

Ergonomics– rok 2023, ročník 66

Číslo 2



Stephanie E. Chappel, Anjum Naweed, Janine Chapman, Corneel Vandelanotte, Andreas Holtermann & Leon Straker. *Can occupational health professionals successfully apply the Goldilocks Work Paradigm in a simulated work redesign?* Pages: 153-166.

This study aimed to assess occupational health professionals' application of the Goldilocks Work Paradigm in redesigning jobs for healthier physical behaviours while maintaining productivity. During a group simulation exercise, participants ($n = 16$) created job descriptions for four different occupation cases (factory worker, office worker, teacher, train driver) and then redesigned the jobs using the Paradigm. Substantial changes in the time spent in sitting (9–30%), standing (8–42%), walking (6–14%), and high-intensity (0–24%) physical behaviours were achieved, which if implemented would likely result in enhanced health for workers. Overall, occupational health professionals were able to successfully redesign fictitious jobs aligned with the Goldilocks Work Paradigm. The simulation task used in this study may be useful to train professionals and assist workplaces to understand and implement the Goldilocks Work Paradigm into practice.

Practitioner summary: This study assessed whether occupational health professionals could be trained in the Goldilocks Work Paradigm through a job redesign simulation task. Participants were able to redesign jobs to achieve a healthier 'just right' balance of physical behaviours. Simulations may help workplaces understand and implement a Goldilocks Work approach into practice.

- **Keywords:** Job design, occupational physical activity, Goldilocks, occupational health, simulation task

Bailu Fu, Rong Zheng, Qing Chen & Yefu Zhang. *An improved clothing size recommendation approach based on subdivision of female body types.* Pages: 167-181.

With the rapid development of clothing online shopping, customers have a higher demand for more accurate clothing size recommendation systems. The work this paper presented is compatible with the four body types specified in the Chinese standard. Then, the subdivision was performed where each of the major body types corresponded to four characteristic indices. In addition, each characteristic index had three attributes.

Therefore, the female body can be subdivided into 81 types for each major type. Subsequently, this paper suggests an improved clothing size recommendation system that considers subdivided body types. The recommendation criteria in the approach were refined by a pressure distribution analysis through a virtual fitting simulation. Finally, case studies were conducted on customers of body type A (accounting for 52.73% of bodies) to demonstrate the procedures of the proposed approach. **Practitioner summary:** This study proposes an improved clothing size recommendation approach based on the subdivision of code-specified female body types. Compared with existing clothing size recommendations, the proposed approach can help customers find formfitting sizes more accurately.

- **Keywords:** Body type classification, size designation of clothing, virtual fitting, pressure distribution analysis

Farzaneh Shahini, Junho Park, Kyle Welch & Maryam Zahabi. *Effects of unreliable automation, non-driving related task, and takeover time budget on drivers' takeover performance and workload.* Pages: 182-197.

The objective of this study was to assess the effects of unreliable automation, non-driving related tasks (NDRTs), and takeover time budget (TOTB) on drivers' takeover performance and cognitive workload when faced with critical incidents. Automated vehicles are expected to improve traffic safety. However, there are still some concerns about the effects of automation failures on driver performance and workload. Twenty-eight drivers participated in a driving simulation study. The findings suggested that drivers require at least 8 s of TOTB to safely take over the control of the vehicle. In addition, drivers exhibited safer takeover performance under the conditionally automated driving situation than negotiating the critical incident in the manual driving condition. The results of drivers' cognitive workload were inconclusive, which might be due to the individual and recall biases in subjective measures that could not capture subtle differences in workload during takeover requests. **Practitioner Summary:** A driving simulation study was conducted to assess the effect of unreliable automation, non-driving related tasks, and different takeover time budgets on drivers' performance and workload. The results can provide guidelines for vehicle manufacturers to improve the design of automated vehicles.

- **Keywords:** Driving performance, automation, cognitive workload, takeover time budget

Carl Mikael Lind, Bart De Clercq, Mikael Forsman, Alain Grootaers, Mathieu Verbrugghe, Lieve Van Dyck & Liyun Yang. [Effectiveness and usability of real-time vibrotactile feedback training to reduce postural exposure in real manual sorting work.](#) Pages: 198-216.

Vibrotactile feedback training may be used as a complementary strategy to reduce time in demanding postures in manual handling. This study evaluated the short- and medium-term effects of concurrent posture-correction vibrotactile feedback training on trunk inclination exposure in real manual sorting work. Fifteen warehouse workers completed the training and the follow-up sessions. Trunk inclination angles were recorded using the ambulatory Smart Workwear System. Questionnaires were used for assessing system usability, perceived physical exertion, and work ability. The results showed reduced time in trunk inclination $>30^\circ$, $>45^\circ$, and $>60^\circ$, and reductions in the 90th, 95th, and 99th percentile trunk inclination angles, when receiving feedback and immediately after feedback withdrawal. No significant reduction was retained after one and three weeks. The wearer's comfort was scored high, and the feedback did not increase the perceived cognitive demands. No significant effects attributed to changed trunk inclination exposure were observed for perceived physical exertion or work ability. The training program has

the potential of contributing to reduced trunk inclination exposure in the short term. Future studies are needed to evaluate if improvements in the feedback training can transfer the short-term results to retained median- and long-term effects. **Practitioner summary:** A two-day training program with concurrent posture-correction vibrotactile feedback can contribute to reduced exposure of trunk inclination in real manual sorting work in the short term. More research is needed on how to design the feedback training programs in order to be effective in the long term.

- **Keywords:** Intervention, augmented feedback, posture correction, work technique training, the Smart Workwear System

Eugénie Avril. *Providing different levels of accuracy about the reliability of automation to a human operator: impact on human performance.* Pages: 217-226.

Previous research has suggested that supervising automation can lead to a decrease in human performance, especially when automation is not totally reliable. Providing context-related information about reliability can help operators to better adjust their behaviour in a human-automation interaction context. However, previous studies have not specified the level of accuracy that this information should provide to the human operator. The objective of this study was to investigate the effects of different levels of information accuracy about an automation's reliability on human performance. Results showed that accuracy of information about reliability improves performance when specific percentages of reliability were given to the participants. Participants had a better performance in the condition of high accuracy of information. A link between perceived reliability and trust was found: the more the trust in automation increased, the more the perceived reliability increased. **Practitioner summary:** The experiment dealt with how accurate information about automation's reliability influences people's performance when supervising an automated task. Overall, this research suggests that designing systems that provide accurate, useful information can reduce the frequency of automation bias. Trust and perceived reliability of automation are related.

- **Keywords:** Reliability, accuracy, predictability, trust, automation

Minseok Son, Jaemoon Jung, Dongwook Hwang, Donghyun Beck & Woojin Park. *The effect of backpack weight on the performance of basic short-term/working memory tasks while walking along a pre-determined route.* Pages: 227-245.

This study investigated possible backpack weight effects on the performance of three basic short-term/working memory (STM/WM) tasks conducted concurrently with the physical task of route walking. The STM/WM tasks were the Corsi block-tapping, digit span, and 3-back tasks, and, were employed to examine the visuo-spatial sketchpad, phonological loop and central executive components of the WM system. Four backpack weight levels (0%, 15%, 25% and 40% of body mass) were considered. Thirty participants conducted the three experimental tasks requiring physical-cognitive multitasking. Data analyses revealed that: (1) increased backpack weight resulted in decreases in the performance of the Corsi block-tapping and the 3-back task, but (2) backpack weight did not significantly affect the digit span task performance. The study results suggest that reducing backpack weight could benefit the performance of various cognitive tasks during route walking. The study findings may be useful for the ergonomics design of body-worn equipment and human-system interfaces. **Practitioner summary:** This study examined the backpack weight effects on the performance of three basic short-term/working memory tasks conducted concurrently with the physical task of route walking. The study revealed that reducing backpack weight could benefit various

cognitive tasks during physical-cognitive multitasking, especially cognitive tasks that require visuospatial processing and executive control.

- **Keywords:** Body-worn equipment, backpack weight, cognitive task performance, working memory multitasking

Miki Casey Azuma, Frank Bryan Giordano, Stacy Ann Stoffregen, Leah Shely Klos & Jin Lee. *It practically drives itself: autonomous vehicle technology, psychological attitudes, and susceptibility to risky driving behaviors.* Pages: 246-260.

This study examines how favourable attitudes towards autonomous vehicle technology and automation-induced complacency relate to unsafe driving behaviours using semi-autonomous vehicles as an exemplar. The sample consisted of 441 college students and a repeated measures design was used to examine the relationships between psychological attitudes and susceptibility to risky driving behaviours across three scenarios. Linear regression analyses were conducted for hypothesis testing. Study 1 showed that favourable attitudes towards autonomous vehicle technologies were not significantly associated with susceptibility to risky driving behaviours. Study 2 replicated this finding, however, automation-induced complacency was significantly associated with susceptibility to risky driving behaviours. Additionally, evidence was found for the incremental validity of automation-induced complacency over favourable attitudes towards autonomous features. In distinguishing favourable attitudes towards autonomous features from automation-induced complacency, future research and policy-making can separately address these constructs for the promotion of traffic safety and policy-making. **Practitioner summary:** We aimed to assess inclinations towards risky driving behaviours in semi-autonomous vehicles. Using vignettes, we found that favourable attitudes towards autonomous vehicles are not associated with risky behaviours, but automation-induced complacency was. Our findings suggest policies like educational programs can be implemented to prevent misuse of semi-autonomous vehicles.

- **Keywords:** Automation-induced complacency, risk compensation theory, semi-autonomous, traffic safety/risk-taking

Yang Liu, Qin Gao & Man Wu. *Domain- and task-analytic workload (DTAW) method: a methodology for predicting mental workload during severe accidents in nuclear power plants.* Pages: 261-290.

Excessive mental workload reduces operators' performance and threatens the safety of nuclear power plants (NPPs) in severe accident management (SAM). Given the lack of suitable mental workload measurement methods for SAM tasks, we proposed a Domain- and Task-Analytic Workload (DTAW) method to predict SAM workload. The DTAW method is developed in three stages: scenario construction based on work domain analysis, task analysis, and workload estimation with eight workload components scored through task-analytic and projective methods. To demonstrate its utility, we applied the method to construct two SAM scenarios and predict the mental workload demand of operators in these scenarios as compared to two design basis accident scenarios. With statistical analysis, the DTAW method can predict the overall subjective workload rated by NPP operators, be used to identify high-load tasks, cluster tasks with similar workload patterns, and provide direct implications for improving SAM strategies and supporting systems. **Practitioner summary:** To predict mental workload in severe accident management (SAM) scenarios in nuclear power plants, we proposed an analytic method and applied it to estimate mental workload in two SAM scenarios and two design basis accident (DBA) scenarios. We found that the workload pattern in SAM scenarios is different from that in DBA scenarios.

- **Keywords:** Workload, severe accidents, nuclear power plants, task analysis

Jeremy Lopez, Heather Watkins & Richard Pak. *Enhancing component-specific trust with consumer automated systems through humanness design*. Pages: 291-302.

Consumer automation is a suitable venue for studying the efficacy of untested humanness design methods for promoting specific trust in multi-component systems. Subjective (trust, self-confidence) and behavioural (use, manual override) measures were recorded as 82 participants interacted with a four-component automation-bearing system in a simulated smart home task for two experimental blocks. During the first block all components were perfectly reliable (100%). During the second block, one component became unreliable (60%). Participants interacted with a system containing either a single or four simulated voice assistants. In the single-assistant condition, the unreliable component resulted in trust changes for every component. In the four-assistant condition, trust decreased for only the unreliable component. Across agent-number conditions, use decreased between blocks for only the unreliable component. Self-confidence and overrides exhibited ceiling and floor effects, respectively. Our findings provide the first evidence of effectively using humanness design to enhance component-specific trust in consumer systems. **Practitioner summary:** Participants interacted with simulated smart-home multi-component systems that contained one or four voiced assistants. In the single-voice condition, one component's decreasing reliability coincided with trust changes for all components. In the four-voice condition, trust decreased for only the decreasingly reliable component. The number of voices did not influence use strategies.

- **Keywords:** Human-machine systems, human-automation interaction, trust in automation, humanness