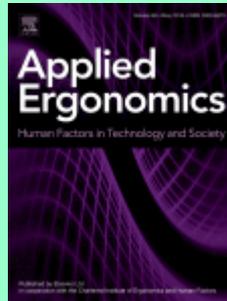


Applied Ergonomics - rok 2018, Volume 67

February 2018



June T. Spector, Jennifer Krenz, Miriam Calkins, Dawn Ryan, Jose Carmona, Mengjie Pan, Anna Zemke, Paul D. Sampson. *Associations between heat exposure, vigilance, and balance performance in summer tree fruit harvesters. Pages 1-8.*

Background: We sought to evaluate potential mediators of the relationship between heat exposure and traumatic injuries in outdoor agricultural workers. **Methods:** Linear mixed models were used to estimate associations between maximum work-shift Wet Bulb Globe Temperature (WBGT_{max}) and post-shift vigilance (reaction time) and postural sway (total path length) in a cross-sectional sample of 46 Washington State tree fruit harvesters in August–September 2015. **Results:** The mean (SD) WBGT_{max} was 27.4 (3.2)°C in August and 21.2 (2.0)°C in September. The mean pre-work-shift participant urine specific gravity indicated minimal dehydration. Twenty-four percent of participants exhibited possible excessive sleepiness. There was no association between WBGT_{max} and post-shift reaction time or total path length. **Conclusions:** Heat exposure was not associated with impaired vigilance or balance in this study, in which the overall mean (SD) WBGT_{max} was 25.9 (4.2)°C. However, the study identified opportunities to ensure adequate pre-work-shift hydration and to optimize sleep and work-shift timing in order to reduce occupational injury and heat-related illness risk.

- **Keywords:** Heat exposure; Postural sway; Psychomotor vigilance

Sara Bragança, Ignacio Castellucci, Simeon Gill, Pascal Matthias, Miguel Carvalho, Pedro Arezes. *Insights on the apparel needs and limitations for athletes with disabilities: The design of wheelchair rugby sports-wear. Pages 9-25.*

Wheelchair rugby is a sport that has been gaining popularity with athletes with disabilities. However, as it is relatively new and not played by the masses, market specific sports-wear is not available for this sport, which impacts directly on performance and clothing satisfaction of the athletes. Therefore, the main objective of this research was to identify the problems that wheelchair rugby players face with the sports-wear they use for playing the game. The data was collected using a focus group and a questionnaire with 61 wheelchair rugby players in the United Kingdom. Based on their suggestions, on the team expertise, and on the literature, a set of design recommendations was proposed for the upper body garments (tops), lower body garments (bottoms), and gloves. The results demonstrated that the gloves currently available negatively impact on players' ability to participate with satisfactory levels of

protection and comfort. Moreover, tops and bottoms also present issues, mainly in the fit and ability to regulate the core body temperature. Hence, the recommendations proposed can provide designers with key information on the specific sports-wear requirements and allow them to design and develop products that can satisfy real needs of specific end-users. This paper intends to raise awareness of the needs of sports-wear for those playing wheelchair rugby and promote the inclusivity of athletes with disabilities.

- **Keywords:** Inclusive design; Sports-wear; Wheelchair rugby

Maryam Zahabi, David Kaber. *Effect of police mobile computer terminal interface design on officer driving distraction.* Pages 26-38.

Abstract: Several crash reports have identified in-vehicle distraction to be a primary cause of emergency vehicle crashes especially in law enforcement. Furthermore, studies have found that mobile computer terminals (MCTs) are the most frequently used in-vehicle technology for police officers. Twenty police officers participated in a driving simulator-based assessment of visual behavior, performance, workload and situation awareness with current and enhanced MCT interface designs. In general, results revealed MCT use while driving to decrease officer visual attention to the roadway, but usability improvements can reduce the level of visual distraction and secondary-task completion time. Results also suggest that use of MCTs while driving significantly reduces perceived level of driving environment awareness for police officers and increases cognitive workload. These findings may be useful for MCT manufacturers in improving interface designs to increase police officer and civilian safety.

- **Keywords:** Mobile computer terminal; Driver performance; Attention allocation; Workload; Situation awareness

Steve N.H. Tsang, Alan H.S. Chan. *Tracking and discrete dual task performance for different visual spatial stimulus-response mappings with focal and ambient vision.* Pages 39-49.

The effect of spatial compatibility for various display-control configurations on human performance was studied with a dual-task paradigm using a tracking task and a discrete response task. Degradation of performance on both tasks within the visual modality was observed and was considered to be most likely due to resource competition resulting from simultaneous task operation. It was found that the more complicated the mapping for the discrete spatial compatibility response task, the more severe the interference with the tracking task. Although performance on both the tracking and spatial response tasks was impaired, the magnitude of impairment was not as great as expected, implying that focal and ambient vision required for the tracking task and spatial task, respectively, might be deployed, at least partly, from separate resources. Participants here seemed to successfully use focal vision for tracking and ambient vision for identifying signal lights concurrently, reducing the expected keen competition for visual resources.

- **Keywords:** Multitasking; Spatial S-R compatibility; Multiple resources; Displays and controls; Visual displays

Tara McCurdie, Penelope Sanderson, Leanne M. Aitken. *Applying social network analysis to the examination of interruptions in healthcare.* Pages 50-60.

Examinations of interruptions in healthcare often focus on a single clinical discipline, and solutions are targeted accordingly. This approach does not take into account the interdisciplinary dependencies and other sociotechnical aspects that make up the healthcare

work system, and suggested solutions may not meet the needs of all stakeholders. In this article a sociotechnical systems perspective is used to uncover the interdependencies between 16 unique work roles that result in interruptions in an intensive care unit (ICU). By applying social network analysis techniques to data collected using the Dual Perspectives Method, we identified targeted systems-based interventions that may reduce unnecessary interruptions while avoiding unintended consequences that impose additional burden on ICU staff. The rich insights gained into the interruptive communication patterns in the ICU work system stand in contrast to findings that would have otherwise been obtained by focusing only on a single clinical discipline or a single perspective.

- **Keywords:** Interruptions; Social network analysis; Sociotechnical systems

Yaar Harari, Raziel Riemer, Avital Bechar. *Factors determining workers' pace while conducting continuous sequential lifting, carrying, and lowering tasks.* Pages 61-70.

To plan a new manual material handling work process, it is necessary to predict the times required to complete each task. Current time prediction models lack validity when the handled object's mass exceeds 2 kg. In this study, we investigated the effect of workplace design parameters on continuous sequential lifting, carrying, and lowering of boxes weighing from 2 kg to 14 kg. Both laboratory and field experiments were conducted. Results revealed that the box's weight and the lifting and lowering heights influenced the tasks' times. Further, the time to perform a task was influenced by the performance of other tasks in the same work process. New time prediction models were developed using the laboratory experiment data. Our models were found to be more accurate on average than the Maynard Operation Sequence Technique (MOST) and Methods Time Measurement (MTM-1) by 42% and 20%, respectively, for predicting the times of real workers at an actual workplace.

- **Keywords:** Manual material handling; Time prediction models; Workplace design

H. Omer, A. Bekker. *Human responses to wave slamming vibration on a polar supply and research vessel.* Pages 71-82.

A polar supply and research vessel is pre-disposed to wave slamming which has caused complaints among crew and researchers regarding interference with sleep, equipment use and research activities. The present work undertook to survey passenger claims of sleep interference, disturbed motor tasks and equipment damage as a result of wave slamming during normal operations of this vessel. The hypothesis was investigated that whole-body vibration metrics from ISO 2631-1 are potentially suitable for the prediction of human slamming complaints. Full-scale acceleration measurements were performed and wave slamming events were subsequently identified from the human weighted acceleration time histories. A daily diary survey was also conducted to gather the human response. The vibration caused by wave slamming was found to be strongly correlated with sleep disturbances and activity interference. Sleep and equipment use were found to be the most affected parameters by slamming. Daily vibration dose values were determined by accumulating the vibration as a result of slamming over 24 h periods. This metric accounted for increased magnitudes and frequency of slamming incidents and proved to be the best metric to represent human responses to slamming vibration. The greatest percentage of activities affected by slamming related to sleep regardless of daily cumulative VDV magnitude. More than 50% of the recorded responses related to sleep when the daily cumulative VDV ranged between 8.0 m/s^{1.75}–10.0 m/s^{1.75}. The peak vertical vibration levels recorded on the vessel reach magnitudes which are associated with sleep disturbance in environments where acoustic noise is present.

- **Keywords:** Wave slamming; Whole-body vibration; Human response survey; Vibration dose value; Ice-going stern design

J. Roca, P. Tejero, B. Insa. *Accident ahead? Difficulties of drivers with and without reading impairment recognising words and pictograms in variable message signs. Pages 83-90.*

A timely and accurate acquisition of the information provided by variable message signs (VMS) can be crucial while driving. In the current study, we assess the difficulties of adults with dyslexia acquiring the information shown in VMS and provide evidence to discuss the controversial use of pictograms as potential countermeasures. Twenty-two adults with dyslexia and 22 matched controls completed a simulated driving session. The legibility of 12 VMS was assessed, including six text messages (e.g. "ACCIDENT") and six single pictograms (e.g. the icon for "accident ahead"). On average, participants with dyslexia started reading text messages when they were closer to the VMS. In addition, while approaching text VMS, they dedicated more gazes and manifested worse control of speed. Regarding pictogram VMS, we observed no differences in response distance, accuracy, response duration, or number of gazes. To sum up, the evidence provided reveals that adults with dyslexia, despite potential compensation effects, may still find difficulties reading text messages in VMS (shorter legibility distances, longer reading times, and increased cognitive effort), whereas we found no such differences in the recognition of pictograms (only some difficulties keeping a steady speed). Research on inclusive measures to improve reading in low-skilled or dyslexic drivers must be encouraged.

- **Keywords:** Traffic sign legibility; Dyslexia; Cognitive demands; Variable message signs; Pictograms; Driver simulator

Grace Teo, Lauren Reinerman-Jones, Gerald Matthews, James Szalma, Florian Jentsch, Peter Hancock. *Enhancing the effectiveness of human-robot teaming with a closed-loop system. Pages 91-103.*

With technological developments in robotics and their increasing deployment, human-robot teams are set to be a mainstay in the future. To develop robots that possess teaming capabilities, such as being able to communicate implicitly, the present study implemented a closed-loop system. This system enabled the robot to provide adaptive aid without the need for explicit commands from the human teammate, through the use of multiple physiological workload measures. Such measures of workload vary in sensitivity and there is large inter-individual variability in physiological responses to imposed taskload. Workload models enacted via closed-loop system should accommodate such individual variability. The present research investigated the effects of the adaptive robot aid vs. imposed aid on performance and workload. Results showed that adaptive robot aid driven by an individualized workload model for physiological response resulted in greater improvements in performance compared to aid that was simply imposed by the system.

- **Keywords:** Adaptive systems; Workload model; Inter-individual variability

Imogen Lyons, Ann Blandford. *Safer healthcare at home: Detecting, correcting and learning from incidents involving infusion devices. Pages 104-114.*

Objective: Complex medical devices such as infusion pumps are increasingly being used in patients' homes with little known about the impact on patient safety. Our aim was to better understand the risks to patient safety in this situation and how these risks might be minimised, by reference to incident reports. **Design:** We identified 606 records of

incidents associated with infusion devices that had occurred in a private home and were reported to the UK National Reporting and Learning Service (2005–2015 inclusive). We used thematic analysis to identify key themes. **Results:** In this paper we focus on two emergent themes: detecting and diagnosing incidents; and locating the patient, lay caregivers and their family in incident reports. The majority of incidents were attributed to device malfunction, and resulted in the patient being under-dosed. Delays in recognising and responding to problems were identified, alongside challenges in identifying the cause. We propose a process model for fault diagnosis and correction. Patients and caregivers did not feature strongly in reports; we highlight how the device is in the home but of the care system, and propose an agent model to describe this; we also identify ways of mitigating this disjoint. **Conclusion:** Devices need to be appropriately tailored to the setting in which they are employed, and within a system of care that ensures they are used optimally and safely. Suggested features to improve patient safety include devices that can provide better feedback to identify problems and support resolution, alongside greater monitoring and technical support by care providers for both patients and frontline professionals. The proposed process and agent models provide a structure for reviewing safety and learning from incidents in home health care.

- **Keywords:** Patient safety; Incident reporting; Qualitative research; Primary care; Infusion devices

Iman Dianat, Ahmad Bazazan, Mohammad Amin Souraki Azad, Seyedeh Sakineh Salimi. *Work-related physical, psychosocial and individual factors associated with musculoskeletal symptoms among surgeons: Implications for ergonomic interventions.* Pages 115-124.

This study evaluated the effect of physical, psychosocial and individual factors on the presence of musculoskeletal symptoms (MSS) among surgeons ($n = 312$) in Iran. Data were collected using questionnaires and analysed by multivariate logistic regression. The prevalence of MSS, particularly in the knees (48.7%), neck (45.8%), low back (42.3%) and shoulders (40.1%) was relatively high. Work-related factors including time spent on surgeries each week (>25 h/week), number of hours working in standing position per day (>4 h/day), moderate to high levels of work–family conflict, duration of each surgery (>3 h), number of years worked as a surgeon (>10 years) and surgical specialty (particularly cardiothoracic and obstetric/gynecologic surgeries) were independently associated with the presence of MSS in different body regions. Individual factors including gender (being female) and little or no involvement in sport and physical activity were also independently associated with the occurrence of complaints. Implications of the findings for further research and development work for improving the working conditions and consequently reducing MSS among this working group are discussed.

- **Keywords:** Operating room; Surgeon; Pain; Discomfort; MSDs

Evona Teh, Samantha Jamson, Oliver Carsten. *Mind the gap: Drivers underestimate the impact of the behaviour of other traffic on their workload.* Pages 125-132

This study examines the effect of traffic demand on driver workload by varying a range of characteristics of traffic behaviour, in particular focusing on the influence of a lane change performed by a neighbouring vehicle. To examine drivers' ability to manage their own workload in these traffic situations, a self-initiated, surrogate mobile phone task was presented to them, to coincide with changes in traffic demand. Results showed that whilst participants delayed the initiation of the task when the lane change was performed in close proximity to them, the delay was insufficient to mitigate the effects of the increased workload, leading to task errors. This was attributed to driver's willingness to engage in secondary tasks, even though their (self-reported) workload had not returned

to baseline levels. The minimum workload recovery period was calculated as being 12 s after the onset of the adjacent vehicle's manoeuvre, and this has implications for the design of workload managers.

- **Keywords:** Driving; Workload; Lane change; Secondary task; Demand

Wonsup Lee, Xiaopeng Yang, Daehan Jung, Seikwon Park, Heeun Kim, Heecheon You. *Ergonomic evaluation of pilot oxygen mask designs.* Pages 133-141.

A revised pilot oxygen mask design was developed for better fit to the Korean Air Force pilots' faces. The present study compared an existing pilot oxygen mask and a prototype of the revised mask design with 88 Korean Air Force pilots in terms of subjective discomfort, facial contact pressure, and slip distance on the face in high gravity. The average discomfort levels, facial contact pressures, and slip distance of the revised mask were reduced by 33%–56%, 11%–33%, and 24%, respectively, compared to those of the existing oxygen mask. The mask evaluation method employed in the study can be applied to ergonomic evaluation of full- or half-face mask designs.

- **Keywords:** Pilot oxygen mask; Ergonomic evaluation; Subjective discomfort; Facial contact pressure; Mask slip distance

Seul Chan Lee, Min Chul Cha, Hwan Hwangbo, Sookhee Mo, Yong Gu Ji. *Smartphone form factors: Effects of width and bottom bezel on touch performance, workload, and physical demand.* Pages 142-150.

This study aimed at investigating the effect of two smartphone form factors (width and bottom bezel) on touch behaviors with one-handed interaction. User experiments on tapping tasks were conducted for four widths (67, 70, 72, and 74 mm) and five bottom bezel levels (2.5, 5, 7.5, 10, and 12.5 mm). Task performance, electromyography, and subjective workload data were collected to examine the touch behavior. The success rate and task completion time were collected as task performance measures. The NASA-TLX method was used to observe the subjective workload. The electromyogram signals of two thumb muscles, namely the first dorsal interosseous and abductor pollicis brevis, were observed. The task performances deteriorated with increasing width level. The subjective workload and electromyography data showed similar patterns with the task performances. The task performances of the bottom bezel devices were analyzed by using three different evaluation criteria. The results from these criteria indicated that tasks became increasingly difficult as the bottom bezel level decreased. The results of this study provide insights into the optimal range of smartphone form factors for one-handed interaction, which could contribute to the design of new smartphones.

- **Keywords:** Smartphone form factor; Touch behavior performances; One-handed interaction

Howard Chen, Mark C. Schall, Nathan Fethke. *Accuracy of angular displacements and velocities from inertial-based inclinometers.* Pages 151-161.

The objective of this study was to evaluate the accuracy of various sensor fusion algorithms for measuring upper arm elevation relative to gravity (i.e., angular displacement and velocity summary measures) across different motion speeds. Thirteen participants completed a cyclic, short duration, arm-intensive work task that involved transferring wooden dowels at three work rates (slow, medium, fast). Angular displacement and velocity measurements of upper arm elevation were simultaneously measured using an inertial measurement unit (IMU) and an optical motion capture (OMC)

system. Results indicated that IMU-based inclinometer solutions can reduce root-mean-square errors in comparison to accelerometer-based inclination estimates by as much as 87%, depending on the work rate and sensor fusion approach applied. The findings suggest that IMU-based inclinometers can substantially improve inclinometer accuracy in comparison to traditional accelerometer-based inclinometers. Ergonomists may use the non-proprietary sensor fusion algorithms provided here to more accurately estimate upper arm elevation.

- **Keywords:** Inclinometer; Kalman filter; Inertial measurement units; Inertial-based motion capture

Alison C. McDonald, Spencer M. Savoie, Daanish M. Mulla, Peter J. Keir. *Dynamic and static shoulder strength relationship and predictive model.* Pages 162-169.

Static strength is typically used to standardize occupational tasks in an effort to limit over-exertion injuries; however, workplace tasks are commonly dynamic in nature. The purpose of this investigation was to assess factors influencing isokinetic shoulder strength and to develop predictive equations for isokinetic shoulder flexion and extension strength using isometric strength. Fifteen women performed a set of concentric isokinetic and isometric shoulder flexion and extension maximal exertions across a series of movement planes, angular velocities, and grip types. Data were used to generate two stepwise multiple regression models for predicting isokinetic shoulder flexion and extension strength across the various exertion parameters. The final regression models explained a high degree of variance in predicting isokinetic shoulder flexion ($R^2 = 0.59$) and extension ($R^2 = 0.67$) with a subset of four and five inputs, respectively. The predictive equations can help establish acceptable force limits for workplace tasks requiring dynamic actions using more easily attainable static forces.

- **Keywords:** Shoulder; Strength; Workplace design

Helene Højberg, Charlotte Diana Nørregaard Rasmussen, Richard H. Osborne, Marie Birk Jørgensen. *Identifying a practice-based implementation framework for sustainable interventions for improving the evolving working environment: Hitting the Moving Target Framework.* Pages 170-177.

Our aim was to identify implementation components for sustainable working environment interventions in the nursing assistant sector to generate a framework to optimize the implementation of workplace improvement initiatives. The implementation framework was informed by: 1) an industry advisory group, 2) interviews with key stakeholder, 3) concept mapping workshops, and 4) an e-mail survey. Thirty five stakeholders were interviewed and contributed in the concept mapping workshops. Eleven implementation components were derived across four domains: 1) A supportive organizational platform, 2) An engaged workplace with mutual goals, 3) The intervention is sustainably fitted to the workplace, and 4) the intervention is an attractive choice. The highest rated component was "Engaged and Active Management" (mean 4.1) and the lowest rated was "Delivered in an Attractive Form" (mean 2.8). The framework provides new insights into implementation in an evolving working environment and is aiming to assist with addressing gaps in effectiveness of workplace interventions and implementation success.

- **Keywords:** Denmark; Working environment; Concept mapping; Implementation; Sustainability

Jung Hyup Kim. The effect of metacognitive monitoring feedback on performance in a computer-based training simulation. Pages 193-202.

This laboratory experiment was designed to study the effect of metacognitive monitoring feedback on performance in a computer-based training simulation. According to prior research on metacognition, the accurate checking of learning is a critical part of improving the quality of human performance. However, only rarely have researchers studied the learning effects of the accurate checking of retrospective confidence judgments (RCJs) during a computer-based military training simulation. In this study, we provided participants feedback screens after they had completed a warning task and identification task in a radar monitoring simulation. There were two groups in this experiment. One group (group A) viewed the feedback screens with the flight path of all target aircraft and the triangular graphs of both RCJ scores and human performance together. The other group (group B) only watched the feedback screens with the flight path of all target aircraft. There was no significant difference in performance improvement between groups A and B for the warning task (Day 1: group A – 0.347, group B – 0.305; Day 2: group A – 0.488, group B – 0.413). However, the identification task yielded a significant difference in performance improvement between these groups (Day 1: group A – 0.174, group B – 0.1555; Day 2: group A – 0.324, group B – 0.199). The results show that debiasing self-judgment of the identification task produces a positive training effect on learners. The findings of this study will be beneficial for designing an advanced instructional strategy in a simulation-based training environment.

- **Keywords:** Retrospective confidence judgments; Computer-based training; Human-in-the-loop simulation; Human performance

Chad E. Gooyers, Tyson A.C. Beach, David M. Frost, Samuel J. Howarth, Jack P. Callaghan. *Identifying interactive effects of task demands in lifting on estimates of in vivo low back joint loads. Pages 203-210.*

This investigation examined interactions between the magnitude of external load, movement speed and (a)symmetry of load placement on estimates of in vivo joint loading in the lumbar spine during simulated occupational lifting. Thirty-two participants with manual materials handling experience were included in the study. Three-dimensional motion data, ground reaction forces, and activation of six bilateral trunk muscle groups were captured while participants performed lifts with two loads at two movement speeds and using two load locations. L4-L5 joint compression and shear force-time histories were estimated using an EMG-assisted musculoskeletal model of the lumbar spine. Results from this investigation provide strong evidence that known mechanical low back injury risk factors should not be viewed in isolation. Rather, injury prevention efforts need to consider the complex interactions that exist between external task demands and their combined influence on internal joint loading.

- **Keywords:** Interaction; Task demands; Joint loads

Jean Theurel, Kevin Desbrosses, Terence Roux, Adriana Savescu. *Physiological consequences of using an upper limb exoskeleton during manual handling tasks. Pages 211-217.*

This study aimed to assess the physiological consequences of using an upper limb exoskeleton during manual handling task, as muscle activity, upper limb kinematics, postural balance and cardiac cost. Participants performed three tasks (load lifting (LIFT), carrying (WALK) and stacking-unstacking (STACK)) with (EXOS) and without (FREE) an exoskeleton. During LIFT and STACK, the activity of the deltoid anterior muscle was significantly lower for EXOS than for FREE. During LIFT, the activity of the triceps brachii (TB) and tibialis anterior muscles significantly increased for EXO. The TB muscle activity significantly decreased for EXOS during WALK. The cardiac cost tended to increase with the use of the exoskeleton during LIFT, compared to FREE. The upper limb kinematics significantly differed between the EXOS and FREE conditions for all tasks. The benefits of the upper limb exoskeleton to reduce shoulder flexor muscle activity has been

demonstrated, while broader physiological consequences have also been evidenced as increased antagonist muscle activity, postural strains, cardiovascular demand, and modified kinematics.

- **Keywords:** Workload; TMS; EMG

Jeremy Yang Lee, Richelle Baker, Pieter Coenen, Leon Straker. *Use of a footrest to reduce low back discomfort development due to prolonged standing.* Pages 218-224.

Prolonged standing is common in many occupations and has been associated with low back discomfort (LBD). No recent studies have investigated a footrest as an intervention to reduce LBD associated with prolonged standing. This study investigated the effect of a footrest on LBD and sought to determine if LBD changes were accompanied by changes in muscle fatigue and low back end-range posture and movement. Twenty participants stood for two 2-h trials, one with and one without a footrest. LBD, lumbar erector spinae electromyography, upper lumbar (UL) and lower lumbar (LL) angles were measured. A significant increase in LBD occurred in both conditions but the footrest did not significantly decrease LBD. The only significant finding between conditions was that UL lordosis became more similar to usual standing over time with footrest use. These findings suggest that footrest use may not reduce LBD development and that development of LBD with prolonged standing is unlikely to be due to muscle fatigue or end-range posture mechanisms.

- **Keywords:** Prolonged standing; Low back discomfort; Footrest; Muscle fatigue; Low back postures

Divyaksh Subhash Chander, Maria Pia Cavatorta. *Multi-directional one-handed strength assessments using AnyBody Modeling Systems.* Pages 225-236.

Digital human modeling tools support proactive ergonomics in optimizing work tasks and workplace layouts. Empirical-statistical model based tools are often used to estimate the force exertion capability of the operators. This work is intended to serve as an initial probing into the usability of a musculoskeletal model based software, AnyBody Modeling Systems (AMS), in evaluating the force exertion capability at different points in the workspace and for various exertion directions. As a first step, it focuses on the modeling approach and the accuracy of one-handed isometric strength estimates of AMS. An existing literature database was used to compare the predicted strength at 8 hand locations and in 26 exertion directions, while simulating the empirical postures. The results show a correlation coefficient of 0.7 between the simulated and the experimental strength. AMS emphasizes the biomechanical advantages in strength due to the alignment of force exertion direction with the shoulder. Additionally, some discrepancies have been identified and discussed.

- **Keywords:** Musculoskeletal modeling; Workplace optimization; Standing exertion

Sang Min Ko, Yong Gu Ji. *How we can measure the non-driving-task engagement in automated driving: Comparing flow experience and workload.* Pages 237-245.

In automated driving, a driver can completely concentrate on non-driving-related tasks (NDRTs). This study investigated the flow experience of a driver who concentrated on NDRTs and tasks that induce mental workload under conditional automation. Participants performed NDRTs under different demand levels: a balanced demand-skill level (fit condition) to induce flow, low-demand level to induce boredom, and high-demand level

to induce anxiety. In addition, they performed the additional N-Back task, which artificially induces mental workload. The results showed participants had the longest reaction time when they indicated the highest flow score, and had the longest gaze-on time, road-fixation time, hands-on time, and take-over time under the fit condition. Significant differences were not observed in the driver reaction times in the fit condition and the additional N-Back task, indicating that performing NDRTs that induce a high flow experience could influence driver reaction time similar to performing tasks with a high mental workload.

- **Keywords:** Automated driving; Flow experience; Take-over time; Eye-tracking; NASA-TLX

Renée C. Lurie, Stephanie R. Cimino, Diane E. Gregory, Stephen H.M. Brown. *The effect of short duration low back vibration on pain developed during prolonged standing.* Pages 246-251.

Abstract: The purpose of this study was to determine if vibration, a potential method of pain management, applied to the low back could alleviate pain developed during prolonged standing. Eighteen healthy individuals participated in a 2.5-h standing task during which vibration (3-min duration) was applied at the 2-h and 2.25-h marks. During the full 2.5 h, participants recorded their perceived pain scores every 15 min using a 10 cm visual analogue scale (VAS). Following each vibration bout, those who developed low back pain (LPB) reported statistically lower VAS scores compared to prior to the vibration; however, when the vibration ceased, LBP returned to pre-vibration levels. It appears that vibration may be an effective method of alleviating LBP caused by prolonged standing; however, the effects seem to be temporary. Further research is needed to investigate the optimal vibration frequency and time period to maximize pain management effectiveness.

- **Keywords:** Vibration; Massage belt; Centre of pressure; Visual analogue scale; Low back pain

Raimundo Jiménez, Jesús Vera. Effect of examination stress on intraocular pressure in university students. Pages 252-258.

Abstract: Intraocular pressure (IOP) has been investigated as a possible objective index of mental stressors. Here, we assessed the effect of examination stress on IOP in 33 university students. A repeated-measures design was used with two experimental conditions (examination and control) and two points of measurements (pre- and post-sessions). Also, the cardiovascular response, subjective perceived stress, as well as calculated ocular perfusion pressure and blood-pulse pressure were determined. A Bayesian statistical analysis showed higher IOP values in the examination in comparison to the control condition ($BF_{01} < 0.001$). A similar pattern was found for the cardiovascular indices (diastolic and systolic blood pressure, and heart rate), and these findings were corroborated by subjective reports ($BF_{01} < 0.001$ in all cases). Our data incorporates evidence in relation to the utility of IOP as an objective marker of examination stress, and it may help in the assessment and management of stress in applied scenarios.

- **Keywords:** Examination stress; Intraocular pressure; Cardiovascular physiology

Charlotte Diana Nørregaard Rasmussen, Helene Højberg, Elizabeth Bengtsen, Marie Birk Jørgensen. *Identifying knowledge gaps between practice and research for implementation components of sustainable interventions to improve the working environment: a rapid review.* Pages 178-192.

In a recent study, we involved all relevant stakeholders to identify practice-based implementation components for successful implementation and sustainability in work environment interventions. To understand possible knowledge gaps between evidence and practice, the aim of this paper is to investigate if effectiveness studies of the 11 practice-based implementation components can be identified in existing scientific literature. PubMed/MEDLINE, PsycINFO, and Web of Science were searched for relevant studies. After screening, 38 articles met the inclusion criteria. Since some of the studies describe more than one practice-based implementation concept a total of 125 quality criteria assessments were made. The overall result is that 10 of the 11 practice-based implementation components can be found in the scientific literature, but the evaluation of them is poor. From this review it is clear that there are knowledge gaps between evidence and practice with respect to the effectiveness of implementation concepts.

- **Keywords:** Workplace; Occupational health; Nursing assistants