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Marc Syndicus, Bettina S. Wiese & Christoph van Treeck. *Too hot to carry on? Disinclination to persist at a task in a warm office environment.* Pages: 476-481.

We investigated the effect of an elevated ambient temperature on performance in a persistence task. The task involved the coding of incorrect symbols and participants were free to decide how long to spend performing this task. Applying a between-subject design, we tested 125 students in an office-like environment in one of the three temperature conditions. The comfort condition (Predicted Mean Vote [PMV] = 0.01) featured an average air temperature of 24 °C. The elevated ambient temperature condition was 28 °C (PMV = 1.17). Condition three employed an airstream of approximately 0.8 m/s, intended to compensate for performance decrements at the elevated air temperature (28 °C, PMV = 0.13), according to Fanger's thermal comfort equation. Participants in the warm condition were significantly less persistent compared with participants in the control and compensation conditions. As predicted by the thermal comfort equation, the airstream seemed to compensate for the higher temperature. Participants' persistence in the compensation and comfort conditions did not differ.

Practitioner Summary: A laboratory experiment involving a simulated office environment and three ambient temperature conditions (24 °C, 28 °C and 28 °C plus airstream) showed that persistence at a task is significantly impaired at 28 °C. An airstream of 0.8 m/s at 28 °C compensated for the disinclination to persist with the task.

- **Keywords:** Thermal environment, thermal comfort, ambient temperature, persistence, cognitive impairment

J. L. Szalma, T. N. Daly, G. W. L. Teo, G. M. Hancock & P. A. Hancock. *Training for vigilance on the move: a video game-based paradigm for sustained attention.* Pages: 482-505.

The capacity for superior vigilance can be trained by using knowledge of results (KR). Our present experiments demonstrate the efficacy of such training using a first-person perspective movement videogame-based platform in samples of students and Soldiers. Effectiveness was assessed by manipulating KR during a training phase and withdrawing it in a subsequent transfer phase. Relative to a no KR control condition, KR systematically

improved performance for both Soldiers and students. These results build upon our previous findings that demonstrated that a video game-based platform can be used to create a movement-centred sustained attention task with important elements of traditional vigilance. The results indicate that KR effects in sustained attention extend to a first person perspective movement based paradigm, and that these effects occur in professional military as well as a more general population. Such sustained attention training can save lives and the present findings demonstrate one particular avenue to achieve this goal. **Practitioner Summary:** Sustained attention can be trained by means of knowledge of results using a videogame-based platform with samples of students and Soldiers. Four experiments demonstrate that a dynamic, first-person perspective video game environment can serve to support effective sustained attention training in professional military as well as a more general population.

- **Keywords:** Sustained attention, vigilance, knowledge of results, transfer of training, video game-based vigilance, IED detection

Raimundo Jiménez, David Cárdenas, Rosario González-Anera, José R. Jiménez & Jesús Vera. *Measuring mental workload: ocular astigmatism aberration as a novel objective index.* Pages: 506-516.

This study assessed the effect of two perceptually matched mental tasks with different levels of mental demand on ocular aberrations in a group of young adults. We measured ocular aberration with a wavefront sensor, and total, internal and corneal RMS (root mean square) aberrations were calculated from Zernike coefficients, considering natural and scaled pupils (5, 4.5, and 4 mm). We found that total, internal and corneal astigmatism RMS showed significant differences between mental tasks with natural pupils ($p < .05$), and this effect was maintained with 5 mm scaled pupils (total RMS astigmatism, $p < .05$). Consistently, pupil size, intraocular pressure, perceived mental load and cognitive performance were influenced by the level of mental complexity ($p < .05$ for all). The findings suggest that ocular astigmatism aberration, mediated by intraocular pressure, could be an objective, valid reliable index to evaluate the impact of cognitive processing in conjunction with others physiological markers in real world contexts. **Practitioner Summary:** The search continues for a valid, reliable, convenient method of measuring mental workload. In this study we found ocular astigmatism aberration is sensitive to the cumulative effect of mental effort. It shows promise of being a novel ocular index which may help to assess mental workload in real situations.

- **Keywords:** Ocular physiology, optical quality, astigmatism aberration, pupil size, mental workload

Edith Galy, Julie Paxion & Catherine Berthelon. *Measuring mental workload with the NASA-TLX needs to examine each dimension rather than relying on the global score: an example with driving.* Pages: 517-527.

The distinction between several components of mental workload is often made in the ergonomics literature. However, measurements used are often established from a global score, notably with several questionnaires that originally reflect several dimensions. The present study tested the effect of driving situation complexity, experience and subjective levels of tension and alertness on each dimension of the NASA-TLX questionnaire of workload, in order to highlight the potential influence of intrinsic, extraneous and germane load factors. The results showed that, in complex situation, mental, temporal and physical demand (load dimensions) increased, and that novice drivers presented high physical demand when subjective tension was low on performance. Moreover, increase of mental and physical demand increased effort. It thus, appears essential to distinguish the different components of mental workload used in the NASA-TLX

questionnaire. **Practitioner Summary:** Currently, global score of NASA-TLX questionnaire is used to measure mental workload. Here, we considered independently each dimension of NASA-TLX, and results showed that mental load factors (driving situation complexity, experience, subjective tension and alertness) had a different effect on dimensions, questioning global score use to evaluate workload.

- **Keywords:** Mental workload, load dimensions, driving, experience, alertness

Bronson Boi Du, Philip L. Bigelow, Richard P. Wells, Hugh W. Davies, Peter Hall & Peter W. Johnson. *The impact of different seats and whole-body vibration exposures on truck driver vigilance and discomfort.* Pages: 528-537.

Laboratory studies have shown that exposure to whole-body vibration (WBV) increases physical and mental fatigue, which are common issues professional drivers face. The objective of this study was to determine whether altering WBV exposures had any effect on driver vigilance and discomfort. A repeated measures crossover design of five truck drivers with regular 10-h routes was used. Active and passive suspension truck seats were evaluated. For each seat, WBV exposures were measured. Participants completed a discomfort questionnaire and a reaction time task before and after their shift for two weeks, one week per seat. Compared with the passive seat, the active seat significantly reduced WBV exposures, decrements in the optimal and mean reaction times ($p = 0.02$, 0.047 , respectively), and discomfort in the lower back and wrist(s)/forearm(s) ($p < 0.01$, 0.01 , respectively). Study results indicated that reducing WBV helps reduce discomfort and maintain vigilance, which may improve drivers' health and reduce the risk of truck collisions. **Practitioner Summary:** The active suspension seat used in this study reduced truck drivers' exposure to whole-body vibration (WBV) by over 33% in relation to their current industry standard passive suspension seat. This study demonstrated that reducing truck drivers' exposure to WBV reduced fatigue and discomfort development over a workday.

- **Keywords:** Whole-body vibration, attention and vigilance, back pain, transportation safety

Shuchi Agarwal, Craig Steinmaus & Carisa Harris-Adamson. *Sit-stand workstations and impact on low back discomfort: a systematic review and meta-analysis.* Pages: 538-552.

Background: Sit-stand workstations are proposed solutions to reduce sedentary time at work. Numerous companies are using them to mitigate health concerns such as musculoskeletal discomfort. *Objective:* To review the literature on sit-stand workstations and low back discomfort. *Method:* We conducted a meta-analysis on literature published before 17 November 2016 that addressed the relationship between sit-stand workstations and musculoskeletal discomfort, focusing on the low back. *Results:* Twelve articles were identified and eight that presented results in means (SD) were included. Among a pain-free population, the standardised mean difference was -0.230 for low back discomfort with use of sit-stand workstations. When applying the SMD to studies using the 10-point pain scale, the effect estimates ranged between -0.30 and -0.51 . *Conclusion:* sit-stand workstations may reduce low back pain among workers. Further research is needed to help quantify dosage parameters and other health outcomes. **Practitioner Summary:** In a sedentary population, changing posture may reduce the chance of developing low back pain. The literature lacks studies on specific populations such as those who have pre-existing low back pain and also does not adequately address the dosage of sit-stand time required to help reduce pain.

- **Keywords:** Sit-stand workstation, sit-stand desk, height adjustable workstation, musculoskeletal discomfort, low back pain

Simon S. W. Li & Daniel H. K. Chow. *Effects of backpack load on critical changes of trunk muscle activation and lumbar spine loading during walking.* Pages: 553-565.

This study investigated the effects of carrying a backpack while walking. Critical changes featuring the disproportionality of increases in trunk muscle activation and lumbar joint loading between light and heavy backpack carriage weight may reveal the load-bearing strategy (LBS) of the lumbar spine. This was investigated using an integrated system equipped with a motion analysis, a force platform and a wireless surface electromyography (EMG) system to measure the trunk muscle EMG amplitudes and lumbar joint component forces. A predictive goal programming model was developed to determine the most critical changes in trunk muscle activation and lumbar joint loading. Results suggested that lightweight backpack carriage at approximately 3% of body weight (BW) might reduce the peak lumbosacral compression force by 3% during walking compared with no load condition. The most critical changes in both trunk muscle activation and lumbosacral joint loading were found at a backpack load of 10% of BW. **Practitioner Summary:** This study investigated the effects of backpack load on the LBS of lumbar spine while walking. A backpack load of 3% of BW might reduce the peak lumbosacral compression force by 3 and 10% of BW induced the most critical changes in LBS of lumbar spine.

- **Keywords:** Trunk muscle activation, lumbar joint loading, backpack carriage, goal programming, load-bearing strategy

Gavin K. Lenton, Tim L. A. Doyle, David J. Saxby, Dan Billing, Jeremy Higgs & David G. Lloyd. *Integrating a hip belt with body armour reduces the magnitude and changes the location of shoulder pressure and perceived discomfort in soldiers.* Pages: 566-575.

Soldiers carry heavy loads that may cause general discomfort, shoulder pain and injury. This study assessed if new body armour designs that incorporated a hip belt reduced shoulder pressures and improved comfort. Twenty-one Australian soldiers completed treadmill walking trials wearing six different body armours with two different loads (15 and 30 kg). Contact pressures applied to the shoulders were measured using pressure pads, and qualitative assessment of comfort and usability were acquired from questionnaires administered after walking trials. Walking with hip belt compared to no hip belt armour resulted in decreased mean and maximum shoulder pressures ($p < 0.005$), and 30% fewer participants experiencing shoulder discomfort ($p < 0.005$) in best designs, although hip discomfort did increase. Laterally concentrated shoulder pressures were associated with 1.34-times greater likelihood of discomfort ($p = 0.026$). Results indicate body armour and backpack designs should integrate a hip belt and distribute load closer to shoulder midline to reduce load carriage discomfort and, potentially, injury risk. **Practitioner Summary:** Soldiers carry heavy loads that increase their risk of discomfort and injury. New body armour designs are thought to ease this burden by transferring the load to the hips. This study demonstrated that designs incorporating a hip belt reduced shoulder pressure and shoulder discomfort compared to the current armour design.

- **Keywords:** Shoulder pressure, military, injury, load carriage, design

Sanne Pagh Møller, Charlotte Brauer, Sigurd Mikkelsen, Tine Alkjær, Henrik Koblauch, Ellen Bøtker Pedersen, Erik B. Simonsen & Lau Caspar Thygesen. *Risk of subacromial shoulder disorder in airport baggage handlers: combining duration and intensity of musculoskeletal shoulder loads.* Pages: 576-587.

Musculoskeletal shoulder load among baggage handlers measured by combining duration and intensity based on biomechanical and epidemiological information may be a stronger predictor of subacromial shoulder disorders than baggage handler seniority. In 2012, a cohort of baggage handlers employed at Copenhagen Airport in 1990–2012, and a cohort of unskilled otherwise employed men answered a survey. Self-reported information on work tasks during employment in the airport in combination with work task specific biomechanically modelled forces in the shoulder joint was used to estimate shoulder load. Exposure measures were accumulated shoulder abduction moment, accumulated shoulder compression force, accumulated supraspinatus force and baggage handler seniority. The outcome was subacromial shoulder disorder registered in the Danish National Patient Register. When analyses were adjusted by all confounders except age, exposure variables showed close to significant associations with subacromial shoulder disorder. Results could not confirm our hypothesis that combined information on work task duration and shoulder load intensity was stronger associated with subacromial shoulder disorder than seniority. **Practitioner Summary:** In this study we sought to identify if the exposure to work-related musculoskeletal shoulder loading including duration and intensity among baggage handlers was associated with subacromial shoulder disorder. We found that there was an association but this was not stronger than that between baggage handler seniority and subacromial shoulder disorder.

- **Keywords:** Shoulder disorders, shoulder load, baggage handlers, epidemiology, biomechanics, manual material handling, surveys and questionnaires

Jessica A. Dobson, Diane L. Riddiford-Harland, Alison F. Bell & Julie R. Steele. *The three-dimensional shapes of underground coal miners' feet do not match the internal dimensions of their work boots.* Pages: 588-602.

Mining work boots provide an interface between the foot and the ground, protecting and supporting miners' feet during lengthy coal mining shifts. Although underground coal miners report the fit of their work boots as reasonable to good, they frequently rate their boots as uncomfortable, suggesting that there is a mismatch between the shape of their feet and their boots. This study aimed to identify whether dimensions derived from the three-dimensional scans of 208 underground coal miners' feet (age 38.3 ± 9.8 years) differed from the internal dimensions of their work boots. The results revealed underground coal miners wore boots that were substantially longer than their feet, possibly because boots available in their correct length were too narrow. It is recommended boot manufacturers reassess the algorithms used to create boot lasts, focusing on adjusting boot circumference at the instep and heel relative to increases in foot length. **Practitioner Summary:** Fit and comfort ratings suggest a mismatch between the shape of underground coal miners' feet and their boots exists. This study examined whether three-dimensional scans of 208 miners' feet differed from their boot internal dimensions. Miners wore boots substantially longer than their feet, possibly due to inadequate width.

- **Keywords:** Work boots, mining, fit, scanning, feet