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Rebecca Hood, Juliana Zabatiero, Desiree Silva, Stephen R. Zubrick & Leon Straker. *'There's good and bad': parent perspectives on the influence of mobile touch screen device use on prenatal attachment.* Pages: 1593-1608.

The potential for human–computer interaction to have a substantial impact on adults is well documented. However, its potential importance prior to birth has rarely been reported. Parental use of smartphones and tablet computers could influence the relationship between parent and baby during pregnancy (prenatal attachment) and thus child development. Twenty-seven families were interviewed to explore how parents used these devices during pregnancy, and how device use influenced parents' thoughts, feelings and behaviours towards their baby while in utero. All used devices for a variety of purposes, and all described good levels of prenatal attachment. Parents described both disrupted and enhanced connectedness as a result of device use, and increased parental stress. The findings highlight a new opportunity for how device design and use guidelines could support families to maximise benefits and reduce detriments of device use to optimise prenatal attachment, and thus future parent–child attachment and child development. **Practitioner summary:** Many parents regularly use smartphones and tablet computers while pregnant. This qualitative study found that how devices were used either enhanced or disrupted feelings of prenatal attachment. Practitioners should be aware of potential beneficial and detrimental impacts of device use during pregnancy given implications for future attachment and child development.

- **Keywords:** Human–computer interaction, mobile touch screen device use, prenatal attachment, screen timetechnology use, The ORIGINS Project, thematic analysis qualitative research

Shamus K. Roeder, David G. Wilder & Nathan B. Fethke. *Novel methods to detect impacts within whole-body vibration time series data.* Pages: 1609-1620.

We present three candidate mathematical models for detecting impacts within time series accelerometer data in the context of whole-body vibration (WBV). In addition to WBV, data included recordings of erector spinae muscle activity and trunk posture collected

during use of agricultural machines in a previous study. For each model, we evaluated associations between several mechanical and biomechanical variables at the time of predicted impact onset and the odds of subsequently observing a bilateral response of the erector spinae muscles. For all models, trunk posture at the time of impact onset was strongly associated with an observed bilateral muscle response; these associations were not observed when impacts were randomly assigned. Results provide a framework for describing the number and magnitudes of impacts that may help overcome ambiguities in current exposure metrics, such as the vibration dose value, and highlight the importance of considering posture in the evaluation of occupational WBV exposures. **Practitioner summary:** Common metrics of exposure to whole-body vibration do not quantify the number or magnitudes of impacts within time series accelerometer data. Three candidate impact detection methods are presented and evaluated using real-world data collected during use of agricultural machines. Results highlight the importance of considering posture when evaluating vibration exposure.

- **Keywords:** Whole-body vibration, mechanical shocks, impact detection, electromyography, posture

Yan-xia Li, Lin Li, Xing Chen, Yang Zhao, Xi Zhao & Chong-long Zhang. *Assessment of grip force sense test-retest reliability in healthy male participants.* Pages: 1621-1630.

There has been a lack of research to date regarding the test-retest reliability of grip force sense in healthy adult males. This study was therefore designed to explore this topic across a series of target force levels using an ipsilateral force reproduction task. The same experienced research staff conducted two testing sessions for each study participant, with 1 week between test sessions. Intraclass correlation coefficient values indicated that these force sensing tests exhibited good to fair reliability with respect to both absolute error (0.42–0.63) and constant error (0.49–0.60), although variable error was indicative of poor reliability (–0.85 to 0.14). Together, these results suggest that researchers can achieve a fair level of test-retest reliability when analysing grip force sense in healthy adult males, with results being most reliable at force levels of 20 N and 50 N, as determined based upon measured constant error and absolute error. **Practitioner summary:** To ensure that grip force sense can be accurately interpreted over time, it is important to assess the test-retest reliability. It is recommended that practitioners measure the absolute error and constant error at force levels of 20 N and 50 N when assessing grip force sense in a clinical setting.

- **Keywords:** Gripforce sensing, test–retest reliability, force reproduction task, proprioception

Faeze Sarraf & Sakineh Varmazyar. *Comparing the effect of the posture of using smartphones on head and neck angles among college students.* Pages: 1631-1638.

Smartphone users' posture can affect the musculoskeletal load of the user's neck. This study aims to compare the effect of the posture of using smartphones on head and neck angles among college students. The cross-sectional study was conducted among 80 college students. The Severity of Neck Pain (SNP) and the head and neck tilt angles, the gaze angle, and the amount of change in the forward head posture were determined. The angles were measured in three postures including standing, sitting on a chair with and without a backrest. Most of the participants (51.3%) reported moderate and severe neck pain. The angles during using smartphone had a significant difference in different positions, so that the best head ($100.6 \pm 11.3^\circ$) and neck ($32.5 \pm 11.2^\circ$) tilt angles and gaze angle ($58.2 \pm 13.7^\circ$) were in sitting position with leaning on a backrest of the chair. Head ($109.6 \pm 14.4^\circ$) and neck ($22.0 \pm 12.6^\circ$) tilt angles, and the forward head posture (15.9 ± 4.9 cm) have the worst posture in sitting position on a chair without a backrest

while gaze angle ($67.1 \pm 12.0^\circ$) has the most awkward posture in standing. **Practitioner summary:** The posture of using a smartphone affects the amount of pressure on the neck. This study aims to investigate the effect of different positions of using smartphone on head and neck angles among Iranian university students. The angles during using smartphone had a significant difference in different positions.

- **Keywords:** Neck, posture, student, smartphone

J. Navarro, F. Osiurak, S. Ha, G. Communay, E. Ferrier-Barbut, A. Coatrine, V. Gaujoux, E. Hernout, J. Cegarra, W. Volante & P. A. Hancock. *Development of the Smart Tools Proneness Questionnaire (STP-Q): an instrument to assess the individual propensity to use smart tools. Pages: 1639-1658.*

Humans have developed a prolonged and special relationship with their tools, which themselves exhibit the propensity to become ever more intelligent across the years. A 'smart tool' is defined as to representing any entity, machine, or device that can complete an informational, mechanical, or electronic work. This work explains the development of the Smart Tool Proneness Questionnaire (STP-Q), which is designed to measure an individual's propensity to use smart tools. Data collection was designed to (1) identify the psychological dimensions underlying smart tool use (2) establish the questionnaire's reliability (3) validity, (4) propose a normalisation, and (5) provide an English translation of the French original. The work therefore implements a reliable and valid questionnaire, sensitive to inter-individual differences regarding the propensity to use smart tools. Statistical analysis reveals that the individual self-reported propensity for smart tool use rests on three factors (1) utilitarian use, (2) hedonic and social use, and (3) proneness to delegate. From a theoretical perspective, this individual propensity to use smart tools might be considered key to our species development. In practical terms, measuring an individual's propensity to use smart tools can be of considerable benefit to the design of future smart tools in both professional and non-professional settings. **Practitioner summary:** The STP-Q, a self-reported measure of an individual's propensity to use smart tools, was developed. STP-Q offers practitioners a measure of individual propensity to use smart tools along three dimensions: utilitarian use, hedonic and social use, and proneness to task delegate. Individual results can easily be interpreted from normalizations that STP-Q provides.

- **Keywords:** STP-Qquestionnaire, smart tools, technology, automation

James C. Ferraro, Mustapha Mouloua, Phillip M. Mangos & Gerald Matthews. *Gaming experience predicts UAS operator performance and workload in simulated search and rescue missions. Pages: 1659-1671.*

Unmanned aircraft systems (UAS) operator training and selection procedures are still being refined to effectively address challenges related to performance, workload, and stress in UAS operation. Research suggests that experience with commercial videogames may test skills relevant to modern UAS operation. This study investigated the ability of videogame experience to predict operator performance, workload, and stress. Forty-nine participants performed 9 trials of a simulated search and rescue mission. It was expected that participants who more frequently played videogames would report lower levels of distress and workload, higher task engagement, and better overall performance. Results showed that gaming experience was negatively correlated with subjective workload and positively correlated with multiple measures of performance. Furthermore, nearly all observed gender-related differences were not present when gaming experience was controlled for. These results have implications for the role of gaming experience in remotely operated systems operator recruitment, selection, and training. **Practitioner summary:** This study examined how gaming experience influences UAS operator success

in simulated search and rescue missions. Participants reported on their experience playing videogames before completing multiple experimental trials on a desktop computer. Results indicated that experience playing videogames significantly impacted performance, workload, and stress.

- **Keywords:** Simulated environments, unmanned aircraft systems, operator workload, complex systems, individual differences

Victoria Banks, Craig K. Allison, Katie Parnell, Katherine Plant & Neville A. Stanton. *Predicting and mitigating failures on the flight deck: an aircraft engine bird strike scenario. Pages: 1672-1695.*

Engine damage as a consequence of foreign object debris (FOD) during flight is frequently caused by birds. One approach to minimising disruption caused by this damage is to provide flight crew with accurate information relating to the continuing operational status of the aircraft's engines. Before designing such avionic systems however, understanding of current procedures is needed. Hierarchical Task Analysis (HTA) and Systematic Human Error Reduction and Prediction Approach (SHERPA) were used to identify potential failures that flight crew may make when managing an engine bird strike. Workshops with commercial pilots generated insights into current practice and a commercial pilot SME reviewed outputs for accuracy. Over 200 potential failures were identified, most commonly related to communication. Remedial measures, considering future avionic systems, are proposed to mitigate identified failures. This analysis provides a starting point for future design concepts for assisting flight crew in dealing with engine malfunction due to FOD strikes. **Practitioner summary:** Hierarchical Task Analysis was conducted to show all tasks involved in dealing with an in-flight aircraft engine bird strike. Systematic Human Error Reduction and Prediction Approach analysis was performed and over 200 possible failures were identified when managing this event. Remedial measures are proposed to help mitigate possible failures.

- **Keywords:** Aviation, HTASHERPA, failure analysis, bird strike

Kiana Kia, Harold T. Bae, Peter W. Johnson, Jack T. Dennerlein & Jeong Ho Kim. *Evaluation of vertical and multi-axial suspension seats for reducing vertical-dominant and multi-axial whole body vibration and associated neck and low back joint torque and muscle activity. Pages: 1696-1710.*

The primary aim of this laboratory-based human subject study was to evaluate the biomechanical loading associated with mining vehicles' multi-axial whole body vibration (WBV) by comparing joint torque and muscle activity in the neck and low back during three vibration conditions: mining vehicles' multi-axial, on-road vehicles' vertical-dominant, and no vibration. Moreover, the secondary aim was to determine the efficacy of a vertical passive air suspension and a prototype multi-axial active suspension seat in reducing WBV exposures and associated biomechanical loading measures. The peak joint torque and muscle activity in the neck and low back were higher when exposed to multi-axial vibration compared to the vertical-dominant or no vibration condition. When comparing the two suspension seats, there were limited differences in WBV, joint torque, and muscle activity. These results indicate that there is a need to develop more effective engineering controls to lower exposures to multi-axial WBV and related biomechanical loading. **Practitioner Summary:** This study found that mining vehicles' multi-axial WBV can increase biomechanical loading in the neck and back more so than on-road vehicles' vertical-dominant WBV. While a newly-developed multi-axial active suspension seat slightly reduced the overall WBV exposures, the results indicate that more effective engineering controls should be developed.

- **Keywords:** 3-Dimensional motion capture, off-road motor vehicles, surface electromyography, musculoskeletal disease, professional drivers

Kihyun Park, Haeseok Jeong, Jaemoon Jung, Soomin Hyun, Seungwon Baek, Juhee Park & Woojin Park. *Sex differences in perceived discomfort during seated static posture holding*. Pages: 1711-1721.

This study investigated how sex modifies postural discomfort perception during a sagittally-symmetric, seated static posture holding (SPH) task. Ten male and 10 female participants performed SPH and conducted subjective discomfort ratings in a total of 108 task conditions. A regression analysis found that the impacts of the body joint reactive moments on perceived discomfort were larger for the female group than the male whereas that of the shoulder joint angle was more pronounced for the male than the female. Also, some of the 108 task conditions were found to be more uncomfortable for the male group, while some others, for the female. The observed sex impacts are thought to be due to the sex differences in physical work capacities (muscular strength and joint flexibility). The results suggest that new posture analysis tools allowing sex-specific analyses are needed as they would improve the accuracy and precision of ergonomics posture analyses. **Practitioner summary:** This study empirically investigated how sex modifies postural discomfort perception during a seated posture holding (SPH) task. Sex was found to modify the impacts of joint reactive moments and the shoulder joint angle. The study results seem to reflect the sex differences in muscular strength and joint flexibility.

- **Keywords:** Postural discomfort, sex, joint reactive moment, joint angle static posture holding

Te Miao & Yuguo Li. *Modelling the thermal microenvironment of footwear subjected to forced ventilation*. Pages: 1722-1739.

In this paper, we develop a mathematical model of the thermal microenvironment in footwear that considers forced ventilation of the footwear cavity. The developed model was validated using a newly developed thermal foot-manikin system and the results show that the model effectively predicts the total dry thermal insulation of footwear under various dynamic conditions. The footwear cavity model is then integrated with a thermoregulation model, and the integrated model effectively predicts changes in foot skin temperature resulting from forced ventilation (0–90 L/min). At an air temperature of 26.4 °C and a foot thermal comfort temperature of 32.2 °C, the required minimum ventilation rate was found to be 5.4–24.6 L/min, which corresponds to a total static thermal insulation of footwear of 0.10–0.20 m²·K·W⁻¹–1.m²·K·W⁻¹. This indicates that ventilation can adequately control the thermal microenvironment of the footwear cavity, thereby maintaining foot thermal comfort. **Practitioner summary:** An adverse footwear thermal microenvironment results in foot thermal discomfort and foot hygiene problems. We hypothesise that forced ventilation may enable thermal control of footwear microenvironments. A mathematical model was developed which can determine the forced ventilation rate required in a given type of footwear to create foot thermal comfort.

- **Keywords:** personalised ventilation foot, wear, dynamic insulation, thermoregulation model, thermal comfort, thermal foot manikin