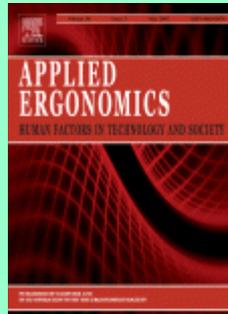


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Andreas Sonderegger, Juergen Sauer. *The influence of socio-cultural background and product value in usability testing.* Pages 341-349.

This article examines the influence of socio-cultural background and product value on different outcomes of usability tests. A study was conducted in two different socio-cultural regions, Switzerland and East Germany, which differed in a number of aspects (e.g. economic power, price sensitivity and culture). Product value (high vs. low) was varied by manipulating the price of the product. Sixty-four test participants were asked to carry out five typical user tasks in the context of coffee machine usage, measuring performance, perceived usability, and emotion. The results showed that in Switzerland, high-value products were rated higher in usability than low-value products whereas in East Germany, high-value products were evaluated lower in usability. A similar interaction effect of socio-cultural background and product value was observed for user emotion. Implications are that the outcomes of usability tests do not allow for a simple transfer across cultures and that the mediating influence of perceived product value needs to be taken into consideration.

- **Keywords:** Usability testing; Culture; Product value; Coffee machine

Anjali Rameshbabu, Diane M. Reddy, Raymond Fleming. *Correlates of negative physical health in call center shift workers.* Pages 350-354.

The call center industry, a burgeoning sector is characterized by unique job demands, which render it susceptible to high attrition rates and negative health concerns. This study examined the relationship between job stress from interpersonal factors, job stress from work factors, coping, inadequate sleep, and negative physical health reports among call center shift workers ($n = 239$), a relatively under-researched population. Inadequate sleep and job stress from interpersonal factors were associated with negative physical health outcome for the participants in this study. Further, spending longer in the call center industry was associated with negative health outcome for the shift worker participants.

- **Keywords:** Call center shift work; Job stress; Inadequate sleep

S. Andy Sparks, Duncan Orme, Lars R. Mc Naughton. *The effect of carrying a portable respiratory gas analysis system on energy expenditure during incremental running.* Pages 355-359.

This study aimed to assess the effect of portable gas analysis system carriage on energy expenditure (EE) during incremental treadmill running. Eight males (Mean \pm SD) age

25.0 ± 9.47 y, body mass 78.5 ± 8.39 kg, completed an experimental trial (PT) during which they wore the system in a chest harness and a control trial (CT) when the system was externally supported. Each protocol consisted of 4 min stages at speeds of 0, 4, 7, 10, 12, 14 km h⁻¹. Increments continued until volitional exhaustion. The EE was greater (3.95 and 7.02% at 7 and 14 km h⁻¹ respectively) during PT ($p < 0.05$) but no significant differences were observed during standing, walking or VO_{2max}. (4.10 ± 0.53, and 4.28 ± 0.75 l min⁻¹ for CT and PT respectively), HR or RPE. Portable gas analysis systems therefore only increase EE when running sub-maximally, but VO_{2max} is unaffected, suggesting that using portable gas analysis systems in field-based situations is appropriate for maximal aerobic capacity measurement, but the effects of prolonged use on EE remains unclear.

- **Keywords:** Exercise; Energy expenditure; VO_{2max}

Allard J. van der Beek, Svend Erik Mathiassen, Alex Burdorf. *Efficient assessment of exposure to manual lifting using company data.* Pages 360-365.

The objective of this study, based on an extensive dataset on manual materials handling during scaffolding, was to explore whether routinely collected company data can be used to estimate exposure to manual lifting.

The number of manual lifts of scaffold parts while constructing/dismantling scaffolds was well predicted by the number of scaffolders in the team and the type of worksite, in combination with company data of either the number of scaffold parts or the scaffold volume. The proportion of explained variance in the number of lifts ranged from 77% to 92%, depending on the variables in the model. Data on scaffold parts and scaffold volume can easily be obtained from the company's administration, since this is its usual paperwork supporting logistics and customer invoicing, respectively.

We conclude that company data can be a promising source of information for ergonomic practitioners and researchers, to support assessment of manual lifting in scaffolding.

- **Keywords:** Lifting; Company data; Exposure assessment

Sjan-Mari van Niekerk, Quinette Abigail Louw, Karen Grimmer-Somers, Justin Harvey, Kevan John Hendry. *The anthropometric match between high school learners of the Cape Metropole area, Western Cape, South Africa and their computer workstation at school.* Pages 366-371.

Study design

Descriptive study.

Objective

The objective of this study was to present anthropometric data from high school students in Cape Metropole area, Western Cape, South Africa that are relevant for chair design and whether the dimensions of computer laboratory chairs currently used in high schools match linear anthropometrics of high-school students. Summary of Background Data. Learner-chair mismatch is proposed as a cause of poor postural alignment and spinal pain in adolescents. A learner-chair mismatch is defined as the incompatibility between the dimensions of a chair and the anthropometric dimensions of the learner. Currently, there is no published research to ascertain whether the furniture dimensions in school computer laboratories match the anthropometrics of the students. This may contribute to the high prevalence of adolescent spinal pain.

Methods

The sample consisted of 689 learners, 13–18 years old. The following body dimensions were measured: stature, popliteal height, buttock-to-popliteal length and hip width. These measurements were matched with the corresponding chair seat dimensions: height, depth and width. Popliteal and seat height mismatch was defined when the seat

height is either >95% or <88% of the popliteal height. Buttock–popliteal length and seat depth mismatch was defined when the seat depth is either >95% or <80% of the buttock–popliteal length. Seat width mismatch is defined where the seat width should be at least 10% and at the most 30% larger than hip width.

Results

An 89% of learners did not match the seat. Five percent of learners matched the chair depth, the majority was found to be too big. In contrast, 65% of the learners matched the chair width dimension.

Conclusions

A substantial mismatch was found. The school chairs failed standard ergonomics recommendations for the design of furniture to fit the user. This study supports the conclusion that there is no one-size-fits-all solution. There is an urgent need for chairs that are of different sizes or that are adjustable.

- **Keywords:** Adolescents; Computer chair; Anthropometry; Spinal pain; Ergonomics; Mismatch

Yu-Hsiu Hung, Woodrow W. Winchester III, Tonya L. Smith-Jackson, Brian M. Kleiner, Kari L. Babski-Reeves, Thomas H. Mills III. *Identifying fall-protection training needs for residential roofing subcontractors.* Pages 372-380.

Falls remain the leading cause of injuries and fatalities in the small residential roofing industry and analogous investigations are underrepresented in the literature. To address this issue, fall-protection training needs were explored through 29 semi-structured interviews among residential roofing subcontractors with respect to recommendations for the design of fall-protection training. Content analysis using grounded theory was conducted to analyze participants' responses. Results of the analysis revealed six themes related to the design of current fall-protection training: (1) barriers to safety training; (2) problems of formal safety-training programs; (3) recommendations for training implementation; (4) important areas for fall-protection training; (5) training delivery means; and (6) design features of training materials. Results of the study suggest the need for informal jobsite safety training to complement what had been covered in formalized safety training. This work also provides recommendations for the design of a more likely adopted fall-protection training program.

- **Keywords:** Safety; Fall-protection training; Residential construction

A. Yu, K.L. Yick, S.P. Ng, J. Yip. *2D and 3D anatomical analyses of hand dimensions for custom-made gloves.* Pages 381-392.

Measuring hand anthropometric data for the development of good-fitting gloves is crucial. In pursuing higher accuracy in hand anthropometric measurements, scanning of hand surfaces with the aids of image analysis system to acquire measurements is an alternative to the manual methods. This study proposes a new hand measuring approach by using 2D and 3D scanning which are evaluated through comparisons of manual measurements. Thirty-three dimensions are measured by using (1) tape and calliper measurement; (2) 2D image analysis; (3) 3D image analysis based on ten captures; and (4) 3D image analysis based on three captures, respectively. Repeated-measures ANOVA, correlation analysis and RMSE are used to examine the results. The hand dimensions obtained from the four methods are highly linearly correlated. Hand data taken from 3D image analysis has no significant difference compared with manual measurements on hand and wrist circumferences, length and breadth dimension, regardless of the number of captures.

- **Keywords:** Hand anthropometry; Image analysis; Custom-made gloves

Xianxue Li, Li Ding, Alan Hedge, Huimin Hu, Zhifeng Qin, Qianxiang Zhou. *An experimental study on the ergonomics indices of partial pressure suits.* Pages 393-403.

Partial pressure suits (PPSs) are used under high altitude, low-pressure conditions to protect the pilots. However, the suit often limits pilot's mobility and work efficiency. The lack of ergonomic data on the effects of PPSs on mobility and performance creates difficulties for human factor engineers and cockpit layout specialists. This study investigated the effects of PPSs on different ergonomic mobility and performance indices in order to evaluate the suit's impact on pilot's body mobility and work efficiency. Three types of ergonomics indices were studied: the manipulative mission, operational reach and operational strength. Research results indicated that a PPS significantly affects the mobility and operational performance of the wearers. The results may provide mission planners and human factors engineers with better insight into the understanding of pilots' operational function, mobility and strength capabilities when wearing PPS.

- **Keywords:** Ergonomics indices; Operational performance; Partial pressure suits

Jenni Raines, Rodney Snow, Aaron Petersen, Jack Harvey, David Nichols, Brad Aisbett. *The effect of prescribed fluid consumption on physiology and work behavior of wildfire fighters.* Pages 404-413.

The purpose of this study was to examine 1) wildfire fighters' ability to consume the prescribed fluid volume (1200 mL h^{-1}), 2) the effect of fluid intake on plasma sodium and hydration, and 3) the effect of fluid intake on firefighters' heart rate, core temperature and activity during emergency suppression shifts.

Methods

Thirty-four firefighters were divided into ad libitum (AD, $n = 17$) and prescribed (PR, $n = 17$) drinking groups.

Results

PR drinkers did not meet the prescribed fluid target, yet consumed over double the volume of AD drinkers. No differences between groups in plasma sodium or hydration were noted. PR drinking resulted in lower core temperature between 2 and 6 h. This did not coincide with reduced cardiovascular strain, greater work activity or larger distances covered when compared to AD drinkers.

Conclusion

Extra fluid consumption (above AD) did not improve firefighter activity or physiological function (though PR firefighters core temperature was lower earlier in their shift). Firefighter can self-regulate their fluid consumption behavior and work rate to leave the fireground euhydrated.

G.P.Y. Szeto, T.K.T. Wong, R.K.Y. Law, E.W.C. Lee, T. Lau, B.C.L. So, S.W. Law. *The impact of a multifaceted ergonomic intervention program on promoting occupational health in community nurses.* Pages 414-422.

Introduction

Community nurses are exposed to high physical demands at work resulting in musculoskeletal disorders. The present study examined the short- and long-term benefits of a multifaceted intervention program designed especially for community nurses in Hong Kong.

Methods

Fifty community nurses working in 4 local hospitals participated in the study. All of them underwent an 8-week intervention program consisting of ergonomic training, daily exercise program, equipment modification, computer workstation assessment and typing training.

Results

All participants showed significant improvement in musculoskeletal symptoms and functional outcomes comparing pre- and post-intervention results. Significant reduction in symptom score was observed at 1-year follow-up compared to post-intervention. Symptomatic group ($n = 40$) showed more significant changes overall compared to asymptomatic group ($n = 10$).

Conclusion

Results support the positive benefits, both short- and long-term, of the multifaceted ergonomic intervention programme for community nurses.

- **Keywords:** Nurse; Work-related musculoskeletal disorders; Ergonomics; Intervention

Bazil Basri, Michael J. Griffin. *Predicting discomfort from whole-body vertical vibration when sitting with an inclined backrest.* Pages 423-434.

Current methods for evaluating seat vibration to predict vibration discomfort assume the same frequency weightings and axis multiplying factors can be used at the seat surface and the backrest irrespective of the backrest inclination. This experimental study investigated the discomfort arising from whole-body vertical vibration when sitting on a rigid seat with no backrest and with a backrest inclined at 0° (upright), 30°, 60°, and 90° (recumbent). Within each of these five postures, 12 subjects judged the discomfort caused by vertical sinusoidal whole-body vibration (at frequencies from 1 to 20 Hz at magnitudes from 0.2 to 2.0 m s^{-2} r.m.s.) relative to the discomfort produced by a reference vibration (8 Hz at 0.4 m s^{-2} r.m.s.). With 8-Hz vertical vibration, the subjects also judged vibration discomfort with each backrest condition relative to the vibration discomfort with no backrest. The locations in the body where discomfort was experienced were determined for each frequency at two vibration magnitudes. Equivalent comfort contours were determined for the five conditions of the backrest and show how discomfort depends on the frequency of vibration, the presence of the backrest, and the backrest inclination. At frequencies greater than about 8 Hz, the backrest increased vibration discomfort, especially when inclined to 30°, 60°, or 90°, and there was greater discomfort at the head or neck. At frequencies around 5 and 6.3 Hz there was less vibration discomfort when sitting with an inclined backrest.

- **Keywords:** Backrest angle; Whole-body vibration; Ride comfort; Prediction model

Natassia Goode, Paul M. Salmon, Michael G. Lenné. *Simulation-based driver and vehicle crew training: Applications, efficacy and future directions.* Pages 435-444.

Simulation is widely used as a training tool in many domains, and more recently the use of vehicle simulation as a tool for driver and vehicle crew training has become popular (de Winter et al., 2009; Pradhan et al., 2009). This paper presents an overview of how vehicle simulations are currently used to train driving-related procedural and higher-order cognitive skills, and team-based procedural and non-technical teamwork skills for vehicle crews, and evaluates whether there is evidence these training programs are effective. Efficacy was evaluated in terms of whether training achieves learning objectives and whether the attainment of those objectives enhances real world performance on target tasks. It was concluded that while some higher-order cognitive skills training programs have been shown to be effective, in general the adoption of simulation technology has far outstripped the pace of empirical research in this area. The paper concludes with a discussion of the issues that require consideration when developing and evaluating vehicle simulations for training purposes – based not only on what is known from the vehicle domain, but what can be inferred from other domains in which simulation is an established training approach, such as aviation (e.g. Jentsch et al., 2011) and medicine (e.g. McGaghie et al., 2010).

Statement of relevance

Simulation has become a popular tool for driver and vehicle crew training in civilian and military settings. This review considers whether there is evidence that this training method leads to learning and the transfer of skills to real world performance. Evidence from other domains, such as aviation and medicine, is drawn upon to inform the design and evaluation of future vehicle simulation training systems.

- **Keywords:** Simulation; Vehicle; Training

A. Naweed, G.R.J. Hockey, S.D. Clarke. *Designing simulator tools for rail research: The case study of a train driving microworld. Pages 445-454.*

The microworld simulator paradigm is well established in the areas of ship-navigation and spaceflight, but has yet to be applied to rail. This paper presents a case study aiming to address this research gap, and describes the development of a train driving microworld as a tool to overcome some common research barriers. A theoretical framework for microworld design is tested and used to explore some key methodological issues and characteristics of train driving, enhancing theory development and providing a useful guideline for the designers of other collision-avoidance systems. A detailed description is given of the ATREIDES (Adaptive Train Research Enhanced Information Display & Environment Simulator) microworld, which simulates the work environment of a train driver in a high-speed passenger train. General indications of the testable driving scenarios that may be simulated are given, and an example of an ATREIDES-based study is presented to illustrate its applied research potential. The article concludes with a review of the design process, considers some strengths and limitations, and explores some future initiatives towards enhancing the systematic study of rail research in the human factors community.

- **Keywords:** Train driving; Microworld simulation; Human factors; Applied research; Information design

Xingda Qu. *Effects of cognitive and physical loads on local dynamic stability during gait. Pages 455-458.*

The objective of this study was to examine the main and interactive effects of cognitive and physical loads on soldiers' gait characteristics. Twelve young healthy male participants volunteered to take part in the study. They were instructed to walk on the treadmill at their comfortable speed under different combinations of physical and cognitive loads. The physical load was applied by carrying backpack load that was set at 0 kg, 8.5 kg, and 20 kg, respectively. The cognitive task was to speak out the name of the months in a reverse order as accurately as possible, starting from any random month specified by the experimenter. Gait characteristics were assessed using local dynamic stability measures. Only physical load had significant effects on local dynamic stability. No interactive effects between cognitive and physical loads were found. The findings from this study can aid in better understanding gait characteristics of load-carrying soldiers. In addition, practical implications can also be derived from the results of this study. For instance, in order to prevent unnecessary fall accidents in military training and combat, measures should be taken to reduce the backpack load for soldiers.

- **Keywords:** Gait characteristics; Load carriage; Cognitive load; Local dynamic stability

Jihong Hwang, Taezoon Park, Wonil Hwang. *The effects of overall robot shape on the emotions invoked in users and the perceived personalities of robot. Pages 459-471.*

The affective interaction between human and robots could be influenced by various aspects of robots, which are appearance, countenance, gesture, voice, etc. Among these, the overall shape of robot could play a key role in invoking desired emotions to the users and bestowing preferred personalities to robots. In this regard, the present study experimentally investigates the effects of overall robot shape on the emotions invoked in users and the perceived personalities of robot with an objective of deriving guidelines for the affective design of service robots.

In so doing, 27 different shapes of robot were selected, modeled and fabricated, which were combinations of three different shapes of head, trunk and limb (legs and arms) – rectangular-parallelepiped, cylindrical and human-like shapes. For the experiment, visual images and real prototypes of these robot shapes were presented to participants, and emotions invoked and personalities perceived from the presented robots were measured. The results showed that the overall shape of robot arouses any of three emotions named 'concerned', 'enjoyable' and 'favorable', among which 'concerned' emotion is negatively correlated with the 'big five personality factors' while 'enjoyable' and 'favorable' emotions are positively correlated. It was found that the 'big five personality factors', and 'enjoyable' and 'favorable' emotions are more strongly perceived through the real prototypes than through the visual images. It was also found that the robot shape consisting of cylindrical head, human-like trunk and cylindrical head is the best for 'conscientious' personality and 'favorable' emotion, the robot shape consisting of cylindrical head, human-like trunk and human-like limb for 'extroverted' personality, the robot shape consisting of cylindrical head, cylindrical trunk and cylindrical limb for 'anti-neurotic' personality, and the robot shape consisting of rectangular-parallelepiped head, human-like trunk and human-like limb for 'enjoyable' emotion.

- **Keywords:** Invoked emotion; Perceived personality; Shape of robot

Yu Zhang, Elizabeth Harris, Meghan Rogers, David Kaber, Joseph Hummer, William Rasdorf, Jia Hu. *Driver distraction and performance effects of highway logo sign design. Pages 472-479.*

Driver distraction and safety concerns have been identified for new highway logo sign configurations. This study assessed driver perception of logo signs and distraction under nine-panel, overflow-combination, or standard six-panel formats. A nine-panel sign has nine business panels within a single sign; a six-panel sign has six panels within a sign; an overflow-combination consists of a standard six-panel sign and a six-panel sign displaying two different services (e.g., food and gas). In this study, twenty-four participants searched for target food business logos while driving in a high-fidelity driving simulation under each signage condition. Gas and lodging signs were also displayed along the road in conventional six-panel formats. Dependent variables included signal detection, visual attention allocation, and vehicle control measures. Experiment results showed nine-panel signs drew greater visual attention and produced lower average speed than overflow-combination signs, and produced a lower speeding percentage compared to six-panel signs. However, there was no evidence the new configurations (nine-panel and overflow) caused substantive performance changes with safety implications. This study suggested the use of nine-panel and overflow-combination logo signs may be suitable for interchanges where there are more than six qualifying businesses in a category in terms of driver performance and safety.

- **Keywords:** Roadway logo signs; Driving simulation; Driver performance; Driver distraction; Highway safety

Emile Tompa, Roman Dolinschi, Julianne Natale. *Economic evaluation of a participatory ergonomics intervention in a textile plant. Pages 480-487.*

In this study we report on the economic evaluation of a participatory ergonomics process undertaken at a clothing manufacturer in Southwestern Ontario, Canada that employs approximately 300 workers. We undertake a cost-benefit analysis from the company perspective.

Intervention costs amounted to \$65,787 and intervention benefits \$360,614 (2011 Canadian dollars). The net present value was \$294,827, suggesting that the intervention was worth undertaking based on the costs and consequences over the measurement period spanning more than four years. Based on these costs and benefits, the benefit-to-cost ratio is 5.5.

Overall, the findings from this study suggest that participatory ergonomics interventions can be cost beneficial from the company perspective. Even though the changes were typically low-cost and low-tech interventions implemented by the plant mechanics and maintenance personnel, benefits were realized on both the health and financial fronts.

- **Keywords:** Textile industry; Ergonomics; Participatory; Economic evaluation

Christopher Bearman, Peter A. Bremner. *A day in the life of a volunteer incident commander: Errors, pressures and mitigating strategies.* Pages 488-495.

To meet an identified gap in the literature this paper investigates the tasks that a volunteer incident commander needs to carry out during an incident, the errors that can be made and the way that errors are managed. In addition, pressure from goal seduction and situation aversion were also examined. Volunteer incident commanders participated in a two-part interview consisting of a critical decision method interview and discussions about a hierarchical task analysis constructed by the authors. A SHERPA analysis was conducted to further identify potential errors. The results identified the key tasks, errors with extreme risk, pressures from strong situations and mitigating strategies for errors and pressures. The errors and pressures provide a basic set of issues that need to be managed by both volunteer incident commanders and fire agencies. The mitigating strategies identified here suggest some ways that this can be done.

- **Keywords:** Fire fighters; Strong situations; Goal seduction; Situation aversion; Decision making; Incident management

P. Simeonov, H. Hsiao, J. Powers, I.-J. Kim, T.-Y. Kau, D. Weaver. *Research to improve extension ladder angular positioning.* Pages 496-502.

A leading cause for extension ladder fall incidents is a slide-out event usually related to suboptimal ladder inclination. An improved ladder positioning method or procedure could reduce the risk of ladder stability failure and the related fall injury. The objective of the study was to comparatively evaluate the effectiveness of a multimodal angle indicator with other existing methods for extension ladder angular positioning.

Twenty experienced and 20 inexperienced ladder users participated in the study. Four ladder positioning methods were tested in a controlled laboratory environment with 4.88 m (16 ft) and 7.32 m (24 ft) ladders in extended and retracted positions. The positioning methods included a no-instruction method, the current standard anthropometric method, and two instrumental methods – a bubble level indicator, and a multimodal indicator providing direct feedback with visual and sound signals. Performance measures included positioning angle and time.

The results indicated that the anthropometric method was effective in improving the extension ladder positioning angle ($p < 0.001$); however, it was associated with considerable variability and required 50% more time than no-instruction. The bubble level indicator was an accurate positioning method (with very low variability), but required more than double the time of the no-instruction method ($p < 0.001$). The multimodal indicator improved the ladder angle setting as compared to the no-instruction

and anthropometry methods ($p < 0.001$) and required the least time for ladder positioning among the tested methods ($p < 0.001$).

An indicator with direct multimodal feedback is a viable approach for quick and accurate ladder positioning. The main advantage of the new multimodal method is that it provides continuous feedback on the angle of the device and hence does not require repositioning of the ladder. Furthermore, this indicator can be a valuable tool for training ladder users to correctly apply the current ANSI A14 standard anthropometric method in ladder angular positioning.

The multimodal indicator concept has been further developed to become a hand-held tool in the form of a smart phone application.

- **Keywords:** Extension ladders; Ladder safety; Angular positioning; Anthropometric method; Angle indicators; Multimodal indicator

Marcelo Castro, Sofia Abreu, Helena Sousa, Leandro Machado, Rubim Santos, João Paulo Vilas-Boas. *Ground reaction forces and plantar pressure distribution during occasional loaded gait.* Pages 503-509.

This study compared the ground reaction forces (GRF) and plantar pressures between unloaded and occasional loaded gait. The GRF and plantar pressures of 60 participants were recorded during unloaded gait and occasional loaded gait (wearing a backpack that raised their body mass index to 30); this load criterion was adopted because is considered potentially harmful in permanent loaded gait (obese people). The results indicate an overall increase (absolute values) of GRF and plantar pressures during occasional loaded gait ($p < 0.05$); also, higher normalized (by total weight) values in the medial midfoot and toes, and lower values in the lateral rearfoot region were observed. During loaded gait the magnitude of the vertical GRF (impact and thrust maximum) decreased and the shear forces increased more than did the proportion of the load (normalized values). These data suggest a different pattern of GRF and plantar pressure distribution during occasional loaded compared to unloaded gait.

- **Keywords:** Backpack; Ground reaction forces; Loaded gait; Load carriage; Plantar pressure