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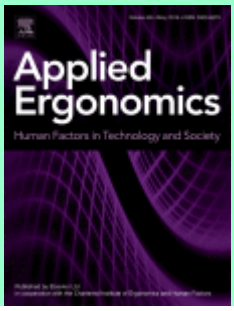

Hazreen H. Harith, Muhammad Fuad Mohd, Sharence Nai Sowat. *A preliminary investigation on upper limb exoskeleton assistance for simulated agricultural tasks*. 103455.

Manual harvesting is still prevalent in the agricultural industry. Accordingly, it is one of the largest contributors toward work-related musculoskeletal disorder. The cutting task in oil palm harvesting uses a long pole and involves repetitive and forceful motion of the upper limbs. Exoskeleton technology is increasingly explored to assist manual tasks performance in manufacturing and heavy industries, mainly for reducing discomfort and injuries, and improving productivity. This paper reports an initial investigation on the feasibility of using an upper limb exoskeleton to assist oil palm harvesting tasks. Previous studies highlighted that exoskeletons for agricultural activities should be adaptable to changing field tasks, tools and equipment. The immediate difference in the activity of three muscles were analyzed for a range of harvesting-simulated tasks. Lower activities were observed for tasks involving overhead work when using the prototype. Nevertheless, users' feedback highlighted that its design should be optimized for better acceptance.

- **Keywords:** Wearable; Agriculture; EMG; Exoskeleton

Kaj Gijsbertse, Lotte Linssen, Arend Woering, Milène Catoire. *The effects of mass, bulk and stiffness of personal protective equipment and clothing on physical performance when performing a military mobility obstacle course*. 103448.

Background: Soldiers are required to conduct tasks and operations in physically demanding situations, where the ability to move (mobility) quickly is important to lethality and survivability. This study employed a specially designed suit to try to isolate the main mass property characteristics of personal protective clothing/equipment (PPCE) including mass, bulk and stiffness as much as possible and evaluated their effects on soldier performance across operationally-relevant mobility tasks. **Method:** Eight male military subjects performed the load effects assessment program (LEAP) obstacle course while wearing 7 different configurations of specifically designed suit: unencumbered (control), 10 kg mass, 30 kg mass, 20 L bulk, medium stiffness, high stiffness and a mixed configuration consisting of 10 kg mass, 20 L bulk and medium stiffness. The primary outcome measure was total LEAP completion time. Additionally, heart rate, rating of perceived exertion (RPE), range of motion and vertical jump heights were measured and related to LEAP performance. **Results:** All configurations degraded or

tended to degrade the total LEAP completion times (p-value < 0.05), except for the medium stiffness configuration. Heart rate did not differ significantly between configurations, while RPE scores of configurations 30 kg and mix were significantly higher compared to control (p < 0.01). **Conclusion:** Mass, bulk and stiffness all negatively influence LEAP obstacle performance. Therefore, all three have to be considered when trying to reduce the physical burden on soldiers.

- **Keywords:** Clothing and equipment; Military performance; LEAP obstacle Course

Stephven Kolose, Tom Stewart, Patria Hume, Grant R. Tomkinson. *Prediction of military combat clothing size using decision trees and 3D body scan data*. 103435.

Aim: To determine how well decision tree models can predict tailor-assigned uniform sizes using anthropometry data from the New Zealand Defence Force Anthropometry Survey (NZDFAS). This information may inform automatic sizing systems for military personnel. **Methods:** Anthropometric data from two separate samples of the New Zealand Defence Force military were used. Data on Army personnel from the NZDFAS (n = 583) were used to develop a series of shirt- and trouser-size prediction models based on decision trees. Different combinations of physical, automatic, and post-processed measurements (the latter two derived from a 3D body scan) were trialled, and the models with the highest cross-validation accuracy were retained. The accuracy of these models were then tested on an independent sample of Army recruits (n = 154). **Results:** The automated measurement method (measurements derived automatically by the body scanner software) were the best predictors of shirt size (58.1% accuracy) and trouser size (61.7%), with body weight and waist girth being the strongest predictors. Clothing sizes that were incorrectly predicted by the model where generally one size above or below the tailor-predicted size. **Conclusions:** Anthropometry measurements, when used with decision tree models, show promise for classifying clothing size. Methodological changes such as fitting gender-specific models, using additional anthropometry variables, and testing other data mining techniques are avenues for future work. More research is required before fully automated body scanning is a viable option for obtaining fast and accurate clothing sizes for military clothing and logistics departments.

- **Keywords:** Anthropometry; 3-D body scanning; Decision tree; CART; Clothing size

Yacine Taibi, Yannick A. Metzler, Silja Bellingrath, Andreas Müller. *A systematic overview on the risk effects of psychosocial work characteristics on musculoskeletal disorders, absenteeism, and workplace accidents*. 103434.

The present article provides a systematic overview on the relationship between psychosocial work characteristics and musculoskeletal disorders, absenteeism, and workplace accidents. The study identified and reviewed the findings of 24 systematic reviews or meta-analysis and 6 longitudinal studies. Publications were systematically searched in several databases from 1966 to January 2021. To summarize the level of evidence, a best evidence synthesis was performed, and the quality of included studies was rated. High job demands, high job strain, high effort/reward-imbalance and low social support showed a strong evidence to increase the risk for musculoskeletal disorders. In addition to job demands and job strain, low perceived fairness proved to be a risk factor of absenteeism with strong evidence. Due to the small number of studies, no reliable evidence assessment for workplace accidents was possible. The summarized findings can improve risk assessment methods, by providing a systematic estimation of

the potential risk severity of psychosocial work characteristics and assist practitioners in further developing the psychosocial risk assessment.

- **Keywords:** Psychosocial work characteristics; Risk assessment; Stress

Michael Rettenmaier, Sabrina Dinkel, Klaus Bengler. *Communication via motion – Suitability of automated vehicle movements to negotiate the right of way in road bottleneck scenarios*. 103438.

The introduction of automated vehicles (AVs) into urban areas initially leads to mixed traffic, consisting of AVs, human drivers, and vulnerable road users. Since the AV's passenger is no longer actively involved in the driving task, there may be changes in the interaction between AVs and surrounding human road users. Therefore, it is essential for an AV to behave in a comprehensible manner in order to maintain or even enhance traffic efficiency and traffic safety. This work investigates the interaction of an AV and a simultaneously oncoming human driver at road bottlenecks due to double-parked vehicles on both sides of the road. Based on findings derived from AV-pedestrian interaction, comfort limits in terms of driving dynamics, and traffic observations, we designed nine AV movements to either yield the right of way or to insist on it by varying the AV's speed (maintain speed, one-step deceleration, two-step deceleration) and its lateral offset (no offset, close offset, distant offset). The different vehicle movements were evaluated with 34 participants in a driving simulator study. The results show participants' shorter passing times, fewer crashes, and significantly higher ratings of the AV's communication if the AV movement contained a lateral offset. In addition to the regular encounters, we analyzed the controllability of an automation failure and its aftereffect on participants' trust in AVs. The experience of the automation failure reduced the trust rating significantly. From the results we conclude that the AV should communicate the right of way not only via speed adjustments but also via the performance of a lateral offset to enhance traffic efficiency and safety. Moreover, a change in the AV's maneuver due to an automation failure must be avoided since it is not controllable by the human driver.

- **Keywords:** Automated driving; Movement design; Implicit communication; Road bottleneck scenario

Brittany D. Bulbrook, Nicholas J. La Delfa, Alison C. McDonald, Carmen Liang, Jack P. Callaghan, Clark R. Dickerson. *Higher body mass index and body fat percentage correlate to lower joint and functional strength in working age adults*. 103453.

As the prevalence of obesity grows worldwide, it becomes an increasing concern in working populations. Ergonomists are faced with the challenge of accommodating workplace layouts to include this worker demographic. This study investigated the relationship between shoulder and low back isometric joint strengths across body mass index (BMI) groups. Additionally, relationships between body fat percentage (BF%), absolute strength, and strength normalized to body mass were examined. Ninety, healthy, working age participants performed 11 functional and isometric joint strength exertions. BMI group influenced normalized strength, as the obese 2+ (BMI >35.0) group had up to 63.1% lower joint strength than all other BMI groups ($p < 0.05$). Significant strong to moderate negative linear relationships existed between BF% and normalized strength for both males and females, and relationships were stronger for females. These strength deficits highlight the importance of considering body composition during ergonomics analyses and configuration of occupational tasks.

- **Keywords:** Obesity; BMI; Body composition; Strength; Occupational injury

Hugh H.K. Fullagar, Edgar Schwarz, Andrew Richardson, Sean R. Notley, Donna Lu, Rob Duffield. *Australian firefighters perceptions of heat stress, fatigue and recovery practices during fire-fighting tasks in extreme environments*. 103449.

Objectives: The aim of this study was to assess current perceptions of heat stress, fatigue and recovery practices during active duty in Australian firefighters. **Design:** Prospective survey. **Methods:** 473 firefighters from Fire and Rescue New South Wales completed a two-part, 16-item survey. Questions included perceptions of the operational activities and body areas associated with the most heat stress, the most mentally and physically demanding activities, and levels of fatigue felt. Further questions focussed on the use and importance of recovery practices, effectiveness of currently used heat-mitigation strategies and additional cooling strategies for future use. **Results:** Around a third of firefighters (62%) reported structural fire-fighting as the hottest operational activities experienced, followed by bushfire-fighting (51%) and rescue operations (38%). The top three responses for which body-parts get the hottest ranked as 'the head' (58%), 'the whole body' (54%) and 'the upper back' (40%), respectively. The majority of firefighters (~90%) stated they always or sometimes use the opportunity to recover at an incident, with the top three being 'sit in the shade' (93%), 'cold water ingestion (drinking)' (90%) and 'removing your helmet, flash hood and jacket' (89%). Firefighters reported higher usefulness for more easily deployed strategies compared to more advanced strategies. Limited age and gender differences were found, although location of active service differences were present. **Conclusion:** These findings may inform future research, and translation to operational directives for recovery interventions; including exploration of protective gear and clothing, education, resources and provision of cooling methods, as well as recovery aid development.

- **Keywords:** Occupational health; Safety; Survey; Demands; Physiology

Pavlo Bazilinskyy, Tsuyoshi Sakuma, Joost de Winter. *What driving style makes pedestrians think a passing vehicle is driving automatically?* 103428.

An important question in the development of automated vehicles (AVs) is which driving style AVs should adopt and how other road users perceive them. The current study aimed to determine which AV behaviours contribute to pedestrians' judgements as to whether the vehicle is driving manually or automatically as well as judgements of likeability. We tested five target trajectories of an AV in curves: playback manual driving, two stereotypical automated driving conditions (road centre tendency, lane centre tendency), and two stereotypical manual driving conditions, which slowed down for curves and cut curves. In addition, four braking patterns for approaching a zebra crossing were tested: manual braking, stereotypical automated driving (fixed deceleration), and two variations of stereotypical manual driving (sudden stop, crawling forward). The AV was observed by 24 participants standing on the curb of the road in groups. After each passing of the AV, participants rated whether the car was driven manually or automatically, and the degree to which they liked the AV's behaviour. Results showed that the playback manual trajectory was considered more manual than the other trajectory conditions. The stereotype automated 'road centre tendency' and 'lane centre tendency' trajectories received similar likeability ratings as the playback manual driving. An analysis of written comments showed that curve cutting was a reason to believe the car is driving manually, whereas driving at a constant speed or in the centre was associated with automated driving. The sudden stop was the least likeable way to decelerate, but there was no consensus on whether this behaviour was manual or automated. It is concluded that AVs do not have to drive like a human in order to be liked.

- **Keywords:** Human-like driving; Manual driving; Automated driving; Trajectory; Deceleration; Pedestrians

Kapil Chalil Madathil, Joel S. Greenstein. *Designing comprehensible healthcare public reports: An investigation of the use of narratives and tests of quality metrics to support healthcare public report sensemaking*. 103452.

A key challenge for designers of healthcare public reports is the development of a presentation format that accurately communicates the variability in the quality of care among healthcare systems. This study conducted in the United States explored whether presenting public report information within narratives and with tests of healthcare quality metrics supported the public report sensemaking process. The study involved 200 participants and employed a 2 (public report information presented in the standard format, presented within a narrative) * 2 (no tests of quality metrics added to standard report, metrics tests added) between-subjects experimental design. The participants viewed the scenario of a patient looking for dialysis facility-related information. They were then asked which dialysis facility they would choose for their care and their level of confidence in their choice. Subsequently, a knowledge quiz evaluating how the participants interpreted the information presented to them, the NASA-TLX workload survey, and a usability questionnaire were administered. The results showed that the probability of choosing the better facility from the perspective of the quality measures included in the report changed from 0.69 to 0.89 when information was presented within a narrative rather than with the standard public report format. The results also found a significantly higher comprehension score (M = 54.58, SD = 18.51) when information was presented within the narrative than when presented in the standard public report format (M = 44.57, SD = 25.13). When information was presented to the participants within a narrative, the narrative may have enabled the participants to visualize themselves as the person depicted in the narrative and this may have increased the perceived relevance of the quality measures. Total workload, mental demand and perceived usability were higher when information was presented within the narrative than when presented in the standard format. The high workload and mental demand may be due to the stress placed on the information processing channels while reading a narrative and the effort expended to relate it to the quality measures. They may also be markers of more deliberative decision making facilitated by the narratives. No significant effect of tests of quality metrics was found on the dependent variables of choice of the better healthcare facility, comprehension, and usability. There was also no significant effect of quality metrics tests on overall workload. However, the effect of quality metrics tests on the mental demand subscale of NASA-TLX was significant. Mental demand was higher without quality metrics tests than with quality metrics tests. No significant interaction was found between the two independent variables on the dependent variables of choice of the better healthcare facility, comprehension, workload, and usability. It is recommended that narratives be used to present public report information to support informed healthcare decisions.

- **Keywords:** Healthcare public reports; Comprehension; User interface design; Usability

A. Lindenmann, M. Uhl, T. Gwosch, S. Matthiesen. *The influence of human interaction on the vibration of hand-held human-machine systems – The effect of body posture, feed force, and gripping forces on the vibration of hammer drills.* 103430.

In hand-held human machine systems the biodynamic response of the human hand arm system influences the overall dynamic behavior. The biodynamic response of the hand arm system is affected by several influencing factors. These influencing factors include the feed force, body posture, gripping force, and anthropometric properties. In present

studies the importance of the gripping force on the biodynamic response is highlighted. In the state of the art; however, the magnitude of gripping forces as well as the influence of the human factors body posture and feed force on hammer drills for a larger group of professional users is unclear. To analyze the influence that these human factors have on hammer drill vibrations, a study with 15 professional power tool test personnel has been conducted. Characteristic gripping force values have been measured (Median: 84 N–156 N at the main handle, 10 N–30 N on the auxiliary handle) for different feed forces (100 N, 150 N, 200 N) and body postures. Then the influence of body posture, feed force, and gripping force on the hammer drill vibration is determined. A significant influence of the body posture (ANOVA: $p = .003$, $r = .367$) on the RMS acceleration of the main handle was observed. Furthermore, the feed force has a significant influence on the vibration of the hammer-drill for some groups. The data also demonstrates that for increasing gripping forces, the RMS of the acceleration and frequency weighted acceleration ahv on the main and auxiliary handle decrease. The findings of this study represent a starting point for the development of adjustable hand-arm models for the reproducible vibration assessment of power tools.

- **Keywords:** Hand-arm vibration; Hammer drilling; Gripping forces; Human factors; Power tool; Human-machine system

Ido Morag, Liliane Pintelon. *Erratum to "Digital wayfinding systems in hospitals: A qualitative evaluation based on managerial perceptions and considerations before and after implementation" [Appl. Ergon. 90 (2020) 103260]*. 103387.

Despite the benefits that digital wayfinding systems offer hospital visitors and patients as well as the hospitals themselves, their actual presence in hospitals is low. This study, carried out in twenty hospitals, presents an evaluation of these systems. Interviews with hospital managers (with and without systems) indicate considerations and evidence-based information that are new to the literature such as reducing task complexity and overall user stress and anxiety; enhancing user control and empowerment; decreasing the amount of time medical staff must devote to providing directions to patients; and reducing rate of delayed and missed appointments. While these systems have considerable potential for assisting the elderly and those with disabilities, this potential is not being realized. Findings may benefit system planners, hospital administrators and eventually provide users with more suitable systems upon which to rely.

- **Keywords:** The elderly and disabled users; Digital wayfinding systems; Hospitals

Philémon Marcel-Millet, Alain Groslambert, Philippe Gimenez, Sidney Grosprêtre, Gilles Ravier. *Psychophysiological responses of firefighters to day and night rescue interventions*. 103457.

This study aimed 1) to assess the psychophysiological responses throughout a rescue intervention performed during the day and at night and 2) to determine if a vibrating alarm influences these psychophysiological responses at night. Sixteen male firefighters completed a simulated intervention under three different conditions: 1) during the day with a sound alarm signal (DaySA), 2) during the night with a sound alarm signal (NightSA), 3) during the night with a vibrating alarm signal (NightVA). Cardiovascular and psychological stress were recorded throughout the interventions. During the alarm signal, HR reactivity was greater in NightSA than in DaySA ($p < 0.01$). Parasympathetic reactivation and self-confidence were significantly lower in NightSA than in DaySA ($p < 0.05$). HR reactivity was decreased in NightVA in comparison to NightSA ($p < 0.05$). Overall, the rescue intervention had a greater impact on the psychophysiological variables during the night than during the day, and the type of alarm had a minor effect.

- **Keywords:** Firefighting activity; Autonomic nervous system; Heart rate variability

P. Bazilinskyy, L. Kooijman, D. Dodou, J.C.F. de Winter. *How should external human-machine interfaces behave? Examining the effects of colour, position, message, activation distance, vehicle yielding, and visual distraction among 1,434 participants*. 103450.

External human-machine interfaces (eHMIs) may be useful for communicating the intention of an automated vehicle (AV) to a pedestrian, but it is unclear which eHMI design is most effective. In a crowdsourced experiment, we examined the effects of (1) colour (red, green, cyan), (2) position (roof, bumper, windshield), (3) message (WALK, DON'T WALK, WILL STOP, WON'T STOP, light bar), (4) activation distance (35 or 50 m from the pedestrian), and (5) the presence of visual distraction in the environment, on pedestrians' perceived safety of crossing the road in front of yielding and non-yielding AVs. Participants (N = 1434) had to press a key when they felt safe to cross while watching a random 40 out of 276 videos of an approaching AV with eHMI. Results showed that (1) green and cyan eHMIs led to higher perceived safety of crossing than red eHMIs; no significant difference was found between green and cyan, (2) eHMIs on the bumper and roof were more effective than eHMIs on the windshield, (3) for yielding AVs, perceived safety was higher for WALK compared to WILL STOP, followed by the light bar; for non-yielding AVs, a red bar yielded similar results to red text, (4) for yielding AVs, a red bar caused lower perceived safety when activated early compared to late, whereas green/cyan WALK led to higher perceived safety when activated late compared to early, and (5) distraction had no significant effect. We conclude that people adopt an egocentric perspective, that the windshield is an ineffective position, that the often-recommended colour cyan may have to be avoided, and that eHMI activation distance has intricate effects related to onset saliency.

- **Keywords:** Automated driving; eHMI; Crowdsourcing; Distraction; Pedestrian safety

Jesse A. Stein, Timothy C. Hepler, Sarah J. Cosgrove, Katie M. Heinrich. *Critical tasks from the Global War on Terror: A combat-focused job task analysis*. 103465.

- **Keywords:** Job analysis questionnaire; Military; Physical employment standard; Work analysis; Survivability

Xueyan S. Xu, Daniel E. Welcome, Thomas W. McDowell, Christopher Warren, Samantha Service, Hansheng Lin, Qingsong Chen, Ren G. Dong. *An investigation of the effectiveness of vibration-reducing gloves for controlling vibration exposures during grinding handheld workpieces*. 103454.

Prolonged and intensive vibration exposures during the grinding of handheld workpieces may cause hand-arm vibration syndrome. The objectives of this study are to develop an on-the-hand method for evaluating vibration-reducing (VR) gloves, and to determine whether VR gloves can significantly reduce the vibration exposures. A worker holding and pressing a typical workpiece (golf club head) against a grinding wheel or belt in order to shape the workpiece was simulated, and the input vibration and those on the workpiece and hand-arm system were measured. Ten human subjects participated in the experiment. The results demonstrate that VR gloves significantly reduced the vibrations at the palm, hand dorsum, and wrist. The grinding interface condition and hand feed force did not substantially affect glove effectiveness. The use of gloves slightly increased the workpiece resonant response, but the resonant response did not significantly affect glove effectiveness. This study concluded that the use of VR gloves can help control vibration exposures of workers performing grinding of handheld workpieces.

- **Keywords:** Hand-arm vibration; Handheld workpiece vibration; Vibration-reducing glove; Anti-Vibration glove

Andrew G. Siddall, Mark P. Rayson, Ella F. Walker, Julianne Doherty, Josh I. Osofa, Tessa R. Flood, Beverley Hale, Steve D. Myers, Sam D. Blacker. *Development of physical employment standards of specialist paramedic roles in the National Ambulance Resilience Unit (Naru)*. 103460.

Aim: To develop evidence-based role-specific physical employment standards and tests for National Ambulance Resilience Unit (NARU) specialist paramedics. **Methods:** Sixty-two (53 men, 9 women) paramedics performed an array of (1) realistic reconstructions of critical job-tasks (criterion job performance); (2) simplified, easily-replicable simulations of those reconstructions and; (3) fitness tests that are portable and/or practicable to administer with limited resources or specialist equipment. Pearson's correlations and ordinary least products regression were used to assess relationships between tasks and tests. Performance on reconstructions, subject-matter expert and participant ratings were combined to derive minimum acceptable job performance levels, which were used to determine cut-scores on appropriate correlated simulations and tests. **Results:** The majority of performance times were highly correlated with their respective simulations (range of r: 0.73–0.90), with the exception of those replicating water rescue (r range: 0.28–0.47). Regression compatibility intervals provided three cut-scores for each job-task on an appropriate simulation and fitness test. **Conclusion:** This study provides a varied and easily-implementable physical capability assessment for NARU personnel, empirically linked to job performance, with flexible options depending on organisational requirements.

- **Keywords:** Physical employment standards; Paramedics; Fitness; Occupational demands

Grégoire S. Larue, Sepehr G. Dehkordi, Christopher N. Watling, Anjum Naweed. *Loud and clear? Train horn practice at railway level crossings in Australia*. 103433.

The road environment has changed markedly over the years. Train horns are ostensibly used to alert road users and are typically mandatory on approach to railway level crossings. However, they have increasingly been seen as a nuisance. Beyond their negative aspects, a study has yet to comprehensively evaluate train horn effectiveness and understand if they remain beneficial and relevant in the contemporary environment. Hence, this study aimed to provide evidence on the actual use of train horns. Field observations were conducted at 54 railway crossings across four Australian States. The effects of level crossing type, location, and environmental conditions were investigated in relation to train horn loudness as objectively measured at the crossing. Results revealed that train horns were not always used, presenting an issue for passive level crossings. However, when sounded, train horn use was redundant and insufficiently loud at level crossings equipped with bells. Taken together, current train horn practice was found to be highly variable and dependent on crossing type, remoteness, and individual train drivers, thus resulting in inconsistent warnings and raising important implications for standardisation.

- **Keywords:** Rail; Road; Safety; Noise; Loudness; Crossing; Standards

Adam T. Biggs, Dominick Pistone, Mackenzie Riggenbach, Joseph A. Hamilton, Kara J. Blacker. How unintentional cues can bias threat assessments during shoot/don't-shoot simulations. 103451.

Objective: Identify whether contextual information may unintentionally alter decision-making during lethal force training. **Background:** Lethal force decisions inherently involve a threat assessment, where an individual learns to identify a threat and use force commensurate to the situation. This decision is ultimately subject to numerous cognitive influences, particularly during training where artificial factors may bias decision-making. **Method:** Participants made threat assessments for tasks that presented hostile stimuli (pointing guns) and non-hostile stimuli (holding cell phones). Experiment 1 identified issues in target design by applying scoring rings as cues to targets, whereas Experiment 2 used bullet holes to assess cues due to target reuse. Experiment 3 applied these cues equally to hostile and non-hostile stimuli to prevent a predictive relationship from forming. **Results:** Significant cueing effects were observed in both Experiments 1 and 2. For Experiment 3, response times were not impacted by the invalid cues as participants could no longer reliably use the cue to distinguish between hostile and non-hostile stimuli. **Conclusion:** Stimulus-related factors can unintentionally create predictive relationships during lethal force training. These predictive factors are problematic because they allow participants to make threat assessments during training in a way that would never be realistic in the field. **Application:** Modifications should be made to hostile and non-hostile targets in equal measure to avoid creating an unintentionally predictive relationship that identifies hostile targets. In practice, scoring rings and bullet holes should be added to non-hostile stimuli to better parallel hostile stimuli.

- **Keywords:** Cue; Lethal force; Training; Threat assessment; Military; Law enforcement; Shoot/don't-shoot

Jennifer L. Gay, Kaitlyn E. Carmichael, Chantal C. LaFlamme, Patrick J. O'Connor. *Novel use of radio frequency identification (RFID) provides a valid measure of indoor stair-based physical activity*. 103431.

This study sought to test the validity of radio frequency identification (RFID) technology to measure indoor stair walking. RFID and Bluetooth sensors (accelerometers with the proximity function) were placed at landings across three floors within a stairwell. Participants (n = 29) were randomized to stair walking or sedentary control and concomitantly wore RFID tags at the hip, chest and neck. An accelerometer worn at the hip captured criterion physical activity data. RFID devices detected sedentary control and stair walking participants (mean RFID detections: 15.50, 47.33 respectively). Neck lanyard RFID tags were detected most frequently. RFID correctly classified all participants in both groups. RFID-based energy expenditure estimates were strongly correlated with accelerometer estimates (r = 0.78–0.94). Percent agreement for floor detection between the Bluetooth and RFID readers (38.6%) was consistent with known limitations of Bluetooth proximity sensing. It is concluded that, during self-paced stair walking in young adults, RFID devices provide valid data on participant movement and estimated energy expenditure.

- **Keywords:** Exercise; Energy expenditure; Measurement; Stairs; Technology; Walking

Mike Fray, Patrick Waterson, Evi Carman. *Care transitions in healthcare: The 'high-hanging fruit'*. 103437.

- **Keywords:** Care transitions; Healthcare; Special edition; Quality improvement

Tiwana Varrecchia, Alberto Ranavolo, Silvia Conforto, Alessandro Marco De Nunzio, Michail Arvanitidis, Francesco Draicchio, Deborah Falla. *Bipolar versus high-density surface electromyography for evaluating risk in fatiguing frequency-dependent lifting activities*. 103456.

Workers often develop low back pain due to manually lifting heavy loads. Instrumental-based assessment tools are used to quantitatively assess the biomechanical risk in lifting activities. This study aims to verify the hypothesis that high-density surface electromyography (HDsEMG) allows an optimized discrimination of risk levels associated with different fatiguing lifting conditions compared to traditional bipolar sEMG. 15 participants performed three lifting tasks with a progressively increasing lifting index (LI) each lasting 15 min. Erector spinae (ES) activity was recorded using both bipolar and HDsEMG systems. The amplitude of both bipolar and HDsEMG can significantly discriminate each pair of LI. HDsEMG data could discriminate across the different LIs starting from the fourth minute of the task while bipolar sEMG could only do so towards the end. The higher discriminative power of HDsEMG data across the lifting tasks makes such methodology a valuable tool to be used to monitor fatigue while lifting and could extend the possibilities offered by currently available instrumental-based tools.

- **Keywords:** Bipolar and high-Density (HD) sEMG; Biomechanical risk; Fatiguing frequency-dependent lifting activities

Victoria Smy, Marie Cahillane, Piers MacLean, Mike Hilton, Lisa Humphreys. *Evaluating teamwork development in combat training settings: An exploratory case study utilising the Junior Leaders' Field Gun competition*. 103459.

A behaviourally-anchored observational rating scale (BAORS) of teamwork based upon the 'Big Five' teamwork model (Salas et al., 2005) was selected and adapted for use in a combat training setting – a UK military field gun competition. The teamwork development of 16 newly-formed teams training to master a historic tactical drill was evaluated over the course of a week-long residential programme. Training culminated in a timed field gun competition. Teams were trained and mentored in respects to teamwork and taskwork by experienced military instructors. Teamwork was assessed at the outset and end of training. Significant improvements were evident on all teamwork process dimensions, with the greatest improvement seen in teams' shared understanding of teamwork roles and strategies (shared mental models). The lack of an association between teamwork development and final drill performance is explored, as is the utility of the measurement protocol developed for teamwork assessment in other settings.

- **Keywords:** Applied teamwork measurement; Teamwork training; Military field gun combat exercise

Weerasak Tapanya, Rungthip Puntumetakul, Manida Swangnetr Neubert, Torkamol Hunsawong, Rose Boucaut. *Ergonomic arm support prototype device for smartphone users reduces neck and shoulder musculoskeletal loading and fatigue*. 103458.

Smartphone use is a risk factor for both neck and shoulder musculoskeletal disorders. The objective of this study was to evaluate an ergonomic arm support prototype device, which may help improve posture while using a smartphone, by determining its effect on muscle activity, muscle fatigue, and neck and shoulder discomfort. Twenty-four healthy young adult smartphone users performed 20 min of smartphone game playing under two different conditions, smartphone use with support prototype device (i.e. intervention condition) and without (i.e. control condition), while neck and shoulder posture were controlled at 0° neck flexion and 30° shoulder flexion. Activity and fatigue of four muscles were measured using surface electromyography (sEMG), these were: anterior deltoid (AD), cervical erector spinae (CES), upper trapezius (UT) and lower trapezius (LT). The intervention condition showed significantly decreased activity of all muscles. Fatigue of all muscles, except LT, significantly increased over time compared to the start point in the control condition. There was no significant difference in muscle fatigue

between each time point in the intervention condition. In conclusion, the ergonomic arm support prototype device can be used as ergonomic intervention to reduce neck and shoulder muscle loading and fatigue.

- **Keywords:** Arm support device; Smartphone gaming; Electromyography; Muscle activity; Discomfort score

D.Z. Wojcik, C.J.A. Moulin, A. Fernandez. *Assessment of metacognition in aviation pilot students during simulated flight training of a demanding maneuver*. 103427.

This study adapted the Demand Resource Evaluation Scores (DRES) as a metacognitive indicator in assessing pilot students' perceptions during simulated training of a novel maneuver. Typically, positive DRES are associated with perceiving a demanding situation as a challenge and with improved performance, while negative DRES are linked to a perception of the situation as a threat, and to poorer performance. The novelty here was to assess DRES before and after the task and across three missions. Overall, students were found to change their perceptions from threat to challenge over time. Also, increased DRES were positively correlated with performance progressing from mission to mission, indicating that the students reflect on their performance as they advance in their training. These findings show that individual metacognitive evaluations of a stressful aviation maneuver might be important for the progress in performance. The results are discussed in terms of flight safety and pilot training.

- **Keywords:** Simulated flight training; Metacognition; Cognitive appraisal