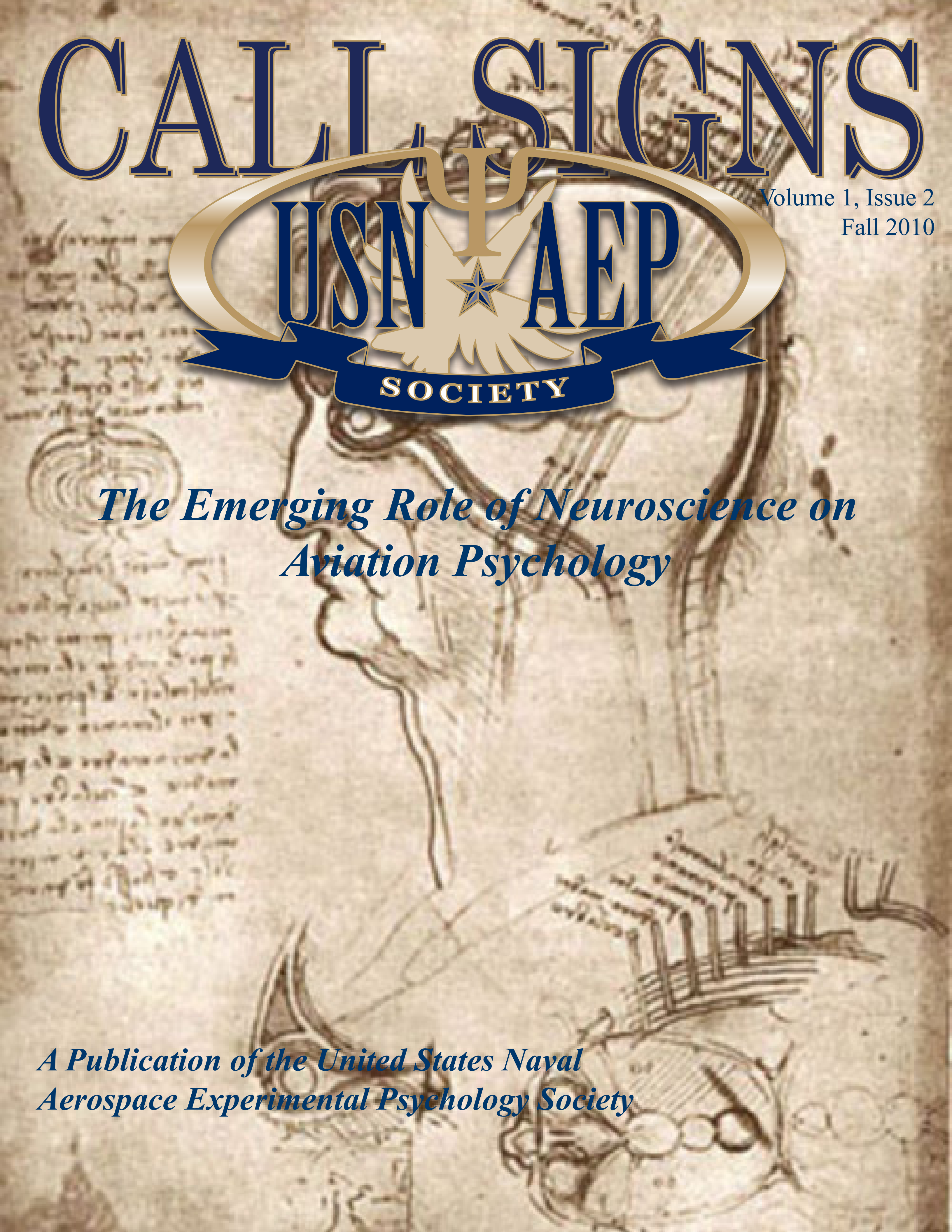

CALL SIGNS

Volume 1, Issue 2
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USN AEP SOCIETY

The Emerging Role of Neuroscience on Aviation Psychology

A Publication of the United States Naval Aerospace Experimental Psychology Society

Contents

About the USN★AEP Society

As military transformation continues to affect today's and tomorrow's Department of Defense and the Navy Medical Service Corps, the need to promote the role of Aerospace Experimental Psychologists as leaders and innovators in aerospace psychology continues.

Naval Aerospace Experimental Psychologists offer a unique combination of education, knowledge, skills, and experiences that will enable them to excel in the emerging joint and coalition environment.

The U.S. Naval Aerospace Experimental Psychology Society (USNAEPS) is an organization intent on:

• Advancing the operational effectiveness and safety of Naval aviation fleet operators, maintainers, and programs through increases in knowledge base, utilization of tools and practices of aviation psychology.
• Fostering professional development of its members and enhancing the practice of Aerospace Experimental Psychology within the Navy.
• Strengthening professional relationships within the community.

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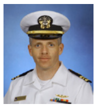

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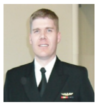

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WELCOME

LCDR Joseph Cohn

Greetings and welcome to the United States Naval Aerospace Experimental Psychology Society's second issue of Call Signs. As recent headlines indicate, the technologies underlying our next generation aircraft – both military and commercial - continue to evolve at an astonishing rate. One need only consider the recent unveiling of both Airbus and Boeing's newest passenger aircraft, as well as the roles that UAVs continue to play in combat operations, to understand how far aircraft technology has evolved in just the first decade of the 21st Century. While these advances represent major technological leaps, they also present novel challenges to the human aviators who must interact with these technologies. To keep pace with these innovations, Aerospace Experimental Psychologists (AEPs) continue to exploit the latest advances in understanding human behavior, drawing heavily on academic and military research in the neurosciences. Recent advances in behavioral neuroscience, cognitive neuroscience and neural-imaging provide AEPs with the tools and capabilities to gain a deeper understanding of the performance possibilities and limitations of aviators and the aircraft they fly. Armed with this knowledge, AEPs are able to provide technical and programmatic guidance to ensure that our Naval aviators remain the best in the world and that our Naval aircraft are equipped with the most advanced and effective technologies available.

In addition to providing an update on the AEP community, this issue of Call Signs will highlight several AEP-led breakthroughs in neuroscience, and provide insight into how these efforts may be leveraged to enable more effective human-system interactions in the rapidly changing world of aviation. Specific attention will be given to helping neuroscientists understand how they could support, or be a part of, Aerospace Experimental Psychology and to helping AEPs better understand how to use and benefit from advances in neuroscience.

State of the AEP Community

CAPT Dylan Schmorrow

It is my pleasure to write that FY10 has been a pivotal year for the Aerospace Experimental Psychology (AEP) community. During this fiscal year, our community met its recruitment goals, trained an outstanding group of new accessions, and has produced an impressive volume of original research. We also saw the results of our officers' dedication and expertise pay off with 100% selection rates among AEPs up for Commander and Lieutenant Commander.

I am also happy to report that we are fully manned and have no gapped AEP billets as of this writing. Through the innovation and dedicated recruiting efforts of our ASL LCDR Hank Phillips and key members of our community who have assisted with recruiting and interviewing, we have brought in a particularly strong group of accessions over the past 18 months. Although we are experiencing this good fortune now, we are continuing to recruit at professional conferences (e.g. SIOP and HFES) to keep the buzz alive about our program and hopefully influence Ph.D. students to target our community for possible future employment. We have had the good fortune to land the #1 of 19 candidates in the recent past, and by keeping up our efforts hopefully we can continue to draw upon a well-qualified pool.

I would also like to congratulate the AEPs who were promoted in FY10, including CAPT Russell Shilling, CDR Sidney Fooshee, LCDR Justin Campbell, LCDR Chris Foster, LCDR Philip Fatolitis, and LCDR Jeff Grubb. I also would like to recognize the AEPs selected for promotion in this coming fiscal year, including CDR(S) Joseph Cohn, CDR(S) Michael Lowe, LCDR(S) Tatana Olson, LCDR(S) Peter Walker, and LCDR(S) Will Wells.

FY10 saw several AEPs deploy in support of Operation Enduring Freedom, including CDR Barry Adams, LCDR Justin Campbell, and LT Marc Taylor. CDR Adams, in fact, has just returned and I am looking forward to hearing from him regarding his support to Mental Health Assessment Team 7.

During FY10, the AEP community amassed over 70 publications and presentations, a testimony to the expertise and bench-level participation in active research our community maintains. We also have several officers who are members of the Defense Acquisition Workforce, and many who possess DAWIA certifications.

I am proud to say that AEPs currently serve in several key leadership positions, including:

- Vice-Commander of the Naval Air Warfare Center – Aircraft Division
- Acting Director, Human Performance, Training and BioSystems Directorate, Office of the Director, Defense Research and Engineering
- Director, Human Systems (AIR 4.6), Research & Engineering Group, Naval Air Systems Command
- Program Director, Medical Readiness & Advanced Development, Office of the Assistant Secretary of Defense for Health Affairs

- Military Deputy Human and Bioengineered Systems Division, Office of Naval Research

AEPs remain uniquely positioned to serve as both the producers and proponents of critical research and practice in support of naval aviation and Navy Medicine. We often function as the bridge between the scientific practitioner and the U.S. naval leadership, by virtue of our dual roles in the conduct of research and the crafting of future research agendas to help ensure that the Navy's research focus retains strategic alignment with the needs of the Naval Aviation Enterprise and the larger National Security Strategy.

One key area AEPs focus on in meeting the current and future needs of the warfighter is operational neuroscience, the focus of this issue of Call Signs. AEPs collectively have done pioneering work in the establishment of the field of Augmented Cognition and training in virtual environments. The deeper understanding such programs have given us about the information-processing and attentional capabilities and limitations of operators and trainees are already shaping the next generation of user interface designs for warfighter systems, and changing the way we train operators in all warfare environments. I applaud the continued focus on this next frontier our community is maintaining, as demonstrated by several of the articles in this issue.

These programs, and their contributions to our nation's future capabilities, are the result of the efforts of generations of AEPs. We are where we are today because of the innovation, insight, and dedication of our predecessors, who asked the tough questions and kicked down the right doors. We stand on the shoulders of giants, which is fortunate for us, because we have higher still to reach.

This is my challenge to our community: AEPs today are doing important work in critical areas, but what are we doing to ensure we remain relevant and engaged tomorrow? Last year marked the first time the U.S. Air Force trained more unmanned aerial system operators than pilots (USA Today, June 16, 2009). How long will it be until the naval services follow suit? What research questions will be paramount for the Naval Aviation Enterprise when this transition truly gets underway? If our community is to remain at the forefront of aviation research ten years from now, we must engage on these issues today.

In closing, I would like to commend the Editorial Board of the US Naval Aerospace Experimental Psychology Society for the outstanding job they have done through the Society's inaugural year. The Society's first meeting at AsMA earlier this year was a great success. This has been a banner year for our community in every respect. I am honored and humbled to be able to serve as Specialty Leader for such a truly outstanding group of officers.

http://www.usatoday.com/news/military/2009-06-16-drones_N.htm

The Inaugural Meeting of the USN AEP Society

The United States Naval Aerospace Experimental Psychology Society (USNAEPS) held its inaugural meeting in Phoenix Arizona on 10 May 2010 in coordination with the Annual Scientific Meeting of the Aerospace Medical Association. As part of the festivities, the USN AEP Society agreed to host the Navy luncheon.

Commander Robert S. Kennedy, Ph.D. (Ret.), who was winged as AEP #10 in 1959 served as the Distinguished Speaker for this event. The Navy Luncheon focused on various community updates from Naval aeromedical officer communities including Naval Flight Surgery, Aerospace Physiology, Aerospace Optometry, and of course Aerospace Experimental Psychology. The highlight of the luncheon included the presentations of awards to those individuals that have provided signifcant contributions to the field of Aerospace Psychology.

LCDR Joseph Cohn speaks to guests at the Navy Luncheon sponsored by the USN AEP Society.

In recognition of their tireless support of the establishment of the USN AEP Society, CAPT(Ret.) Michael Lilienthal, CAPT(Ret.) Paul Chatelier, and CDR(Ret.) Kennedy were awarded the Founder's Award which recognizes their contributions by lending their namesakes to their respective awards and in recognition for their service as Aerospace Experimental Psychologists and their achievements in support of Naval Aviation throughout their careers.

The CAPT Michael G. Lilienthal Leadership Award was awarded to LCDR Henry L. Phillips in recognition of his leadership in advancing the field of Aerospace Experimental Psychology over the past year. LCDR Phillips has consistently demonstrated his ability to motivate and inspire others, apply foresight and resourcefulness in anticipating and overcoming significant challenges, and maintained strength of character in the face of adversity.

The CDR Robert S. Kennedy Award for Excellence in Aviation Research is awarded to an individual who has made significant and outstanding contributions to the field of aerospace psychology through original research over the past year. For the inaugural event, this award was presented to Dr. Eric Muth for his work on defining the effects of stress on performance in high workload environments. Dr. Muth has consistently demonstrated his ability to apply scientific rigor in the pursuit of solving research challenges of critical importance to the Naval Aviation community.

Finally, CAPT (Ret.) William Maroney was awarded the CAPT Paul R. Chatelier Award for Lifetime Achievement. The Lifetime Achievement award honors individuals who have significantly and uniquely shaped the field of Aerospace Experimental Psychology through scientific, analyt-

Inaugural Meeting

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ic, managerial and leadership excellence over the course of their career. Award recipients have demonstrated a broadness of vision combined with force of character to achieve long-ranging goals that have often run counter to common wisdom. The results of their dedication, persistence and foresight have led to paradigm-shifting accomplishments that enable the Naval Aviation community to rapidly and effectively overcome current and emerging challenges and threats.

In addition to sponsoring the Navy Luncheon, the society hosted the inaugural meeting of the USN AEP Society. The meeting was attended by twenty members of the society including active duty and retired AEPs and members of academia.

During the inaugural meeting, LT Peter Walker was awarded the Beacon Award for his initiative, leadership, perseverance, and hard work in the establishment of the United States Naval Aerospace Experimental Psychology Society, dedicated to the advancement of operational effectiveness and safety in Naval Aviation, the professional development of its members, and enhancement of the practice of Aerospace Experimental Psychology within the Navy.

The week was a tremendous success for the society and we would like to thank all those in attendance. We hope to see everyone next year!

Welcome our Newest Student AEP Accession

The AEP Specialty Leader is pleased to announce our final accession for FY10: LT Stephen Eggan.

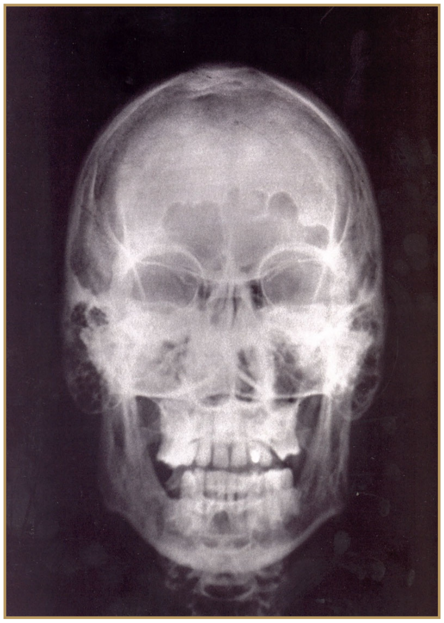
LT Eggan was commissioned on August 27, 2010, in a ceremony in Pittsburgh, Pensylvania. He completed his doctorate in Neuroscience at the University of Pittsburgh in 2007, and has been employed as a Senior Research Principal at the Western Psychiatric Institute and Clinic at the University of Pittsburgh Medical Center since 2007. He reported to Officer Development School in Newport, Rhode Island on 12 September, and will join Aeromedical Officer Class 2011-03 on 2 November in Pensacola, Florida. LT Eggan is an accomplished researcher, with an impressive record of publications. We congratulate him on his commissioning, and look forward to his future accomplishments.

Toward a Neuroadaptive Representation of Aviator Performance

LCDR Joseph Cohn

Today's aviation environment demands increasingly complex interactions between the human aviator and the aircraft, creating a control paradigm in which aviator and aircraft roles and responsibilities must dynamically change according to task and context. Current methodologies for integrating the aviator into the (aircraft) system have not kept pace with this paradigm shift. An important consequence of this mismatch between aviator and aircraft is that failures often lead to catastrophic and unrecoverable accidents. In order to reintegrate the aviator into the (aircraft) system, new approaches for representing the aviator, in terms of his or her individual cognitive and behavioral capacities, limitations and changing needs are required.

As early as the 1940s, Craik and other researchers attempted to understand how to represent the human element in human systems in order to develop effective control schemes for allocating tasks between the two, with much of these early efforts focusing specifically on the aviator-aircraft system. Based in part on this early work, Licklider and others suggested a "vision" using a control paradigm which automated task allocation through predefined heuristics to parse tasks into those at which a machine excelled and those at which a human excelled. Yet over the course of even a basic task or mission, situations change, information changes and people's capabilities change. Early automation methods were incapable of adapting to these changes, proving, as Rouse and Woods suggested, too brittle for the range of complex tasks humans and their systems were called upon to accomplish.



As modeling and simulation techniques became more pervasive, the focus of automation shifted toward creating more dynamic and adaptive techniques to allocate tasks in response to user performance, with application domains expanding to include manufacturing, shiphandling and power plant control room operations, as well as aviation. An important consideration with this approach, known as adaptive automation, is how the adaptation is triggered, which is tightly linked to how human performance is represented in these control paradigms. Adaptive automation relies on observation-based representations of human performance to guide task allocation. A major challenge with this approach is that such representations do not account well for an individual's mental and physiological states, their unique and evolving experiences and their distinct inclinations and preferences. As well, observed human performance typically evolves over a timescale measured in seconds or even minutes, while machine action – and external events - may occur over a millisecond timescale. Adaptive automation is therefore limited by how human performance is represented.

Recent attempts to get around the human representation challenge have focused on adding another dimension of measurement , based on neurophysiologically detectable processes.

The expectation was that these richer metrics would provide a more dynamic and flexible input into an adaptive automation system. In practice, while these measures did provide a more effective diagnostic metric indicating when automation might be useful, they didn't provide deeper descriptions of what tasks should be automated, how they should be automated, and when they must be automated. These determinations, in the current approach, are left to predefined strategies that are implemented based on the triggering of these measures.

The many advances made in the neurosciences throughout the course of these past efforts have given rise to a new area of research, known as Neuroadaptation. Neuroadaptation focuses on enabling adaptive interactions between humans and their machines using deeper and more representative measures of human neural action underlying behavior than those used in traditional adaptive automation technologies. With these representations, high-fidelity individualized models of human performance can be crafted, which can be expected to behave in a manner analogous to that in which the human brain on which they are based will behave. Although still in their infancy, neuroadaptive systems are beginning to be realized as a direct result of major advances in neuroscience and engineering. These advances include: new technologies for detecting high fidelity neural activity; new methodologies for decoding neural activity; and new techniques for modeling these data. As recent articles in high-impact journals like Science and Nature suggest, these advances provide the basis for developing a new kind of human performance representation based on the underlying neural activity driving cognition and behavior. These new representative models offer the promise of the increased flexibility and adaptability necessary to effectively incorporate the human element into the systems they use, leading to more effective overall performance in the aviation domain and beyond.

63rd Biannual Technical Advisory Group (TAG)

Readiness for the Future

The Department of Defense Human Factors Engineering Technical Advisory Group (TAG) met in Tempe, Arizona from 3 through 8 May, 2010. The focus for the biannual meeting was *Readiness for the Future*. Specifically, this particular TAG was intended to address the human performance issues in ensuring that our nation will be ready to respond to future planned and unplanned major events.

The 63rd Bi-annual TAG continued to witness overwhelming support from the AEP community. CAPT Dylan Schmorrow was nominated as the Vice Chair of the TAG and will continue his role as a leader and major proponent for the organization. In addition, LCDR Jeff Grubb was selected to serve as the Navy representative for TAG. Finally, LT Pete Walker will be taking over for Dr. Richard Arnold as the acting SubTAG chair for Personnel Selection and Classification.

AEPs were featured speakers at a number of SubTAGs. For example, during the Workload and Stress SubTAG, both LT Tony Anglero and LCDR Jeff Grubb presented ongoing research. LT Anglero's presentation focused on strategies for stress mitigation in high risk environments while LCDR Grubb presented data on the Navy's new Performance Based Measurement (PBM) test and how it may be used as a predictor for flight training success. The SUSOPS SubTAG was co-chaired by both CAPT Schmorrow and LCDR Grubb.

LT Gregory Gibson, as the chair for the Human Modeling and Simulation SubTAG, invited speakers from DoD, private industry, and academia. The session highlighted many of the recent advances in modeling and simulation. For example, Carryl Baldwin from Dr. Joseph Coyne's laboratory in the Office of Naval Research presented EEG data and suggested that this data might be used to identify neurological markers of teamwork.

As part of the plenary session for the Spring TAG, the acting Director, Defense Research & Engineering and AEP specialty leader, CAPT Dylan Schmorrow announced his intention to sponsor two themes for the FY 10 Office of Secretary Defense Small Business Innovation Research (SBIR) cycle. The Cognitive Readiness Technology (CRT) topic was approved with 10 SBIR proposals announced earlier this year. In addition, the Human Social and

CAPT Dylan Schmorrow presents LT Jeff Grubb with a Certificate of Appreciation at TAG 63

63rd Biannual TAG

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Cultural Technology (HSCT) topic recieving another 9 SBIR topics. The review process for this program is currently underway.

The 63rd Biannual HFE TAG was an overwhelming success. The theme *Readiness for the Future* served to highlight the recent innovations by Human Factors professionals and how these innovations can be applied to a number of high risk environments.

CAPT Dylan Schmorrow presents LT Tony Anglero with a Certificat of Appreciation for his presentation on strategies for stress mitigation.

CAPT Russell Shilling Wins AHA FHCE Award for Excellence

LCDR Henry Phillips

On 25 March 2010, Aerospace Experimental Psychologist (AEP) CAPT Russell Shilling was presented the Federal Health Care Executive (FHCE) Award for Excellence by the American Hospital Association (AHA) at the American College of Healthcare Executives annual meeting in Chicago. This award recognizes a senior federal health care executive who has distinguished him- or herself through singularly significant leadership or innovative achievements contributing to the mission of the federal health care system.

CAPT Shilling was presented this award for his work while assigned as Executive Director for Science and Technology at the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury, which he helped establish in 2007. While at the center, he created a successful program with Sesame Workshop to help the children of servicemembers cope with parental deployments and with having a parent injured in combat either physically or psychologically. After producing more than 800,000 bi-lingual DVD kits, the program was awarded a prestigious CINE Golden Eagle award in 2009 in the Children and Entertainment category. In April 2009, a companion website, www.sesamestreetfamilyconnections.org, was launched, containing all the DVD materials and allowing military families to create private accounts in a Sesame Street themed environment. In this environment, families can trade videos, photos, artwork and even perform interactive activities. The website has already been awarded a “Best in Class” award by the Interactive Media Association. Pro-

Shilling Award

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gram materials are also available on iTunes. The kit program was accompanied by the broadcast of a separate PBS Prime Time Special on 1 April 2009, When Families Grieve, hosted by Queen Latifah and John Mayer showcasing the kit material. This special was nominated for an Emmy Award in July 2010.

CAPT Shilling is also considered a leader in medical research program management and a leading expert on the use of advanced simulation, videogame technology, and entertainment assets to supplement medical education, training, and treatment. He also helped transition the Virtual Reality Therapy (VRET) program he created at the Office of Naval Research, which has been adopted in over 40 clinics, hospitals, and other treatment facilities across DoD, VA, and civilian sectors. VRET uses fully immersive computer recreations of Iraq and Afghanistan to give therapists tools to supplement traditional approaches to cognitive behavioral therapy.

Additionally, he initiated a major research program with the Institute for Creative Technologies (ICT) at the University of Southern California (USC) to develop the use of advanced intelligent computer avatars to use as educational outreach tools to warriors and families to help destigmatize psychological health treatment, lead those in need to live therapists, and link those seeking help with the best resources where they live.

We congratulate CAPT Shilling on this prestigious, well-deserved award. He is a role model for us all, and we look forward to more outstanding accomplishments from him in his new assignment at the Defense Advanced Research Projects Agency (DARPA). Bravo Zulu!

CAPT Russ Shilling on the set of Sesame Street sitting in Hooper's Store. As the Executive Director for Science and Technology at the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury, CAPT Shilling's work focused on helping children cope with a parent wounded in combat. The Sesame Workshop program was awarded the prestigious CINE Golden Eagle award in 2009 in the Children and Entertainment category.

AEPs, Neuroscience, and the "Machine that Goes Ping!"

LCDR Jeff Grubb

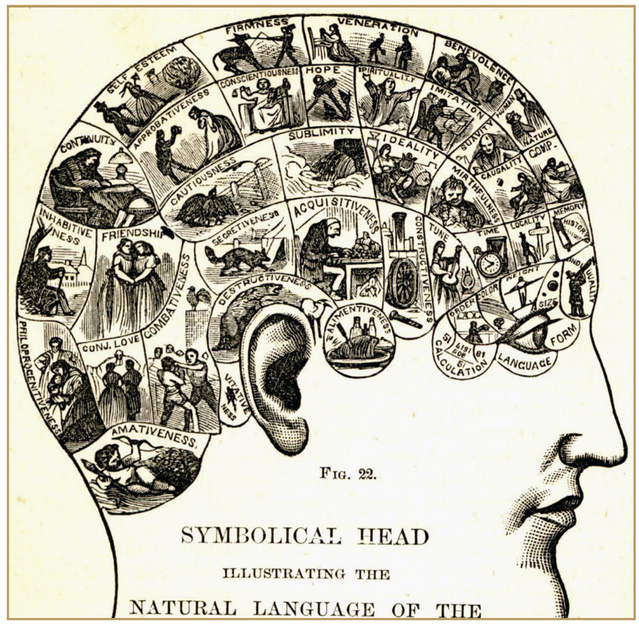
In the opening scene of Monty Python's *The Meaning of Life*, two physicians disapprovingly survey the delivery room in which they are about to preside over a birth. They quickly conclude that the room does not contain enough equipment and order their staff to bring in a wide assortment of monitors and devices. One device they specifically call for is the "Machine that Goes Ping!" It is a device that makes a sound that is reminiscent of Hollywood's take on active sonar. It also adds an aura of technology, impresses visiting administrators, and likely makes submariners nervous, but beyond that it is never clear what purpose the machine actually serves. I often worry that the same complaint can justly be levied against the discipline of cognitive neuroscience and its off-shoots.

The term "cognitive neuroscience" was coined by Michael Gazzaniga and George Miller as they shared a cab ride to a dinner for neuroscientists and experimental psychologists in the late 1970s. With the cognitive revolution of the mid-20th Century, covert mental phenomena had returned to the realm of scientific acceptability and experimental psychologists developed various information processing models to explain everything from attention allocation to reading comprehension. The scientists at the dinner were meeting to discuss strategies to link these behaviorally-inferred theories to observable brain states, and Gazzaniga and Miller supplied the catch phrase to describe the endeavor.

In principle, cognitive neuroscience has obvious potential benefits for both parent disciplines. The psychologists' experimental designs could provide a framework by which the neuroscientists could link their physiological recordings to higher mental functions. In turn, the neuroscientists' physiological recordings could provide hard data with which to constrain and test cognitive theories. Over the 30+ years since Gazzaniga and Miller paid their cab fare, the same logic has spawned a host of similar disciplines, including social neuroscience, affective neuroscience, neuro-economics, neuroergonomics, political neuroscience, operational neuroscience etc. As the technical experts on behavioral science for Naval Aviation, the question that AEPs must answer is whether or not adding neuroscience provides any benefits beyond what we were already doing.

Adding neuroscience undeniably provides "ping." Bar graphs describing the results of behavioral studies rarely draw the public's attention. In contrast, colorful fMRI slides regularly grace the covers of not only *Science* and *Nature*, but also *Time* and *Newsweek*. Hunt and Ellis's (2004) *Fundamentals of Cognitive Psychology* is found on library shelves at BF371.E525. That is, it resides in the philosophy section between books on sex therapy and books on parapsychology. Kolb and Wishaw's (2009) *Fundamentals of Human Neuropsychology* is located at QP360.K64, in the science section between books on vertebrate evolution and books on microbiology. A quick key word search for "cognitive psychology" in the NIH's online database of active funding opportunities on 14 June 2010 yielded 3 hits. Changing "psychology" to "neuroscience" yielded 9 hits.

For all of the increased visibility, respectability, and funding opportunity, it is sometime difficult to see how much the addition of "neuro" improves the science. For example, Michael I. Posner was an early convert from cognitive psychology to cognitive neuroscience. Through the 1970s, he used classic cognitive psychology experiments to develop a model of how spatial attention is deployed (Posner, 1980). By the mid-1980s, he and his colleagues (Posner, Walker, Friedrich, and Rafal, 1984) had expanded this model with tests on patients who had various cortical lesions. The patients' behavioral results led Posner et al. to refine the boxes in their flow chart of covert orienting and the location of the patients' lesions allowed them to speculate that the functional boxes of their model occupied specific regions of cortex. This was followed up with imaging studies in which neurologically intact participants performed the same behavioral tasks while undergoing positron emission tomography (PET; Corbetta et al., 1993). When intact participants performed the task, they showed increased activity in those regions of the brain that Posner et al. had previously identified as task-essential. The initial behavioral work, which was the foundation for Posner's model, was low risk and inexpensive. The patient work, which expanded the theory somewhat and linked its boxes to gyri and sulci, was more complicated. It required a larger and more diverse team of researchers and some significant prior misfortune on the part of the subject pool, but was otherwise low-risk and straight-forward. In contrast, the PET study was expensive. It required a radiology department and several expensive pieces of equipment. Moreover, for the equipment to work, the participants had to be injected with a radioactive tracer. For the increased risk and expense, the PET study essentially confirmed the neuroanatomical findings of the patient study, albeit in a very photogenic way. According to PubMed, the patient study, which was essentially an old-school cognitive psychology study conducted with a special subject population, has been cited 68 times by other articles in the database. The PET study, which was essentially an old-school cognitive psychology study conducted in the presence of a big, expensive machine that detects gamma rays, has been cited 3 times.



From an AEP perspective, the major advantage of the imaging study over the patient and the purely behavioral studies is that it indicates that it may be possible to observe an individual's spatial orienting behavior without that individual making an overt action. For example, if a given pattern of cortical activity is strongly associated with preparation to shift visual attention, a machine that could detect that activity could in principle tell whether or not a pilot was fixated on a particular region of the cockpit. The thinking goes that such a system could be used to do a variety of things such as preempting operator errors and providing objective assessments of the operator's cognitive workload and situation awareness. Thus, all one would need to reap these benefits is some physiological signal that is correlated to whatever cognitive or behavioral state is of interest. Happily, journals that are dedicated to behavioral science are currently awash in studies that purport to link specific physiological signals to everything from object identification to political affiliation.

However, these findings may contain more "ping" than substance. Vul, et al. (2009) examined the findings and methods of 55 recent fMRI studies in which authors purported to find specific neural correlates of a variety of cognitive and emotional states. The reported correlations between the fMRI data and behavioral measures often exceeded the reliability coefficients of those behavioral measures. Even if fMRI is 100% reliable, which it is not, the reliability of the behavioral measure should form an upper bound on such correlations. Vul, et al., found that most of the suspiciously high correlations occurred when authors used analysis techniques that involved first computing individual correlations between the behavioral measure and each voxel in the scan and then only reporting summary analyses that were conducted on those voxels whose individual correlations exceeded given thresholds. Naturally, the resulting summary correlations with the behavioral measure are inflated. As Vul, et al. noted, such data reduction techniques are common in neuroimaging studies, meaning that the problems that they identified in the 55 papers that they examined are likely to be common in the field in general.

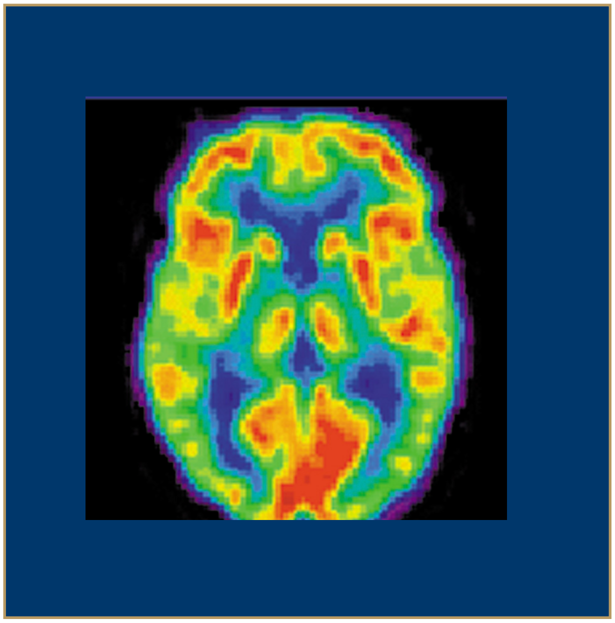
So, what does this all mean for AEPs? Should we scrap cognitive neuroscience? No. On a basic level, the brain is the organ of thought and behavior, so we should naturally ensure that our assumptions about how people process information are aligned with how the brain operates. Moreover, not all imaging studies use dodgy analysis techniques and the value of the finding of those studies that do use such techniques should be judged based on their replicability. The promise of cognitive neuroscience is great. We just need to approach it with some appropriate scientific skepticism. Thus, I propose the following guidelines for AEPs who want to apply cognitive neuroscience in operational settings.

1. Conduct an honest analysis of the operational problem you are trying to solve. If a less complicated or expensive method will solve the problem, don't try to force neuroscience methods on your program. If a simple neuroscience measure will solve the problem, don't propose a more complicated and expensive one.

2. When proposing or reviewing a project that will capitalize on a recent imaging finding, consider how often that finding has been replicated. If it has only been reported once, you stand a decent chance of building your program around a fiction.

3. Don't over-sell the capabilities of your technique. If you tell the program office that your neuroscience solution is operationally hardened and 90% reliable when it is neither, they'll stop listening as soon as the next guy (maybe me) says the word "neuroscience."

4. Always remember that as scientists, both enthusiasm and skepticism are virtues.



Looking Past the BOLD Print: An Alternative Analytic Approach to fMRI

LT Peter Walker

During the latter half of the 1990s, an aviation mishap occurred that would continue to influence aviation medicine, even today. In this particular mishap, the pilot was performing a seemingly routine night air to ground mission. The mission briefing called for a 30 degree dive at 350 knots. However, the impact site suggested the pilot was flying a 60 degree dive at 550 knots. Even more surprisingly, the pilot appeared to not be maneuvering the aircraft at the time of the mishap.

A more thorough investigation of the mishap revealed several significant findings that have influenced aviation medicine, still today. While the cause of the mishap was attributed to a spatial disorientation episode of the pilot, it was also revealed that the pilot had suffered from a closed-head injury less than two years prior to the mishap. Unfortunately, at the time of the closed-head injury, aviation medicine lacked any standardized and formal process to determine whether this particular aviator had regained his motor and cognitive function prior to the accident. As a result, a number of neuroscientists, flight surgeons, and other aeromedical health care providers would spend the next twenty years developing approaches to standardizing the modeling of and rehabilitation of patients with closed-head injuries.

Many of the approaches that have since been applied to studying closed-head injuries have capitalized on the latest innovations in neuroimaging. For example, modern brain imaging techniques such as MRI and, more recently, fMRI have been used in the comparison of healthy and brain damaged patients. One approach to measuring brain activity is through the use of Blood Oxygen Level Dependence (BOLD). BOLD levels are measured under the assumption that more neuronal activity requires more glucose and oxygen to be delivered through the blood stream rapidly. Therefore, blood releases glucose to neurons in areas of brain activation. Measurement of BOLD activity compares glucose and oxygenation for presumed processing areas against those that are not presumed to operate during a specific task.

While BOLD measurements are commonly viewed as the 'gold standard' in neuroscience today, some have criticized it for its inability to measure specific regional activity. A new and hitherto unexplored approach to measuring brain activity using fMRI technology involves a low-rank tensor decomposition approach. The Low-rank tensor approximation process involves loading images from an fMRI scan into an order-4 tensor, with

Tensor Analysis

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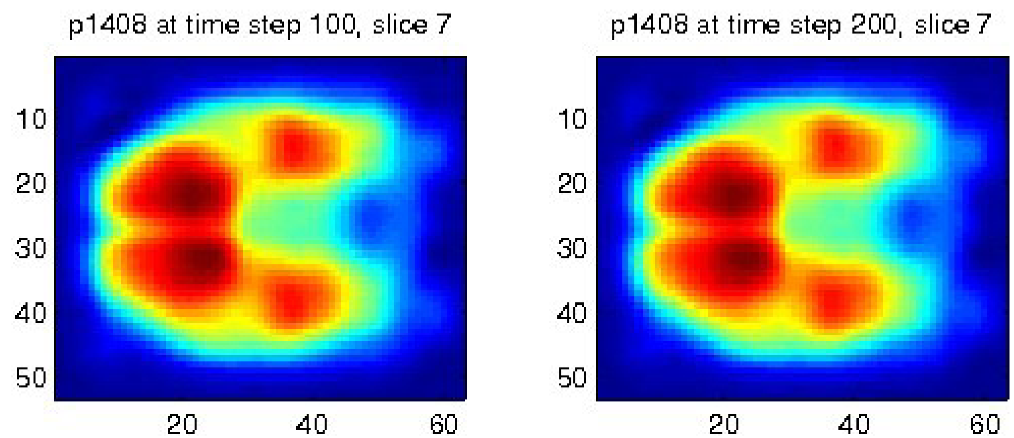
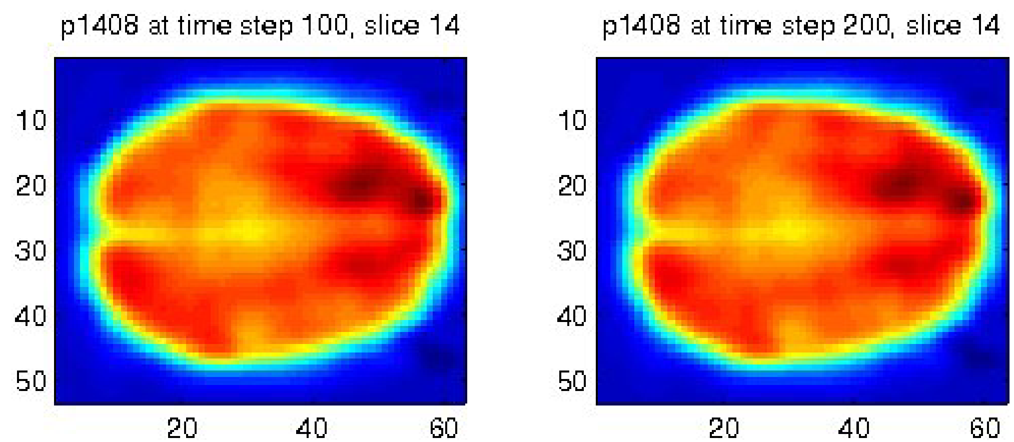


Slice 7 from an fMRI scan from the same patient at different time sequences. Note that very little difference exists between the two scans across time intervals.



Slice 14 from an fMRI scan from the same patient at different time sequences. Very little difference exists between the two scans across time intervals.

dimensions 53 × 63 × 28 × 235. After the image is loaded into the tensor, a canonical decomposition is performed such that each slice may be analyzed independently at separate locations and at different times.

The tensor decomposition approach outlined above ultimately may prove beneficial to a number of applied domains. Specifically, we have suggested that this approach may be used in the identification of specific neural pathways during learning and rehabilitation. By identifying common neural pathways during learning and rehabilitation, it has been suggested that we may begin to identify those neural pathways that might bypass neural pathways affected by cortical injury or strengthen those pathways that promote neural plasticity.

To illustrate this process, we have applied this tensor decomposition process to fMRI images from patients while at rest. Since a 53×63×28×235 tensor can also be considered as 53×63×28 tensors over 235 time steps, we are able to compare these tensors (from the same patient) over

Tensor Analysis

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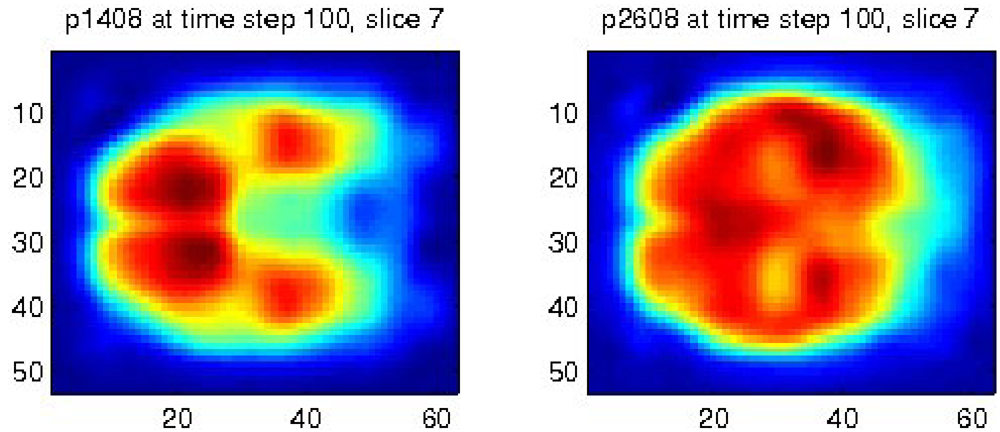
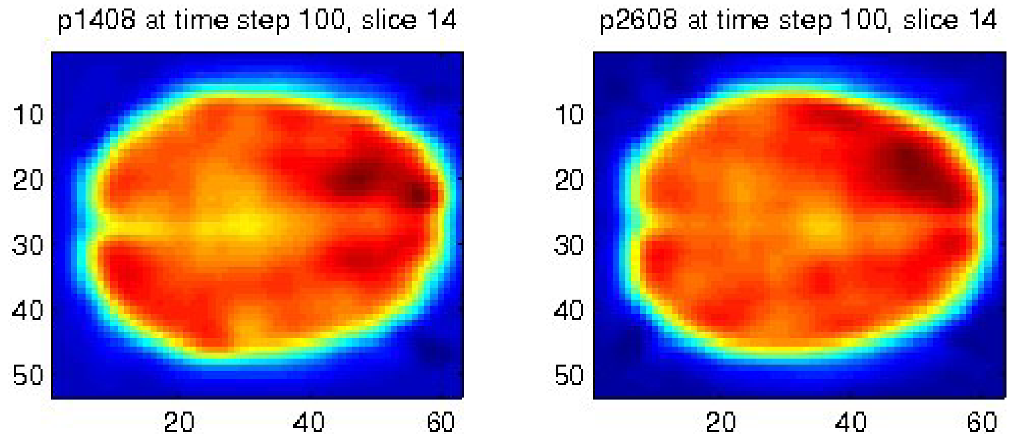


Slice 7 from an fMRI scan from two different patients at the same time sequences. Note the different levels of activation from the two patients.



Slice 14 from an fMRI scan from two differnt patients at the same time sequences. Note the different levels of activation from the two patients.

we conduct this comparison we find that the tensors do not differ much (because patients are at rest). However, when we compare two tensors from two different patients, we find them noticeably different. Together, these results provide converging evidence that this approach does provide an alternative analytic approach to brain imaging techniques.

As aviation continues to evolve at such an astonishing rate, Aerospace Experimental Psychologists must continue to adapt as well. The challenge to AEPs is in the application of innovative and current research methodologies available to scientists. Specific training in neuroscience may ultimately develop into a pillar of strength onto which AEPs can continue to develop their niche with the operational communities.

An Officer and a Psychologist

From *Virginia Tech News,* by Catherine Doss. Reprinted with permission.

BLACKSBURG, VA., Aug. 26, 2010 – When Rolanda Findlay learned she would be attending flight school as part of her commission in the U.S. Navy, she was more than taken aback, she says.

"I was thinking 'who learns how to fly … who gets to do that?'" Findlay said. As a psychologist, she was not expecting that learning the basics of piloting would be part of her on-the-job training. "It was an amazing experience … once in a lifetime."

Back on the ground, Findlay, who earned master's and doctoral degrees from Virginia Tech in 2007 and 2009, respectively, uses her skills in industrial and organizational (I/O) psychology to assist in the selection and training of future Navy pilots. [Among other things,] I/O psychologists research and identify how behaviors and attitudes can be improved through hiring practices, training programs, and feedback systems for employees.

"I/O is very broad," she said, "and the opportunities in the field are endless."

A month after defending her doctoral dissertation, Findlay began what she says she hopes will be a long-lasting career with the Navy.

"I never really considered joining the military," Findlay said. "But this opportunity came along, and now I feel so blessed."

Findlay's path to the Navy began in the summer of 2005 when, as a young graduate student, she joined her advisor, Neil Hauenstein, associate professor of psychology in the College of Science, at the Summer Faculty Research Program of the Defense Equal Opportunity Management Institute (DEOMI) at Patrick Air Force Base in Florida. The institute offers Equal Opportunity/Equal Employment Opportunity (EO/EEO) education and training for military active duty and reservists, as well as civilians. Findlay assisted Hauenstein with his research and was invited back to the institute three times to continue her research. Much of her work at DEOMI involved the development of tests to determine the effectiveness of equal opportunity education and training.

"To be able to go to DEOMI as a graduate student and be a summer researcher was unheard of," Findlay said. "To be repeatedly selected to come back was mind-blowing." Findlay was the only graduate student to participate in the institute's Summer Faculty Research Program during its 22-year history.

"I was impressed with Rolanda's maturity and conscientiousness," Hauenstein said. "The institute shared my regard."

Those who know her say Findlay lives life with a passion — passion for what she's doing and passion for others.

"Rolanda's personal qualities are rooted in her strong faith," Hauenstein said. "The universal reaction is that Rolanda brightens any day; she is such a positive force that you cannot help but feel better having spoken with her."

One recent DEOMI project called upon Findlay to develop a series of video-based Situational Judgment Tests (SJTs) to be used as interactive training tools for EO/EEO professionals. In each SJT, users are presented with a video of an EO/EEO scenario followed by several options for addressing the situation and are given feedback and rationale for each option.

"SJTs have an important role in training because most of the military is a team environment," Findlay said. "People have to respect one another and break down barriers in order to get the job done. It's a great feeling to know that what you've worked on has an impact."

As her studies at Virginia Tech were coming to a close, Findlay was recruited to join the Navy as an AEP. Her previous work at DEOMI combined with her academic record made her a highly qualified recruit.

"[Virginia] Tech's graduate program in psychology really made me stand out," she said. "It was a rigorous program, but it paid off. Every day, I get to work on things I have learned and apply them to a military environment."

Now at the Naval Air Station in Pensacola, FL, Findlay's first tour of duty includes responsibilities such as assisting with the selection of future pilots and conducting performance evaluations. So why was she given pilot training?

"I am going to be assisting with the selection of future Navy pilots, so I need to know what they go through so that I can do my job effectively," she said.

She completed a seven-month Aeromedical Flight Officer training program, which included class work as well as some serious boot camp requirements, such as swimming a mile fully clothed in her flight suit. Before the program, she didn't even know how to swim. She earned her gold wings last spring.

"The Navy teaches me things I never thought I would be doing." she said. "This is a job I can be proud of."

The College of Science at Virginia Tech gives students a comprehensive foundation in the scientific method. Outstanding faculty members teach courses and conduct research in biology, chemistry, economics, geosciences, mathematics, physics, psychology, and statistics. The college offers programs in many cutting edge areas, including those in energy and the environment, developmental science across the lifespan, infectious diseases, computational science, and nanoscience. The College of Science is dedicated to fostering a research intensive environment that promotes scientific education and outreach.

Calendar: Mark These Dates Down!

November 1-3, 2010
116th Annual Meeting of Association of Military Surgeons (AMSUS) in Phoenix, AZ

November 8-10, 2010
Aerospace Experimental Psychology (AEP) meeting in conjunction with ONR Science and Technology Conference in Arlington, VA

February 8-10, 2011
HSCB Focus 2011: Integrating Social Science Theory and Analytic Methods for Operational Use at the Westfields Marriot Hotel in Chantilly, VA

Promotion Announcements

Fiscal Year 2010 Promotions
CAPT Dylan Schmorrow
CAPT Russell Schilling
CDR Sidney Fooshee
LCDR Justin Campbell
LCDR Philip Fatolitis
LCDR Chris Foster
LCDR Jeff Grubb

Fiscal Year 2011 Selectees
LCDR Joseph Cohn
LCDR Michael Lowe
LT Tatana Olson
LT Marc Taylor
LT Wilfred Wells
LT Peter Walker

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