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Grace E. Waldfogle, Allison E. Garibaldi, Alexis R. Neigel & James L. Szalma. 'I need a break': the effect of choice of rest break duration on vigilance. Pages: 1509-1521

Vigilance is the ability to sustain attention for an extended period of time and to respond to infrequently occurring critical signals. One of the most replicable findings within the vigilance literature is the performance decrement; the decline in performance as time on task increases. In an effort to attenuate the decrement, and decrease the workload and stress associated with vigilance, the present study investigated the role of choice of rest break duration on vigilance performance, perceived workload, and stress. Participants were assigned to one of three conditions: (1) choice condition, (2) no-choice condition (yoked-control), and (3) a no-break control condition. Participants completed a sensory vigilance task and common measures of workload and stress. A vigilance decrement was observed in all conditions. Participants in the choice condition exhibited more conservative responses and fewer false alarms than the no-choice condition. Across all conditions, task engagement and worry decreased, and distress increased. **Practitioner Summary:** This study shows the impact of rest breaks and autonomy on vigilance task performance. The findings suggest that resource theory is a plausible explanation for the vigilance decrement. Additionally, providing a choice in rest break length changes the operator's criterion following the break.

- **Keywords:** Rest break, sustained attention, stress, vigilance, workload

Sang Hyeok Lee, Martha Kim, Hyosun Kim & Choul Yong Park. Visual fatigue induced by watching virtual reality device and the effect of anisometropia. Pages: 1522-1531

The effect of small anisometropia on visual fatigue when using virtual reality (VR) devices was investigated. Participants ($n = 34$) visited three times. In the first visit, VR exposure (10 min) was conducted with the full correction of the refractive error of both eyes. Experimental anisometropia was induced by adding a + 1.0 dioptre spherical lens either on the dominant eyes in the second visit or on the non-dominant eyes in the third visit. At each visit, the participants played a predetermined video game using a head-mounted display VR for 10 min. Visual fatigue was assessed before and after playing VR game

using the Virtual Reality Symptom Questionnaire (VRSQ) and high-frequency component of accommodative microfluctuation. Results showed that watching VR induced significant increase of VRSQ score, significant decrease in the maximum accommodation power and objective increase in visual fatigue. Experimental anisometropia induction either on the dominant or non-dominant eyes did not aggravate visual fatigue. **Practitioner summary:** Mild differences in refractive error (up to 1.0 dioptre) between both eyes do not significantly increase ocular fatigue by viewing virtual reality device (10 min). The impact of small anisometropia may be limited in developing a virtual reality device.

- **Keywords:** Virtual reality, visual fatigue, accommodation, anisometropia, myopia

Simone Grassini, Karin Laumann, Virginia de Martin Topranin & Sebastian Thorp. *Evaluating the effect of multi-sensory stimulations on simulator sickness and sense of presence during HMD-mediated VR experience.* Pages: 1532-1542

Some lines of evidence have shown that sensory input, especially related to vestibular and somatosensory stimulation, may reduce the symptoms related to simulator sickness and increase the sense of presence in VR. The present study aims at understanding how mechanical vibration and auditory stimulation can be used to improve user experience in the context of VR mediated by head-mounted displays. Four different groups comprising a total of 80 participants were tested under different conditions of sensory input (visual and vibration, visual-auditory, combined visual-auditory and vibratory, and visual only), during a VR roller-coaster experience. No significant differences in simulator sickness were found between the groups exposed to seat vibration and/or audio. However, sense of presence showed to be increased when vibratory stimuli were included. Post-hoc analyses showed that female users but not male ones, experienced an increase of sense of presence when vibratory stimulation was used. **Practitioner summary:** The study showed that including sound or vibration stimulation during VR experience does not reduce simulator sickness. However, sense of presence is promoted by vibratory stimulation. Post-hoc analyses showed that female users experienced an increase of sense of presence by vibratory stimulation, but not male ones.

- **Keywords:** Virtual reality, simulator sickness, presence, HMDs, vibration

Micaela Porta, Pier Francesco Orrù & Massimiliano Pau. *Use of wearable sensors to assess patterns of trunk flexion in young and old workers in the Metalworking Industry.* Pages: 1543-1554

Workers exposed to repeated trunk flexions are at risk of onset of low-back disorders and in individuals aged over 50 this issue is exacerbated by the physiologic decline of the musculoskeletal system and longer lifetime occupational exposure. In this study, we investigated the existence of possible age-related differences in patterns of trunk flexion of workers in the metalworking industry. Thirty-three subjects were monitored during an actual shift using a wearable Inertial Measurement Unit (IMU) to assess trunk flexion angles (i.e. between 30° and 60°, 60°–90° and > 90°). Results show that older workers spent less time with their trunk flexed, regardless of the class of flexion considered, with respect to their younger colleagues. Although further studies are necessary to clarify the existence of strategies aimed at optimising trunk movements during ageing, the IMU-based approach appears useful in highlighting potentially harmful conditions, especially in workers with marked signs of decline in their physical capacities. **Practitioner summary:** Wearable sensors, which are well tolerated and minimally intrusive, represent a valid option to continuously monitor trunk posture in workers employed in metalworking industry. The results of this study show that they provide valuable information about the patterns of flexion of young and old individuals engaged in physically demanding tasks.

- **Keywords:** Inertial Measurement Unit (IMU), ageing, continuous monitoring, musculoskeletal disorders (MSD)

Dohyung Kee. *Development and evaluation of the novel postural loading on the entire body assessment.* Pages: 1555-1568

This study aimed to develop and evaluate a novel observational technique for postural Loading on the Entire Body Assessment (LEBA). The technique was developed based on discomfort and epidemiological data from previous research, from which posture classification and scoring systems of representative observational methods were adopted and modified. The LEBA score reflected the effects of posture, external load, motion repetition, static loading, and coupling. The LEBA score for a given posture was obtained by summing the scores for these factors (except coupling) and multiplying the sum by the coupling multiplier. LEBA scores were classified into four action categories, depending on the urgency of corrective actions. Correlation analyses between LEBA scores and postural load criteria yielded confirmative results, with correlation coefficients of >0.60 . Application to epidemiological cases of work-related musculoskeletal disorders indicated that LEBA action categories aided in determining whether musculoskeletal disorders were work-related. Acceptable reliability and usability were also observed. **Practitioner summary:** This study developed and evaluated a novel observational technique for postural loading on the entire body assessment (LEBA), based on perceived discomfort and epidemiological data from previous studies. LEBA scores aided in determining risk levels and urgent indications for more detailed assessments and/or interventions and the work-relatedness of musculoskeletal disorders.

- **Keywords:** Postural loading, observational technique: musculoskeletal disorder, posture classification scheme

Seungwon Baek, Jaemoon Jung, Philjun Moon & Woojin Park. *Obesity impacts on task performance and perceived discomfort during seated foot target reaches.* Pages: 1569-1578

This study examined obesity impacts on task performance and perceived discomfort during seated foot target reaches. Three independent variables, participant group, movement distance, and, movement direction, were considered. The task performance measures employed were reaction time, movement time and task performance time. Perceived discomfort was measured using a modified Borg CR-10 scale. Statistical analyses revealed that: obesity was associated with increases in movement time, reaction time and performance time; movement distance significantly affected the three task performance measures and discomfort rating; and, movement direction significantly affected movement time, performance time and discomfort rating. The obesity impacts observed are thought to reflect the decelerating effects of the extra fat mass in the obese body during foot reaches and possibly obesity-related physiological and cognitive changes. Design improvements of foot-operated systems, such as reducing distances to targets, increasing target sizes and avoiding forward foot reaches, may help counteract the observed obesity impacts. **Practitioner Summary:** This study empirically investigated the obesity impacts on task performance and perceived discomfort during seated foot target reaches. Obesity was found to be associated with increases in movement time, reaction time and performance time. The observed obesity impacts seem attributable to the anthropometric, motor and cognitive characteristics of the obese.

- **Keywords:** Obesity, foot operation, foot reach, target reach, seated work

Liuxing Tsao, Sunwook Kim, Liang Ma & Maury A. Nussbaum. *An exploratory study comparing three work/rest schedules during simulated repetitive precision work.* Pages: 1579-1594

The pattern of work and rest can influence both physical fatigue and task performance in manual operations. However, there is relatively limited evidence regarding the influences of specific work/rest schedules in tasks requiring high repetitiveness and precision demands, along with relatively low exertion levels. Eighteen participants completed an exploratory study that simulated such tasks, to compare the effects of three distinct work/rest schedules (i.e. short frequent [short] and long infrequent breaks [long], and a self-selected schedule) on muscle fatigue, task performance (in terms of accuracy and speed), and preference. Schedules with long or self-selected breaks generally induced less muscle fatigue, compared with the short break condition. Participants preferred the self-selected condition the most and the long-break condition the least. The different schedules tested did not influence task performance. A self-selected schedule may be beneficial for repetitive precision task, to achieve a balance across muscle fatigue, task performance, and individual preference. **Practitioner summary:** Influences of three work/rest schedules (i.e. short and long breaks, and a self-selected schedule) on fatigue, performance, and preference were explored during repetitive precision tasks. Schedules with long or self-selected breaks induced less muscle fatigue and none of the three schedules influenced performance. A self-selected schedule was the most preferred.

- **Keywords:** Repetitive task, precision task, muscle fatigue, performance

Davis A. Forman, Garrick N. Forman & Michael W. R. Holmes. *Wrist extensor muscle activity is less task-dependent than wrist flexor muscle activity while simultaneously performing moderate-to-high handgrip and wrist forces.* Pages: 1595-1605

The aim of this study was to characterise wrist extensor and flexor muscle activity during combinations of moderate-to-high handgrip and wrist forces that are similar to actions and intensities used in many workplace settings. Surface electromyography was recorded from three wrist flexors and three wrist extensors while participants performed simultaneous handgrip forces and wrist forces ranging in intensities from 15% to 60% of maximum. While the wrist flexors were highly task-dependent, in that their activity significantly changed between conditions, wrist extensor activity was consistently high throughout the experiment. Wrist joint co-contraction was also significantly higher when the wrist extensors were functioning as the antagonists. These findings suggest that the wrist extensors likely demonstrate consistently higher muscle activity during most tasks of the hand and wrist, which is likely a leading mechanism behind why they develop chronic overuse injuries more frequently than the wrist flexors. **Practitioner Summary:** This study was conducted to identify forearm muscle activity patterns that might help explain why the wrist extensors develop overuse injuries more frequently than the flexors. Results demonstrated that the wrist extensors are consistently, highly active during combined handgrip and wrist forces and exhibit no periods of low muscle activity.

- **Keywords:** Isometric, forearm, hand, grip, muscle activity, co-contraction

Rebecca Hood, Juliana Zabatiero, Stephen R. Zubrick, Desiree Silva & Leon Straker. *The association of mobile touch screen device use with parent-child attachment: a systematic review.* Pages: 1606-1622

Mobile touch screen devices (smartphones and tablet computers) have become an integral part of many parents' and children's lives, with this interaction linked to physical, mental and social outcomes. Despite the known importance of parent-child attachment,

evidence on the association between device use and attachment was yet to be reviewed. Following protocol pre-registration, databases were searched, papers screened, and methodological quality assessed. Three papers met the inclusion criteria, and reported some negative associations between duration of parent/child smartphone use and attachment outcomes. A narrative synthesis on two groups of related papers found child time using any screen technology (including television viewing), and child 'problematic' internet, mobile phone, gaming and social media use, was negatively associated with attachment outcomes. Currently there is limited direct evidence on any association between time parents or children spend using these devices and parent-child attachment to support time guidelines for families and professionals working with families.

Practitioner summary: Many parents and children regularly spend time using smartphones and tablet computers. This systematic review found limited evidence evaluating associations between child/adolescent or parent time using devices and parent-child attachment. Until quality evidence exists, practitioners should be alert to potential impacts of device use on family relationships and child outcomes.

- **Keywords:** Mobile touch screen device use, parent-child attachment, screen time, technology use, children

Celeste E. Coltman, Brooke R. Brisbine & Julie R. Steele. *Bra-body armour integration, breast discomfort and breast injury associated with wearing body armour.* Pages: 1623-1633

This study investigated whether female soldiers experience bra integration or breast discomfort/injuries related to body armour use and whether these issues were associated with breast size. Ninety-seven Australian Defence Force female soldiers completed a questionnaire and had their breast volume assessed (range: 91–919 ml/breast) using three-dimensional scanning. Twenty-two percent ($n = 21$) of participants reported integration issues between their bra and body armour, 63% ($n = 61$) reported breast discomfort while wearing body armour and 27% ($n = 26$) reported experiencing a breast injury related to wearing body armour. Although bra-body armour integration was not dependent upon breast size, female soldiers with medium-large breasts reported significantly more breast discomfort and injuries when using body armour compared to participants with small breasts. These findings highlight the importance of developing body armour systems that cater to the range of breast sizes of female soldiers in order to improve bra-body armour integration and reduce breast discomfort and injury.

Practitioner summary: This exploratory research provides evidence of bra integration issues, breast discomfort and breast injury experienced by female soldiers when wearing body armour. Given the growing representation of women in military organisations, strategies to alleviate these issues for female users of body armour, particularly those with larger breast sizes, are required.

- **Keywords:** Body armour, female soldier, bra-body armour integration, breast discomfort, breast injury