thermal resistance (I_t) and vapour resistance (R_e) were measured using the sweating fabric manikin – ‘Walter’, and the air gap volumes of the garments were determined by a 3D body scanner. The results showed the relative changes of I_t and R_e of thawbs due to wind and walking motion are greater than those of cheongsams, which provided an explanation of why thawbs are preferred in extremely hot climate. It is further shown that thermal insulation and vapour resistance of thawbs increase with the air gap volume up to about 71,000 cm³ and then decrease gradually. Thawbs with higher air permeability have significantly lower evaporative resistance particularly under windy conditions demonstrating the advantage of air permeable fabrics in body cooling in hot environments. **Practitioner Summary:** This paper aims to better understand the thermal insulation and vapour resistance of traditional Arabian thawbs and Chinese cheongsams, and the relationship between the thermal properties and their fit and design. The results of this study provide a scientific basis for designing ethnic clothing used in hot environments.

- **Keywords:** Thawb, cheongsam, air gap, thermal insulation, vapour resistance

Wenfang Song & Faming Wang. *The hybrid personal cooling system (PCS) could effectively reduce the heat strain while exercising in a hot and moderate humid environment*. Pages 1009-1018.

This study aimed to examine the effectiveness of a hybrid personal cooling system (PCS) in mitigating body heat stain while exercising in a hot environment. Eight subjects underwent two trials: PCS and CON (i.e. no cooling). All trials were conducted at an air temperature of 36 ± 0.5 °C and RH = $59 \pm 5\%$. The key findings demonstrated that the PCS could significantly reduce the core temperature, mean skin temperature, heart rate and physiological strain index during both exercise and recovery periods ($p < 0.05$). Subjective perceptions were also significantly alleviated in PCS at the end of the exercise

and during the recovery ($p < 0.05$). Besides, the PCS could also bring remarkable benefits in lowering local skin temperatures and in improving perceptual sensations in both upper and lower body during both exercise and recovery periods ($p < 0.05$). It was thus concluded that the hybrid PCS is effective in mitigating body heat strain while exercising in a hot environment. **Practitioner Summary:** In hot and humid environments, body heat dissipation through sweating is greatly restricted. Our newly developed hybrid PCS could effectively alleviate heat strain while exercising in hot environments. The findings contribute to the body of knowledge in improving the health and well-being of sportsmen while exercising in hot environments.

- **Keywords:** Heat stress, hybrid personal cooling system, phase change materials (PCMs), air ventilation fans, hot environment

Brian K. McFarlin, Andrea L. Henning, Adam S. Venable, Randall R. Williams & Jill N. Best Sampson. *A shirt containing multistage phase change material and active cooling components was associated with increased exercise capacity in a hot, humid environment.* Pages 1019-1025.

Recent advances in clothing design include the incorporation of phase change materials (PCM) and other active cooling components (ACC) to provide better body heat dissipation. The purpose of this study was to determine the effect of wearing a shirt containing multistage PCM/ACC on exercise capacity at low (5.0), moderate-high (7.5) and extreme (9.0) levels of the physiological strain index (PSI). Fourteen individuals tested two shirts (control vs. cooling) during 45-min of interval running in a hot, humid (35 ± 1 °C; $55 \pm 6\%$ RH) environment. The cooling shirt resulted in an 8% improvement in exercise capacity at a PSI of 7.5 ($p < 0.05$). The observed increase in exercise capacity would likely translate to a significant improvement in exercise performance. More research is needed to determine a best practice approach for the use of cooling clothing as a counter to exercise-induced heat exposure. **Practitioner Summary:** In this report, we demonstrate that when forced to exercise in a hot, humid environment, an individual's exercise capacity may increase by as much as 8% when wearing a shirt composed of multistage phase change material and active cooling components.

- **Keywords:** Core body temperature, thermal comfort, exercise performance, extreme environment

Khairil Anas Md Rezali & Michael J. Griffin. *Transmission of vibration through gloves: effects of material thickness.* Pages 1026-1037.

It might be assumed that increasing the thickness of a glove would reduce the vibration transmitted to the hand. Three material samples from an anti-vibration glove were stacked to produce three thicknesses: 6.4, 12.8 and 19.2 mm. The dynamic stiffnesses of all three thicknesses, the apparent mass at the palm and the finger and the transmission of vibration to the palm and finger were measured. At frequencies from 20 to 350 Hz, the material reduced vibration at the palm but increased vibration at the finger. Increased thickness reduced vibration at the palm but increased vibration at the finger. The measured transmissibilities could be predicted from the material dynamic stiffness and the apparent mass of the palm and finger. Reducing the dynamic stiffness of glove material may increase or decrease the transmission of vibration, depending on the material, the frequency of vibration and the location of measurement (palm or finger). **Practitioner Summary:** Transmission of vibration through gloves depends on the dynamic response of the hand and the dynamic stiffness of glove material, which depends on material thickness. Measuring the transmission of vibration through gloves to the palm of the hand gives a misleading indication of the transmission of vibration to the fingers.

- **Keywords:** Anti-vibration gloves, biodynamics, transmissibility, impedance, hands, fingers

Marco Tarabini, Stefano Solbiati, Bortolino Saggin & Diego Scaccabarozzi. *Apparent mass matrix of standing subjects exposed to multi-axial whole-body vibration*. Pages 1038-1049.

This paper describes the experimental characterisation of the apparent mass matrix of eight male subjects in standing position and the identification of nonlinearities under both mono-axial and dual-axis whole-body vibration. The nonlinear behaviour of the response was studied using the conditioned response techniques considering models of increasing complexity. Results showed that the cross-axis terms are comparable to the diagonal terms. The contribution of the nonlinear effects are minor and can be endorsed to the change of modal parameters during the tests. The nonlinearity generated by the vibration magnitude is more evident in the subject response, since magnitude-dependent effects in the population are overlaid by the scatter in the subjects' biometric data. The biodynamic response is influenced by the addition of a secondary vibration axis and, in case of dual-axis vibrations, the overall magnitude has a marginal contribution. **Practitioner Summary:** We have measured both the diagonal and cross-axis elements of the apparent mass matrix. The effect of nonlinearities and the simultaneous presence of vibration along two axes are smaller than the inter-subject variability.

- **Keywords:** Whole-body vibration, nonlinearity, apparent mass, cross-axis apparent mass

Takahiro Wada & Keigo Yoshida. *Effect of passengers' active head tilt and opening/closure of eyes on motion sickness in lateral acceleration environment of cars*. Pages 1050-1059.

This study examined the effect of passengers' active head-tilt and eyes-open/eyes-closed conditions on the severity of motion sickness in the lateral acceleration environment of cars. In the centrifugal head-tilt condition, participants intentionally tilted their heads towards the centrifugal force, whereas in the centripetal head-tilt condition, the participants tilted their heads against the centrifugal acceleration. The eyes-open and eyes-closed cases were investigated for each head-tilt condition. In the experimental runs, the sickness rating in the centripetal head-tilt condition was significantly lower than that in the centrifugal head-tilt condition. Moreover, the sickness rating in the eyes-open condition was significantly lower than that in the eyes-closed condition. The results suggest that an active head-tilt motion against the centrifugal acceleration reduces the severity of motion sickness both in the eyes-open and eyes-closed conditions. They also demonstrate that the eyes-open condition significantly reduces the motion sickness even when the head-tilt strategy is used. **Practitioner Summary:** Little is known about the effect of head-tilt strategies on motion sickness. This study investigated the effects of head-tilt direction and eyes-open/eyes-closed conditions on motion sickness during slalom automobile driving. Passengers' active head tilt towards the centripetal direction and the eyes-open condition greatly reduce the severity of motion sickness.

- **Keywords:** Motion sickness, carsickness, head tilt, open/closed eyes, lateral acceleration

S. J. Lackey, J. N. Salcedo, J.L. Szalma & P.A. Hancock. *The stress and workload of virtual reality training: the effects of presence, immersion and flow*. Pages 1060-1072.

The present investigation evaluated the effects of virtual reality (VR) training on the performance, perceived workload and stress response to a live training exercise in a

sample of Soldiers. We also examined the relationship between the perceptions of that same VR as measured by engagement, immersion, presence, flow, perceived utility and ease of use with the performance, workload and stress reported on the live training task. To a degree, these latter relationships were moderated by task performance, as measured by binary (Go/No-Go) ratings. Participants who reported positive VR experiences also tended to experience lower stress and lower workload when performing the live version of the task. Thus, VR training regimens may be efficacious for mitigating the stress and workload associated with criterion tasks, thereby reducing the ultimate likelihood of real-world performance failure. **Practitioner Summary:** VR provides opportunities for training in artificial worlds comprised of highly realistic features. Our virtual room clearing scenario facilitated the integration of Training and Readiness objectives and satisfied training doctrine obligations in a compelling engaging experience for both novice and experienced trainees.

- **Keywords:** Stress, workload, virtual reality, presence, immersion, flow

Jenny C.A. Read, Alan Godfrey, Iwo Bohr, Jennifer Simonotto, Brook Galna & Tom V. Smulders. [Viewing 3D TV over two months produces no discernible effects on balance, coordination or eyesight](#). Pages 1073-1088.

With the rise in stereoscopic 3D media, there has been concern that viewing stereoscopic 3D (S3D) content could have long-term adverse effects, but little data are available. In the first study to address this, 28 households who did not currently own a 3D TV were given a new TV set, either S3D or 2D. The 116 members of these households all underwent tests of balance, coordination and eyesight, both before they received their new TV set, and after they had owned it for 2 months. We did not detect any changes which appeared to be associated with viewing 3D TV. We conclude that viewing 3D TV does not produce detectable effects on balance, coordination or eyesight over the timescale studied. **Practitioner Summary:** Concern has been expressed over possible long-term effects of stereoscopic 3D (S3D). We looked for any changes in vision, balance and coordination associated with normal home S3D TV viewing in the 2 months after first acquiring a 3D TV. We find no evidence of any changes over this timescale.

- **Keywords:** Stereoscopic displays, 3D television, stereo vision, binocular vision

Sarah Domone, Daniel Lawrence, Ben Heller, Tim Hendra, Sue Mawson & Jonathan Wheat. [Optimal fall indicators for slip induced falls on a cross-slope](#). Pages 1089-1099.

Slip-induced falls are among the most common cause of major occupational injuries in the UK as well as being a major public health concern in the elderly population. This study aimed to determine the optimal fall indicators for fall detection models which could be used to reduce the detrimental consequences of falls. A total of 264 kinematic variables covering three-dimensional full body model translation and rotational measures were analysed during normal walking, successful recovery from slips and falls on a cross-slope. Large effect sizes were found for three kinematic variables which were able to distinguish falls from normal walking and successful recovery. Further work should consider other types of daily living activities as results show that the optimal kinematic fall indicators can vary considerably between movement types. **Practitioner Summary:** Fall detection models are used to minimise the adverse consequences of slip-induced falls, a major public health concern. Optimal fall indicators were derived from a comprehensive set of kinematic variables for slips on a cross-slope. Results suggest robust detection of falls is possible on a cross-slope but may be more difficult than level walking.

- **Keywords:** Fall detection, slips, falls, kinematics, cross-slope, balance control

Wen-Ruey Chang, Yueng-Hsiang Huang, Chien-Chi Chang, Christopher Brunette & Nils Fallentin. [Straight ladder inclined angle in a field environment: the relationship among actual angle, method of set-up and knowledge](#). Pages 1100-1108.

Ladder inclined angle is a critical factor that could lead to a slip at the base of portable straight ladders, a major cause of falls from heights. Despite several methods established to help workers achieve the recommended 75.5° angle for ladder set-up, it remains unclear if these methods are used in practice. This study explored ladder set-up behaviours in a field environment. Professional installers of a company in the cable and other pay TV industry were observed for ladder set-up at their worksites. The results showed that the actual angles of 265 ladder set-ups by 67 participants averaged 67.3° with a standard deviation of 3.22°. Although all the participants had training on recommended ladder set-up methods, only 3 out of 67 participants applied these methods in their daily work and even they failed to achieve the desired 75.5° angle. Therefore, ladder set-up remains problematic in real-world situations. **Practitioner Summary:** Professional installers of a cable company were observed for portable straight ladder set-up at their worksites. The ladder inclined angle averaged 67.3° with a standard deviation of 3.22°, while the recommended angle is 75.5°. Only a few participants used the methods that they learned during training in their daily work.

- **Keywords:** Ladder set-up, field study, extension ladder, angle measurement

Samuel Aupetit, Virginie Gallier, Jacques Riff, Stéphane Espié & Flavien Delgehier. *Naturalistic study of the risky situations faced by novice riders*. Pages 1109-1120.

This article sets out to identify the typical risky situations experienced by novice motorcyclists in the real world just after licensing. The procedure consists of a follow-up of six novices during their first two months of riding with their own motorbike instrumented with cameras. The novices completed logbooks on a daily basis in order to identify the risky situations they encountered, and were given face-to-face interviews to identify the context and their shortcomings during the reported events. Data show a large number of road configurations considered as risky by the riders (248 occurrences), especially during the first two weeks. The results revealed that a lack of hazard perception skills contributed to the majority of these incidents. These situations were grouped together to form clusters of typical incident scenarios on the basis of their similarities. The most frequent scenario corresponds to a lane change in dense traffic (15% of all incidents). The discussion shows how this has enhanced our understanding of novice riders' behaviour and how the findings can improve training and licensing. Lastly, the main methodological limitations of the study and some guidelines for improving future naturalistic riding studies are presented. **Practitioner Summary:** This article aims to identify the risky situations of novice motorcyclists in real roads. Two hundred forty-eight events were recorded and 13 incident scenarios identified. Results revealed that a lack of hazard perception contributed to the majority of these events. The most frequent scenario corresponds to a lane change in dense traffic.

- **Keywords:** Novice riders, risky situations, naturalistic study, interview, road safety

Diana Pereira, Sarah Bucher & Achim Elfering. *Daily impaired detachment and short-term effects of impaired sleep quality on next-day commuting near-accidents – an ambulatory diary study*. Pages 1121-1131.

This study investigated the short-term effects of daily recovery, that is, impaired psychological detachment from work and various actigraphical indicators of sleep quality, on near-accidents when commuting to work the next morning. Furthermore, the mediating effect of actigraphically assessed sleep quality on the relationship between impaired psychological detachment from work and near-accidents when commuting to work was analysed. Fifty-six full-time employees of a Swiss assurance company participated in the one-week study. Multilevel analyses revealed that impaired detachment was highly related to a decrease in sleep duration. Furthermore, impaired daily recovery processes, such as impaired psychological detachment from work and disturbed sleep quality, were related to commuting near-accidents. Impaired sleep quality mediated the effect of impaired psychological detachment from work on these near-accidents. Our results show that occupational safety interventions should address both impaired psychological detachment from work and sleep quality in order to prevent near accidents when commuting to work. **Practitioner Summary:** Commuting accidents occur frequently and have detrimental effects on employees, organisations and society. This study shows that daily lack of recovery, that is, impaired psychological detachment and impaired sleep quality, is related to near-accidents when commuting to work the next morning. Primary prevention of commuting accidents should therefore address daily lack of recovery.

- **Keywords:** Impaired psychological detachment, sleep quality, actigraphy, commuting near-accidents, diary