Letter from the Editor ................................................................. 2
Kollmorgen Award 2015 ............................................................... 3
“Closing the loop” on Communications for Human-Robot Teaming .......... 4
From Cues to Signals: Augmenting Human Performance with Socially Intelligent Robots ................................................................. 4
Implicit Measures as a Calibration Tool for the Symbiotic Human/Robot System ......................................................... 5
The Cognitive Design of Augmented and Mixed Reality Displays .......... 7
2014-2015 ACTG Officers ............................................................. 9
ACTG Contact Information .......................................................... 11

In This Issue:

60th Annual Meeting

The next HFES conference is September 19th – September 23rd at the Washington Hilton Washington, DC. The 2016 AC-TG Business Meeting is planned for Wednesday, September 21, 2016, 3:30 pm - 5:15 pm. The technical session is: Wednesday, September 21, 2016, 10:30 am - 12:00 pm. The discussion panel is: Friday, September 23, 2016, 10:30 am - 12:00 pm.
Message from the Editor

I want to thank all of those who submitted content to this year’s newsletter. If you did not have a chance to submit this year, please consider submitting content to share with the AugCog community for next year’s newsletter. See tg.hfes.org/actg/actg_submit.htm for details.

If you are able to attend this year’s Human Factors and Ergonomics Society Annual Meeting at the Washington Hilton in Washington, D.C., there are several AugCog events you may find interesting which can be found here: http://www.hfes.org/web/HFESMeetings/2016HFESAnnualMeetingProgram.pdf.

Please consider checking out the Augmented Cognition posters on Tuesday, September 20th, from 5:00 pm - 6:30 pm. This year’s Augmented Cognition Technical Session is on Wednesday, September 21st from 10:30 am - 12:00 pm and features six lectures addressing several topics including physiological assessment, baseline methodology, and mental workload detection. Later on Wednesday, the Augmented Cognition business meeting is being held in Georgetown West (Concourse Level) at 3:30 pm. We hope you can attend and network with other technical group members and share your ideas to help guide the future of the TG. On Friday, September 23rd from 10:30 am - 12:00 pm in Georgetown West, a discussion panel will address the challenges of gathering meaningful data from novices and simplified environments to inform augmented cognition in highly complex environments.

I hope you enjoy this year’s newsletter and have the opportunity to attend the Aug Cog events at HFES!

Best Wishes,
Ryan W. Wohleber, Ph.D.
The focus of Dr. Joseph Cohn's two-decade long career has been on optimizing human performance and survivability through cutting-edge biomedical and human systems science & technology. Dr Cohn received his Ph.D. in Neuroscience from Brandeis University in 1998 under the mentorship of Drs. James Lackner and Paul DiZio. His thesis work focused on understanding how the brain adapts to new and unusual contextual information, using the then-novel technology known as 'virtual reality.' He followed this with a post doctoral fellowship under Dr. Scott Kelso, where he focused on applying non-linear dynamical approaches to modeling the linkages between brain and behavior. Since then, Dr Cohn has co-authored over 80 Human Performance and Biomedical related publications, chaired numerous panels and workshops and been invited to speak at national and international conferences. He co-edited three-volume handbook on virtual environments for training and education, a book on enhancing human performance in high risk environments and is co-editing a book focusing on individual and group decision making processes, as influenced by society and culture. He is a Fellow of the American Psychological Association, and the Society of Military Psychologists, and Associate Fellow of the Aerospace Medical Association. He co-chairs the International Cross Cultural Decision Making Conference, was the Principal Human Systems Subject Matter Expert to the 2015 National Defense Industrial Association’s Human Systems Division Conference, and is the Deputy Chair of the Human Performance Committee, Aerospace Medical Association. He is an Active Duty Naval Officer, and an Aerospace Experimental Psychologist (AEP) in the U.S. Navy’s Medical Service Corps.
Robots have been used in a variety of military missions such as search and rescue, and bomb disposal operations. Traditionally, the Human-Robot Interaction (HRI) has involved a human operator explicitly controlling an unmanned asset using a Human-Computer Interface (HCI). With teleoperation remaining the contemporary standard, operators continue to interact with unmanned systems as simple tools under their direct control, rather than as responsive members of their team. One way for robots to be more like teammates is for them to have the ability to receive communications implicitly through inputs that do not require overt actions or response by the human operator. Such input can include physiological indicators of mental state and workload of the human. Physiological workload measures have the advantage of being able to monitor operator state continuously. Common measures used for this purpose include EEG (Hankins & Wilson, 1998), heartrate variability (Mulder, De Waard, & Brookhuis, 2005), cerebral blood flow velocity (Warm & Parasuraman, 2007), ocular fixation duration (Schulz et al., 2010) among others. These physiological measures also have relatively high temporal resolution and do not need overt responding from the human operator that may interfere with the tasks at hand. This would enable the robot teammate to respond to changes in its human teammate and adapt its behaviors accordingly. For instance, when the human teammate is experiencing high workload and is unable to issue explicit commands, the robot teammate would be able to assist with tasks and anticipate needs by “pushing up” information or messaging for help. When workload returns to a manageable level, the robot teammate can return full task control to the human operator. To build such an adaptive system, a robust workload model using physiological workload measures is needed. The model would need to map various physiological response profiles to the various levels of workload, and then classify workload levels. Two major challenges in developing such a model are (i) the multidimensional construct of workload, and (ii) the large inter-individual variability in physiological workload responses. When these have been addressed, adaptive systems that feature advanced online classification of mental states based on physiological measures can be developed to enable the robotic teammate’s ability to respond to their human teammates’ needs as they change throughout a dynamic operational environment, improving the performance of the team as a whole.

References


The last decade has seen tremendous strides in robotics R&D. Robots are virtually ubiquitous in the modern factory. But, in addition to a presence in controlled industrial settings, robots are now venturing out into the ‘wild’ and learning to interact in the real world. Increasingly, robots are taking on tasks that do not replace humans, but rather, augment human performance. Robots are playing an important role as members of a team in a variety of contexts – from military operations to high-risk surgeries to search and rescue missions. To ensure such robotic teammates effectively augment team performance, we must better understand the socio-cognitive factors at play when humans and robots interact in social and team settings. In the Cognitive Sciences Lab at the University of Central Florida, we are interested in understanding how we can leverage what we know from research in human-human interaction to better inform human-robot interaction (HRI). To do this, we study the exchange of social information between humans and between humans and robots.

Central to our work is Social Signal Processing (SSP), an area of research that utilizes a multidisciplinary approach to provide computers and automated systems, like robots, with the ability to perceive, interpret, and display social meaning (Vinciarelli et al., 2012). SSP focuses on the non-verbal behaviors that are often inconsistent in meaning but which provide critical context to identifying the needs of another during joint action. To understand how bidirectional communication and social understanding is accomplished between robot and human, we have developed a research program following the three main focal points in SSP: modeling, analysis, and synthesis. Modeling involves the conceptual aspects of developing a framework for explaining how social interactions take place. Analysis incorporates the tools and techniques we use to record behavioral aspects of the interaction. This includes data acquisition through sensors or response data, and data processing through machine learning or statistical methods. Finally, synthesis encompasses the engineering challenges of controlling an artificial agent so that it can articulate social cues in a way that is natural for the human to interpret.

As an example of our work in SSP modeling, we have studied social cues – physical appearance or behavior patterns – and social signals – the mental state that conveys intentions, emotions, or status (Lobato et al., 2015). Here, we examined the relationship between attributions made and cue weights following a Brunswikian lens model approach (see also Wiltshire et al., 2013). In the area of SSP synthesis we have studied how social cues expressed by a robot alter how humans perceive and interact with the robot (Wiltshire et al., 2015). Using the iRobot Ava platform we manipulated robotic proxemic and gaze cues to see how these changed the interpersonal attributions made by, and the interaction behaviors of, humans interacting with Ava (see also Fiore et al., 2013). Finally, in the area of SSP analysis, we have developed algorithms using machine learning approaches applied to data from humans making mental state attributions (Best et al. in press). By exploring machine classification on a large cue set, we were able to show how machine classifiers can correctly identify social signals with nearly 90% accuracy (see also Best et al. 2015; Wiltshire et al. 2014).
Currently, we are building from this research to investigate real-time HRI with robotic platforms to investigate how other non-verbal behaviors influence how humans perceive the mental states of robots. Additionally, we are studying how the degree of anthropomorphism in robots influences judgments concerning social presence and human perceptions of the robot. Our hope is that, by combining our research from human-human interaction with our research in HRI, we can optimize the ability of humans and robots to work collaboratively. In sum, our HRI research demonstrates the utility of an interdisciplinary approach to better understand how social cues (observable features) map to social signals (the mental state or meaning conveyed during interaction). This has implications for robot design, given that development and implementation of algorithms for social signal processing allow for rapid consolidation and interpretation of large amounts of data are essential for augmenting human-robot team performance in deployed environments. The overarching goal for our work is, not only to better understand socio-cognitive processes in the context of social robotics, but to develop computational formalisms, modeling recommendations, and techniques that help facilitate effective HRI in a variety of contexts.

References


Implicit Measures as a Calibration Tool for the Symbiotic Human/Robot System

Ashley L. Reardon, William G. Volante, Tracy Sanders, and Peter A. Hancock, Ph.D.

Currently, robots are employed in many diverse fields, some of which include critical tasks like search and rescue, space exploration and colonization, and combat missions. The advancement of these robots such as NASA’s Valkyrie, TARTAN Rescues CHIMP, and the U.S. Air Forces’ ARTS has led researchers to embark on the novel task of improving human cognitive capabilities to enhance human performance. Known as augmented cognition, this field uses neuropsychological measures such as EEG, NIRS, heart rate, voice stress and task performance to detect, analyze, and autonomously modify and mediate the user’s cognitive state, especially in high stress environments (Schmorrow & Kruse, 2002).

As tasking becomes more complex, so too does the behavior and comprehensibility of the automated system, forcing users to rely heavily on trust (Miller, 2005). The current goals of augmented cognition are to move away from treating “human system” and “autonomous system” as two separate entities, and instead work on forming a synergistic working relationship that functions intuitively yet unobtrusively. Just like any successful relationship, this dual-entity relies heavily on trust. But how does one form appropriate trust with an autonomous system? Are certain people predisposed to distrust these systems? How do we measure trust levels automatically in order to mitigate miscalibration of trust?

The first step to answering these questions lies in the understanding of factors that affect trust in human robot interaction (HRI). From the maniacally evil HAL 9000, to the iconic and lovable R2-D2, robots that are conceptualized in the media take many forms of ‘bad’ and ‘good’. What is it about these robots that makes us want to either run away in fear, or adopt as some sort of space companion? According to Hancock et al., the antecedents of trust are broken into three categories: robot-related factors, environment-related factors, and human-related factors (2011). Robot-related factors range from attribute characteristics like design and interface, to how well the robot performs a given task. Environment-related factors include interaction with the team and the culture of the teammates. Finally, human-related factors include prior experience and training, personality factors, and attitudes toward robots (Oleson et al., 2011).

Here, we are interested in human-related factors and how to utilize them to improve HRI relationships through augmented cognition. Specifically, we are looking at learned attitude associations regarding robots that develop naturally and unconsciously through our lived experiences, which have the power to influence our beliefs and behavior without our conscious awareness. Known as implicit associations, these attitudes provide valuable insight into beliefs we either fail to divulge or even fail to recognize. By using the Implicit Associations Test (IAT) that was developed by Greenwald, McGhee, and Schwartz in 1988, researchers are able to pair targets with stimuli in order to measure the strength of associations.
For instance, in a study conducted at the University of Central Florida, we looked at associations between humans and robots in order to detect robot bias, which can affect trust. The IAT pairs negative and positive stimuli with our target categories, human and robots, to elicit reaction times that represent participant’s automatic responses. Stimuli included pairings of negative and positive words such as “wonderful”, “best”, “awful”, and “terrible” with pictures of humans and robots. Our target categories were represented by pictures of a variety of military, medical, and social robots, and varying pictures of male and female humans. The IAT is comprised of 7 computerized tasks containing 2 classification trials asking participants to identify pictures of humans or robots, and 1 classification trial asking participants to identify good or bad words. The following 2 tasks combine negative word pairings with ‘Human’, and positive word pairings with the ‘Robot’ to be used to identify robot and human images. The final 2 tasks follow the same structure except the word order is changed to combine positive word pairings with ‘Human’, and negative word pairings with ‘Robot’. When participants are charged with responding as quickly as possible, they cannot take the time needed to formulate an explicit response and must rely heavily on automatic, uncontrolled processes to optimize their reaction time. In theory, the greater a participant subconsciously associates two words or items, the faster these implicit processes can facilitate a response. Thus, quicker responses imply greater association.

Our results show that reaction times were higher for tasks which paired robots with positive stimuli and humans with negative stimuli, and lower for tasks which paired robots with negative stimuli and humans with positive stimuli. The IAT describes a positive relationship with humans and a negative relationship with robots. Further studies are needed to describe the complexity of both relationships, especially as human-robot interaction penetrates further into military and government critical tasks.

Using the IAT to develop a measure of association between robot partner and operator lays the groundwork for understanding how implicit associations indicate trust in automation. Utilizing this tool before task engagement allows the opportunity to detect implicit distrust levels across multiple users, which can then be used to calibrate the robot partner in regards to user’s dispositional trust in automation. As we move forward in synchronizing the human/robot pair, we must also synchronize the complex interpersonal workings of both systems if we hope to achieve complete symbiosis. Understanding how to use implicit measures to mitigate distrust is the first step in achieving this symbiosis to improve human performance. The next step is to adapt or create implicit methods that are more conducive to online assessments for continuous monitoring.

References


The Cognitive Design of Augmented and Mixed Reality Displays

Anthony Selkowitz, Ph.D.

Future displays will incorporate a user’s environment, placing objects within the environment of the user. This is the reality of augmented and mixed reality displays (A/MR). Unlike traditional displays which are confined to the limitations of their screen size, A/MR displays will transform the user’s environment into an interactive display. A/MR displays will allow users to interact with their environment like never before. Their environment will become a dynamic interactive display in which information is overlaid upon both normal objects and objects designed to be interactive with A/MR displays. Presenting information through A/MR displays is different from traditional displays in that A/MR displays will require the user to utilize hand gestures, and voice commands to interact with the display. The purpose of this article is to outline factors, based on human cognition, to be investigated and taken into account when designing A/MR displays.

Co-production of Gestures and Voice Commands

Gestures and voice commands may impede one another. If the A/MR display incorporates both gestures and voice commands the user’s natural inclination to gesture may interfere with their usage of the A/MR display. Research has shown that using gestures facilitates one’s speech production in verbal working memory (Morsella & Krauss, 2004). For example, if in an A/MR display the user is required to interact with an object by picking it up through a gesture or controller manipulation and they have to produce a verbal command simultaneously, this may lead to a large number of errors when compared to performing these two actions separately. Additionally, gestures play a role in how users process spatial information (Alibali, 2005) and including them in an A/MR display should be used to convey a similar spatial relationship to how they would produce that gesture naturally.

Clutter

When A/MR displays are released into the market, the displays are at the behest of the environment around them. The amount of clutter/layout of the environment may affect the display in unintended ways and make it difficult to use the features of the display. Research investigating visual search in cluttered environments has shown that when required to search for objects in unfamiliar environments with an increased amount of local clutter, search times increased (Beck, Lohrenz, & Trafton, 2010). Designers and researchers should study how the clutter of the augmented environment affects users when interacting with A/MR displays.
Context

The context in which users process and learn information has an effect on their recall of that information (Godden & Baddeley, 1975). This context dependent recall could affect the use of A/MR displays since one of their appeals is that the user can use them in whatever environment they are in. This could be accounted for in the design of A/MR displays by producing features for when the user is outside of their normal usage zones.

In summary, this article proposed some cognition-based factors that should be investigated further and considered in the design of A/MR displays. Research should be conducted on these factors in future A/MR displays.

References


2015-2016 AC-TG Officers

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AC-TG ListServ: Email the AugCog listserv at hfes-actg@hfes.org with anything you would like to share with the community such as job announcements, funding opportunities, scholarships, questions, etc.

AC-TG Website: Also, be sure to check out our updated website: http://tg.hfes.org/actg/

AC-TG Group on LinkedIn: Join the Augmented Cognition LinkedIn Group:
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