Human Factors – rok 2023, roč. 65

Číslo 7 (November)

SPECIAL ISSUE: IN MEMORY OF PROFESSOR JOHN W. SENDERS

P. A. Hancock, John D. Lee, John W. Senders. *Attribution Errors by People and Intelligent Machines*. pp. 1293–1305.

Objective: To explore the ramifications of attribution errors (AEs), initially in the context of vehicle collisions and then to extend this understanding into the broader and diverse realms of all forms of human–machine interaction. **Background:** This work focuses upon a particular topic that John Senders was examining at the time of his death. He was using the lens of attribution, and its associated errors, to seek to further understand and explore dyadic forms of driver collision. **Method:** We evaluated the utility of the set of Senders' final observations on conjoint AE in two-vehicle collisions. We extended this evaluation to errors of attribution generally, as applicable to all human–human, human–technology, and prospectively technology–technology interactions. **Results:** As with Senders and his many other contributions, we find evident value in this perspective on how humans react to each other and how they react to emerging forms of technology, such as autonomous systems. We illustrate this value through contemporary examples and prospective analyses. **Applications:** The comprehension and mitigation of AEs can help improve all interactions between people, between intelligent machines and between humans and the machines they work with.

Shashank Mehrotra, Fangda Zhang, Shannon C. Roberts. *Looking out or Looking Away? Exploring the Impact of Driving With a Passenger on Young Drivers' Eye Glance Behavior*. pp. 1306–1322.

Objective: To explore how passenger presence and the degree of association between young driver and passenger influences young drivers' eye glance behavior when they are subjected to distraction. **Background:** Young drivers (18–20 years old) are at an elevated crash risk when subjected to distraction. They are likely to be distracted even further when they drive with passengers. However, the eye glance behavior of these drivers when driving with passengers has not been explored. **Method:** Eye glance data of 34 young drivers between the ages of 18 and 20 years were collected. Participants drove with and without a passenger while subjected to three distracting tasks (visual-manual, cognitive, or visual-cognitive) and driving scenarios that required driver attention.

Results: Visual-cognitive as well as visual-manual states of distraction result in higher mean and standard deviation of glance duration, along with higher number of glances away from road. Passenger presence is found to negatively influence young drivers' eye glance behavior. The degree of association between the young driver and the passenger may help reduce the deviation of eye glances towards the task-related objects. **Conclusion:** In addition to distraction, passengers have a negative influence on the eye glance behavior of young drivers. However, a high degree of association between driver and passenger may mitigate the negative impact of distraction on the eye glance behavior of young drivers. **Application (non-theoretical works):** This research may aid in the design of interventions that improve young drivers' eye glance behavior when they drive with their peers.

Huei-Yen Winnie Chen, Paul Milgram. *Testing Senders' Visual Occlusion Model: Do Operators (Drivers) Really Predict During Visual Occlusion?* pp. 1323–1335.

Objective: The present study tests the hypothesis that humans are capable of predicting the state of a system during visual occlusion, an assumption often made in models of sampling behaviour, but seldom tested. **Background:** In 1967, John Senders introduced the visual occlusion paradigm to evaluate attentional demand of tasks such as automobile driving. Despite multiple studies employing this paradigm, the concept of operators actually being able to resolve uncertainty during occlusion by predicting system output has remained unvalidated. **Method:** A self-paced visual occlusion monitoring task was contrived, involving a randomly rotating basin with a ball at the bottom. Participants were required to detect critical events (ball falling off the edge) while looking only as often as subjectively deemed necessary. Assuming the need to resolve uncertainty imposed by the random rotations, we examined relations between occlusion durations and system states preceding occlusion, for different glance durations, to infer whether predicting may have taken place. **Results:** Results suggested that glance requests were consistent with the use of simple first order predictions. This pertained not only for longer (300 and 500 ms) glances, but even for 100 ms glances whenever critical events were imminent. **Conclusion:** The presumption that human operators are capable, under certain circumstances, of predicting system state in the absence of visual information appears feasible; however, glance duration plays an important role. **Applications:** By providing support for some of its basic premises, the use of Senders' visual occlusion paradigm as a potential tool for evaluating human monitoring performance has been strengthened.

Joost C F de Winter, Mehdi Saffarian, John W Senders. *The effect of an occlusion-induced delay on braking behavior in critical situations: a driving simulator study*. pp. 1336–1344.

Objective: To share results of an experiment that used visual occlusion for a new purpose: inducing a waiting time. **Background:** Senders was a leading figure in human factors. In his research on the visual demands of driving, he used occlusion techniques. **Methods:** In a simulator experiment, we examined how drivers brake for different levels of urgency and different visual conditions. In three blocks (1 = brake lights, 2 = no brake lights, 3 = occlusion), drivers followed a vehicle at 13.4 or 33.4 m distance. At certain moments, the lead vehicle decelerated moderately (1.7 m/s2) or strongly (6.5 m/s2). In the occlusion condition, the screens blanked for 0.4 s (if 6.5 m/s2) or 2.0 s (if 1.7 m/s2) when the lead vehicle started to decelerate. Participants were instructed to brake only after the occlusion ended. **Results:** The lack of brake lights caused a delayed response. In the occlusion condition, drivers adapted to the instructed late braking by braking harder. However, adaptation was not always possible: In the most urgent condition, most participants collided with the lead vehicle because the ego-vehicle's deceleration limits were reached. In non-urgent conditions, some drivers braked unnecessarily hard. Furthermore, while waiting until the occlusion cleared, some drivers lightly touched the

brake pedal. **Conclusion:** This experimental design demonstrates how drivers (sometimes fail to) adjust their braking behavior to the criticality of the situation. **Application:** The phenomena of biomechanical readiness and (inappropriate) dosing of the brake pedal may be relevant to safety, traffic flow, and ADAS design.

Yuval Zak, Yisrael Parmet, Tal Oron-Gilad. *Facilitating the Work of Unmanned Aerial Vehicle Operators Using Artificial Intelligence: An Intelligent Filter for Command-and-Control Maps to Reduce Cognitive Workload*. pp. 1345–1360.

Objective: Evaluating the ability of a Gibsonian-inspired artificial intelligence (AI) algorithm to reduce the cognitive workloads of military Unmanned Aerial Vehicle (UAV) operators. **Background:** Military UAV operators use the command-and-control (C2) map for developing mission-relevant situation awareness (SA). Yet C2 maps are overloaded with information, mostly irrelevant to the mission, causing operators to neglect the map altogether. To reduce irrelevant information, an intelligent filtering algorithm was developed. Here we evaluate its effectiveness in reducing operators' cognitive workloads. **Method:** Two-stage operational scenarios were conducted with professional ex-military UAV operators, using two filter protocols and a no-filter control. High-end real-time techniques were used to continuously assess workload from muscle behavior and machine learning models. **Results:** Lower cognitive workload was found when applying the algorithm's protocols, especially when fatigue started to accumulate (Stage II). However, concerns about the quality of SA arose. **Conclusion:** The algorithm was positively evaluated for its ability to reduce operators' cognitive workloads. More evaluations of operators' SA are required. **Application:** The algorithm demonstrates the possibility of integrating AI to improve human performance in complex systems, and can be applied to other domains where spatial-temporal information needs to be contextually filtered in real time.

ACCIDENTS, HUMAN ERROR

Joseph W. Hendricks, S. Camille Peres, Stefan V. Dumlao, Cara A. Armstrong, Timothy J. Neville. *The Impact of Hazard Statement Design Elements in Procedures: Counterintuitive Findings and Implications for Standards*. pp. 1361–1380.

Objective: The objective of these studies was to identify hazard statement (HS) design elements in procedures that affected whether both workers and lab participants performed the associated hazard mitigation. **Background:** Many of the incidents in high-risk industries are the result of issues with procedures (e.g., standard operating procedures; SOPs) workers use to support their performance. HSs in these procedures are meant to communicate potential work hazards and methods of mitigating those hazards. However, there is little empirical research regarding whether current hazard design guidelines for consumer products translate to procedures. **Method:** Two experimental studies—(1) a laboratory study and (2) a high-fidelity simulation—manipulated the HS design elements present in procedures participants used while performing tasks. Participants' adherence to the mitigation of the hazard was compared for the HS designs. **Results:** The guidelines for HSs from consumer products did not translate to procedures. Specifically, the presence of an alert icon, a box around the statement, and highlighting the statement did not improve adherence to HSs. Indeed, the only consistent finding was for the Icon, with its presence reliably predicting nonadherence in both studies. Additionally, the total number of design elements did not have a positive effect on adherence. **Conclusion:** These findings indicate that more fundamental procedure HSs research is needed to identify effective designs as well as to

understand the potential attentional mechanisms associated with these findings. **Application:** The findings from these studies indicate that current regulations and guidelines should be revisited regarding hazard presentation in procedures.

BIOMECHANICS, ANTHROPOMETRY, WORK PHYSIOLOGY

Olfa Haj Mahmoud, Charles Pontonnier, Georges Dumont, Stéphane Poli, Franck Multon. *A Neural Networks Approach to Determine Factors Associated With Self-Reported Discomfort in Picking Tasks*. pp. 1381–1393.

Objective: A neural networks approach has been proposed to handle various inputs such as postural, anthropometric and environmental variables in order to estimate self-reported discomfort in picking tasks. An input reduction method has been proposed, reducing the input variables to the minimum data required to estimate self-reported discomfort with similar accuracy as the neural network fed with all variables. **Background:** Previous works have attempted to explore the relationship between several factors and self-reported discomfort using observational methods. The results showed that this relationship was not a simple linear relationship. Another study used neural networks to model the function returning reported discomfort according to static posture, age, and anthropometrics variables. The results demonstrated the model's ability to predict reported discomfort. But all the available variables were used to design the neural network. **Method:** Eleven subjects carried-out picking tasks with various masses (0, 1, 3 kg) and imposed duration (5, 10, or 15 s). Continuous REBA score, anthropometric and environmental data were computed, and subjects' discomfort were collected. The data set of this work consisted in the computed continuous REBA score, anthropometric, environmental data and collected subjects' discomfort. **Results:** The results showed that the correlation between the estimated and experimental tested data was equal to 0.775 when using all the 14 available variables. After data reduction, only 6 variables were left, with a very close performance when predicting discomfort. **Conclusion:** A neural network approach has been proposed to estimate self-reported discomfort according to a minimum set of postural, anthropometric and environmental variables in picking tasks. **Application:** This method has the potential to support ergonomists in workstation designing processes, by adding discomfort prediction to virtual manikins' behaviors in simulation tools.

Jessa M. Buchman-Pearle, Kayla M. Fewster, Brendan L. Pinto, Jack P. Callaghan. *Moving Toward Individual-Specific Automotive Seat Design: How Individual Characteristics and Time Alter the Selected Lumbar Support Prominence*. pp. 1394–1406.

Objective: To explore how individual characteristics influence selected lumbar support prominence (LSP), seated lumbar flexion, seatback average pressure, contact area, and center of pressure (CoP) location before and after 1 hr of driving. **Background:** An LSP can alter posture and may reduce low back pain during prolonged driving. Although LSP preference varies across individuals and may change over time, few investigations have explored the time-varying response to individually selected adjustable seat parameters. **Method:** Forty individuals selected LSP settings in an automotive seat through a series of systematic adjustment trials. The average LSP setting was fixed for a 1-hr driving simulation, followed by one final adjustment trial. Regressions were performed between individual characteristics and selected LSP, lumbar posture, and measures of seatback pressure from the initial adjustment trials. ANOVAs were performed to determine the effect of time and sex on these dependent variables. Discomfort was also monitored throughout the protocol. **Results:** Individual's standing lumbar lordosis, selected LSP,

and height and mass were significant predictors for seated lumbar flexion, seatback average pressure, and contact area, respectively. Discomfort levels remained low; however, following the driving protocol, individuals altered their posture to decrease lumbar flexion and increase seatback average pressure without significant adjustments to the LSP. **Conclusion:** These findings highlight individual characteristics to consider in automotive seat design and that the method for determining LSP settings may facilitate appropriate LSP selection. **Application:** A systematic method to determine LSP settings may reduce discomfort and automate seat adjustments, such that only short-term postural adjustments may be required.

Po-Tsun Chen, Hsiu-Yun Hsu, You-Hua Su, Chien-Ju Lin, Hsiao-Feng Chieh, Li-Chieh Kuo, Fong-Chin Su. *Force Control Strategy of Five-Digit Precision Grasping With Aligned and Unaligned Configurations*. pp. 1407–1421.

Objective: To investigate the digit force control during a five-digit precision grasp in aligned (AG) and unaligned grasping (UG) configurations. **Background:** The effects of various cylindrical handles for tools on power grasp performance have been previously investigated. However, there is little information on force control strategy of precision grasp to fit various grasping configurations. **Method:** Twenty healthy young adults were recruited to perform a lift-hold-lower task. The AG and UG configurations on a cylindrical simulator with force transducers were adjusted for each individual. The applied force and moment, the force variability during holding, and force correlations between thumb and each finger were measured. **Result:** No differences in applied force, force correlation, repeatability, and variability were found between configurations. However, the moments applied in UG were significantly larger than those in AG. **Conclusion:** The force control during precision grasp did not change significantly across AG and UG except for the digit moment. The simulator is controlled efficiently with large moment during UG, which is thus the optimal configuration for precision grasping with a cylindrical handle. Further research should consider the effects of task type and handle design on force control, especially for individuals with hand disorders. **Application:** To design the handle of specific tool, one should consider the appropriate configuration according to the task requirements of precision grasping to reduce the risk of accumulating extra loads on digits with a cylindrical handle.

COGNITION

Philip C. Butler, Andy Bowers, Andrew P. Smith, Sabrina R. Cohen-Hatton, Robert C. Honey. *Decision Making Within and Outside Standard Operating Procedures: Paradoxical Use of Operational Discretion in Firefighters*. pp. 1422–1434.

Objective: To understand how firefighters' use of rules (i.e., standard operating procedures [SOPs]) and deliberative decision making (i.e., operational discretion [OD]) interacts with acute stress. **Background:** Current operational guidance for UK firefighters combines the provision of SOPs, for routine incidents, with the use of OD, under prescribed conditions (e.g., when there is a risk to human life). However, our understanding of the use of SOPs and OD is limited. **Methods:** Incident commanders (ICs; n = 43) responded to simulated emergency incidents, which either licensed the use of OD or required use of a SOP. Video footage of IC behavior was used to code their response as involving a SOP or OD, while levels of acute stress were assessed using a blood-based measure and self-report. **Results:** ICs were less likely to use OD selectively in the simulated emergency incident that licensed its use than in the one for which use of an SOP was appropriate; IC command level did not affect this pattern of results; and the

incident that licensed OD resulted in more acute stress than the incident that required use of a SOP. **Conclusion:** SOPs and OD were not used in the manner prescribed by current operational guidance in simulated emergency incidents. **Application:** These results suggest that firefighter training in SOPs and OD should be augmented alongside personal resilience training, given the impact of stress on health and wellbeing, but also to improve the deployment of SOPs and OD under stress.

Amy S. McDonnell, Trent G. Simmons, Gus G. Erickson, Monika Lohani, Joel M. Cooper, David L. Strayer. *This Is Your Brain on Autopilot: Neural Indices of Driver Workload and Engagement During Partial Vehicle Automation*. pp. 1435–1450.

Objective: This research explores the effect of partial vehicle automation on neural indices of mental workload and visual engagement during on-road driving. **Background:** There is concern that the introduction of automated technology in vehicles may lead to low driver stimulation and subsequent disengagement from the driving environment. Simulator-based studies have examined the effect of automation on a driver's cognitive state, but it is unknown how the conclusions translate to on-road driving. Electroencephalographic (EEG) measures of frontal theta and parietal alpha can provide insight into a driver's mental workload and visual engagement while driving under various conditions. **Method:** EEG was recorded from 71 participants while driving on the roadway. We examined two age cohorts, on two different highway configurations, in four different vehicles, with partial vehicle automation both engaged and disengaged. **Results:** Analysis of frontal theta and parietal alpha power revealed that there was no change in mental workload or visual engagement when driving manually compared with driving under partial vehicle automation. **Conclusion:** Drivers new to the technology remained engaged with the driving environment when operating under partial vehicle automation. These findings suggest that the concern surrounding driver disengagement under vehicle automation may need to be tempered, at least for drivers new to the experience. **Application:** These findings expand our understanding of the effects of partial vehicle automation on drivers' cognitive states.

HUMAN-ROBOT INTERACTION

Dov Dori, Ahmad Jbara, Yongkai E. Yang, Andrew M. Liu, Charles M. Oman. *Object-Process Methodology as an Alternative to Human Factors Task Analysis*. pp. 1451–1472

Objective: We define and demonstrate the use of OPM-TA—a model-based task analysis (TA) framework that uses object-process methodology (OPM) ISO 19450 as a viable alternative to traditional TA techniques. **Background:** A variety of different TA methods exist in human factors engineering, and several of them are often applied successively for a broad task representation, making it difficult to follow. **Method:** Using OPM-TA, we modeled how an International Space Station (ISS) astronaut would support extravehicular activities using the existing robotic arm workstation with a new control panel and an electronic procedure system. The modeling employed traditional TA methods and the new OPM-TA approach, enabling a comparison between them. **Results:** While the initial stages of modeling with OPM-TA follow those of traditional TA, OPM-TA modeling yields an executable and logically verifiable model of the entire human–robot system. Both OPM's hierarchical set of diagrams and the equivalent, automatically generated statements in a subset of natural language text specify how objects and processes relate to each other at increasingly detailed levels. The graphic and textual OPM modalities specify the system's architecture, which enables its function and benefits its users. To verify the model logical correctness model, we executed it using OPM's

simulation capability. **Conclusion:** OPM-TA was able to unify traditional TA methods and expand their capabilities. The formal yet intuitive OPM-TA approach fuses and extends traditional TA methods, which are not amenable to simulation. It therefore can potentially become a widely used means for TA and human–machine procedure development and testing.

HUMAN-SYSTEMS INTEGRATION

Steph Michailovs, ,Stephen Pond ,Megan Schmitt, Jessica Irons, Matthew Stoker, Troy A. W. Visser, Samuel Huf, Shayne Loft. *The Impact of Information Integration in a Simulation of Future Submarine Command and Control*. pp. 1473–1490.

Objective: Examine the extent to which increasing information integration across displays in a simulated submarine command and control room can reduce operator workload, improve operator situation awareness, and improve team performance. **Background:** In control rooms, the volume and number of sources of information are increasing, with the potential to overwhelm operator cognitive capacity. It is proposed that by distributing information to maximize relevance to each operator role (increasing information integration), it is possible to not only reduce operator workload but also improve situation awareness and team performance. **Method:** Sixteen teams of six novice participants were trained to work together to combine data from multiple sensor displays to build a tactical picture of surrounding contacts at sea. The extent that data from one display were available to operators at other displays was manipulated (information integration) between teams. Team performance was assessed as the accuracy of the generated tactical picture. **Results:** Teams built a more accurate tactical picture, and individual team members had better situation awareness and lower workload, when provided with high compared with low information integration. **Conclusion:** A human-centered design approach to integrating information in command and control settings can result in lower workload, and enhanced situation awareness and team performance. **Application:** The design of modern command and control rooms, in which operators must fuse increasing volumes of complex data from displays, may benefit from higher information integration based on a human-centered design philosophy, and a fundamental understanding of the cognitive work that is carried out by operators.

NEUROERGONOMICS

Dongwon Kim, Corine Nicoletti, Subaryani D. H. Soedirdjo, Raziyeh Baghi, Maria-Gabriela Garcia, Thomas Läubli, Pascal Wild, Alberto Botter, Bernard J. Martin. *Effect of Periodic Voluntary Interventions on Trapezius Activation and Fatigue During Light Upper Limb Activity*. pp. 1491–1505.

Objective: The effects of diverse periodic interventions on trapezius muscle fatigue and activity during a full day of computer work were investigated. **Background:** Musculoskeletal disorders, including trapezius myalgia, may be associated with repeated exposure to prolonged low-level activity, even during light upper-extremity tasks including computer work. **Methods:** Thirty healthy adults participated in a study that simulated two 6-hour workdays of computer work. One workday involved imposed periodic passive and active interventions aimed at disrupting trapezius contraction monotony (Intervention day), whereas the other workday did not (Control day).

Trapezius muscle activity was quantified by the 3-dimensional acceleration of the jolt movement of the acromion produced by electrically induced muscle twitches. The spatio-temporal distribution of trapezius activity was measured through high-density surface electromyography (HD-EMG). **Results:** The twitch acceleration magnitude in one direction was significantly different across measurement periods ($p = 0.0156$) on Control day, whereas no significant differences in any direction were observed ($p > 0.05$) on Intervention day. The HD-EMG from Intervention day showed that only significant voluntary muscle contractions (swing arms, Jacobson maneuver) induced a decrease in the muscle activation time and an increase in the spatial muscle activation areas ($p < 0.01$). **Conclusion:** Disruption of trapezius monotonous activity via brief voluntary contractions effectively modified the ensuing contraction pattern (twitch acceleration along one axis, active epochs reduction, and larger spatial distribution). The observed changes support an associated reduction of muscle fatigue. **Application:** This study suggests that disruptive intervention activity is efficient in reducing the impact of trapezius muscle fatigue.

PHYSIOLOGICAL AND PSYCHOLOGICAL CONDITIONS ("INTERNAL ENVIRONMENT")

Sonia Ortiz-Peregrina, Oscar Oviedo-Trespalacios, Carolina Ortiz, Rosario G. Anera. *Self-Regulation of Driving Behavior Under the Influence of Cannabis: The Role of Driving Complexity and Driver Vision*. pp. 1506–1524.

Objective: This study analyzed the self-regulation behaviors of drivers under the influence of cannabis and its relationship with road complexity and some driver traits, including visual deterioration. **Background:** Cannabis is the illicit drug most often detected in drivers; its use results in significant negative effects in terms of visual function. Self-regulation behaviors involve the mechanisms used by drivers to maintain or reduce the risk resulting from different circumstances or the driving environment. **Methods:** Thirty-one young, occasional cannabis users were assessed both in a baseline session and after smoking cannabis. We evaluated the visual function (visual acuity and contrast sensitivity) and driver self-regulation variables of both longitudinal and lateral control as the speed adaptation and standard deviation of lateral position (SDLP). **Results:** Visual function was significantly impaired after cannabis use. Recreational cannabis use did not result in self-regulation, although some road features such as curved roads did determine self-regulation. Male participants adopted mean faster driving speeds with respect to the speed limit. Driver age also determined better lateral control with lower SDLPs. In addition, visual impairment resulting from cannabis use (contrast sensitivity) was linked with self-regulation by changes in longitudinal and lateral control. **Conclusion:** Contrast sensitivity could be a good indicator of individual visual status to help determine how drivers self-regulate their driving both in normal conditions and while under the influence of cannabis. **Application:** The findings provide new insights about driver self-regulation under cannabis effects and are useful for policy making and awareness campaigns.

Maria-Gabriela Garcia, Melany Estrella, Angie Peñafiel, Paul G. Arauz, Bernard J. Martin. *Impact of 10-Min Daily Yoga Exercises on Physical and Mental Discomfort of Home-Office Workers During COVID-19*. pp. 1525–1541.

Objective: Evaluate the effects of 10 min/day of yoga for 1 month on musculoskeletal discomfort and mood disturbance of home-office workers. **Background:** The COVID-19 pandemic forced many people to switch to teleworking. The abrupt change from an office

setting to an improvised home-office may negatively affect the musculoskeletal and emotional health of workers. By providing mental and physical exercises, yoga may be effective in reducing adverse effects. **Method:** Fifty-four participants (42 women, 12 men) followed a 1-month yoga program, while 40 participants (26 women, 14 men) continued with their common work routine. The Cornell Musculoskeletal Discomfort Questionnaire was used to evaluate severity, interference with work and frequency of pain, and to obtain a total discomfort score for 25 body areas. Mood disturbance was evaluated with the Profile of Mood States questionnaire. Both groups completed both questionnaires, before and after the experimentation period. **Results:** After 1 month, for the yoga group only, significant reductions were observed in the discomfort of eyes, head, neck, upper and lower back, right wrist, and hips/buttocks, as well as reductions in discomfort severity, frequency and interference for the neck, upper and lower back. Total mood disturbance was also significantly reduced for the yoga group only. No favorable changes occurred for the control group. **Conclusion:** The yoga intervention program appears to reduce musculoskeletal discomfort and mood disturbance of home-office workers. **Application:** Sedentary workers may benefit from 10 min/day of yoga during the workday to attenuate potential physical and emotional discomfort during the current pandemic and beyond.

TEAMS AND GROUPS

Nicolas Michinov, Sophie Jeanson. *Creativity in Scientific Research: Multidisciplinarity Fosters Depth of Ideas Among Scientists in Electronic "Brainwriting" Groups*. pp. 1542–1553.

Objective: The aim of this study was to examine the potential benefits of multidisciplinarity among agri-food researchers working in small groups to generate ideas to stimulate innovation in the context of a laboratory project. **Background:** Research on the role of multidisciplinarity in scientific research teams remains limited, particularly regarding the generation of ideas to innovate in a real laboratory project, and on a task with a real challenge for innovation. **Method:** Researchers and agri-food research staff were assigned to small groups of either multidisciplinary or unidisciplinary composition to produce ideas on a cross-cutting theme for an innovative laboratory project using an electronic "brainwriting" application. **Results:** A greater depth in idea generation (number of ideas per category) was observed in the multidisciplinary condition than in the unidisciplinary condition. **Conclusion:** The main benefits of this study were to experimentally examine the effects of multidisciplinarity in small scientific research groups on the production of ideas in a field study conducted on the premises of an agri-food laboratory. **Application:** This study provides advice on how to promote innovative projects by stimulating ideation processes, which includes constructing small multidisciplinary groups and using an electronic "brainwriting" technique.

Craig J. Johnson, Mustafa Demir, Nathan J. McNeese, Jamie C. Gorman, Alexandra T. Wolff, Nancy J. Cooke. *The Impact of Training on Human–Autonomy Team Communications and Trust Calibration*. pp. 1554–1570.

Objective: This work examines two human–autonomy team (HAT) training approaches that target communication and trust calibration to improve team effectiveness under degraded conditions. **Background:** Human–autonomy teaming presents challenges to teamwork, some of which may be addressed through training. Factors vital to HAT performance include communication and calibrated trust. **Method:** Thirty teams of three, including one confederate acting as an autonomous agent, received either entrainment-based coordination training, trust calibration training, or control training before executing a series of missions operating a simulated remotely piloted aircraft. Automation and autonomy failures simulating degraded conditions were injected during missions, and measures of team communication, trust, and task efficiency were collected. **Results:**

Teams receiving coordination training had higher communication anticipation ratios, took photos of targets faster, and overcame more autonomy failures. Although autonomy failures were introduced in all conditions, teams receiving the calibration training reported that their overall trust in the agent was more robust over time. However, they did not perform better than the control condition. **Conclusions:** Training based on entrainment of communications, wherein introduction of timely information exchange through one team member has lasting effects throughout the team, was positively associated with improvements in HAT communications and performance under degraded conditions. Training that emphasized the shortcomings of the autonomous agent appeared to calibrate expectations and maintain trust. **Applications:** Team training that includes an autonomous agent that models effective information exchange may positively impact team communication and coordination. Training that emphasizes the limitations of an autonomous agent may help calibrate trust.