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ARTICLE

P. A. Hancock. *Some pitfalls in the promises of automated and autonomous vehicles*. Pages: 479-495.

Differing forms of self-operating transportation are already among us and some have been in operation now for an extended period of time. From elevators and escalators to airport transit trams, we already use many fully automatic systems. Now such technologies are very publicly and prominently penetrating into the on-road environment of everyday personal vehicle usage. The present article raises and addresses a number of the specific and more general human factors/ergonomic issues associated with such an evolutionary step. One particular concern is that of identified responsibility when such systems fail to perform flawlessly. The ways in which this (r)evolution will impact the social and cultural fabric of affected societies is also considered. Further observations as to the vector of the future characteristics of these vehicular forms and how they and other autonomous systems will affect our world are examined. The very future of the human experience depends upon the ways in which such systems are designed, enacted and integrated into everyday life and these are fundamentally ergonomic endeavours. **Practitioner's Summary:**The prominence of practitioners working on advanced human-machine systems will increase with public concerns surrounding self-driving vehicles. Driverless cars are not only a technological step but they will also exert widespread effects throughout society. Practitioners should prepare for these broad socio-technical challenges in an evolving, autonomous world.

ARTICLE COMMENTARY

Mica R. Endsley. *The limits of highly autonomous vehicles: an uncertain future. Commentary on Hancock (2019) Some pitfalls in the promises of automated and autonomous vehicles*. Pages: 496-499

Peter Hancock (this issue) provides an interesting treatise on the overpromises of highly autonomous vehicles (HAV), defined here as SAE levels 2–5, that is for the most part spot on, as the past several decades of research on automation attest to. While it is likely that driver assistive technologies (SAE level 1) will make widespread penetration of the

transportation system and for the most part, are expected to be beneficial (Endsley 2018Endsley, M. R. 2018. "Situation Awareness in Future Autonomous Vehicles: Beware the Unexpected." Paper presented at the 20th Congress of the International Ergonomics Association, Florence, Italy. [Google Scholar], in press), the future of HAV is far less certain and will substantially rest on successful human-autonomy integration (HAI).

John D. Lee. *Trust and the teleology of technology. Commentary on Hancock (2019) Some pitfalls in the promises of automated and autonomous vehicles*. Pages: 500-501.

Hancock does an admirable job of painting a picture of how human factors and ergonomics can guide automated vehicle (AV) development. He paints a broad landscape of AV development and not a detailed portrait, provoking readers to consider the social issues rather than focussing on the details of the user interfaces. This broad perspective urges us to consider the teleology of technology (Hancock 1996) the purpose and motivation that guide technology development. The hope is that we develop automation to serve human needs not simply because it is possible. This perspective becomes more important as technology exerts greater influence on individual and collective behaviour and even on the structure of society. While Hancock considers the full range of AV design, here I focus on driverless vehicles or SAE Level 4 automation, where the role of a person is a rider rather than a driver.

Paul M. Salmon. *The horse has bolted! Why human factors and ergonomics has to catch up with autonomous vehicles (and other advanced forms of automation). Commentary on Hancock (2019) Some pitfalls in the promises of automated and autonomous vehicles*. Pages: 502-504.

In 'Some pitfalls in the promises of Automated and Autonomous Vehicles', Peter Hancock (2019) eloquently discusses his concerns regarding automated and autonomous vehicles. It is not a trivial inventory, covering issues ranging from acceptability, trust, freedom, and out-of-the-loop humans to the potential wide-ranging societal impacts of autonomous vehicles and indeed questions around whether we should embrace advanced automation in the first place. Hancock closes by broadening the scope to automation generally, stating that the future of humankind is dependent on the way in which automated systems are designed, implemented and operated.

In discussing the critical role of Human Factors and Ergonomics (HFE) in the design of automated vehicles, Hancock asserts that 'the horse has left the stable'. This is a statement that is as sobering as it is true. HFE is again playing catch up and in the not so distant future, we will likely be engaged in projects designed to solve the issues introduced by autonomous vehicles (as opposed to being wholly involved now in projects that have direct input into their design). That this continues to be the case across the HFE domains is frustrating and reflects a wider issue for our discipline. I will return to this once I have touched on some of the issues raised by Hancock.

J. C. F. de Winter. *Pitfalls of automation: a faulty narrative? Commentary on Hancock (2019) Some pitfalls in the promises of automated and autonomous vehicles*. Pages: 505-508.

In 2018, Elon Musk claimed that the media ignore the benefits of automation and that the perils of automation receive disproportionate amounts of negative attention (Tesla 2018). At present, there are insufficient data to comment on whether Tesla's current Autopilot, or other types of (partially) automated driving systems, are safe or unsafe compared to manual driving, nor is the present commentary about Tesla per se. The

quotes from Musk, Table 1, are included to illustrate the possible dangers of an overly sceptical attitude towards nascent technology.

Patrick Waterson. *Autonomous vehicles and human factors/ergonomics – A challenge but not a threat. Commentary on Hancock (2019) Some pitfalls in the promises of automated and autonomous vehicles*. Pages: 509-511.

Peter Hancock's paper in Ergonomics is a welcome addition to the others which have appeared in the journal on the subject of automation (Hancock 2014, 2017). The need to better understand the future socio-technical challenges brought about by driverless cars is something that needs to be constantly emphasised and taken seriously, both within the profession of human factors/ergonomics (HFE) and elsewhere. However, there are also a number of problems. One issue is that it focuses almost exclusively on the disadvantages of new technology and sets out a vision of the future which appears overly pessimistic. The paper needs to be balanced with an acknowledgement that many forms of automation and new technology have the potential not only to enrich, but transform the lives of their users.

Colleen Emmenegger & Don Norman. *The challenges of automation in the automobile. Commentary on Hancock (2019) Some pitfalls in the promises of automated and autonomous vehicles*. Pages: 512-513.

This commentary responds to the article by Peter Hancock, 'Some Pitfalls in the Promises of Automated and Autonomous Vehicles' (Hancock 2018). Hancock points out that the vehicle will need to function in a real-world environment consisting of a mélange of manual, automated, and autonomous vehicles on the road, not to mention multiple other road users. Additionally, it has long been known that the last stages of automation are the most dangerous (Bainbridge 1983, Norman 1990). today, the automation of commercial automobiles is entering the danger zone. Hancock states that 'As is often the case in Human Factors and Ergonomics (HF/E), we are left to play "catch-up" to a technology that effectively moves faster than our science can react'.

P. A. Hancock. *Some promises in the pitfalls of automated and autonomous vehicles: A response to commentators. Commentaries on Hancock's (2019) Some pitfalls in the promises of automated and autonomous vehicles.* Pages: 514-520.

My interlocutors have offered numerous and important responses to my target article. Here, I endeavour to respond to the issues raised. Despite some contentions over specifics, the overall tenor of these commentaries is one of general agreement. One particular challenge, as noted, is how to disseminate our discipline's knowledge beyond the pages of our journals to effect the impact and change in the world to which we aspire. This is a challenge that transcends efforts solely associated with automated vehicles, but it may be in this specific realm that our science can offer its most widespread impact in the immediate, coming future.

- **Keywords:** Automation, autonomy, traffic safety, transportation

ARTICLES

Brid Sona, Erik Dietl & Anna Steidle. *Recovery in sensory-enriched break environments: integrating vision, sound and scent into simulated indoor and outdoor environments*. Pages: 521-536.

To deal with stress and exhaustion at work, personal resources need to be replenished during breaks. The aim of this laboratory study ($n = 122$ students) was to test the restorative potential of sensory-enriched break environments (SEBEs) in between-subjects with repeated measures design, focusing on the type of the environment (natural outdoor vs. built indoor environment) and sensory input (no sensory input vs. audiovisual input vs. audiovisual and olfactory input). Analyses showed that SEBEs simulating either a natural or a lounge environment were perceived as more pleasant and restorative (fascination/being away) than a standard break room, which in turn facilitated the recovery of personal resources (mood, fatigue, arousal). Moreover, adding a congruent scent to an audiovisual simulation indirectly facilitated the recovery of personal resources via greater scent pleasantness and higher fascination and being away. The current study shows the opportunities for sensory enrichment to foster restoration in break environments. **Practitioner summary:** This project reveals the impact of the recovery process of simulated environments on personal resources. Analyses confirmed that sensory-enriched environments were perceived as more restorative than less enriched environments, which in turn facilitated the recovery of personal resources. The results highlight the relevance of holistic sensory impressions to fostering recovery.

- **Keywords:** Ambient scents, restorative environments, personal resources, fascination, being away

Simon S. W. Li, Otto H. T. Chan, T. Y. Ng, L. H. Kam, C. Y. Ng, W. C. Chung & Daniel H. K. Chow. *Effects of backpack and double pack loads on postural stability*. Pages: 537-547.

Measurement of postural stability is crucial for identifying predictors of performance, determining the efficacy of physical training and rehabilitation techniques and evaluating and preventing injuries, particularly for heavy load carriage in hikers, mountain search and rescue personnel and soldiers. This study investigated the effect of load distribution on postural stability in an upright stance using backpack and double pack loads under conflicting or impaired somatosensory, visual and vestibular conditions. The sensory organisation tests were conducted on 20 young adults before and after a 10-min level walking exercise. Young adults' ability to use inputs from somatosensory and visual systems to maintain postural stability was significantly reduced following a 10-min walking exercise with a heavy backpack (30% of body weight), whereas no significant changes were observed for double pack carriage. Thus, the distribution of heavy loads to the front and back provides superior balance control compared with back-only loading. **Practitioner summary:** This study investigated the effects of heavy (30% of body weight) load distribution on postural stability after a 10-min walking exercise. Backpack carriage significantly reduced postural stability, whereas there was no significant effect under double pack loads. Distribution of heavy loads on the front-and-back is desirable for superior balance control.

- **Keywords:** Load distribution, heavy load carriage, postural stability, sensory organisation test

Minseok Son, Soomin Hyun, Donghyun Beck, Jaemoon Jung & Woojin Park. *Effects of backpack weight on the performance of basic short-term/working memory tasks during flat-surface standing*. Pages: 548-564.

This study empirically investigated the effects of backpack weight on the performance of three basic short-term/working memory (STM/WM) tasks during flat-surface standing. Four levels of backpack weight were considered: 0, 15, 25 and 40% of the body weight. The three STM/WM tasks were the Corsi block, digit span and 3-back tasks, corresponding to the visuo-spatial sketchpad, phonological loop and central executive of

WM, respectively. Thirty participants conducted the STM/WM tasks while standing with loaded backpack. Major study findings were that (1) increased backpack weight adversely affected the scores of all three STM/WM tasks; and, (2) the adverse effect of backpack weight was less pronounced for the phonological loop STM task than the other STM/WM tasks. The study findings may help understand and predict the impacts of body-worn equipment weight on the worker's mental task performance for various work activities requiring simultaneous performance of mental and physical tasks. **Practitioner summary:** The current study empirically examined the effects of backpack weight on the performance of three basic STM/WM tasks. The study findings entail that reduces the weight of body-worn equipment can positively impact the worker's mental task performance in addition to reducing the worker's bodily stresses.

- **Keywords:** Backpack weight, body-worn equipment weight, short-term/working memory (STM/WM) task performance, flat-surface standing

Benoit Lafleur, Tyler B. Weaver, Alyssa Tondat, Veronique Boscart & Andrew C. Laing. *Manual patient transfers: factors that influence decisions and kinematic strategies employed by nursing aides*. Pages: 565-574.

While extensive literature has characterised factors that influence the acceptable mass of 'boxes' during MMH tasks, less is known about these factors when moving 'people' in healthcare settings. This study examined factors that influence decisions/approaches employed during manual patient transfers. Sixteen nursing aides manually-transferred a standardised 'patient'; patient mass was adjusted (using a weight vest) to determine a maximum acceptable patient mass for this task ($mass_{max}$). Grip strength was the only worker characteristic significantly associated with $mass_{max}$ ($r = 0.48$). Older worker age was associated with smaller peak trunk flexion ($r = -0.58$) and shoulder abduction ($r = -0.59$), and greater trunk axial twist ($r = 0.52$). Workers emphasised that patient characteristics (e.g. physical/cognitive status) influenced their decisions when performing transfers. These findings extend previous literature by suggesting that grip strength is a useful predictor of perceived work capacity, older workers adapt protective postural strategies during patient transfers and worker-patient dynamics are crucial during this high-risk occupational task. **Practitioner Summary:** This study examined manual patient transfers performed by nursing aides. Worker grip strength (but not age or size) was associated with perceptions of maximum acceptable patient mass. Kinematic changes suggested more conservative strategies used by older workers. Workers emphasised that patient characteristics substantially influenced their decisions when performing transfer tasks.

- **Keywords:** Healthcare ergonomics, patient transfers, load limits, psychophysics, musculoskeletal disorders

Charity Brown, Emma Portch, Faye C. Skelton, Cristina Fodarella, Heidi Kuivaniemi-Smith, Kate Herold, Peter J. B. Hancock & Charlie D. Frowd. *The impact of external facial features on the construction of facial composites*. Pages: 575-592.

Witnesses may construct a composite face of a perpetrator using a computerised interface. Police practitioners guide witnesses through this unusual process, the goal being to produce an identifiable image. However, any changes a perpetrator makes to their external facial-features may interfere with this process. In Experiment 1, participants constructed a composite using a holistic interface one day after target encoding. Target faces were unaltered, or had altered external-features: (i) changed hair, (ii) external-features removed or (iii) naturally-concealed external-features (hair, ears, face-shape occluded by a hooded top). These manipulations produced composites

with more error-prone internal-features: participants' familiar with a target's unaltered appearance less often provided a correct name. Experiment 2 applied external-feature alterations to composites of unaltered targets; although whole-face composites contained less error-prone internal-features, identification was impaired. Experiment 3 replicated negative effects of changing target hair on construction and tested a practical solution: selectively concealing hair and eyes improved identification. **Practitioner Summary:** The research indicates that when a target identity disguises or changes hair, this can lead to a witness (or victim) constructing a composite that is less readily identified. We assess a practical method to overcome this forensic issue.

- **Keywords:** Facial composite, altered external-features, hair, holistic face processing, witness