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AugCog *Technical group*

THE AC-TG SEEKS TO SERVE AS A FORUM FOR FOSTERING THE CONTINUAL DESIGN AND DEVELOPMENT OF AUGCOG S&T AND FOR THE EXCHANGE AND DISSEMINATION OF INFORMATION

2012 Business Meeting

The 2012 Augmented Cognition Technical Group (AC-TG) Business Meeting was productive. Dr. Ron Stevens from the UCLA's School of Medicine and Brain Research Institute was awarded the Admiral Leland S. Kollmorgen Spirit of Innovation Award. Rebecca Leis from the University of Central Florida received the annual Student Grant Award, which included a $500 cash prize. Michael W. Boyce, also from the University of Central Florida, received the honor of AC-TG's Best Student Paper Award.

The 2012 business meeting marked the occasion of Dr. Lauren Reinerman-Jones's completion of many years of successful leadership in service of the TG. While she is still very much a part of the TG, her enthusiasm, and commitment will be missed in an official capacity. In addition to Lauren's transition, several other official positions were filled:

- LT Lee Sciarini will serve as the Technical Group Chair
- Dr. Grant Taylor will serve as the Program Chair
- Dr. Heather Lum will serve as the Newsletter Editor
- Ms. Rebecca Leis will serve as the Assistant Newsletter Editor
- Baron Summers will serve as the Student Outreach Officer.

The 2012 Conference in Boston marked the sixth year in which the Augmented Cognition Technical Group was affiliated with HFES. As we prepare for the 2013 meeting in San Diego, we would like you to help welcome students, professors, practitioners and other interested persons to participate, contribute, and help guide the future of the TG. As a whole, we encourage others to continue to foster the scientific exploration, development, and application of real-time physiological and neurophysiological sensing technologies to improve and enhance users' interactions with systems and technologies, which shape our complex world.

57th Annual Meeting

The next HFES conference is September 30th - October 4th at the Hilton San Diego Bayfront in San Diego, CA. The 2013 AC-TG Business Meeting is planned for Wednesday, October 2, 2013, 3:30-5:30 pm. Additional sessions include: Adaptive Systems and Applied Psychophysiology: Tuesday, October 1, 2013, 1:30 pm-3:00 pm and Adaptive Training at 8am Wednesday, which is a co-sponsored session with the Training TG.

Leland S. Kollmorgen Spirit of Innovation Award Nomination

The Leland S. Kollmorgen Spirit of Innovation Award was instituted in 2007 by the HFES AC-TG in honor of Leland S. Kollmorgen, Rear Admiral, U.S. Navy (Ret.). The award recognizes exceptional scientists and engineers who have made substantial and innovative contributions to the field of Augmented Cognition. The recipient will be someone whose extensive endeavors have pushed the frontiers of discovery, innovation, and design in Augmented Cognition transcending the boundaries of human-systems computing and is a true inspiration to the HSI field.

The Leland S. Kollmorgen Spirit of Innovation Award recipient is judged not only on accomplishments in the last year, but also on a career history of efforts contributing to the advancement of the Augmented Cognition field. Other criteria for selection include: resourcefulness and dedication in promoting and accomplishing innovative human-systems computing technologies, demonstrated leadership in forming and promoting teamwork among the various disciplines represented within the Augmented Cognition field, demonstrated professionalism and integrity, and the embodiment of the spirit of innovation and collaboration.

If you are interested in nominating an individual or nominating yourself, please complete the form below and return to Lee Sciarini (lwsciari@nps.edu) by September 15th, 2013. The recipient will be honored at the 2013 HFES AC-TG Business Meeting in San Diego, CA.

Nominator Information:

_____ _____

Your Name **Your Affiliation**

_____ _____

Your Email **Years of Affiliation with HFES and Aug Cog**

Nominee Information (If Different from Above):

_____ _____

Nominee Name **Nominee Affiliation**

_____ _____

Nominee Email **Years of Affiliation with HFES and Aug Cog**

Please summarize in 1-2 paragraphs why this person embodies the spirit of this award, including contributions, collaborations, and other honors received pertaining to the field of Augmented Cognition

Student Research Grant Opportunity and Request for Reviewers

Baron Summers, Student Ambassador, AC-TG

The HFES Augmented Cognition Technical Group (AC-TG) is soliciting proposals for the student Grant Program. This program supports student research in the application of human factors in Augmented Cognition. Student affiliate HFES members from various universities across the country and around the world are invited to participate.

The program is open to all HFES student members and Augmented Cognition International Student Affiliates. We offer financial support for research expenses including, but not limited to, purchase of research materials, paying participants, partial payment
for equipment, etc. This year, the ACTG will offer one award of $500. Each submitted proposal will be evaluated on the following criteria:

- Clarity in presentation of ideas
- Clarity of research methods and methodology appropriateness
- Relevance of project to current psychological theory
- Project's potential to advance research in a specified area (theoretical and practical)
- Budget match for scope and requirements of the research

Submission Process
To have the grant proposal considered for the ACTG-SGP, the following information needs to be submitted:

Cover Letter
Include the following information:

- Name and Current mailing address
- Telephone number and e-mail address
- Area of research
- University Affiliation
- Full name(s) of other(s) involved in the project

Letter from Faculty Sponsor
This letter should describe

- The amount of faculty involvement in the project
- An assessment of the student's capabilities in completing the project
- The degree of independence exhibited by the student in developing the research idea

Request for Reviewers

If you are interested in being a reviewer for this award, please contact Baron Summers at baroncs@gmail.com by September 9, 2013.

Proposal Narrative
Complete a typewritten (single-spaced, no more than 4 pages) project description summarizing the purpose and methodology of the proposed project. This summary should include the research project's title (without author's name) at the top of each page and must include text on the following:

- A synopsis of previous related research
- A short description of the theoretical implications of the research
- A short description of the practical implications of the research
- Specific objectives of the current project
- Clearly stated hypothesis or set of hypotheses (if relevant)
- Proposed methodology
- Budget (budget justification explaining costs and why the proposed expenditures are necessary)

Send the above materials to Baron Summers at baroncs@gmail.com by September 9, 2013. The winner of the award will be announced at the 2013 HFES meeting. Any questions regarding the program or awards can be directed to Baron Summers at baroncs@gmail.com.

Increasing Student Participation: Ideas to discuss at 2013 Business Meeting

Baron Summers, Student Ambassador, AC-TG

The ACTG Officers have discussed a multitude of ways to increase student engagement and participation in both HFES and ACTG events and publications. Submissions decreased from 2012 to 2013, but it appears to have also been down across the society in general. If you plan to attend the ACTG business meeting on Wednesday October 2, 2013, 3:30-5:30 pm, we ask that you please prepare and contribute your ideas about increasing participation so we can discuss and develop actions to implement in the 2013-2014.

Potential aspects could include:

- Webinar or lecture series about future AC trends. This would mean we would need volunteers to develop and conduct each one of these.
- Strategies for further engaging student chapters, professors/advisors, and student members of the TG.
- Suggestions for enabling students to conduct AugCog research given challenges of getting access to equipment and expertise to conduct this research.
- Create an ACTG best professional (non-student) paper recognition award. This one excludes students but it increases awareness and participation.
- Interacting with other student initiatives. For example, Haydee Cuevas holds HFES Mentor-Mentee Luncheons for students at the annual meetings. Perhaps one or more of our senior members could volunteer as a mentor at the luncheon which would help promote AugCog and the TG.

Any other ideas? Please think about what we can do and propose your ideas at our business meeting this October.

Mentoring Participation

Each year at the HFES Annual Meeting, Mentor-Mentee luncheons are held for students and early career professionals to interact with our more experienced members. If any senior ACTG members are interested in participating as mentors at this year's meeting, this would be extremely helpful. The time commitment is only during the lunch break where each mentor would have lunch with approximately five mentees and discuss opportunities in the field, share experiences, and their answer questions. A complementary boxed lunch is provided to all attendees and there is no other time commitment involved. Currently, a few more mentors are needed and this is an opportunity to expose students to opportunities in AugCog. If you are one of our senior members, will be attending the annual meeting this year in San Diego, and would be willing to participate in one of the luncheons, then please contact Haydee Cuevas at hmcuevas@earthlink.net.

Life Beyond the Award: Updates on 2012 Student Award Winners

Rebecca Leis, 2012 ACTG Student Grant Award Winner & Assistant Newsletter Editor;
Michael Boyce, 2012 ACTG Best Student Paper Award Winner

2012 ACTG Student Grant Award Winner: Rebecca Leis, M.S.

The committee presented the annual Student Grant Award at last year's ACTG Business meeting to Ms. Rebecca Leis. Her project focused on assessing metrics of workload used in testing Nuclear Power Plant (NPP) operations. During the past year, Ms. Leis has expanded her project scope to investigate the workload (WL) experience by both novice and experienced populations during NPP tasks. She is measuring WL using both subjective and physiological metrics in order to determine not only the perceived workload experienced by both sample populations but also to determine the physiological changes that occur during varying NPP tasks. Ms. Leis plans to expand upon this research to publish a dissertation. She is currently working towards her Ph.D. in Modeling and Simulation at the University of Central Florida. Ms. Leis also has volunteered her time to the ACTG as the Assistant Newsletter Editor.

This award has given me the chance to flourish in my work and continue research with equipment and materials that many students do not have the opportunity to work with. I consider myself very lucky to work with Dr. Lauren Reinerman-Jones at the Applied Cognition and Training in Immersive Virtual Environments (ACTIVE) Lab at the Institute for Simulation and Training.

- Rebecca Leis, M.S.

2012 ACTG Best Student Paper Award Winner: Michael Boyce

Since receiving the best student paper from the ACTG last year, Michael has received more opportunities to investigate the interaction of mind and machine. Thanks to Dr. Peter Hancock, Michael has successfully obtained a position at the Institute of Simulation and Training working on Human-Robot Interaction. Michael's area of research is in automation transparency in which Michael and his coworkers look at the mental model of the user and work to design interfaces that convey the necessary information in a timely manner. Michael is currently starting his final year of his PhD and he will be defending in January.

As far as future opportunities for me, most promising looks to be a postdoc through the Army Research Laboratory under Dr. Jessie Chen. Again, it will be focused on Human-Robot Interaction, and all of this started because of the paper I submitted to HFES last year. I encourage every student/professional in the technical group to look for ways not to just write to submit a paper, but write to start a career. Thank you again for the honor of being an award recipient last year.

-Michael Boyce

Tips and Lessons Learned from a Foray into Functional Near-Infrared (*f*NIR) Spectroscopy

J. Christopher Brill and Veronica E. Scerra

Our laboratory at Old Dominion University, the Applied Sensory Psychology Laboratory, recently acquired new equipment for obtaining a variety of psychophysiological, electrocortical, and hemodynamic measures. With great anticipation, we designed several studies making use of our new equipment, one of which was a multimodal vigilance study using Functional Near-Infrared (fNIR) Spectroscopy (sometimes referred to as NIRS). Being relatively new to NIRS, we sought the advice of fellow researchers who have used similar systems. Consulting experienced users was invaluable for avoiding potential pitfalls and frustrations. We appreciate the guidance we received and learned new lessons through pilot testing, experimentation, trial and error, and simply playing with the system. We would like to pass on seven "tips and lessons learned" for researchers who are also relatively new to NIRS. Most of these tips should generalize to nearly any fNIR system, though the final tip may be idiosyncratic to our system (fNIR 100 by BIOPAC).

1. **When fitting the sensor headband, ask participants to hold their hair back themselves.** A major advantage of *f*NIR over other cerebrohemodynamic measures is the speed and ease with which the sensors can be fitted. However, we found that some procedures for applying the sensor headband work better than others. We recommend asking the participant to hold his/her hair back (if sufficient in length), placing the headband against the forehead, and then asking the participant hold it in place while the experimenter ties it on. This will help ensure that participants' hair doesn't get in the way of the fitting and minimizes the potential for accidentally pulling hair.

2. **Use a broad black elastic headband placed over the *f*NIR sensor headband to block ambient light seepage.** NIRS works by projecting near-infrared light into the prefrontal cortical vasculature and detecting signature reflections from oxygenated and deoxygenated hemoglobin (Rolfe, 2000). Ambient light can interfere with sensory accuracy and produce artifacts. Although our *f*NIR system came with "self-adhesive" sports bandaging to help hold the sensor headband in place, the black elastic headband was less fussy, more secure, and more effective.

3. **Allow time for a custom fit.** Every head is different, so be prepared to spend a few minutes adjusting and checking the oxygenation readouts at the beginning of any recording session to make sure the headband is accurately recording data.

4. ***f*NIR is fairly resistant to motion artifacts, but there are limits.** We bought the *f*NIR system, in part, to serve a gross measure of prefrontal cortical activity in a motion environment. Some of our investigations involve vestibular stimulation via whole-body acceleration, which includes oscillation (i.e., fore-aft rocking). We have tested the system while volunteers were "rocked" at frequencies ranging from 0.05 to 0.40 Hz with displacements of 4-10 in. at a peak acceleration of 0.2 m/s^2. We have yet to see any influence of motion (at least within these parameters) on *f*NIR readings. However, don't dare touch the sensor headband! Vigorous rocking may not affect the readings, but brushing or bumping against the sensor headband will cause a major disruption in the readings. As a result, it's important to make sure the headband is comfortable and securely affixed to the forehead so that participants don't try to adjust it or fix their hair once the experiment begins.

5. **Wait a few minutes following any physical contact with the participant to record *f*NIR readings.** Oxygenation reacted fairly immediately to participants being touched (on the hand) by the experimenter - so be sure to equip all other apparati and give the participant plenty of time after physical interaction before taking baseline *f*NIR measures. Oxygenation levels were not affected by verbal interaction or experimenter proximity, only physical touch.

6. **Select which voxels seem most realistic for your sample.** Hair blocks infrared light and interferes with sensor readings. Small foreheads and low hairlines can be problematic for obtaining good readings from all of the voxels (the individual sensors in the headband). We eliminated the outermost voxels (top and bottom) and used readings from the two innermost rows of voxels, which provided quality readings for all participants.

7. **Take screen shots of the data before closing the experiment**. The COBI software that came with our *f*NIR system does not appear to record a visual record of the data. Having the screenshots allowed us to quickly clear up any questions regarding artifacts and abnormal data, particularly if readings were inflated from a transient brush against the sensory headband. To illustrate, in one case, a participant touched one side of the headband during the experiment, probably to scratch an itch. When the data were aggregated, it looked as though a huge hemispheric effect was present. However, after double-checking the screen shot of the output, we realized the readings for two voxels on the right side were completely off the charts for a matter of 5 seconds (and resumed normalcy thereafter). Without reviewing the screenshots, we might have reported interesting, but entirely faulty findings, based upon data artifacts that weren't readily apparent in the software's data output.

Certainly this is not an exhaustive list of tips, but we nonetheless hope you find them useful, especially for users who are new to NIRS. We have found our *f*NIR system to be a useful and flexible tool with a relatively small learning curve.

If you would like to share your own tips, feel free to contact us at jcbrill@odu.edu.

Dr. J. Christopher Brill is an assistant professor of psychology at Old Dominion University in Norfolk, VA. He is a faculty member for the PhD program in Human Factors and advisor to the ODU student chapter of HFES.

Veronica Scerra is a graduate student in ODU's MS program for Experimental Psychology. She is completing her master's thesis (under Dr. Brill's advisement) and has just begun a neuroscience PhD program at Wake Forest University in Winston-Salem, NC.

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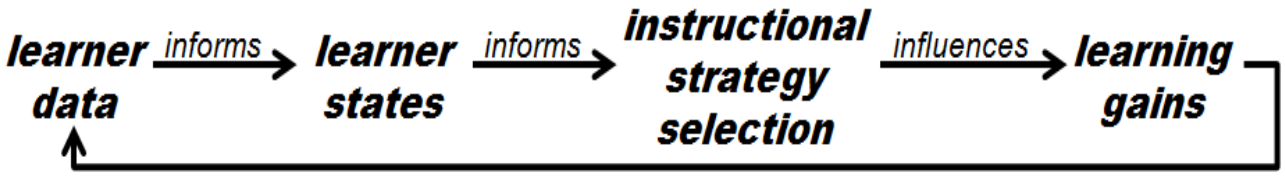
Acknowledgements

We would like to thank Ryan McKendrick, a doctoral student from the ARCH Laboratory at George Mason University, for his assistance. He was especially helpful to our research team, and I'm sure that, in some form or fashion, some of these tips came from conversations and correspondence with him.

The Generalized Intelligent Framework for Tutoring (GIFT)

Robert A. Sottilare, Keith W. Brawner, Benjamin S. Goldberg, Heather K. Holden, & Anne M. Sinatra; U.S. Army Research Laboratory and Learning in Intelligent Tutoring Environments (LITE) Laboratory

The Generalized Intelligent Framework for Tutoring (GIFT) is an open-source modular framework for creating Computer-Based Tutoring Systems (CBTS). CBTS have been shown to be as effective as expert human tutors (VanLehn, 2011); however, the availability and use of CBTS have been constrained by their high development costs, their limited reuse, a lack of standards, and their inadequate adaptability to the needs of learners (Picard, 2006). To this effect, GIFT is designed with three primary functions. First, it is an authoring capability to develop new CBTS components, and whole tutoring systems. Second, GIFT is an instructional manager that integrates selected tutoring principles and strategies for use in CBTS. Finally, GIFT is an experimental testbed to analyze the effectiveness and impact of CBTS components, tools, and methods. GIFT is based on a learner-centric approach and a primary driver for tutoring research conducted by the Learning in Intelligent Tutoring Environments (LITE) Lab at Army Research Laboratory (ARL) is to improve linkages in the adaptive tutoring learning effect chain.



From an application perspective, GIFT provides tools and methods to augment training experiences based on individual differences linked to a specific learner. The framework provides the ability to adapt training content prior to interaction. This tailoring is based on stored data linked to an individual's knowledge, skills, and abilities within a domain of interest, and contains information on traits and preferences that can be used to augment the type of content a learner will be presented. GIFT also affords the ability to monitor interaction within a training environment in real-time to diagnose learner states that can inform adaptations and interventions to be executed by the system. These include states linked to performance (i.e., comparing a learner's actions against a prescribed expert model) and states linked to affective and cognitive responses experienced during the interaction (i.e., determining if a learner is becoming bored, frustrated, or mentally over worked).

Affective and cognitive reactions are captured through physiological and behavioral sensing technologies found to correlate with states of interest. To enhance the adaptability of the CBTS, methods are needed to accurately classify learner states (e.g., cognitive, affective, psychomotor, social) and to select optimal instructional strategies given the learner's existing states. A more comprehensive learner model will allow the CBTS to adapt more appropriately to address the learner's needs by changing the instructional strategy (e.g., content, flow or feedback). An instructional strategy that is better aligned to the learners' needs is more likely to positively influence their learning gains.

GIFT 3.0 was released in May 2013. GIFT 4.0 is currently under development and will be available in November 2013. The build schedule for GIFT has one release every six months over the next five years, and each release builds upon previous versions of the framework. For more information on GIFT, please visit GIFTtutoring.org.

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October is National Ergonomics Month (NEM): A Time for Teaching, Learning, Networking, Service, and Fun!

NEM is an opportunity to increase awareness of the Human Factors and Ergonomics fields and to further the development of HFES members. The concept is simple: the more the world knows of Human Factors and Ergonomics, the more opportunities there will be for our services. So, become involved with NEM, and spread the word. Attend the NEM Expo at this year's meeting on Monday.

If you want to bring software or hardware to demo, or have a poster that you think would help raise awareness, please send a note to Joe Keebler (joekeebler@gmail.com or joseph.keebler@wichita.edu) and let him know what you are doing so he can reserve space. Further, Dr. Keebler can assist you in obtaining "Games to Explain Human Factors: Come, Participate, Learn and Have Fun" and will have some giveaways to send to you for use with your NEM program! For more information check out the NEM website http://www.hfes.org/web/natergomonth/natergomonth.html

Modeling the Complex Dynamics of Teamwork – An HCI Augmented Cognition Session Review

Ron Stevens Ph.D. – Moderator

During the Foundations of Augmented Cognition sub-series of the 2013 Human-Computer Interaction (HCI) meeting, several of the 'black boxes' in the teaming literature began to be opened, and the shapes and sizes of new black boxes began to be defined.

One important question about team functioning that was addressed by multiple studies was, Why / how some teams get 'in the groove' whereas others seem 'out of synch' (i.e.in terms of team dynamics and rhythms)? Multiple presentations in the 'Modeling the Complex Dynamics of Teamwork' session revealed that the idea of team rhythm, which pretty much everyone can see when it's there (or not), is becoming less mysterious.

- Silke Dodel's (dodel@ccs.fau.edu) presentation, 'The Geometry of Behavioral and Brain Dynamics in Team Coordination', showed the importance of a team 'getting off on the right foot' in the first few seconds of the task. They used dual electroencephalography (EEG) to measure brain dynamics of dyadic teams performing a virtual room clearing task and developed a novel geometrical framework to tackle variability. They found that successful team coordination at the beginning of a trial, reflected in the readiness of a team to engage in the task, was associated with increased sustained team cognition in later stages of the trial.
- Next, Maja Stikic's (maja@b-alert.com) studies with business teams raised the possibility of being able to determine when leaders emerge in a team setting. The goal of the study presented in the paper "Neurophysiological Estimation of Team Psychological Metrics" was to explore the feasibility of continuous EEG based assessment of different psychological aspects of a team process, such as engagement and leadership. Teams consisted of MBA students who discussed and attempted to solve a case problem dealing with child labor and corporate social responsibility. The experimental results suggested that EEG could be effectively utilized to determine when leaders emerge in a team setting. This study also raised the possibility that EEG could be used in the future to build optimal teams to accomplish such tasks successfully and effectively.
- Dr. Stevens and colleagues (ron@teamneurodynamics.com) then showed the generality of using neurophysiologic approaches for studying team dynamics ('How Tasks Help Shape the Neurodynamic Rhythms and Organizations of Teams'). One finding that was seen in team / task situations, including submarine piloting & navigation, anti-submarine warfare, high school problem solving, and business case discussions, was that teams often required 2-5 minutes to acquire what could be defined as a 'normal operating neurodynamics rhythm' related to the task being performed.

Combined, these studies could have significance for the corporate training industry, which as John Kolm reminded us, spends ~$131B annually for in-house and external training. In this context, John Kolm of TeamResults USA (john.kolm@teamresultsusa.com) presented research that drew on his years of experience in corporate training to develop a five-state taxonomy for neurodynamic symbols derived from experiments jointly conducted by UCLA and Team Results USA, which were then supported by other data. A Markov model with five neurodynamic states (Collegiate, Dormant, Dominant, Dyadic and Outlier) was shown to be necessary and sufficient to describe the engagement of a work team and contained significant state-transition properties that seem to apply to all work teams studied to date.

A second emerging theme was the coupling of human systems and behavior. Specifically, in the 'Research Projections for 2050' session early in the week at HCI, there were discussions on the importance of developing robust models of information flow that incorporate the natural oscillatory dynamics seen in dynamic team environments.

- In support of this, Adam Strang's (adam.strang@ctr.wpafb.af.mil) presentation explored the physio-behavioral coupling of teammates (e.g., synchronized heart rhythms and movements), a phenomenon which has been detected reliably in cooperating teammates and can be used to predict team processes (e.g., cohesion) and performance. His research highlighted the differing utility of linear and nonlinear coupling measures that can be used to index this phenomenon and which could be incorporated into complex models of information flow.

- Jamie Gorman (jamie.gorman@ttu.edu) then presented research that included instantiating some of these coupling measures in a study linking oscillatory team neurodynamic (EEG) patterns with semantic elements of team communication during submarine navigation training. As expected based on prior research, communication metrics differentiated between less vs. more experienced teams and type of training segment. However, these current results additionally suggest that neurodynamic and cognitive/behavioral aspects of team coordination may become differently coupled depending on amount and/or type of training.

Together, these presentations help to address the 'Big Data' challenge of developing sophisticated models and metrics of teamwork, where the whole of the event, comprised of conversation elements, cognitive performance, physiological, and behavioral responses, may be mined for salient properties and then integrated to obtain a holistic and dynamical understanding of team coordination and performance.

Lastly, it is great to see that researchers such as LT Tara Smallidge (tara.smallidge@med.navy.mil), Eric Jones (ejones@aptima.com), and others are willing to tackle real-world, difficult, and important tasks, which have practical implications. As submarine tactical teams are faced with increasingly complex missions, they must remain resilient: they must have the capacity to recognize developing danger and opportunity under ambiguous and uncertain conditions. That capacity to recognize danger and opportunity must be present and cultivated at all levels of the team, from the basic watch stander to the Commanding Officer. Tools and emerging technologies are being developed to assess and enhance resilience, and their integration within team environments is not that far off and will be very exciting particularly when combined with the above two themes from this session.

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AugCog around the Navy

U.S. Naval School of Aviation Safety Human Factors Laboratory

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Located at Naval Aviation Schools Command, the laboratory occupies approximately 400 square feet of office space. Because of its location in Pensacola, the laboratory has access to novice, fleet-seasoned and executive-level Naval Aviation personnel. Access to this unique representative sample promotes the validity of inferential results.

Effort in the laboratory is primarily aimed at conducting applied human factors research as a means to mitigate the incidence of aviation mishaps. Support of Naval Aviation safety is the laboratory's ultimate goal. Despite the focus of conducting applied research, basic research can be conducted to support aviation safety on an "as needed" basis. Research approaches include, but are not limited to, psychophysiology, human performance measurement and survey administration.

Psychophysiology experiments include the utilization of electroencephalograph (EEG) and remote eye tracking technology. Human performance measurement is conducted using Windows-based computing systems that include both commercially available and Navy-procured software packages. Flight simulator software can also be used in the laboratory to collect human performance data. Survey research and mixed methods are always an option at the laboratory as well.

The School of Aviation Safety's Laboratory data collection and processing capabilities include:

- 128 Channel EEG GES 300 (with Mac Pro Xeon 64-Bit Workstation)
- ISCAN ETL-300 Remote Eye-tracking System
- Dell Precision T-7500 CPU
- Dell Optiplex 780
- E-Prime stimulus software
- Validated computer-based human performance measures
- Basic computer-based flight simulation systems

A multi-disciplinary approach to solving aviation human factors problems is not only pragmatic, but it actually solves problems. Therefore, the collaborative philosophy of the laboratory is reflected in current efforts being conducted with organizations such as the Naval Safety Center, Naval Aerospace Medical Institute, the Institute for Human and Machine Cognition, and Embry-Riddle University.

Naval Air Warfare Center Expands Augmented Cognition Capabilities

LT David Rozovski
Naval Air Warfare Center – Training Systems Division, Orlando, FL

As a Center of Excellence the Naval Air Warfare Center-Training Systems Division (NAWCTSD) in Orlando, FL has tirelessly worked towards improve its ability to provide objective measurement for research, design, test and evaluation (RDT&E) and the acquisition of training system solutions for the Naval Aviation Enterprise, the Naval Services, and its Department of Defense partners.

Recently, NAWC-TSD made a significant addition to its capabilities through the acquisition of several technologies to create a neurophysiological measurement and assessment laboratory. With this investment, researchers at NAWCTSD now have an impressive list of technologies at its disposal including two Electrical Geodesics flagship 128 channel electroencephalogram (EEG) systems, two Seeing Machines Face Labs eye tracking systems, two Thought Technologies physiological measurement suites, three Advanced Brain Monitoring BeAlert X-24 EEG systems, and an X-10 EEG.

The combination of these systems, NAWCTSD's personnel, and the Navy's continuing mission are leading the way in the creation of new measures to identify, validate, and verify new training systems as well as working with external partners in leveraging both new and existing technologies. With the new state-of-the-art lab, NAWCTSD's in-house capability to improve training, learning, and performance will take an evolutionary step in assessing the human-system relationship and substantially increase its participation in the fields of Augmented Cognition and Neuroergonomics. Further, not to be limited to those fields listed above, NAWCTSD's researchers will work to expand RDT&E in areas including teamwork assessment, personnel selection, interface design through basic and applied physiological signal monitoring and interpretation. Most importantly, while new, the neurophysiological assessment lab has been designed to be flexible and grow to meet existing, emerging and future needs as they arise as both the technology and the needs of the Navy mature.

NPS Labs Leverage Human Factors Experience with UAV Advances

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On August 7th, a new sight was spotted at Camp Roberts, a California National Guard post at which the Naval Postgraduate School (NPS) hosts quarterly field experimentation events in innovative science and technology areas. A ground command station operator, responsible for managing the launch, mission, and landing phases for unmanned aerial systems (UASs), was sporting an EEG headset. While she coordinated and oversaw three UASs flying simultaneously, her brain activity was recorded in real time. This data collection effort was the work of two NPS labs pooling their areas of expertise to explore the potential of flexible systems to reduce supervisory task load during the operation of multiple unmanned systems.

Two Labs Join Forces. The Training Expert Navigation (TEN) Lab uses psychophysiological measures to understand underlying cognitive strategies and visual scan processes employed by expert pilots during challenging flight operations. By understanding which strategies work and which don't, the TEN Lab aims to improve pilot training effectiveness. Their previous work has demonstrated that expertise differences in scan pattern occur and that analysis of visual scan patterns can detect underlying cognitive strategies during overland navigation. (Sullivan et al, 2011, Yang et al, 2013, Yang et al, in press).

The Advanced Robotic System Engineering Laboratory (ARSENL) focuses on integration across diverse disciplinary interfaces in support of robotics education and research, including active efforts to advance swarm UAS capabilities. ARSENL has recently demonstrated live-fly field experiments with up to ten UASs under simultaneous and autonomous flight and is actively working towards expanding this capability to upwards of *fifty* aerial robots. ARSENL is also engaged in research in the design of swarm algorithms, integration of swarm UAS launch and recovery systems, innovative low-cost and/or open-source designs, and novel methods for communication and coordination in operationally realistic scenarios.

Recognizing that supervisory control through automation does not make an operator's job easier and that it effectively changes the nature of the task (Parasuraman and Manzey, 2010), the TEN Lab and ARSENL have joined forces to investigate human systems integration challenges for swarm UAS operations, cognitive workload analysis, and augmented swarm autonomy with the goal of reducing human operator workload while maximizing the number of UASs airborne at a given time. One avenue that is being investigated is the incorporation of physiological measures (e.g., electroencephalography, respiration, eyetracking) to provide operator state information and indications for when and/or what to automate in order to reduce operator workload.

While these areas are interesting in their own right, the exploration of these areas could have far reaching results. Notably, the Defense Science Board (2012) stated that "increased autonomy can enable humans to delegate those tasks that are more effectively done by computer, including synchronizing activities between multiple unmanned systems, software agents and warfighters". This simple declaration reinforces that the reliance on automation and unmanned systems will continue to expand. Understanding that operators will need tools, methods of communication, and interfaces to support mission success and armed with their capabilities, passion and unique position at the NPS, the TEN-ARSENL team is poised to make significant contributions in human-robotic interaction and teaming, swarm control, and counter swarming capabilities.

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