

**DRAFT**

**DEPARTMENT OF DEFENSE  
HUMAN FACTORS ENGINEERING  
TECHNICAL ADVISORY GROUP**

MINUTES OF THE FIFTY-FIFTH MEETING  
15-18 MAY 2006  
LAS VEGAS, NEVADA

HOST:

USAF WARFARE CENTER  
NELLIS AIR FORCE BASE

CHAIR:

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**DEPARTMENT OF DEFENSE  
HUMAN FACTORS ENGINEERING TECHNICAL ADVISORY GROUP**



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## Executive Summary

The fifty-fifth meeting of the Department of Defense Human Factors Engineering Technical Advisory Group (TAG) was held at the Aladdin Resort and Casino 15-18 May 2006. The meeting was hosted by the Air Combat Command, Nellis AFB, Nevada. There were approximately 125 attendees.

Ms. Maureen Bergondy-Wilhelm, TAG Chair, would like to express her gratitude and appreciation to all the plenary presenters, subTAG chairs, and to the TAG Program Coordinator for their contributions to the success of this meeting.

### Theme

Enabling Decision Superiority with HSI - Decision making is a human activity and, as such, the quality of human systems integration (HSI) for the development and design of technology that will be used to achieve decision superiority is crucial. Technology cannot replace accurate decision making, good strategy and progressive thinking, but technology can provide the information that the individual needs to maximize the capability to make decisions. Decision superiority requires adapting to changes in a broad range of circumstances faster than circumstances can change or the adversary can adapt. Those responsible need to:

- Balance capabilities
- Manage risks
- Act simultaneously or sequentially

These attributes are needed to achieve the desired end-state with the least amount of risk and cost in lives and assets. Decision superiority will increase the ability to respond effectively and proactively thereby impairing the ability of circumstances to degrade or in a combat setting of an adversary to react effectively. Whether on the battlefield or at a control station, decision superiority in the civilian and military front is equally important. The focus of decision superiority is to anticipate all situational circumstances and capabilities that will be used for any occurrence be it conflict or crisis before it happens. Decision superiority requires a singular networked environment that will enable:

- Continuous and collaborative planning,
- Adaptive command and control
- Employment of tailored, capabilities-based force packages

Decision superiority allows the individual, warfighter or controller, to make better informed decisions as circumstances unfold. Vast amounts of information need to be integrated into the decision making process through data fusion-manipulating and combining data from numerous sources to form useful information. Decision makers need to know the players in their global decision space, anticipate challenges and

uncertainties, understand consequences of all responsive and reactive actions, and be proactive to minimize negative outcomes.

Achieving decision superiority in a net-centric environment requires new ways of thinking about how people acquire, integrate, interpret, use, and share information. As the theme for the 55<sup>th</sup> Human Factors Engineering Technical Advisory Group, the focus will be on how HSI and its component specialty areas will impact the involved net-centricity and the need for decision superiority by facilitating this inherently human endeavor where the human is key.

## **Meeting Highlights**

**Call to Order** – Ms. Maureen Bergondy-Wilhelm called the fifty-fifth meeting of the TAG to order and welcomed presenters, guest, and attendees.

### **Highlights –**

**Social** - TAG attendees were treated to an evening of entertainment at the Variety Theater in the Aladdin. On Wednesday, May 17 2006, join us for an evening of entertainment at the Variety Theater in the Aladdin. The show included magic, special effects, death-defying stunts, wild comedy, visual artists, physical insanity and much more! It's variety, it's Vegas, it's V the Ultimate Variety Show, with something for everyone!

**Tour** – On Thursday, TAG members toured Nellis Air Force Base. Nellis Air Force Base is home of the Predator and the Combined Air and Space Operations Center - Nellis (CAOC-N). Program officials briefed on both programs in the Threat Training Facility.

## **Announcements**

The Human Factors in Extreme Environments and System Safety/Health Hazards/Survivability subTAGs did not meet at TAG-55.

## **Administrative Business**

### ***SubTAG Reports –***

**Design: Tools and Techniques** – Dr. Pamela Savage-Knepshield, ARL-HRED, and Mr. Joseph Barretta, ARL-HRED will take over the subTAG as co-chairs..

**Human Factors in Extreme Environments** – Mhriban Whitmore, NASA JSC, will take over leadership of the subTAG.

**System Safety/Health Hazards/Survivability** – Ms. Barbara Palmer will co-chair with George Murnyak.

### ***Caucus Reports –***

**Air Force** Mr. Darren Cole, Edwards AFB, will be the new service representative.

**Army** New Caucus representative is Dr. Pamela Savage-Knepshield, ARL-HRED. Ms. Katrina Baker, Aberdeen Test Center, was elected as TAG Vice Chair.

**Navy** LT Brent Olde, Naval Postgraduate School, will be the service representative.

***Executive Committee/Operating Board Reports –***

**NASA Participation** – The TAG would like to encourage and support additional participation of one of the TAG sponsors, NASA especially since there is increased efforts to collaborate with other agencies. Dr. Choo, NASA, signed a letter on joint HSI with the Army, Air Force, and the Navy. The TAG will focus meeting themes to be of interest and appropriate to all participating organizations. NASA would like to host a meeting in the near future, either at NASA Ames or Langley Research Center.

**HSI Tools Workshop** – To respond to input from Dr. Foster, TAG Proponent, TAG members and other supporting organizations have developed an HSI Tools Workshop. The tasking is to review the HSI program plan DID, capture executive level MANPRINT briefing, and directly support Dr. Foster’s challenge to provide government guidance to industry.

**Funding TAG Products (1472 Pocket Guide)** – Mr. Ric Etheridge promised Navy funding to print additional copies of the pocket guide.

**Upcoming TAG meetings** - TAG-56 will be hosted by the Navy with possible NASA co-hosting in Monterey, CA.

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# Meeting Agenda

## Monday, 15 May

0830 - 1000 Executive Committee meeting

1000 - 1100 New member orientation

1100 - 1300 Luncheon Break

- Welcome and Overview - Mr. James S. "Odie" Davis, Air Force Research Laboratory Liaison to USAF Warfare Center, Nellis Air Force Base
- *Title Pending* - LTC David Weston, Chief of Staff, 6<sup>th</sup> Recruiting Brigade
- Operational Neuroscience and its Impact on Decision Superiority - Dr. Amy Kruse, Program Manager, DARPA-DSO
- The Role of Collaboration in Decision Superiority - Ms Laura Militello, Sr. Research Psychologist, University of Dayton Research Institute
- Enabling Decision Superiority with HSI - Major Peter Garretson, Chief, Future Technologies Branch, HQ USAF Future Concepts and Transformation
- *Title Pending* - Mr. Rick Etheridge, Director Human Performance and Systems Acquisition Branch, Chief of Naval Operations OPNAV N173
- Resource Foraging Strategies in Uncertain, Event-Driven Environments - Ms. Sandra Garrett, Purdue University

1800 - 2000 Networking Mixer

## Tuesday, 16 May

0730 - 0830 Technical Society/Industry

0830 - 1100 Personnel Selection and Classification - Part 1

0830 - 1100 Workload and Stress - Part 1

0830 - 1100 Human Factors Standardization

0930 - 1000 Networking, coffee

1100 - 1230 Luncheon Break

1230 - 1430 Personnel Selection and Classification - Part 2

1230 - 1430 Workload and Stress - Part 2

1230 - 1430 Design: Tools and Techniques - Part 1

1430 - 1500 Networking, coffee

1500 - 1700 Design: Tools and Techniques - Part 2

1500 - 1700 Human Modeling and Simulation

1500 - 1700 Human Factors Test and Evaluation

1700 - 1800 Service Caucuses and TS/I Meetings

## Wednesday, 17 May

0830 - 1100 Controls and Displays

0830 - 1100 Human Factors in Training - Part 1

0930 - 1000 Networking, coffee

1100 - 1230 Luncheon Break

1230 - 1430 Human Factors Engineering/Human Systems Integration:  
Management and Applications

1230 - 1430 User-Computer Interaction

1230 - 1430 Human Factors in Training - Part 2

1430 - 1500 Networking, coffee

1500 - 1700 Sustained/Continuous Operations

1700 - 1800	Mission Performance Measurement Interest Group
1915 - 2100	Social
<i>Thursday, 18 May</i>	
0830 - 1000	Operating Board
1000 - 1600	Tour

## Plenary Session

Abstracts for Plenary Presenters were not submitted. Please see entire plenary briefings on the TAG website at <http://hfetag.dtic.mil/briefs/TAG-55-briefs.html>.

(The following was submitted by Mr. Stephen Merriman)

**Air Force Host Welcome and Overview:** Mr. James S. “Odie” Davis, Air Force Research Laboratory Liaison to USAF Warfare Center, Nellis Air Force Base welcomed the TAG participants to Las Vegas ([james.davis@nellis.af.mil](mailto:james.davis@nellis.af.mil), (702) 652-8003). Nellis certifies most all USAF equipment and performs operational testing. It is the single source for tactics and doctrine development, provides graduate education and top adversary top graduates, hosts joint exercises and integrated training – in short, it provides solutions to combat problems. The Air Force Research Lab (AFRL) and Air Force Warfare Center (AFWC) have a partnership:

- ◆ The 98<sup>th</sup> range wing employs spatially-separated audio for range control.
- ◆ The USAF Weapons School performs performance evaluation in high stress environments.
- ◆ The Combined Air and Space Operations Center provides “ACMI for the CAOC.”
- ◆ The Joint Air-to-Ground Operations Group provides joint air to ground operational training.
- ◆ The Predator and UAV Battle Lab performs research on crew fatigue, manning and scheduling for Middle East operations.
- ◆ The Security Forces and Desert Warfare Training Center employs multi-spectral devices, etc.

Future priorities include: enhancing decision making as a process, capability performance enhancement and providing innovative solutions to urgent needs.

**Enabling Decision Superiority with HSI** - Major Peter Garretson, Chief, Future Technologies Branch, HQ USAF Future Concepts and Transformation ([peter.garretson@pentagon.af.mil](mailto:peter.garretson@pentagon.af.mil), (703) 692-4795) is a C-5 and C-9 pilot, currently at the Pentagon as a long-term planner for the Air Staff. He is an OODA loop advocate. The new scarcity in Air Force aviation is **human attention**. As the number of airmen is reduced, a high percentage of those remaining will be decision makers. HSI can help select the best decision makers, train them to higher standards, conserve and protect decision makers, understand decision making and eliminate waste, and apply cognitive prostheses. A new thrust, AFSO-21 is causing the Air Force to start over in the way it looks at decision making: investigation areas will include data visualization and augmented reality/augmented cognition, both of which are critical to making significant progress. A much closer working relationship will be needed between HSI and Information Technology (IT) disciplines.

**62<sup>nd</sup> Engineering CBT Battalion (H):** LTC Dave Weston, Engineering Officer, US Army Chief of Staff, 6<sup>th</sup> Recruiting Brigade. In Iraq, LTC Watson’s Battalion laid 225 miles of pipeline from Camp Virginia to Talil Airfield. This included:

- ◆ 60,000 pieces of pipe

- ◆ 18 pumping stations (800 gallons/minute)
- ◆ 6 tactical petroleum terminals
- ◆ 20 million gallon total capacity
- ◆ Weighing over 4,500 tons
- ◆ One heavy combat brigade for four months.

During this operation there was very little C<sup>2</sup>. Over the course of about 15 minutes, LTC Weston provided the audience with a graphics-based presentation illustrating the hardships faced by the Army in working in this environment. This provided many examples of where HSI could help.

**Operational Neuroscience and its Impact on Decision Superiority:** Dr. Amy Kruse, Program Manager, DARPA-DSO, provided several examples of how DARPA is investigating this relationship (amy.kruse@darpa.mil (571) 218-4338). The focus at DARPA is on the human in the loop – with the brain at the center of command and control. DARPA has explored several methods of sensing brain activity:

- ◆ EEG Electro-encephalography
- ◆ MEG Magneto- encephalography
- ◆ fMRI Functional Magnetic Resonance Imaging
- ◆ PET Positron Emission Tomography
- ◆ fNIR Functional Near Infrared

EEG (electrical activity) and fNIR (oxygenation) hold near-term promise. Their goal is to develop a closed-loop computational system where the computer adapts to the warfighter in order to improve performance. Three different DARPA research projects were briefly discussed:

- ◆ The Boeing Company (Dr. Rich Edwards, et al), in conjunction with Dr. Glenn Wilson at WPAFB has explored control of four UAVs at a time using fNIR and EEG to sense workload.
- ◆ The Neuro-technology for Intelligence Analysts (NIA) program has as its goal helping analysts move through imagery more quickly. They are exploring the question: “Are their brain signals associated with targets in satellite imagery?” In this study, EEG 200 msec after target presentation was determined to be associated with target detection. Different scanning techniques were explored to speed target detection. The methodologies being studied have potential application to TSA baggage screening and mammogram screening.
- ◆ Another program being conducted by Lockheed-Martin, involves Tomahawk Tactical Work Station (TTWS). L-M is attempting to use neuroscience measures to help Human-Computer Interface (HCI) designers identify more usable interfaces that make operators less error-prone. They are attempting to develop a tool to detect and distinguish work workload-induced errors. Primary indicators are EEG, heart rate, GSR and off-head eye tracking.
- ◆ Another area of investigation is in the training area, where the goal is to use the innate plasticity of the brain to accelerate learning in the operational environment, to accelerate the transition from novice to expert by inducing localized plasticity

in the brain. It is thought that increased plasticity in sensory brain structures results in enhanced information processing (synesthesia).

**Human Performance Integration – Full Steam Ahead:** Mr. Rick Etheridge, Director Human Performance and Systems Acquisition Branch, Chief of Naval Operations [OPNAV N173] discussed some of the initiatives underway in N173 ([Richard.etheridge@navy.mil](mailto:Richard.etheridge@navy.mil), (703) 602-5160). N173 is supporting warfighting capabilities by maximizing human performance and minimizing LCC through requirements development, resource sponsorship and acquisition guidance.

**The Role of Collaboration in Decision Superiority:** Ms. Laura Militello, a Senior Research Psychologist at the University of Dayton Research Institute ([militello@udri.udayton.edu](mailto:militello@udri.udayton.edu), (937-229-2287) summarized some of the work underway at UDIR; they are working with lots of different military teams to optimize decision-making; e.g., Emergency response teams, Tanker Airlift control teams, Logistics Readiness Centers. They are focusing on both human-human, human-human (computer-mediated) and human-technology collaboration. Human-Human (computer-mediated) collaboration may include phone, email VTC, Chat rooms, VOIP and collaborative spaces such as “Net Meeting” and webex. Human-Technology collaboration involves such things as avatars, decision support systems and RFID. Some of the challenges to collaboration are shown below, with associated UDRI projects:

Delayed, more fragile trust	→	Lab studies of trust in logistics C2
Reduced cohesion		Roles & functions workshops
Natural fault lines	→	Computer-supported conflict mgmt
More extreme decisions	→	Modeling and simulation technology
Asymmetric Information Flow	→	Standing Joint Force HQ knowledge Manager
Clumsy automation	→	Avatars

Next steps for collaboration research include:

- ◆ Frameworks for evaluating collaborative technologies – working with AFRL (Logistics Branch) to study trust, cohesion, decision making, and information flow.
- ◆ Improved Human-Technology communications.
- ◆ Processes of computer-mediated communications

**Resource Foraging Strategies in Uncertain, Event-Driven Environments** - Ms. Sandra Garrett, Purdue University ([garretsk@ecn.purdue.edu](mailto:garretsk@ecn.purdue.edu), (765) 464-8867) described some of the work being accomplished in optimal foraging theory – searching for and obtaining the most food while expending the least energy.

# Controls and Displays

## DEPARTMENT OF DEFENSE HUMAN FACTORS ENGINEERING TECHNICAL ADVISORY GROUP (DoD HFE TAG)

### SUBTAG REPORT

1. SubTAG Name: Controls and Displays
2. Number of members present: There were a total of 47 attendees present
3. Organizations represented:
  - a. Government members represented came from NASA, FAA, Navy, Air Force, and Army.
  - b. Academia members included John Hopkins University
  - c. Government support contractors included MITRE, SAIC, Alion, Boeing, BCI, Titan Corp, Skillsnet Inc., and ARINC.
4. The agenda covered included
  - a. Sign In
  - b. Charter
  - c. Hot Topics
5. Abstracts presented: There were five presentations made for this subgroup. They included:

- a. Dr. Lisa Billman, Naval Surface Warfare Center-Panama City  
ARINC Engineering Services, Title: Display of Mission Planning Information for Intelligent Autonomy in Unmanned Systems

The purpose of the evaluation was to elicit unmanned vehicle operator feedback on the design of two software systems being developed under the ONR Intelligent Autonomy Program. The intent of these two software packages is to develop and demonstrate the use of Intelligent Autonomy in Unmanned Vehicles mission planning and mission monitoring systems. In particular the automation focused on dynamic replanning/autonomous vehicle control and distributed multi-vehicle cooperative control.

One intent of including intelligent autonomy in system design is to reduce the high mental workload often associated with operating and monitoring complex systems. Software designers should attempt to reduce the impact of high workload drivers through the deliberate and appropriate use of intelligent

automation, and the display of the information in such a manner as to enhance operator understanding of the decision making process and situation awareness.

Although the two systems evaluated had slightly different intents, the evaluation of the two systems was conducted using the same protocol, briefings, evaluators and evaluation tool. The design and execution of the evaluation was a cooperative effort between NAVAIR and NAVSEA. Six unmanned vehicle operators were participants in the study, and completed a three part operator evaluation tool designed to evaluate the human factors aspects of the systems, including the user interface and workload.

The results of the evaluation showed that the operators required a high degree of understanding of the decision aiding logic in order to trust the system and be comfortable using the automation. In addition, operators wanted more control over the levels of autonomy, and when the autonomy is employed. Finally, the operators were interested in seeing more consistency with existing/fielded systems, and wanted the interfaces to be more similar to familiar software interfaces (like windows).

b. Ms. Erika Darling, The MITRE Corporation, Title: Reducing Visual Clutter of Map-Based Displays.

Geographic Information Systems (GIS) displays typically contain many data layers ranging in type and level of detail (LOD) that often result in dense, cluttered, and occluded map displays. An alternative to toggling on and off layers is semantic lensing, which is a localized, “detail-on-demand” filtering strategy. Semantic lenses have been shown through experimentation to be a more efficient and desirable approach than traditional filtering.

c. Dr. M. R. Fletcher, US Army Research Laboratory, Human Research and Engineering Directorate, Natick Field Element, Natick Soldier Systems Center, Natick MA, Title: Information Displays for Individual Dismounted Soldiers: A workload Baseline for Modeling

Information-display modalities affect the ability of message recipients to carry out ongoing tasks while attending to and making decisions about new information. IMPRINT models of four information transmission methods that may be used by individual dismounted soldiers illustrate the impact of varying modalities on the recipient’s total workload during ongoing walking and visual-attention tasks. Audio and hand-signal messages impose the smallest maximum workload, while helmet-mounted displays and arm-mounted tablet screens, both visually demanding technologies, result in much greater workloads. Specific real-world data needs for improved dismounted-soldier modeling have emerged from the IMPRINT models, in particular, the demand imposed by the need to monitor foot placement in variable terrains. Experiments are planned to collect and more fully assess visual-attention information during dismounted movement.

d. Ms Denise L. Aleva, Air Force Research Lab, Wright Patterson AFB, OH

With the changing character of warfare, information superiority is a high priority. Our decision makers must be able to accurately assess the situation, decide upon a course of action, and set that course of action in motion before the adversary can react. It's always a challenge to provide decision makers with the right information in an easily understandable format. This is particularly true as more and more information can be made available. It becomes very important to display the right information at the right time and to make it easy to find and understand. Today's new computer and display technologies afford us a broad array of options for information presentation. Our challenge is to develop display interfaces that deliver decision-quality information culled from various sensors/systems directly to decision-makers.

Decision makers want to understand the uncertainties associated with the information provided to them. New display techniques are needed to enable the decision maker to understand the meta-data associated with information. Some examples of meta-data include:

- Where did the information come from?
- What types of uncertainty are associated with the data?
  - Sensor precision & range limits
  - False variation due to noise
  - Human observers' limits of perception or trust/reliability
- How old is the data?
- Has the data been filtered by models? What might have been lost in the filtering process?

Air Force Research Laboratory Human Effectiveness Directorate researchers are working to develop and validate a new generation of icons for battlespace visualization. These "knowledge glyphs" will portray multiple dimensions of information as well as the uncertainty associated with each. There are a number of research issues to be addressed:

- How many dimensions can be displayed in one glyph and be readily understandable by the user?
- How can the uncertainties associated with information be displayed?
- Should glyphs be 2D, 3D, or 4D?
- Should all information associated with a dimension be displayed at once, or should there be drill down?
- Should glyphs be temporally dynamic?
- How will the perception of information change as a function of screen resolution?
- Can glyphs be created that counter information bias?

Decision-makers must be able to visualize the battlespace in order to assess current and future situations. Information portrayal must support this process

and promote more rapid assimilation of data. This requires a systems engineering approach, in which the decision-maker is treated as part of the system along with computer and display technologies. There are many new and creative concepts for display of information. However, very few have been tested. Laboratory experimentation is needed to optimize and validate new display concepts for specific applications.

e. Ms Jennifer A.B. McKneely, John Hopkins University Applied Physics Lab, Laurel, MD, Title: Cognitive State and Operational Performance

JHU/APL proposes using Human-Systems Integration methods to investigate the benefit that fatigue sensors would bring to an operational performance. A Command and Control occurs at all levels in military operations, across all services (including homeland protection) and is critical to mission success. Its cognitive complexity and the associated demands required of staff, such as leadership, rapid decision making in a dynamic environment, situational awareness and vigilance make it an ideal environment for understanding implications of cognitive state on operational performance. As a person becomes fatigued, different cognitive capabilities degrade at different rates. Current fatigue detectors are validated for detecting Stage 0, the onset of sleep. However, experience shows that cognitive function starts degrading before this point, and additionally, potential countermeasures may take a period of time to restore cognitive effectiveness. The operational impact of the time period between fatigue-induced cognitive degradation, fatigue detection, and countermeasure effectiveness is uncertain. At this point in time, the causal links between military-relevant tasks, their underlying cognitive functions, fatigue sensor capabilities and countermeasure implementation are not well understood. JHU/APL has begun internal research to begin to bridge these areas to help clarify the value in this approach as well as help identify research gaps in this field. The ultimate goal is an on-line real time system that provides state assessment and countermeasures (both system adaptations and scheduling to aid in prevention of negative states). This presentation will discuss the preliminary findings in a FY05 pilot experiment and plans for FY06 follow-on experiment.

f. Mr. Chris Plott, Micro Analysis and Design, Boulder, CO, Title: Crew Station Design Tool

The Crew Station Design Tool (CSDT) allows designers to visualize and optimize their choices of controls and displays, and the position of those elements in a workstation. It automatically determines the optimum arrangement of controls and displays based upon sound human engineering and ergonomics principles. In order to accomplish this, the CSDT communicates with three different software tools: 1) Micro Saint Sharp - a task network modeling tool, 2) Open Inventor™ - a three-dimensional graphics environment, and 3) Jack® - a human figure (anthropometric) modeling tool. Using the results of a task analysis

as its foundation, the CSDT helps designers select the most appropriate control for a task and build a task network model of the activities performed in their desired workstation. Once executed, the task network model identifies operator-task conflicts and provides frequency-of-use data for each control and display. The CSDT uses this data to place the selected controls and displays in Open Inventor's three-dimensional environment. Finally, the suggested arrangement and the data acquired from the task network model are used to generate and execute a three-dimensional human figure model in Jack. Jack simulates the physical behavior of humans interacting in the workstation and allows designers to visualize the feasibility of certain tasks (i.e., can a human see and actuate a control within the specified environment).

6. There was substantial discussion for all of the presentations, but no action items resulted from the discussion.
7. There was no status change in either chair positions.
8. There were no open action items.
9. Co-Chair: Adrian O. Salinas, 210-536-4428, DSN: 240  
Co-Chair: Marianne Paulsen, 850-235-5527, DSN: 436

# Design: Tools and Techniques

## Session I:

The first session covered a wide-range of topics related to the use of design tools, techniques, and testbeds including: the Manpower and Personnel Integration (MANPRINT) Program, the Improved Performance Integration Tool (IMPRINT), the Combat Automation Requirements Testbed (CART) Program, the Advanced UAV Testbed for Human Operator Research (AUTHOR), the System to Help Empower and Implement Leader Decisions (SHIELD), and the need for common toolsets to perform mission planning, briefing, and After Action Reviews.

- **Case Study for Designing a Simulated Training and Testing System.**

Carole M. Kortenhaus, Engineering Psychologist, US ARL-HRED Field Element, ATTN: AMSRD-ARL-HR-MT, PEO Simulation, Training & Instrumentation, 12350 Research Parkway, Orlando, FL, [carole.kortenhaus@us.army.mil](mailto:carole.kortenhaus@us.army.mil)

Welcome to real world situations of applying tools and techniques to design a future training and testing computer based system that will be a component of the Army's interoperable, systems-of-systems, live-virtual-constructive operational architecture. The system is the One Tactical Engagement Simulation System. OneTESS will support developmental and operational testing and provide tactical training capabilities in an environment simulating combat realism for live trainees.

Today, the Army is facing the challenge of a wider range of threats that will require the incorporation of newer, more robust technologies that are adaptable to a more complex group of operating environments. To meet the challenge we must develop systems that will train soldiers to enhanced levels of performance, achieve and sustain unit and staff proficiency and enable Commanders to make rapid, accurate, superior decisions.

Towards this end, our OneTESS case study examines the application of on-going work in progress, including IMPRINT, at PEO for Simulation, Training and Instrumentation (STRI) in Orlando, FL on the integration of mission simulation and the cognitive modeling of complex human behaviors, such as tactical decision making, problem solving, and planning.

- **Research to Support Design: Automated Feedback and Networked C3 Systems.**

John S. Barnett and Larry L. Meliza, U.S. Army Research Institute for the Behavioral and Social Sciences, Orlando, FL, [john.barnett1@us.army.mil](mailto:john.barnett1@us.army.mil), [larry.meliza@us.army.mil](mailto:larry.meliza@us.army.mil)

The U.S. Army currently employs an evolving family of networked command, control and communication (C3) systems to support situation awareness (SA) and decision making. Automated feedback and alerting tools are likely to play key roles in the continued evolution of these systems in order to help leaders and Soldiers manage information by directing their attention to key events. It is critical to the design of such tools that they direct attention without increasing workload or becoming overly intrusive. Previous research related to automated alerting tools in the aviation field has suggested that the difference between useful and intrusive is often difficult to establish and frequently is a

function of the operational environment and operator workload. Training units to employ these tools in the context of unit missions may require collecting data on tool usage as input for a unit after action review (AAR). The U.S. Army Research Institute is currently conducting research to gain insight into how automated feedback and alerts will affect Soldiers' SA and workload, and also the unit AAR process. The research uses a testbed called the System to Help Empower and Implement Leader Decisions (SHIELD) which provides visual and auditory alerts of critical events (e.g., approaching a minefield or potential fratricide situations), collects data in the form of AAR logs, and provides users with automated intrusiveness filters. SHIELD was designed to be used at any node within a network. It has been demonstrated running as an application on a stand alone system, as an application on Force XXI Battle Command, Brigade and Below (FBCB2), and embedded in the Command and Control PC (C2PC) as an injector. The presentation describes the current study, the testbed which is being employed, and how the findings from this and similar research can be used to design future networked C3 systems to ensure they will provide effective decision support and help set the stage for the unit AAR process.

- **Collaborative Planning, Briefing, and After-Action-Review: An Agenda for Research and Practice.** Lt. Brenda Blueggel and Lt. Dulcinea Yabut, Air Force Research Laboratory, Human Effectiveness Directorate, Mesa, AZ, [dulcinea.yabut@mesa.afmc.af.mil](mailto:dulcinea.yabut@mesa.afmc.af.mil), [brenda.blueggel@mesa.afmc.af.mil](mailto:brenda.blueggel@mesa.afmc.af.mil)

Decision superiority is crucial when conducting military operations. Military operations must be planned, briefed, executed, and reviewed afterwards and carried out in team network environments. All operations include key team players in C2 positions as well as the pilots who execute the mission. Decision superiority of the team members is aided by technology that allows for mission planning, briefing, and after-action-review (AAR). The wave of the future involves execution of operations in a distributed mission environment across a multitude of platforms; this new push for distributed mission operations poses a new challenge for existing technologies. Current methods of mission planning, briefing, and AAR vary greatly and are not always compatible to share information or connect to one another. This creates a problem when key players do not have full access to other players or vital mission information from those players. Mission effectiveness will be greatly increased by providing a common toolset for mission planning, briefing, and AAR. This paper will describe the development of a foundation for research to define and validate the toolset by identifying current methods of collaborative planning, briefing and AAR used by each mission player. Related issues will also be reviewed such as team collaboration, distributed mission operations, and performance measurements to incorporate human factors in the use of this technology. In order to develop a common system, the technology must be user friendly and require minimal training time. Knowledge from the review could provide the baseline for upcoming mission planning, briefing, and AAR. We will discuss the implications of research in these areas.

- **Virtual Warriors: Synthetic Teammates for Command and Control Testing and Training.** Bryan Edward Brett and Jennifer DeVilbiss, SAIC CART Program Chief

Scientist, Science Applications International Corporation, 4031 Colonel Glenn Hwy, Beavercreek, OH, [bryan.e.brett@saic.com](mailto:bryan.e.brett@saic.com), [jennifer.l.devilbiss@saic.com](mailto:jennifer.l.devilbiss@saic.com)

Virtual Warriors is a project under the Air Force Research Laboratory Human Effectiveness Directorate Warfighter Interface Division's Combat Automation Requirements Testbed (CART) program. The goal of Virtual Warriors is to provide synthetic players that can function as teammates and role players in command and control (C2) simulations. These Virtual Warriors are able to interact with live players to receive tasking and provide information and interact with simulated equipment systems to provide data and products that would be generated in the C2 system. This presentation describes the Virtual Warriors concept and reviews progress to date.

- **Advanced UAV Testbed for Human Operator Research (AUTHOR).**

Edward A. Martin, Technical Director, Combat Automation Requirements Testbed (CART) Program, Air Force Research Lab, Human Effectiveness Directorate, Wright Patterson AFB OH, [edward.martin@wpafb.af.mil](mailto:edward.martin@wpafb.af.mil)

This is an informational briefing regarding the Air Force Research Laboratory's (AFRL) AUTHOR Program. The objective of the AUTHOR Program is to develop a testbed capable of supporting research comparing the empirical validity of UAV-supervisory-control human performance models (HPMs) built under disparate architectures. AUTHOR is leveraging DoD's Multiple Unified Simulation Environment (MUSE) / Air Force Synthetic Environment for Reconnaissance and Surveillance (AFSERS) simulation by adding an interface into which an HPM can be integrated using High Level.

## **Session II: HCI Design Patterns**

The second session focused on a single topic – the creation and use of human computer interface Design Patterns (HCI-DP). Presentations during this session expounded on the need for HCI-DP, its benefits to designers, end-users, and DoD-wide acquisition programs, and a case study demonstrating HCI-DP reuse and its beneficial contributions to return on investment.

- **HCI Design Patterns for C4ISR: A Methodology for Reusing HCI Solutions in C4ISR & Homeland Defense.**

Terry Stanard, Research Psychologist, Jeff Wampler, Systems Engineer, and Kendall Conrad, Research Fellow of the Consortium of Universities of the Washington Metropolitan Area, AFRL/HECS, Wright Patterson AFB, OH, and Glenn Osga, Business Area Manager, User-Centered Design Code 2461, Space & Naval Warfare Systems Center San Diego, CA, [terry.stanard@wpafb.af.mil](mailto:terry.stanard@wpafb.af.mil), [jeffrey.wampler@wpafb.af.mil](mailto:jeffrey.wampler@wpafb.af.mil), [kendall.conrad@wpafb.af.mil](mailto:kendall.conrad@wpafb.af.mil), [glenn.osga@navy.mil](mailto:glenn.osga@navy.mil)

Operators within C4ISR domains require well-designed human computer interfaces (HCI) to effectively perform cognitive work. However, a methodology for transforming a requirements analysis into a useful HCI design is lacking. HCI Design Patterns (HCI DP) may help bridge this “design gap”. A set of reusable HCI components known to support operator work functions could reduce the cost and risk associated with the design of

future systems. The Air Force and Navy are identifying HCI DP to assist the cognitive and collaborative work within C4ISR. A DOD-wide Design Reference Library composed of HCI DP could promote a new set of HCI standards across the services. Future designs using a common set of patterns will promote interoperability between operators in different armed services collaborating on joint missions.

- **Work-Centered HCI Pattern Quality Metrics.**

Glenn Osga, Business Area Manager, User-Centered Design Code 2461, Space & Naval Warfare Systems Center, San Diego CA, [glenn.osga@navy.mil](mailto:glenn.osga@navy.mil)

Human-Computer Interface (HCI) Design patterns should represent a higher design quality by virtue of testing and usage experience. Through the maturation process of compiling a library of high quality patterns in C4ISR domains, patterns will improve regarding their human performance support across a variety of task domains. Work-centered design qualities can be built into the patterns proposed for use by designers if these design qualities are identified and understood. In this presentation the author will describe a set of eight (8) design qualities that appear to have a correlation with improved learnability and performance. The work-centered HCI design qualities will be described as key dimensions of a preliminary Design Capability and Maturity Matrix.

- **Exploiting patterns in work-centered HCI design: Leaping from one sensor domain to another – with a safety net.**

Robert Dick, Principal Scientist & V. Alan Spiker, Principal Scientist, Anacapa Sciences, Inc., Santa Barbara, CA, [radick@anacapasciences.com](mailto:radick@anacapasciences.com),  
[vaspiker@anacapasciences.com](mailto:vaspiker@anacapasciences.com)

Extensive research was performed to develop a unique set of design patterns to solve egregious HCI problems in a Navy sensor system that operates in the electromagnetic sensor domain. The dramatic success of the new HCI in reducing operator workload and improving performance ultimately led to a U.S. patent award for a key subset of these patterns. Subsequently, the same patterns were used to design a workload-reducing HCI for another sensor domain – underwater acoustics – without the luxury of first performing significant additional research. Nevertheless, initial evaluation indicates a very successful “transplant” of the design patterns to the second domain, at very low cost. Central to these performance-enhancing patterns are HCI features that substitute for the work practices, cognitive abilities, and cognitive strategies of “super-expert” sensor operators. The presentation illustrates the patterns and provides lessons learned in exploiting them.

- **HCI Design Patterns Discussion Forum: Next Steps.**

Terry Stanard, Research Psychologist, AFRL/HECS, Wright Patterson AFB, OH and Glenn Osga, Space & Naval Warfare Systems Center San Diego, CA,  
[terry.stanard@wpafb.af.mil](mailto:terry.stanard@wpafb.af.mil), [glenn.osga@navy.mil](mailto:glenn.osga@navy.mil)

# Human Factors Engineering / Human Systems Integration: Management and Applications

1. SubTAG Name: Human Factors Engineering (HFE)/Human Systems Integration (HSI): Management and Application
2. Number of members present: There were at total of 36 attendees present
3. Organizations represented:
  - a. Government members represented came from Navy, Air Force, and Army.
  - b. Government support contractors included ARINC, Booz Allen Hamilton and SRS Technologies
4. The agenda covered included
  - a. Sign In
  - b. Charter
  - c. Research and Development projects for military institutions
  - d. Introduction of new subgroup co-chair
5. Abstracts presented: There were five presentations made for this subgroup. They included:
  - a. **Smith Kalita, Associate, Booz Allen Hamilton**  
Optimizing Human Performance (OHP) Front End Analysis (FEA)™  
The OHP FEA process is designed to assist people who analyze, design, develop, test, and evaluate human performance in the workplace to identify interventions that are capable of optimizing total system performance. The process is supplemented by a robust tool that facilitates gathering and categorizing analysis outcomes. Booz Allen Hamilton is currently applying the OHP FEA process on several key government programs. The presentation delivered to the DoD HFE TAG will expand on the OHP FEA process and provide greater detail regarding the benefits of applying the methodology.
  - b. **Katie Shobe, Ph.D., LT, MSC, USN Human Performance Detachment, Submarine Learning Center**  
Identifying Human Performance Problems in a Submarine Environment Utilizing the Human Factors Analysis and Classification System (HFACS) Framework  
This paper describes an effort to develop a proactive, systematic method to identify and correct human performance problems in the Submarine Force. Typically identification of human performance errors comes to light after a mishap. An example of this approach is instantiated in the Human Factors Analysis and Classification System (HFACS). The HFACS was developed by the Department of Defense to assist in determining the human causes of aviation mishaps after it was demonstrated that 80 percent of all flight accidents in the Navy and Marine Corps were caused by human error. Application of the tool, HFACS, now offers assistance in the investigation process, along with targeting training and prevention.

- c. **Uldi, Shvern, Engineer, Army Test and Evaluation Command, Alexandria, VA.**

Automation as a Tool for Enabling Decision Superiority

Automation can be an extremely powerful tool for enabling decision superiority, but only if used judiciously. In designing a complex system it is essential to structure the system as an aid to the human and not to relegate the human to the role of a mere monitor of the system. Since the human will continue to make the crucial decisions, the system needs to be designed so that even if it has a high level of automation, the operator still maintains good situational awareness. A number of broad HSI design principles that support the goal of superior decisions will be discussed. Examples from C4ISR systems will be used to illustrate some specific HSI design issues in the context of decision making.

- d. **David Williamson, Senior Crew Systems Engineer, Human Effectiveness Directorate's Collaborative Interfaces Branch at Wright-Patterson Air Force Base, Ohio.**

Commercial Speech Technology in the Military Domain

Speech recognition technology holds great potential for improving the effectiveness of military operations. However, it has only been within the last several years that current generation speech systems have sufficiently matured to enable the realization of that potential. Commercial speech recognition technology developments aimed at improving robustness for automotive and cellular phone applications have capabilities that can be readily exploited in various military systems. This presentation discusses the results of several recently completed and on-going research and development efforts in the Human Effectiveness Directorate directed toward applying commercial-off-the-shelf speech recognition technology in various military domains. These efforts include the development of a speech recognition interface to the Theater Air Planning system responsible for the generation of air tasking orders in an Air Operations Center, the flight test evaluation of a ruggedized system installed in the Variable Stability In-flight Simulator Test Aircraft (VISTA) F-16, and the evaluation of a speech interface for supervisory control of unmanned aerial vehicles (UAVs). These very different applications clearly demonstrate the military benefits obtainable through the proper human systems integration of speech technology.

- e. **Thomas C. Cook, Army Research Laboratory, Human Research and Engineering Directorate, Redstone Arsenal, Alabama.**

The Army G1 MANPRINT Directorate and the Army Research Laboratory Human Research and Engineering Directorate (HRED) are currently participating in an initiative to improve MANPRINT support to Program Executive Offices and their associated Program Managers located in the Redstone Arsenal community. The initiative involves the embedding of a MANPRINT Directorate person in the HRED Field element at Redstone Arsenal, Alabama. The success of the initiative, to date, has resulted in an increase in MANPRINT situational awareness within the Redstone Arsenal acquisition community and an improved MANPRINT teaming concept to support the program managers and ultimately the Soldier.

6. There was substantial discussion for all of the presentations, but no action items resulted from the discussion.

7. The attendees were introduced to the new subgroup co-chair, Mr. Brad Collie. Mr. Collie will continue to co-chair with Ms. Baker through the November TAG after which he will become full chair of the subgroup.
8. There were no open action items.
9. Co-Chair: Katrina Baker, 410-278-3472, DSN: 298  
Co-Chair: Brad Collie, 850-234-4744, DSN: 436

# Human Factors in Extreme Environments

This subTAG did not meet at TAG-55.

# Human Factors Standardization

The Human Factors Standardization (HFS) SubTAG met on May 16, 2006 with 19 attendees. Following an introduction of the attendees, the SubTAG proceeded through its agenda.

## Status Reports:

**MIL-STD-1472F, Human Engineering:** At the May SubTAG meeting Mr. Lee Gray announced that his office, the Preparing Activity for the human factors standardization area, has no money to support standardization activities. Mr. Tom Cook reiterated that the Army will not be able to continue as the LSA for HFAC. Dr. Jen Narkevicius stated that the Navy may be willing to become the LSA for MIL-STD-1472, she will report at the next meeting.

**MIL-STD-1787D, Aircraft Display Symbology:** Mr. Jim Kinzig reported that the definition Section (Section 3) was updated to include latest definitions; there is a New Rotary Wing (Section 5.2), a New Remotely Operated Aircraft Symbology (Section 5.4). The Appendix for Design Guidance (A) included an Updated Definition Section which added more definitions, acronyms and abbreviations.

The new Rotary Wing Section 5.2 incorporates Army data including information requirements, lessons learned and rationale. This section needs to be consistent with the rest of the document. It includes a mixture of detailed requirements, and guidance with some redundancy with fixed wing requirements. Jim is seeking help to refine the rotary wing section, a repeat of a request he made at the last Flight Symbology Working Group (FSWG) meeting in Oct 2005.

An appendix for Missile Launch Zone and Attack Steering Depictions (G) describes the principles and mathematics behind medium range missile symbology. This information obtained from participation in Launch Zone Working Groups (LZWG).

Areas currently under review for consistency include Remotely Operated Aircraft Symbology (Section 5.4) which replicates relevant paragraphs for the general requirements for manned aircraft and serves as a place holder for future UAV unique display requirements. Efforts are needed to identify the specific requirements for remotely operated aircraft; ways to minimize clutter, what else should be displayed, and symbology for UAR recovery.

The way ahead should include formatting the rotary wing section with the data available, offer the opportunity for appropriate members of the FSWG/FSDG to provide comments, include the results of the efforts of the Tactical Symbology Subgroup and follow closely the HMD symbology efforts of the F-35.

**FAA Human Factors Design Standard:** Ms. Vicki Ahlstrom from the Federal Aviation Administration (FAA) reported on the status of the FAA's Human Factors Design Standard (HFDS). Ms. Ahlstrom described several recent changes that have been made to the website where the HFDS can be downloaded (<http://hf.tc.faa.gov/hfds/default.htm>). In addition to changes in the website format and an updated user comment form, users are now able to download individual chapters if they do not want to download the entire standard. The FAA has also made draft copies of chapter revision on keyboards and non keyboard interaction devices available on their website for review and comment. The FAA has also recently released a draft appendix to the HFDS which contains standard actions for pushbuttons and menus. This appendix provides definitions and recommendations for specific terms commonly used for pushbuttons and menus. Examples include defining when to use the term Exit versus Close.

Ms. Ahlstrom stated that the current area being revised in the HFDS is displays. She gave examples of some of the common issues faced in FAA operations related to displays and described the process being used to update the chapter. The updated chapter will seek to cover newer technology. The work on updating the chapter on displays is in progress and she is actively soliciting information relevant to the chapter update. Any suggestions can be sent to Ms. Ahlstrom at [Vicki.ahlstrom@faa.gov](mailto:Vicki.ahlstrom@faa.gov).

**Crew Systems Integrity Program (USAF):** Ms. Jennifer Farrell briefly explained the Weapon System Integrity (WSI) Process that ensures the specified durability, damage tolerance, performance, reliability, suitability, and safety requirements are achieved and sustained under specified operational conditions over a defined service lifetime. The WSI Process that ensures the weapon system functions over the life of the aircraft by looking at the entire aircraft system/platform/item (including support equipment, ground stations, training systems, and other entities used in supporting critical functions) not just the sum of its parts. The consequences of not using weapon system integrity are: loss of system capability, increased mishaps, inability to assess remaining life of critical components, inability to assess economic life of system, and inability to forecast required support resources.

Specifically the Crew Systems Integrity Program (CrewSIP) is an engineering process to ensure the integrity of crew systems and equipment is achieved in development and maintained throughout the system's operational service life. Emphasis is on design and operational integrity of human-machine systems, including Cockpit/Crew Station Integration, Emergency Egress/Crashworthy Systems, Threat Protection/Mission Enhancement, and Human Systems Integration. CrewSIP, the document, will be ready for review soon; we want input from other services and agencies. The USAF wants to make sure all areas covered without making it too big and convoluted and to avoid an excessive coordination cycle.

**MIL-STD-2525, Common Warfighting Symbolology:** Dr. Jake Wetzel from Basic Commerce and Industries. Inc. briefed that version B, Change 2 prior will be published

to July 2006. 2525B, Change 2 will have only minor editing changes; however, will consist of 50 approved change proposals for adding new symbols or amending existing symbols. Forty-three of the approved changes are additions of icons found within Appendix A (C2 Symbology- Units, Equipment, & Installations); whereas, 3 additions were made to Appendix B (Tactical Graphics) and 4 additions to Appendix E (Military Operations Other Than War: MOOTW). Furthermore, a timetable has recently been established for the publication of MIL-STD-2525C in May 2008. 2525C will represent significant changes within the standard. Namely, a specified set of build rules (or draw rules) will be implemented allowing the user the flexibility to create new icons, not otherwise specified within the standard, using pre-existing icon elements or attributes.

The fluid, dynamic status of 2525 has enabled the US Navy the opportunity to contribute to gaps in maritime and air symbology. 2525 has its origins in land based symbology (MCRP 5-2A; FM 101-5-1) whereby a large majority of its symbols represent land-based operations. Currently efforts were undertaken to 1) create icons within 2525 for platforms/equipment that have a corresponding Link 16 messaging ID and 2) create icons for new US Navy platforms such as the littoral combat ship (LCS) and seafaring unmanned vehicles such as the remote mine-hunting system (RMS) for which no icons are available.

In addition to new symbols, a series of empirical performance tests was conducted to determine the optimal implementation of 2525 symbology onto naval tactical displays. Tests ranged from symbol rendering options, concerning topics such as symbol color and symbol size, to navy-specific implementations like engagement symbology. Tests have also addressed direct changes to the standard. For instance, the representation of assumed friend and suspect tracks was altered from the standard depiction employing an external modifier to alternate version employing change within the symbol itself. Subsequently, the alternate associated with the best performance was submitted as an official change proposal for 2525.

### **Other Business:**

**Election of Chair Select:** The SubTAG Charter calls for election of a Chair Select at the Fall meeting of even numbered years. Dave Britton is expecting nominations at TAG # 56 in November 2006.

## Human Factors Test and Evaluation

There is a call for T&E centers to get a description of what their center does on web site (could send in a brochure and they can just copy it to the site).

POC Teresa Alley ([Talley@dticam.dtic.mil](mailto:Talley@dticam.dtic.mil)) TAG website designer  
also Marcie Langelier ([Marcie.Langelier@navy.mil](mailto:Marcie.Langelier@navy.mil))

Air Force Personnel -- Don't forget to attend the Caucus at 5 pm.

Title	Events Notes
John Rice -- Change in Acquisition and HIS.	Introduced the meeting topic by discussing change. How money is being spent on system capability. Asked how we measure capability. Mission task performance should be used as one measure. There should be an independent Technical oversight of programs to ensure designs are acceptable before it is built.
Trish Hamburger, Representing HSI Director, NAVSEA -- Naval Ships Engineering Command.	Discussed the history of SEA03. SEA03 signs off on systems when they meet HSI success criteria. Puts a focus on Human Performance. Attempt to make appropriate changes as early in the design process as possible. SEA03 works with other groups to assist with HSI technical issues and assessment and attempts to increase collaboration between groups to improve efficiency. SEA03 and OPTEVFOR have signed a letter of agreement. Discussed and showed an example of how early mock-up testing found 19 deficiencies, 5 of which were major and required a structural redesign of a new ship. Human system performance assessment capability. Passed out cards to go to the website. This is to develop a taxonomy of measures and metrics. Go to <a href="http://www.websort.net/go/humanperformanceontology">http://www.websort.net/go/humanperformanceontology</a> Pick a user name (if you want to be anonymous, don't use your name). Read instructions. Drag and drop items into categories provided until you have sorted all items. Should take 30-60 minutes, must be done in one sitting. June 30 is the last day to participate.
Diane (Dee) Quashnock -- HSI	Getting real people in the development of Net centric warfare. It is nice to have the boxes, they look at how

Evaluation of Net-Centric Warfare, representing SPAWAR System Command HSI Director	people use the boxes. Found that NetCool and REMAS were inadequate for operational use. Lacked visualization of functionality. Beginning user-centered design to make it easier for users to determine health of the system.
John Owen finished up for Ms. Quashnock.	Went over “what to do” process and “how to” process to get HSI on systems.
Steve Whitehead -- Technical Director, Commander Operational Test and Evaluation Force (OPTEVFOR)	Integrate, test and evaluate over the life cycle of a product. Don't think of DT, OT, or Contractor test, it is only Test and Evaluation. COI's going to mission capability. Tests are being designed to identify how capable a system is. Intent of OPTEVFOR, leverage the expertise of the people you already have.

A brief business meeting followed the presentations.

Mr. John Rice turned over the Chair of the T&E Group to Mr. Darren Cole, this action was accepted by meeting attendees.

First order of action was to elect a new co-chair.

Ms. Trisha Hamburger volunteered to be the new co-chair and was elected by the meeting attendees.

## Human Modeling and Simulation

This meeting of the Human M&S SubTAG had 4 speakers, focusing loosely on the following NetCentric challenges:

1. How should information be made available to users of the Net?
2. What are some of the current challenges? for example:
  - a. Differential 'need to know'
  - b. Information overload
  - c. Human Information Processing Cycle
3. What would a failure to address these challenges lead to?

1. The first speaker was Dr. Elizabeth Bowman, who covered Effects based operations in two dissimilar coalition headquarters: human performance modeling. Her main points focused on the critical human factors issues for EBO, which include balanced roles and responsibilities, high quality information, trust in process, organization, and technology, manageable workload, effective distributed teamwork, coherent command intent, and situation awareness (individual, team, coalition). If desired levels of these variables can be achieved, the coalition staff will then be able to demonstrate a holistic and dynamic understanding of red, blue, and green. This state will enable decision superiority (better decisions faster).

Models are an efficient tool for evaluating alternative organizational structures, personnel configurations, and communication networks in a C2 domain. Dr. Bowman discussed a modeling architecture known as C3TRACE (C3 Techniques for Reliable Assessment of Concept Execution) which was used to evaluate a multinational concept of effects based planning for an urban scenario as executed in the U.S. Joint Forces Command (USJFCOM) Multinational Experiment 3 (MNE3) in February 2004, and, through an extension of the model, to support Multinational Experiment 4 (MNE 4), scheduled for February 2006, which will include an instantiation of both a distributed coalition headquarters and a co-located NATO Response Force (NRF) headquarters.

Emerging challenges in the structure of the model include the cross-functional nature of the headquarters' staffs, the non-linearity of the task flows, and the need for non-military expertise during critical decision points of the process. Pre-experiment workshops held during 2004 and 2005 have served to identify in more detail the supporting concepts that combine to make EBO feasible in a coalition headquarters. A key element that emerges is the necessity to include non-government experts in the planning process early to ensure that planning assumptions are valid and culturally sound.

2. The second speaker was Dr. Mark Livingston who discussed Situation Awareness for teams of dismounted warfighters and unmanned vehicles. His talk focused on the transformation from large-scale battles to quick-reaction mobile forces and one of the key resultant performance requirements, the increased need for situation

awareness (SA); another is the use of unmanned vehicles, which increases the difficulty for the dismounted warfighter to maintain SA.

Dr. Livingston presented his work on an augmented reality (AR) system, a type of synthetic vision that mixes computer-generated graphics (or annotations) with the real world. Annotations provide information aimed at establishing SA and making decisions. An AR system must decide what annotations to show and how to show them to ensure that the display is intuitive and unambiguous. His work focused on analyzing the problem domain of military operations in urban terrain to determine the utility a synthetic vision system like AR can provide to a dismounted warfighter. The focus was on two related scenarios: working with teams of other warfighters who may be occluded by urban infrastructure and working with unmanned vehicles operating in the environment. Tasks like dynamic planning and deconfliction, navigation, target identification, and identification of friend or foe were discussed as were the issues involved in developing a successful synthetic vision system, the measurements that will reveal how successful such a system will be, and the human factors testing necessary to measure the success of a prototype system.

3. Dr. Judith Orasanu was the next speaker, covering the topic of What needs to be shared in shared situation models? Designers of systems to support shared situation models in distributed decision environments often assume that merely sending the same information to all relevant parties will suffice to maintain shared models (or situation awareness). Shared situation models are thought to be critical to distributed decision making and coordinated effort. Considerable effort has gone into learning how to build shared models and testing their effects on performance in the military and other high-risk environments. However, research at NASA Ames Research Center has shown that (a) even if multiple players in a system have exactly the same information, they will not necessarily interpret it similarly, and (b) the advantages of shared models are not universally supported by data. Efforts to enhance distributed decision-making and performance will require a fuller understanding of the sources of interpretation differences, what actually needs to be shared, and strategies to support effective team decision performance. NASA studies have shown differences in both the *sources* of interpretation of shared information and in the *consequences* of those differences in interpretation.

These studies show that more is involved in supporting coordinated team decision-making than simply shared information. As several authors have pointed out, it is not clear how much or what kind of information or knowledge must be shared to support good decisions (e.g., Cooke, et al., 2003). Differing levels of expertise are ubiquitous; years of research on expert-novice differences show how performance differences reflect the mental structures that support interpretation of information. Expert knowledge serves as the basis for the rapid recognition and interpretation of situations essential to recognition-primed decision making. NASA research shows that an important aspect of situation recognition is assessing the level of risk associated with the conditions and potential courses of action, especially in dynamically evolving situations. Differences in knowledge associated with different

roles in a system appear to drive attention to varying features of a situation and thus influence risk perception. Differing goals influence the salience of situational features which feed back into risk assessment.

4. The fourth and final speaker was Dr. Gina Thomas-Meyers, who introduced the SubTAG to a new NATO Study Group, focusing on Human Behavior Representation in constructive simulation. The differentiating focus of this working group from others is the translation of HBR concepts into a combined "how-to" and "when-to" guide for military simulation "practitioners." Previous efforts have identified the shortcomings and research challenges of current HBR and have surveyed the state-of-the-art, providing the necessary foundation for the work effort of HFM-128.

## Personnel Selection and Classification

- I. SubTAG Name: Personnel Selection and Classification
- II. SubTAG Chairs: LT Tatana M. Olson, Ph.D., MSC, USNR  
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Dr. Ray King  
Federal Aviation Administration  
405-954-1163  
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- III. Number of SubTAG Members Present: 6
- III. Total Number of Participants: 19
- IV. Organizations Represented:
  - a. Naval Aerospace Medical Institute (NAMI)
  - b. OPNAV N1
  - c. United States Air Force Academy (USAFA)
  - d. HQ USAF
  - e. University of Oklahoma
  - f. Naval Aerospace Medical Research Laboratory (NAMRL)
  - g. Human Performance Center (HPC)
  - h. Air Force Research Laboratory (AFRL)
  - i. SPAWAR Systems Command
  - j. OPNAV N141
  - k. Navy Personnel Research, Studies, and Technology (NPRST)
  - l. Army Research Institute
  - m. Booz Allen Hamilton
- V. SubTAG Business
  - a. No elections held
  - b. No SubTAG open actions

## Abstracts

### *Test of Basic Aviation Skills: Pre-Implementation Status*

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In 1993, the US Air force operationally implemented a new pilot candidate assessment program called the Pilot Candidate Selection Method (PCSM). The PCSM equation combined scores from the Air force Officer Qualifying Test (AFOQT), the Basic Attributes Test (BAT), and a measure of flying experience to create a pilot aptitude score. PCSM has demonstrated validity against pilot training performance and has been both reliable and cost-effective. The PCSM program will undergo significant changes this summer. Most notably, the BAT, a component of PCSM, will be replaced by the Test of Basic Aviation Skills (TBAS). The change from the BAT to TBAS is being made to upgrade test hardware and software and extend the PCSM program. The change will be largely transparent to pilot training applicants. The TBAS, like its predecessor, includes measures of cognitive and psychomotor ability, and has demonstrated the ability to improve the prediction of pilot training performance above the AFOQT alone. BAT testing is scheduled to be discontinued on 17 July 2006. TBAS is expected to be fully operational at all testing sites by 14 August 06. Pre-operational activities are focused on final TBAS and PCSM algorithm development, fielding test systems and training test control officers, and development of technical and applicant information materials.

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### *NPRST's Whole Person Assessment Approach to Selection and Classification*

Amanda Lords, EdD  
Navy Personnel Research, Studies, and Technology (NPRST/PERS-1)  
Bureau of Navy Personnel  
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To enlist in Naval service, applicants must meet the minimum basic requirements on the Armed Services Vocational Aptitude Battery (ASVAB), provide information about their criminal and financial history, and pass a brief physical examination. If there is no disqualifying information, the applicant may enlist in Naval service. A classifier uses ASVAB scores and identifies which technical training schools the applicant is likely to pass and compares this list against jobs the Navy identifies as 'critical-to-fill.' The classifier attempts to interest the applicant in one of the critical jobs in a roughly seven-

minute interview. At the conclusion of this very brief meeting, the classifier and applicant come to an agreement and a contract is signed guaranteeing the technical training school, which functionally dictates the applicant's entire Navy career path. However, individuals are more complex and multidimensional than can be measured by the ASVAB alone. Beyond the cognitive abilities assessed by the ASVAB, individuals possess a variety of interests and personal characteristics that should be useful for identifying who will be best suited for military missions of the future. Currently, Navy Personnel Research, Studies, & Technology (NPRST) is seeking to measure these complex multidimensional variables to improve selection and classification in the Navy through the Whole Person Assessment (WPA) approach. Several projects comprise WPA and will be discussed. 1<sup>st</sup> Watch and Officer Competency Assessment (ORCA) both assess a variety of measures including person-environment fit, satisfaction, and commitment at various points of a sailor's (both Enlisted and Officer) progression from recruiting, accessions training, technical training, and into the fleet. Rating Identification Engine (RIDE) and Job Opportunities in the Navy (JOIN) are complementary programs that sort individuals into jobs for which they are cognitively qualified and interested in, respectively. With advancing technologies, Navy personnel are required to attend to and process information from many sources, often in highly demanding and strenuous environments. SYRUS is in year two of development and seeks to quantify individuals' capacity for multitasking. Finally, the Navy Computer Adaptive Personality Scales (NCAPS) is a personality inventory, comprising 10 scales (plus 3 in development), currently undergoing large-scale validation. The goal of NPRST's WPA approach is to develop instruments that can be used in combination to better match Sailors to jobs for which they are best suited, thereby improving job performance, person-job fit, and job satisfaction, and reducing unwanted attrition.

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### *Development of an Army Aviator Selection Instrument*

Lawrence C. Katz, Ph.D.  
Army Research Institute - Rotary Wing Aviation Research Unit (ARI RWARU)  
Fort Rucker, Alabama  
lawrence.katz@rucker.army.mil

The US Army is interested in replacing the current aviator selection instrument, the AFAST, with a computer-based, web-administered test with emphasis upon aptitudes required for Future Force aviator performance within the Future Combat Systems environment. The Army Research Institute's Rotary Wing Aviation Research Unit (ARI RWARU) is approaching completion of these objectives by developing a prototype Selection Instrument for Flight Training (SIFT) that assesses the knowledge, skills, abilities, and non-cognitive attributes (interpersonal and motivational factors) relevant to success in performance as a rotary wing pilot. We accomplished this via six broad tasks: Task 1. Review existing accession process and relevant literature; Task 2. Conduct training and job analysis; Task 3. Develop criterion and predictor measures; Task 4. Construct and pilot-test the prototype instrument; Task 5. Conduct a preliminary validation of the prototype instrument and; Task 6. Produce a comprehensive prototype

selection instrument technical report. This presentation will provide an overview of each of these tasks, the current status of this project, and near-future directions for selection and classification in Army aviation.

*NAMIS Screening Technology Development*

Lisa J. Mills, Ph.D.  
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The Navy Applicant Management Information System (NAMIS) project was launched by N141 and CNRC in FY06 to develop new technology for DEP screening. This system will be used to administer screening instruments to improve the selection and classification of Navy recruits, as well as decrease early attrition.

Two pilot programs were selected to examine proof-of-concept for the NAMIS platform. Special Programs screening was identified as a current Navy priority, particularly for reducing RTC attrition for SEAL, SWCC, EOD, Diver, and Air Rescue personnel. Screening will also focus on seeking new candidates for Special Programs' recruitment within the DEP pool.

The second pilot for this project is DEP PQS. The goal of this effort is to build interactive activities to deliver PQS information in DEP, as well as tracking mechanisms for recruiter monitoring of DEPer progress through the instruction modules. Facilitating and measuring active learning is a primary objective for this pilot, and data will be gathered to evaluate performance correlates of learning styles in basic training.

The main product of NAMIS will be new DEP screening technology to improve Sailor job fit by pushing screening to the front. Better job matching promotes positive outcomes such as increased performance, job satisfaction, and reduced attrition. In addition, this study will yield preliminary findings on the validity of new tools for Special Programs screening and DEP PQS instruction methodologies.

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*Navy Aviation Selection Test Battery (ASTB) Redevelopment Efforts Program Update*

LT Tatana M. Olson, MSC, USNR, Ph.D.  
Naval Operational Medicine Institute, Operational Psychology Department  
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The Aviation Selection Test Battery (ASTB) is the principal "screening tool" used by the Navy, Marine Corps, and Coast Guard to identify qualified candidates for flight training

as aviators and flight officers. Portions of the battery are also used to screen applicants for Officer Candidate School (OCS) and the Reserve Intelligence community. Primarily an aptitude test, the ASTB assesses quantitative skills, the ability to extract meaning from written material, mechanical comprehension, and the ability to visualize and manipulate the orientation of objects in three-dimensional space. In addition, the ASTB includes a knowledge-based test assessing individuals' familiarity with basic aviation and nautical concepts. In use for more than 60 years, the ASTB has demonstrated excellent predictive validity with regards to performance in the introductory phases of flight training. Presently, the ASTB is undergoing a multi-year upgrade and revalidation process led by the Naval Operational Medicine Institute (NOMI) in Pensacola, Florida. The goal of this initiative is to enhance our ability to accurately select student aviators and flight officers that will have the highest chances of success in flight training and ultimately, in the fleet, by exploring areas that were previously untapped by the current ASTB. Efforts involve expanding the test battery to include non-cognitive measures such as personality and biodata inventories and psychomotor or performance-based measures as well as the development of a computer adaptive version of the ASTB. This presentation will provide an overview of the ASTB and an update on the status of research currently underway as part of the ASTB revision project.

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### *Psychomotor Testing in Naval Aviation Selection*

LT Brent A. Olde, MSC, USN, Ph.D.  
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The Aviation Selection Test Battery (ASTB) is currently used to select Navy, Marine Corps, and Coast Guard aviators. A form of this test has been in existence since 1942. Although the ASTB assesses math, reading comprehension, mechanical comprehension, aviation knowledge, and spatial abilities, the pencil-and-paper version of this test is limited by its static presentation. However, advances in computer administered testing now provide the capability to assess previously untapped aviator abilities; specifically, a pilot's ability to track multiple targets while selectively attending to auditory stimuli.

The notion of using psychomotor tests for aviation selection is not new. In fact, these tests have been around since the 1930's (Griffin & Koonce, 1996). Griffin (1987) concluded that psychomotor tests could explain an additional 16% variance above and beyond that explained by the traditional ASTB. Delaney (1992) replicated these findings and asserted that psychomotor measures could account for an additional 14.8% of unique variance. In other words, these two studies indicate that psychomotor tests can provide approximately 15% more "information" about the difference between aviators who get low flight grades and aviators who get high flight grades. This is possible

because psychomotor tests tap a skill set that is not be assessed by the traditional ASTB.

The reason why such tests were never widely adopted by the Navy was that they were deemed too expensive. There are approximately 150 testing facilities across the United States and on average, 10,000 applicants a year take the ASTB. In the past, the notion of managing hardware, software, and technical support for such a large quantity of testing was not cost effective. However, times have changed. High speed computers and internet bandwidths have made psychomotor tests more practical. When one figures the escalating costs of pilot training, the current ease, cost, and speed of technology, and the addition of approximately 15% more predictive power in pilot selection, it is easy to conclude that psychomotor tests should be included in the Navy's pilot selection system.

Building on collaborative research conducted between the USAF's [Air Education and Training Command \(AETC\)](#) Studies and Analysis Squadron (SAS) and the Naval Aerospace Medical Research Laboratory (NAMRL), the Navy's new psychomotor test will contain three main components: a direction orientation task, a dichotic listening task, and a multi-tracking task (the latter two tasks will be combined to make a more difficult multi-tasking test). The current presentation will provide additional details about the specific tests included in the proposed psychomotor battery and include a live demonstration of the prototype version of the Navy's new psychomotor test for aviator selection.

## SubTAG Discussion

After the presentations, the floor was opened to discussion about any of the topics presented during the SubTAG session. Discussion centered around three key themes that were identified from the presentations. The first theme was the growing acceptance of the use of personality assessment for selection and classification purposes in the military. The Army, the Air Force, and the Navy either currently include or are planning on including a personality-based assessment tool in their selection and classification systems for aviators (Army, Air Force, Navy) and enlisted personnel (Navy). The SubTAG agreed that this growing acceptance was due to the increased understanding among upper leadership that these types of personality assessments are not clinical in nature and are not designed to result in a clinical diagnosis of a psychological disorder, thus creating a negative stigma among military personnel of personality testing. Greater support of personality assessment allows the potential of personality to provide incremental validity above and beyond traditional cognitive ability tests in the prediction of performance and attrition in the military to be realized.

The second theme was the growing interest in using computer and internet technology to deliver selection and classification tests. Utilizing a web-based platform provides the increased advantage of being able to test in a greater number of locations, including remote and OCONUS locations. In addition, web-based testing saves costs attributed to mailing, can provide instant scoring, enhances test security, and provides a platform that can be used to administer alternatives to traditional multiple choice tests such as performance-based measures. As bandwidth increases and computer technology becomes more sophisticated and accessible, web-based testing is certain to expand beyond its current capabilities.

The third theme discussed by the SubTAG was a realization that there are more similarities than differences between the services in the knowledge, skills, abilities, and personality traits that they are trying to select for. For example, the Army and the Air Force are working with the Navy to leverage many of the tests used in their Aviation Selection Test Battery for aviation selection within their own services. In addition, the personality traits identified by the Navy as important for performance in aviation are very similar to those identified by NPRST as important for enlisted personnel across multiple ratings. Every service has limited resources that can be allocated to selection and classification projects. Thus, continued collaboration and leveraging of existing technologies across the services can serve to benefit all involved.

# Sustained/Continuous Operations

## 1. SubTAG name

Sustained/Continuous Operations (SUSOPS)

## 2. Number of members present

~30

## 3. Organizations represented:

Speakers: Eye-Com Corp, Ambulatory Brain Monitoring, University of Oklahoma, Navy  
Audience: Army, Navy, AF, NASA, academia, private industry

## 4. Agenda Covered

Wednesday, 17 May 2006

Aladdin Casino & Resort Conference Center- Sapphire A

1500 – 1505 Opening Comments

1505 – 1645 Presentations

1645 – 1700 Summary, questions, discussion, SubTAG business

## 5. Abstract of each presentation

### ***Eye-Com® Oculometric, EEG and Cognitive-Performance Monitoring of Sleep-Deprived Subjects in a Drive/Flight Simulator Outfitted with Tele-Communications Transmission, Recording and Alerting Technology***

William Torch, MD, Eye-Com Corp & Washoe Sleep Disorders Center  
Reno, NV

The evolution and history of the patented Eye-Com Biosensor, Communicator and Controller technology is presented. Eye-Como is a head-worn oculometric biosensor system which is capable of, by means of its Eye-See®© and Eye-Mouse®© software functions, monitoring, transmitting and recording over 20 different monocular and binocular oculometric parameters in real time, along with other bio-physiological (e.g. EEG, EOG, EKG, pulse, oximetry, etc.). Eye-Com® oculometrics may be integrated in real time with alertness and cognitive performance measures as well. By means of an Eye-Como generated Composite Oculometric Fatigue Index (COFI)™ and Safety Response Algorithm, the Eye-Com® Biosensor system will be able to alert a drowsy individual through its tactile vibrating Eye-Com Rumble® Seat as well as auditory or visual alarms. While recording and transmitting its data locally or to a remote monitoring

station through a telecommunications system, Eye-Com® holds promise of being used to monitor personnel for changes in alertness, consciousness and emotion in any domain (e.g. ground-based stationary, boat, submersible, scuba, aerospace, etc.). Besides its relevance to civilian and military safety, Eye-Com's platform technology has multiple medical and non-medical applications. Eye-Com's technology is being developed and will be clinically validated in the AASM-Accredited Washoe Sleep Disorders Center/Eye-Com Corporation Drive/Flight Simulator, and at the USAARL UH-60 Blackhawk Helicopter Simulator facility, Ft. Rucker, Alabama with US Army SBIR Phase II, USDoD and USDoT/NHTSA Congressional Research Initiative support.

***Real-time Quantification of EEG Indices of Drowsiness: Methods for early identification of individuals most susceptible to sleep deprivation***

Chris Berka, Daniel J. Levendowski, Philip Westbrook, Gene Davis, Michelle N. Lumicao, Vladimir T. Zivkovic, Richard Olmstead\*

Ambulatory Brain Monitoring, Inc.

San Diego, CA

\*Veterans Affairs Greater Los Angeles Healthcare System

Los Angeles, CA

An overview of current and future applications of the technologies developed by Advanced Brain Monitoring will be presented, including the portable wireless Sensor Headset designed to acquire EEG in operational environments and the methods for analysis of the EEG in real-time. The B-Alert EEG analysis software quantifies level of drowsiness-alertness and has been validated in full and partial sleep deprivation studies. The EEG indices parallel the circadian cycles in alertness and have been shown to identify individual differences in susceptibility to the effects of sleep deprivation. Patterns in the EEG metrics have proven predictive of performance deficits in vigilance, learning and memory. The EEG system has also been successfully integrated into a real-time, closed-loop system to provide feedback when drowsiness was identified with the goal of optimizing performance during a driving simulation task.

***Computer-based Performance Assessment to Enhance Decision Superiority***

Robert E. Schlegel, Ph.D. & Kirby Gilliland, Ph.D.

Center for the Study of Human Operator Performance (C-SHOP)

University of Oklahoma

Norman, OK

The Center for the Study of Human Operator Performance (C-SHOP) is an established multi-disciplinary research center at the University of Oklahoma that focuses on the development and application of computer-based test systems for assessing human performance capability across a broad range of military, industrial, educational, and medical applications. C-SHOP is one of the nation's premier sites for developing advanced computer-based testing technology and for conducting research exploring the limits of human cognitive and neuropsychological function. It is the only center in the

nation that focuses on the critical requirements for human cognitive performance assessment test systems through the simultaneous coordination of high-level research, test development, quality assurance assessment, and clearinghouse/ coordination activities related to computer-based testing technologies. (<http://www.c-shop.ou.edu/>, 2006)

***“Short Sleepers and Long Sleepers”*: Individual Difference in Performance After Sleep Deprivation**

Marcus Taylor, Ph.D., Naval Health Research Center  
San Diego, CA

Research was presented from a recently completed protocol conducted by the Naval Health Research Center, and the University of California, San Diego, looking at group differences in behavioral performance and cerebral activation (measured with FMRI) following total sleep deprivation. Two separate groups were compared: people who sleep less than 6 hours every night-- “short sleepers,” and those that sleep more than 9 hours every night-- “long sleepers.” There were three tasks (PVT, Serial Subtraction, Verbal Learning) administered under both a well-rested condition and after being sleep deprived for 36-hours, and analyzed. Trends show that there are group differences in both task performance, as well as sleep (normal and recovery) architecture.

**6. Highlights of issues or concerns discussed during the meeting, the results of the discussion and recommendations for action, if any**

No SubTAG business was discussed during the session

**7. Results of any elections held**

No elections held

**8. SubTAG open actions, if any, and the target date for completion**

No open actions created

**9. Name and phone number of chairperson**

**Co-Chairs:**

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## **System Safety/Health Hazards/Survivability**

This subTAG did not meet at TAG-55.

## **Technical Society/Industry**

No report submitted.

# User-Computer Interaction

Sub TAG name: **User-Computer Interaction**

Number of members present: **29**

Organization represented: **SA Technologies, Micro Analysis & Design, Skillsnet, Inc., USAFA, AERL, Purdue University, DARPA, NASA, NAVAIR, Boeing, NAMRL**

Agenda covered: None

Presentations: Five presentations relevant to the theme of Enabling Decision Superiority with HSI were covered during this session. The following are the brief overview of the presentations.

## Presentation 1

Title: Warfighter-Machine Interface for FCS

Presenter: Mica Endsley

Organization: SA Technologies

Abstract:

Dr. Endsley made a highly graphical presentation on the US Army's Future Combat System (FCS) program, emphasizing the user interfaces ("Soldier-Machine Interfaces, or SMI") being conceptualized, designed and built in support of the 18 platforms and network comprising FCS. The Future Combat Systems program is the Army's major modernization effort for the 21st century. It includes a highly integrated structure of 18 manned and unmanned systems, connected across a distributed network. The Battle Command software that operates across FCS integrates networked communications, networked operations, sensors, training and reconnaissance and surveillance capabilities to provide the opportunity for highly advanced levels of situation awareness and force synchronization. The network of distributed warfighters operating across all of these systems will be connected by a common, consistent warfighter-machine interface(WMI) that has been tailored for each of the 113 unique warfighter roles involved. Using a Situation Awareness Oriented Design process, the WMI has been designed from the warfighter up to support the highest levels of situation awareness and minimize unnecessary workload. Information is integrated around the warfighter's goals and decision requirements. There is explicit support for multi-tasking and the at-a-glance understanding of information that is critical for these highly dynamic and fatiguing operational conditions. Operations on the move are supported for a wide variety of collaborative tasks across the distributed warfighting team. The FCS WMI provides a significant advance in warfighter-centered design processes and in achieving a highly usable system for the Army's future warfighters.

## Presentation 2

Title: The Role of Performance Prediction in UCI Design

Presenter: Susan Archer

Organization: Micro Analysis & Design

Abstract: GRBIL – A Tool to Evaluate the Usability of Unmanned Vehicle Interfaces  
Sue Archer, Micro Analysis & Design, Inc.

### Goals

It is important to predict the effectiveness of operator control interfaces before they are actually developed. Under the Army's Advanced Decision Architectures (ADA) Collaborative Technology Alliance (CTA) basic research effort, we are developing a software tool that allows system developers to evaluate the efficiency and effectiveness of an interface design by simply sketching out the interface graphically. This capability is enabled through the integration of a cognitive modeling framework with a traditional human-system integration modeling paradigm so that detailed predictions about the possible cognitive errors that might result can be made early in the design of a human-computer interface.

### Description

The tool, GRaph-Based Interface Language (GRBIL), takes a graphical description of an interface and automatically generates an Adaptive Control of Thought – Rational (ACT-R) cognitive model of the user interacting with an Improved Performance Research Integration Tool (IMPRINT) task network model of the system. This approach to interface evaluation is underpinned by the first-principle models of cognition implemented within the ACT-R architecture. The degree to which an interface supports the user is a matter of understanding the interplay of both general constraints on cognition and the expertise a user might possess. This is an effective method for evaluating system interfaces to detect potential errors and inefficiencies. In addition, researchers can use the models to identify alternative system designs.

### Accomplishments

- Created an extended prototype GRBIL tool that can run multiple Experimental Unmanned Vehicles (XUVs) simultaneously
- Developed an integrated prototype that automatically generates IMPRINT and ACT-R models directly from user input
- Validated the functionality and output of the prototype tool
- Integrated with AVOCET, a tool to help determine the number of operators required to operate multiple unmanned vehicles

### Benefits to Soldiers

- Identifies system designs that are easy to use, easy to learn, and are the most efficient interface
- Predicts the Soldier's ability to effectively control multiple unmanned vehicles

- Informs the design of human-computer interactions early in the design cycle, increasing the likelihood that information technology will actually support the Soldier.

### **Presentation 3**

Title: HSI Constraints on UCI Design

Presenter: Jennifer Narkevicius

Organization: Skillsnet, Inc.

Abstract: User Computer Interfaces have tended to be the province of Human Factors. As UCI become more ubiquitous the user populations continue to become less specific. This more general use, especially in work settings increases the necessity to ensure the user requirements are appropriate and flexible. The Human Systems Integration (HSI) domains all have something to contribute to the requirements definition as well as the design and implementation of the software and hardware. This need is emphasized when the UCI is part of a decision superiority support system. Manpower, Personnel, Training and Human Factors all clearly have useful input to the engineering design trade space when systems are designed and implemented. HSI processes and tools can bring power and rigor to the design and enable to best performance from the UCI. Integration of the tools, especially through modeling will result in effective improvements for the systems and their UCI.

### **Presentation 4**

Title: Eye-tracking Analysis of Usability Evaluation Videos

Presenter: Jenny Coker

Organization: Air Force Academy

Abstract:

Advances in technology have given researchers new methods for evaluating human computer interaction and error. Usability evaluation software such as TechSmith Morae provides the usability evaluator with the capability to record audio, video of the user, and desktop screen activity in a “picture-in-picture” (PIP) format, allowing the evaluator to observe the interface screen and the human user simultaneously. The research reported here examined how much attention is given to the PIP video when evaluators are observing results from a usability evaluation session. Eighteen cadets at the Air Force Academy participated in this study. Half of the participants were considered experienced evaluators and half were novice evaluators. Evaluators watched two video recordings that differed in the quality level of the PIP video. Focus of attention was measured with eye-tracking equipment and software. The results showed a significant difference between experienced and novice usability evaluators in terms of the time spent viewing the PIP and number of problems reported. Experienced evaluators spent nearly double the amount of time looking at the PIP video and also found approximately

one-third more usability problems. All evaluators spent more time looking at the PIP video when it was set to a higher quality. The results also showed that the quality of the PIP video had no significant effect on an evaluator's ability to recognize usability problems. Implications for usability evaluation were discussed in addition to follow-on research in this area.

## Presentation 5

Title: Usability Methods for Undergraduate Education and Research

Presenter: Lt Col Terence Andre  
Organization: Air Force Academy

Abstract: For several years, usability has no longer required justification in most quarters. Because of the growing awareness of its importance, organizations have been expending resources for “doing usability”—building enviable usability laboratories, buying usability equipment, training developers in usability engineering methods and conducting usability testing. This push has created high-end laboratories with state-of-the-art recording equipment. The work at the Air Force Academy has led to the development of a flexible laboratory environment where recording can occur from a large observation room connected to existing research rooms over a local area network. No structural modifications were required to the existing laboratory space (e.g., no one-way mirrors). The large observation room allows for students in human factors, computer science, and systems engineering courses to observe usability recording sessions without any distractions to the participant. As a result, usability evaluation objectives were integrated into the courses with both content and live demonstrations with the objective of making the lab a “teaching machine” for usability. This presentation highlighted the tools that are currently being used in the USAFA laboratory.

### Co-chairs:

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# Workload and Stress

## PURPOSE:

The Workload and Stress subTAG meeting focused on workload and stress to enable decision superiority. The session offered a forum for collaboration of researchers and users working the area of workload and stress that support current and future research and development for enhanced soldier performance decision superiority. Presentations, discussions, and posters shared current science and technologies and ongoing research and development in the areas of workload and stress along with a hands-on demonstration of new technologies to assess fitness for duty in order to enable decision superiority in a global and noncontiguous battlespace.

1. **SubTAG name:**  
Workload and Stress
  
2. **Number of members present:**  
40 (see attached sign-in sheet)
  
3. **Organizations represented:**  
Army  
Navy  
Air Force  
Boeing  
DRDC Toronto  
General Dynamics  
Booz Allen  
(see attached sign in-sheet)
  
4. **Agenda covered:**

### Workload and Stress – Part 1

#### Posters:

Effects of Stress and Coping Style on Basic Combat Training Confidence, Performance, and Discipline – Davis, T.W., PhD (Army Research Laboratory, Human Research and Engineering Directorate)

Effects of Shift Work and Sustained Operations: Operator Performance in Remotely Piloted Aircraft (OP-Repair) – Tvaryanas, A. P., Thompson, W. T., Lopez, N., et al. (311<sup>th</sup> Human Systems Wing, Performance Enhancement Directorate; Air Force Research Laboratory, Human Effectiveness Directorate).

## **Briefings**

Branscome, T. A., & Grynovicki, J.O. (Army Research Laboratory, Human Research and Engineering Directorate)

*Effects of Individual Factors and Workload Level on Performance in a Multi-task Environment*

Klein, E., and Wertz, J.(United States Military Academy, Department of Behavioral Sciences and Leadership)

*A Dynamic Workload Prediction: Applications of Commercial Off-The-Shelf Gaming Environments to Cognitive Exploration*

Smyth, C. (Army Research Laboratory, Human Research and Engineering Directorate)

*Crew Mental Models of Shared Workload for an Automated Military Ground Vehicle*

Bowman, E., PhD, Thomas, J., MS (Army Research Laboratory, Human Research and Engineering Directorate)

*Workload and Information Quality in Effects Based Operations: Lessons from MNE 4*

Taylor, M.K., Sausen, K.P., Mujica-Parodi, L.R., Potterat, E.G., Yanagi, M.A., & Kim, H. (Naval Health Research Center, State University of New York, Fleet Aviation Specialized Training Group)

*Individual Differences in Stress Resilience and Human Performance During Survival, Evasion, Resistance, and Escape Training: The SERE Study*

Mahoney, C.R., Hirsch, E., Hasselquist, L., Leshner, L.L., & Lieberman, H.R. (Natick Soldier Center, Science Applications International Corporation, U.S. Army Research Institute of Environmental Medicine)

*Effect of Movement and Physical Exertion on Dismounted Soldier Vigilance*

## **Workload and Stress – Part 2**

Osborne, L.A.,DNSc, LCDR, O'Connor, K.H., PhD, Coen, M.L., MS, Crepeau, L.J. LCDR, Whanger, J.C., PhD., & Cullum, M.E., PhD, (Naval Institute for Dental and Biomedical Research)

*Salivary Cortisol as a Biological Marker for Enlisted Submariners*

*Hands-On Workshop:*

*Cognitive Readiness in HSI – A demonstration of the Army's newest automated cognitive battery, Army Cognitive Readiness Assessment (ACRA). Ways to incorporate the cognitive data within model-based technology evaluations will be discussed. Fatkin,*

L., Swann, M., Thomas, J. (Army Research Laboratory, Human Research and Engineering Directorate), Schmidt, R. (NTI, Inc.)  
*Workshop is limited to 15 participants, unlimited observers. The registered participants will receive a CD containing the ACRA. "Please see attached flyer for computer system requirements."*

## **5. subTAG Abstracts:**

### **Effects of Stress and Coping Style on Basic Combat Training Confidence, Performance, and Discipline - Thomas W. Davis – Army Research Laboratory**

The attrition rate of enlistees in basic combat training is of particular concern to all Branches of the military due to the high cost associated with recruiting and training a new enlistee. Each year the military loses hundreds of millions of dollars invested in enlistees whom never make it to their first duty station.

Investigators have extensively examined the impact of physiological injuries on the rate of enlistee discharge from basic combat training. Also, investigators have reported that alcoholism, adjustment disorders, mood disorders, and personality disorders were among the leading hospital discharge diagnostic categories for enlistees during the 1990s; especially, within the first six-months of service. Additionally, investigators have reported that the transition process from civilian to military in basic combat training tends to be very stressful and anxiety provoking for enlistees. However, little data has been gathered to assess the relationship of enlistees' physiological and perceived stress levels and their attrition rate.

A study was conducted of 155 soldiers during their nine-week basic combat training at Fort Jackson, South Carolina. Salivary amylase testing was used as an objective measure of physiological stress, and the Multiple Affects Adjective Checklist Revised (MACCL-R) was used as a subjective measure of perceived stress. It was hypothesized that enlistees with higher levels of stress would also have a higher level of depression and hostility resulting in performance degradation. The results of linear regression analyses and multivariate pairwise correlations showed a statistically significant positive relationship among perceived stress, hostility and depression levels. Additionally, the analyses showed that for the soldiers participating in this study, coping style moderated their perceived stress experience. Those soldiers who were able to modify their coping mechanism to meet the physically and mentally demanding challenges of basic combat training tended to be more confident in successfully completing training. Moreover, they were less likely to receive disciplinary action.

### **A Dynamic Workload Prediction:**

#### **Applications of Commercial Off-The-Shelf Gaming Environments to Cognitive Exploration - Edward Klein and Jonathan Wertz - United States Military Academy - Department of Behavioral Sciences and Leadership**

The purpose of this study is to establish an industry standard for predicting dynamic workload in a simulation environment. Historically, workload assessment, such as NASA-TLX studies, has been used to determine post hoc workload of users at discrete points of performance. This type of assessment does not allow for convenient

manipulation of variables or the analysis of workload across a continuous and changing sequence of stressors, tasks, and distracters. Each participant played a single workload mission, in Operation Flash Point, with varying levels of difficulty. The researchers hypothesize that dynamic workload is a function of enemy distance, movement, number, and the presence of noise in the visual environment, and there is a positive relationship between the four factors used to predict workload and a soldier's self-reported workload.

### **Crew Mental Models of Shared Workload for an Automated Military Ground Vehicle – Christopher Smyth – Army Research Laboratory**

Developers of future forces are implementing automated crew stations for military ground vehicles. In designing such systems, the effect of the automation on workload and crew performance is important. In particular, the automation while increasing the task performance, may adversely affect the mental models that the crew members have of the workload shared for crew interaction and planning. To investigate this, workload assessments were conducted through the administering of questionnaires during a technology demonstration of the Vetrionics Technology Testbed (VTT) vehicle. Developed by the U.S. Army Tank Automotive Research Development & Engineering Center, the VTT is a demonstrator of crew automation technology for armored ground vehicles that is operated by a two-soldier crew from identical crew stations within the vehicle. A significant finding is that the crew members have different mental models of the amount of workload performed by each other depending on their role (as determined by their rank). The crew chief rated the work done by the mate as less than the mate rated for himself, while the mate rated the chief's work as more than the chief rated for himself. This was true for the meta-work and the team work but not the task work. Similarly, there is no difference in the self-rated perceived workload measures of the NASA-TLX for the chief and mate, but the other-rated workload measures are significantly greater for the chief than the mate. The differences between the self-rated and other-rated work-types sums and those differences for the perceived workload global sums are positively correlated. The fact that a discrepancy exists between the mental models of work distribution among the crew members in an automated work station environment could be a tactical disadvantage. This is because during high stress conditions the crewmate may not recognize when he or she needs to participate in teaming work, a result that could impact crew interaction and therefore system performance. The automation technology may isolate the crew from those aspects of the task that they need for maintaining an awareness of the teaming status and this can produce a form of task attention deficit that has been reported to occur with automation. The implication is that the automation must support the maintenance of crew mental models that include the shared work.

### **Will Network Centric Warfare Result in Decision Superiority? Lessons from MNE 4 - Elizabeth Bowman, Ph.D and Jeffrey Thomas, MS – Army Research Laboratory**

Multinational Experiment 4 (MNE 4) was conducted by US Joint Forces Command (JFCOM) from 20 Feb – 17 March 2006. Two headquarters represented a distributed Coalition Task Force (CTF) and a collocated NATO Response Force (NRF). The experiment tested a process, organization, and technology for a coalition effects

based approach to operations (EBAO). In this approach, the functions of planning, execution, and assessment were simulated. In the CTF, participating nations included Australia, Canada, France, Finland, Germany, Sweden, UK, and US.

We collected workload data for each headquarters using the NASA Task Load Index (reference). These surveys were administered daily to participants at the conclusion of the experiment day. We used a repeated measures analysis to examine the workload data. Though we did not measure decision quality directly, we asked participants to rate the quality of information they received as a proxy measure. Participants rated information based on timeliness, accuracy, sufficiency, concise presentation format, relevance, completeness, succinctness, accessible, interpretable, and understandable.

In addition to numerical survey responses, participants were allowed to provide comments to each question. Researchers also engaged in direct observation to record notable actions and comments. These methods were triangulated to provide an emerging understanding of how these headquarters generated, processed, and used information to prosecute the EBAO.

Initial evaluations of the workload data indicate that mental workload, on average, generally fell in the 5.5-6.5 range (on a 10 point scale) and that frustration, on average, was high (6.0 – 6.5 range) but fell over time as technology problems declined and participants became more familiar with the computer tools in use. [Data analysis will be completed for the workload scale by approximately 3/31 and will be reported in the presentation in full.] Ratings of information quality were generally in the 5.0-6.0 range (measured on a 7 point scale) but ratings that were related to technology problems (e.g. timeliness, completeness, concise format, and accessibility) were slightly lower. [Data analysis will be completed for information quality by 3/31 and will be reported in the presentation in full.] When comparing the distributed CTF to the collocated NRF, the latter staff reported slightly higher ratings for information quality and lower ratings for workload and frustration. These survey results suggest that distributed staffs expend additional energy in task completion due to the constraints of computer-supported communication and collaboration.

Our conclusions suggest that high levels of mental workload and frustration, combined with moderate levels of information quality, result in a command environment not conducive to high decision quality. We present initial suggestions for technology improvements that could reverse this finding.

NOTE: The experiment was classified as Secret, releasable to NATO and the nations involved in MNE 4. The survey data, observations, and comments provided by participants is now undergoing a cleansing process and will be distributed to analysts by 24 March. We were able to engage in initial data analysis while on site, but could not export data individually. When the authors receive the unclassified data files, we will fully complete our data analysis.

**Individual Differences in Stress Resilience and Human Performance During Survival, Evasion, Resistance, and Escape Training: The SERE Study - Taylor, MK<sup>1</sup>; Sausen, KP<sup>1</sup>; Mujica-Parodi, LR<sup>2</sup>; Potterat, EG<sup>3</sup>; Yanagi, MA<sup>1</sup>; Kim, H.<sup>3 - 1</sup> Naval Health Research Center, San Diego, CA - <sup>2</sup> State University of New York –**

## **Stony Brook - <sup>3</sup> Fleet Aviation Specialized Training Group – Pacific, San Diego, CA**

U.S. military members at high risk of capture are required to attend Survival, Evasion, Resistance, and Escape (SERE) training. This physically and psychologically demanding course is considered a reasonable controlled analogue to the stress imposed by war, captivity, and related catastrophic events – thus offering the scientist a unique and unprecedented medium in which to examine human stress and performance during a realistic operational context. Operational stress is multifaceted, manifesting cerebral, neuroendocrine, cardiac, and cognitive-behavioral characteristics, necessitating multiple methods of measurement to accurately characterize its complexity. In this presentation, we will describe our research methods aimed at characterizing responses to intense operational stress using a variety of techniques, including neuroimaging, neuroendocrine assays, and cognitive performance measures suitable for laboratory and field environments. We will then discuss how these stress measures may predict behavioral performance, declarative memory, symptoms of dissociation, and other key performance endpoints occurring during SERE training. Preliminary data will be presented, testing (across multiple human systems) the conventionally advocated “inverted-U hypothesis” that an optimal level of stress is associated with favorable human performance outcomes. Ultimately, individual differences moderating the stress-performance relationship will be discussed.

## **Effect of Movement and Physical Exertion on Dismounted Soldier Vigilance - Mahoney, C.R.<sup>1</sup>, Hirsch, E.<sup>1</sup>, Hasselquist, L.<sup>1</sup>, Leshner, L. L.<sup>2</sup>, & Lieberman H.R.<sup>3</sup> <sup>1</sup>Natick Soldier Center, Natick, MA, USA - <sup>2</sup>Science Applications International Corporation, Natick, MA, USA - <sup>3</sup>U.S. Army Research Institute of Environmental Medicine, Natick, MA, USA**

The effects of movement and physical exertion on cognitive processes remain unclear. Some studies report improvements in information processing while others report decrements or no change. To address relationships between movement, physical exertion and cognitive performance, vigilance performance was examined while soldiers walked with a heavy (40 kg) load. Volunteers (N=18) completed six 30-minute test sessions on separate days: standing; walking with or without obstacles; while carrying a 40 kg load or no load. Suprathreshold visual, auditory or tactile stimuli were presented during the vigilance task. Dependent measures included accuracy, response time and distance traversed. Volunteers reported higher perceived exertion ( $p < 0.05$ ) when carrying a load and these ratings increased with time ( $p < 0.05$ ). There were fewer correct responses on the vigilance task when carrying a load ( $p < 0.05$ ) or when walking over or around obstacles ( $p < 0.05$ ). Vigilance performance was superior with auditory compared to visual or tactile stimuli ( $p < 0.05$ ). Less distance was covered when carrying a load ( $p < 0.05$ ), traversing the course with obstacles ( $p < 0.05$ ) and when responding to a tactile, compared to an auditory, stimulus ( $p < 0.05$ ). These results indicate that the need to guide movement, the physical exertion of load carriage, and the modality of information presentation affect performance on the basic cognitive function of vigilance. Furthermore, they raise fundamental questions about whether cognitive performance data collected from sedentary, rested volunteers are applicable

to system design for individuals, such as the dismounted soldier, who are often engaged in tasks that require concurrent physical and mental resources.

**Salivary Cortisol as a Biological Marker for Screening Enlisted Submariners - LCDR L.A. Osborne, DNSc<sup>1</sup>, K.H. O'Connor, PhD<sup>1</sup>, M.L. Coen, MS<sup>1</sup>, LCDR L.J. Crepeau<sup>2</sup> and J.C. Whanger, PhD<sup>2</sup>, M.E. Cullum, PhD<sup>1</sup> <sup>1</sup>Naval Institute for Dental and Biomedical Research and <sup>2</sup>Naval Submarine Medicine Research Laboratory**

Submarine duty in the United States Navy is considered to be one of the most stressful assignments in the military. The submarine community requires psychological screening, SUBSCREEN, prior to Enlisted Submarine School (BESS). SUBSCREEN is used to evaluate for specific traits, such as claustrophobia, that are incompatible with submarine service, as well as general psychological fragility. Currently there are no biological sampling techniques used in this evaluation process. Despite the current screening, 18.5% of the submariners who graduate from BESS do not complete their first tour, costing the Navy \$33.3 million dollars annually. It is estimated that at least 50% of this loss is due to stress related conditions.

This correlation design compared SUBSCREEN scores to various indices of cortisol activity of sailors during BESS training. The purpose was to evaluate the relationship of the SUBSCREEN scores and a biological marker of stress to determine the potential value of the additional screening. A long-term objective of the study is to determine if salivary cortisol levels predict attrition in the fleet.

The results of this study show little correlation of the cortisol activity and the SUBSCREEN, suggesting that they are measuring discrete aspects of individual differences in stress response. The results of this study will present preliminary evidence for future longitudinal studies to evaluate cortisol activity in submariners who are more chronically stressed as well as sailors in other communities within the U.S. Navy.

The secondary purpose of the study was to compare the gold standard ELISA to a newly developed assay, by the Naval Institute of Dental and Biomedical Research, utilizing fluorescence polarization. This new assay exploits technology that has been available for serum, but not for saliva. Furthermore, this new assay offers real time results in only three minutes and may prove valuable for far-forward deployed stress studies.

**6. Highlights of issues or concerns discussed during the meeting, the results of the discussion and recommendations for action, if any:**

N/A

**7. The results of any elections held:**

N/A

**8. SubTAG open actions, if any, and the target date for completion:**  
N/A

**9. Name and phone number of chairperson:**  
Debbie Patton  
(COMM) 410-278-5890  
DSN 298-5890

# Human Factors in Training

## **Purpose of this meeting:**

The Human Factors in Training and Development meeting focused on training in virtual environments to enable decision superiority. The session offered an integrated forum conducive to collaboration of researchers, practitioners, and users working in the area or in areas that support future research and development (R&D) or applications for training decision superiority.

Presentations and discussions considered science, technology, ongoing R&D, and new tools and techniques addressing training in virtual environments and enabling decision superiority in a global and noncontiguous battlespace.

## **SubTAG Name:**

- Human Factors in Training and Development

## **Total Attendance:**

- 32

## **Number of Members Present:**

- 11

## **Agenda:**

- A Method to Provide Cognitive Realism to Train Decision Making – Sue Archer, Micro Analysis and Design – Boulder, CO
- Testing System Capabilities Through Manipulation of User Performance and Proficiency – Dr. Dennis Vincenzi – NAVAIR Orlando TSD, Orlando, FL
- Training Dilemmas for Real-Time Command and Control Decision Making – Dr. John Hawley – ARL/HRED, Ft. Bliss, TX
- Locus of Control, Attribution Theory, and the “Five Deadly Sins” of Aviation – Dr. John Stewart – ARI, Ft. Rucker, AL
- Identifying Interface Limitations for Virtual Environment Training Systems – Dr. Roy Stripling – NRL, Washington, DC
- Training to Collaborate: Command Post of the Future in Iraq – Cadet Brandon Kennedy – United States Military Academy – West Point, NY

## **Issues:**

- Dr. John Stewart (ARI, Rotary Wing Aviation Research Unit, Ft. Rucker will be taking over the HF in Training Sub-TAG with TAG-56 (Fall 06) and Danielle Merket (NAVAIR Orlando TSD, Orlando, FL) will be the co-chair for TAG-56. Dr. Stewart will find a new co-chair for the Sub-TAG beginning with TAG-57.

## **Results of Any Elections Held:**

- No elections held

### **SubTAG Open Actions; Target Date for Completion:**

- None

### **Chairpersons:**

- Danielle Merket, NAVAIR Orlando TSD, 407-380-4792
- Melissa Walwanis Nelson, NAVAIR Orlando TSD, 407-380-4749

## **Human Factors in Training and Development Sub-TAG 55 -- Abstracts**

### **A Method to Provide Cognitive Realism to Train Decision Making – Sue Archer, Micro Analysis and Design – Boulder, CO**

Throughout history, victory has favored the side whose commander made superior decisions. Is there a way for technology to assist today's commanders in fostering decision superiority by training superior decision makers? In this presentation, we will present a tool that can help address training in virtual environments to enable decision superiority. The tool called SimFX is a computer-based, outcome-driven simulator to train digital information skills for small unit leaders of the Army's Future Force Warrior program. Realism is an essential component of simulation-based training. For many computer-based simulations, this realism is achieved with the construction of a detailed synthetic environment coupled with devices that allow the student to interact with that environment. While effective for some types of training, immersion in a virtual reality comes with issues and overhead that do not justify its application in every training domain. With SimFX, we describe an alternative approach inspired by Gordon's (2004) work on *Outcome-driven* simulation. SimFX is a lightweight software package that supports the authoring and delivery of simulation-based training in which we trade immersive realism for cognitive engagement.

### **Training Dilemmas for Real-Time Command and Control Decision Making – Dr. John Hawley – ARL/HRED, Ft. Bliss, TX**

During Operation Iraqi Freedom (OIF), U.S. Army Patriot air defense missile units were involved in two fratricide incidents, one involving a British Tornado and a second involving a Navy F-18. Patriot is the Army's first-line surface-to-air missile system, and has been used against both air-breathing and tactical ballistic missile threats. In terms of complexity, connectivity, and command and control relationships, Patriot approximates many features of the Army's notions for future network-centric systems. Human factors and training lessons learned from Patriot are thus relevant to a number of emerging system concepts.

Engagement operations in Patriot are highly automated. Automated engagement operations brings with it what various human factors researchers have referred to as the "Catch-22" of human supervisory control: Automation has been introduced because it can do the job better than a human operator. But humans have been left in the control loop to "monitor" that the automated system is performing correctly and to override the

system when it is “wrong.” The tacit assumption here is that operators can properly decide when the automation’s decisions should be overridden. Human operators are expected to compensate for machine unreliability. Operator decision making in Patriot and other automated systems is an exemplar of real-time, recognition primed decision making, or RPD. In Patriot as in similar systems, the operational setting does not allow decision makers the time or information to generate “perfect” solutions using rational calculations. RPD in action calls for judgments under uncertainty, ambiguity, and time pressure. Decision makers must quickly make sense of situations by using a highly organized experience base of relevant knowledge. RPD settings like Patriot thus take the role of operator expertise more seriously than previous military decision-making paradigms.

The requirement for deeper levels of operator expertise to support decision making in real-time battle command poses several dilemmas for training. First, as a number of human factors researchers have noted, an automated training environment may not be particularly well suited for progressive skill development of the type required to support RPD. Is it necessary for operator trainees to learn first in a less automated performance setting? The answer to this question has significant implications for training design in systems like Patriot. A second training dilemma concerns training for unreliable automation. One of the unmistakable conclusions from OIF combat operations is that the Patriot’s automation is not perfectly reliable in key functional areas. Patriot is not alone in this respect. Automation researchers such as Raja Parasurman argue that trust in automation should not be all-or-none, but graded according to the operational context. This is referred to as situation-specific trust. However, it is not clear that even well-prepared air and missile defense (AMD) operators will be able to reliably make the decisions necessary to realize situation-specific trust.

The presentation discusses these training dilemmas for battle command decision making in real-time AMD operations. Planned research and experimentation directed at exploring these issues using an advanced AMD battle command concept development testbed is also described. The research is directed at training setting design for the next generation of AMD systems.

### **Locus of Control, Attribution Theory, and the “Five Deadly Sins” of Aviation – Dr. John Stewart – ARI, Ft. Rucker, AL**

The construct of Locus of Control (LOC) is based on expectancy theory, and is concerned with a person’s perception of being in control, or controlled by, events in the environment. Over the past two decades, a few researchers have examined the relationship between LOC and the five hazardous attitudes (HAS), and other variables relating to aviation safety and risk management. Most of this work has been correlational, and, in many instances, sample size has been quite small. Participants have been civilian aviators. Organizational pressures make it likely that military pilots would differ in many ways. All of the research to date has shown that pilots show a high degree of internality of LOC, with the most internal of these showing endorsement of the macho attitude cluster on the HAS, followed by invulnerability and impulsivity. Hunter (2002) found that internality was correlated

negatively with self-reports of accidents, much in concurrence with similar research on industrial safety. It should be noted that all the means on the LOC scale for these samples can be said to fall within the internal range; thus, we may be describing degrees of internality. This leads to the question of whether too much internality, for pilots, can be a bad thing. For example, overconfidence is a frequently cited as a contributing factor in aviation accidents in the Army's Risk Management Information System. One possible theoretical model for overconfidence is the optimism (or self-serving) attributional bias, in which people tend to attribute greater competency and lesser vulnerability to themselves than to similar others. Little research has been done on pilots, addressing this attributional bias, though there is some evidence that as pilots acquire more experience, they tend to distort their degree of skill and downplay their chances of being involved in an accident. Also, little is known of how LOC, HAS, self-attributions of confidence change over the career cycle of an aviator. E. Hamilton Lee once stated: "There are old pilots, there are bold pilots, but there are no old, bold, pilots." Is this assertion true, and if so, why is it true?

### **Identifying Interface Limitations for Virtual Environment Training Systems – Dr. Roy Stripling – NRL, Washington, DC**

Many VE training systems are developed rapidly by commercial vendors and pushed to market with little if any evaluation of their training effectiveness. These systems may utilize a variety of interfaces and are being applied to a wide range of complex tasks. The general supposition in this process is that any system that provides a task based challenge to the trainee will be an effective training tool. However, our experience is that VE interfaces that are not well matched to the task will interfere with the acquisition of the desired skill set. The challenge to the human factors community is to get ahead of the production curve by providing generalized guidance to the acquisition community on what attributes of a VE system will make it a more effective training tool.

Our approach is to focus less on the specifics of each interface and instead ask what human sensory and motor components are most important for learning a given task. Our general hypothesis is that training systems developed based on this understanding will have a greater likelihood of being effective and accepted. One example of this approach in our lab is evaluations being conducted on VEs designed to train dismounted infantrymen. VEs for dismounted infantry may make use of handheld controllers such as joysticks and gamepads, or they may involve optically tracking body movements as the user walks across a monitored space or as they walk in place (see Fig. 1). Rather than test all of these interfaces and all of the commercial systems that make use of them, we are sampling a cross section of these locomotion interfaces and evaluating them while users undertake the same set of tasks.

The present experiment evaluated three different VE control interfaces. The interfaces tested were a standard joystick, a body and rifle tracked interface called Gaiter, and a system that tracked only the participant's upper body but had a joystick mounted on the weapon. In the two joystick interfaces, translations were controlled by pushing the joystick in the desired direction; in Gaiter translations were controlled by walking in place. Rotations with the joystick were controlled by twisting the joystick, whereas in

the two body-tracked interfaces they were controlled by physically turning as the user would in the real world.

Participants in studies conducted thus far have performed several tasks including a maze task, moving to a target in the dark, and rotation in the dark. The results from the maze task revealed that the standard joystick interface was associated with performances as good as, or better than, the two body-tracked interfaces. However, results of the rotations in the dark demonstrated that the participants significantly benefited from the proprioceptive feedback afforded to them by the two body tracked interfaces. The results from the movement to a target in the dark task revealed that participants were more accurate with the two joystick-based systems compared to the walking-in-place system (Gaiter). Taken as a whole the results suggest the value of some proprioceptive feedback in a control interface.

### **Training to Collaborate: Command Post of the Future in Iraq – Cadet Brandon Kennedy – United States Military Academy – West Point, NY**

This presentation reports on an embedded computer based trainer developed for Command Post of the Future. On a military battle field, situational awareness is a key ingredient in mission accomplishment. In an effort to keep its commanders informed and its soldiers' situational awareness up, the Army has recently developed and fielded a collaborative system known as the Army Command Post of the Future (CPOF). CPOF is a fully integrated, interactive asynchronous communication system to help speed the flow of information on today's modern battle field, as well as share information and conduct real time battle planning. As the developers boast; "results of user testing by generals and officers have been dramatic: 300% increase in communications, 300% increase in situational awareness, and 400% increase in successful execution." (Mayaviz, 2004). Although newly developed, the Army is beginning to deploy CPOF to Iraq with units such as the 1<sup>st</sup> Cavalry Division. However, with shortages on time and qualified teachers, there are still issues on how to best train soldiers to use such a complicated system. Currently, in pre-deployment settings, some soldiers receive formal classroom training from a CPOF instructor. Classes usually consist of 10-20 students, and last several sessions. For soldiers already in country receiving the software, this is not the case. While in theater, soldiers are often trained on a left seat ride/ right seat ride basis, where a "teacher" will help guide new users through the system (Saz, 2005). We developed an alternative embedded computer based trainer for the most often used CPOF tasks. We then conducted an extensive laboratory study of the computer based trainer against the traditional human instruction. We found no significant difference between the two training systems. With time and labor constraints, the Army does not always have the ability to conduct individual sit down training with every single person who will possibly use the software. Therefore, it is important to look at how the Army currently trains soldiers to use the system and to explore alternate means of training soldiers CPOF usage.

# Mission Performance Measurement Interest Group

No report submitted.

# Air Force Caucus

No report submitted.

## **Army Caucus**

No report submitted.

## **Navy Caucus**

No report submitted.

# TAG Operating Structure

## GOALS

Provide a mechanism for exchange of technical information in the development and application of human factors engineering.

Enhance working-level coordination among Government agencies involved in HFE technology research, development, and application.

Identify human factors engineering technical issues and technology gaps.

Encourage and sponsor in-depth technical interaction, including subTAGs as required in selected topical areas.

Assist as required in the preparation and coordination of triservice documents such as Technology Coordinating Papers and Topical Reviews.

## SCOPE

Because of the diversity of subject matter covered by the HFE discipline, the scope of technical areas addressed by the Technical Advisory Group (TAG) is necessarily broad. In general, HFE, as defined for purposes of TAG operation, deals with concepts, data, methodologies, and procedures which are relevant to the development, operation, and maintenance of hardware and software systems. Subject matter subsumes all technologies aimed at understanding and defining the capabilities of human operators and maintainers and insuring the integration of the human component into the total system to enhance systems effectiveness. Technologies directed toward improved manpower utilization through selection, classification, and training are included as appropriate.

## TOPICAL AREAS

The TAG will address research and technologies designed to impact man-machine system development and operation throughout the complete system life-cycle. The general topics of concern to the TAG include, but are not limited to:

- a. Procedures for use by HFE specialists, system analysts, and design engineers involved in the provision of HFE support during system development or modification.
- b. Methodologies oriented toward the identification and solution of operator/maintainer problems related to equipment design, operation, and cost/effectiveness.
- c. Mechanisms for application of developed HFE technologies, including formal and informal approaches to validation and implementation, and the determination of time windows for application.

## GROUP COMPOSITION

The TAG will consist of technical representatives from Government agencies with research and development responsibility in the topical areas specified above. Additional representatives from activities with allied interests may affiliate with the TAG as appropriate. Attendance at specific meetings may be augmented by technical experts in special topical areas.

## OPERATING BOARD

The TAG Operating Board is responsible for the conduct of TAG business and the implementation of TAG policies. The Board consists of an Executive Committee and the chairpersons of all subTAGs and committees. Operating Board meetings are called at the discretion of the TAG Chair.

The Executive Committee will be responsible for providing required continuity and acting for the full TAG between regular meetings. Regular members of the Executive Committee will be:

- Current Chair
- Immediate Past Chair
- Chair Select
- NASA Representative
- Army Representative
- Navy Representative
- Air Force Representative
- FAA Representative

## CONDUCT OF BUSINESS

Meetings of the TAG will be held semi-annually, in the spring and the fall. Chairing of the group will rotate annually among the Army, Navy, and the Air Force. The Chair Select will be chosen by a caucus of the service whose turn it is to chair the DoD HFE TAG. Advice and counsel will be provided by the Operating Board. The Service Representatives will be selected by service caucus at the spring meetings in even-numbered calendar years. Advice and counsel will be provided by the Operating Board. Minutes of each meeting will be compiled by the Chair. Minutes will be distributed to all plenary session participants, to appropriate OSD offices, and to other agreed-upon agencies. Minutes shall serve as the principal mechanism for the reporting of group activity. A file of Minutes and relevant correspondence shall be maintained by each Chair. This file shall be passed to the succeeding Chair together with any additions to the file.

## TAG SubTAGs

The DoD HFE TAG is composed of two categories of associated groups: SubTAGs and Committees. SubTAGs will be sponsored by the TAG as appropriate to respond to needs for detailed interchange and coordination in specific technical areas. SubTAGs will address problems of a general or continuing nature within a specific field of technology and are to develop their own working charters and operating procedures. SubTAGs may be disestablished upon recommendation by the Executive Committee. Committees will serve at the pleasure of the Operating Board and will address

specifically defined tasks or problems. These committees will be disestablished on completion of those tasks or upon recommendation by the Executive Committee. Reports from each subTAG and committee will be published separately and included as a regular item of business on each TAG meeting agenda. Current subTAGs and committees are identified in the TAG Operating Board.

#### AMENDMENTS

Amendments may be recommended by submitting the suggested change(s) in writing to the TAG Chair. The Operating Structure may be amended by a majority vote of those attending the Operating Board meeting at which recommended amendments are voted upon.

1. Name change from Department of Defense Human Factors Engineering Technical Advisory Group to Department of Defense Human Factors Engineering Technical Group by request of OUSD approved on 19 November, 1987.
2. Amended 14 November, 1989 at TG-23, Killeen, Texas.
3. Amended 3 May 1994 at TG-32, Oklahoma City, Oklahoma.
4. Name change from DoD HFE TG back to DoD HFE TAG on 3 May 1994.
5. Name change from subgroup on 8 May 1996.

## **TAG Policies**

1. Membership (General membership policies are outlined in the Operating Structure, under "Group Composition.")

1.1 Individuals who are not affiliated with Government agencies (but who are associated with technical societies or industrial associations with a stated interest in human factors engineering) wishing to affiliate with the TAG may contact the current Technical Society/Industry subTAG Chair to ascertain eligibility under the TAG Operating Structure. Once eligibility has been ascertained, the individual should submit a letter on the organization's letterhead, confirming his/her status as the organization's representative, to the current Chair of the Technical Society/Industry subTAG.

1.51.2 Emeritus Membership may be approved by the Executive Committee on a case-by-case basis for a former TAG member who is retired from government service or defense industry. Emeritus Membership is automatically deactivated during any period or re-employment with the government or defense industry.

2. Meeting Sites (Sites are recommended by the service caucus whose turn it is to host the TAG with a view toward a balance in geographic location and meeting facilities.)

2.1 TAG members are encouraged to recommend potential meeting sites.

2.2 Organizations who wish to host the TAG should contact their Service Representative or the current TAG Chair.

3. Agenda (The agenda is determined approximately three months before the scheduled meeting. The Chair Select selects the topics from those recommended by the Service Representatives, hosting agency and the TAG Coordinator.)

3.1 TAG members are encouraged to suggest potential agenda topics or topics suitable for tutorial sessions to their Service Representative, the current TAG Chair, or the TAG Coordinator.

4. Registration (Registration fees and the date of the close of registration are announced in an information letter sent approximately two months before the scheduled meeting.)

4.1 All attendees are expected to pre-register and prepay by the announced close of registration.

4.2 Only individuals receiving late travel approvals may register on-site. Payments made at the meeting site must be in cash.

5. Minutes (The Minutes of each meeting serve as the principal mechanism for the reporting of TAG activities. The Minutes will be published as a draft document on the website.)

5.1 Individuals or agencies desiring to be included on the distribution list for a specific meeting should contact the TAG Coordinator.

6. SubTAGs and Committees (See the Operating Structure, section entitled "TAG SubTAGs," for specific information regarding the purposes and operating procedures of subTAGs and committees.)

6.1 All subTAGs and committees are encouraged to meet in conjunction with the TAG at least once each calendar year.

6.2 All subTAGs and committees meeting in conjunction with the TAG are required to provide a chairperson for the specific meeting.

6.3 All subTAG and committee chairpersons are to submit a brief report of each meeting to be included in the set of TAG Minutes covering the subTAG/committee meeting time frame.

6.4 All subTAGs and committees are required to provide the TAG Coordinator with an up-to-date list of their membership for use in the distribution of TAG announcements.

6.5 All subTAGs are required to submit to the Executive Committee a Charter including, but not limited to, statements regarding:

- objectives
- membership policies
- meeting schedule
- scope
- chair selection/tenure

6.6 Committees are required to submit to the Executive Committee a document including, but not limited to, brief statements regarding:

- objectives
- membership policies
- chair selection/tenure

6.7 Rotation of the chair position is determined by subTAG charter. If the position cannot be filled by the appropriate service at the election meeting, the subTAG may progress to the next service willing to chair the subTAG

7. SubTAG Establishment

7.1 Groups interested in addressing technical areas not covered by existing subTAGs may request the TAG Chair to provide meeting time.

7.2 Formal subTAGs and committees may be established by recommendation of the Executive Committee.

8. Chair/Representative Selection (General selection procedures are outlined in the Operating Structure under "Conduct of Business.")

8.1 A Service caucus may be called by the TAG Chair or the current Service Representative.

8.2 Methods of determining the Chair Select and Service Representatives are Service dependent.

8.3 Unexpired terms of office will be filled by appointment by the Executive Committee, until a caucus of the Service can be called at the next regularly scheduled TAG meeting.

9. Funding The funding required for the organization, conduct, franking, and documentation of all TAG meetings shall be done jointly by the three Services and the Federal Aviation Administration and the National Aeronautics and Space Administration. The specific mechanisms to obtain and allocate funding from the Services/agencies shall be determined by the Executive Committee.

10. Policy Changes

10.1 Additions to or amendments of the above policies may be recommended by submitting the suggested change(s) in writing to the TAG Chair.

10.2 Policies may be amended by a majority vote of those Operating Board members in attendance at the Operating Board meeting at which amendments have been proposed.

Amended 14 November 1989 at TG-23, Killeen, Texas.

Amended 3 May 1994 at TAG-32, Oklahoma City, Oklahoma.

Amended 8 May 1996 at TAG-36, Houston, Texas.

Amended 7 November 2002 at TAG-48, Alexandria, Virginia.

## Meeting Location Summary

MTG	DATE	LOCATION	CHAIR	HOST
1	9 - 10 Aug 1977	Ft. Washington, PA	LCDR Norman Lane	Naval Air Development Center
2	24 - 24 Jan 1978	Alexandria, VA	LCDR Norman Lane	Army Research Institute
3	22 - 24 Aug 1978	Dayton, OH	Lt Col Joseph Birt	Human Engineering Division, Wright-Patterson AFB
4	6 - 8 March 1979	San Antonio, TX	Lt Col Joseph Birt	Aerospace Medical Division, Brooks AFB
5	4 - 6 Dec 1979	Sunnyvale, CA	Dr. Edgar Johnson	NASA Ames Research Center Moffett Field
6	17 - 20 Nov 1980	New Orleans, LA	Dr. Edgar Johnson	Naval Biodynamics Lab, Michoud Station
7	18 - 21 May 1981	Monterey, CA	CDR Norman Lane	Naval Postgraduate School
8	12 - 14 Jan 1982	Orlando, FL	CDR Norman Lane	Naval Training Equipment Center
9	27 - 29 July 1982	Colorado Springs, CO	Dr. Richard Schiffler	US Air Force Academy
10	8 - 10 May 1983	El Paso, TX	Dr. Richard Schiffler	US Army Research Institute, Ft. Bliss
11	4 - 6 Oct 1983	Atlantic City, NJ	Mr. Clarence Fry	FAA Tech Center
12	15 - 17 May 1984	Oxnard, CA	Mr. Clarence Fry	Pacific Missile Test Center, Point Mugu
13	6 - 8 Nov 1984	West Point, NY	Mr. Paul Linton	US Military Academy
14	7 - 9 May 1985	San Antonio, TX	Mr. Paul Linton	USAF Aerospace Medical Div/Brooks AFB
15	5 - 7 Nov 1985	San Diego, CA	Mr. Cyrus Crites	Navy Personnel Research and Development Center
16	6 - 8 May 1986	Cocoa Beach, FL	Dr. Michael Strub	NASA - Kennedy Space Center
17	18 - 20 Nov 1986	Monterey, CA	Dr. Michael Strub	Army Research Institute/Presidio of Monterey Field Unit
18	11 - 14 May 1987	Boston, MA	Dr. Michael Strub	Electronic Systems Division/Hanscom Field AFB
19	16 - 19 Nov 1987	Oxnard, CA	Dr. John O'Hare	Pacific Missile Test Center, Point Mugu
20	9 - 12 May 1988	Baltimore, MD	Dr. John O'Hare	US Army Human Engineering Lab, Aberdeen Proving Ground
21	31 Oct - 3 Nov 1988	Albuquerque, NM	Lt Col Thomas McCloy	USAF Operational Test and Evaluation Center, Kirtland AFB
22	15 - 18 May 1989	Orlando, FL	Lt Col Thomas McCloy	Navy Personnel Research and Development Center

MTG	DATE	LOCATION	CHAIR	HOST
23	13 - 16 Nov 1989	Killeen, TX	LTC Gerald Krueger	Darnell Army Hospital, Ft. Hood
24	7 – 10 May 1990	Ft. Walton Beach, FL	LTC Gerald Krueger	US Air Force Munitions Systems Division, Eglin Air Force Base
25	12 - 15 Nov 1990	San Diego, CA	CDR Thomas Mitchell	Naval Health Research Center
26	13 - 16 May 1991	Natick, MA	CDR Thomas Mitchell	US Army Research Institute of Environmental Medicine
27	4 - 7 Nov 1991	San Antonio, TX	Dr. Stephen Rokicki	USAF Armstrong Lab, Brooks AFB
28	21 - 24 April 1992	New Orleans, LA	Dr. Stephen Rokicki	Naval Biodynamics Lab, Michoud Station
29	3 - 6 Nov 1992	Huntsville, AL	Mr. Richard Armstrong	US Army Research Lab, HRED MICOM Field Element
30	11 - 14 May 1993	Dayton, OH	Mr. Richard Armstrong	Human Engineering Division/Crew System Directorate, Armstrong Lab
31	15 - 18 Nov 1993	San Diego, CA	Dr. Carl Englund	Naval Health Research Center and Naval Command Control and Ocean Surveillance Center RDT&E Division
32	2 - 5 May 1994	Oklahoma City, OK	Dr. Carl Englund	FAA Civil Aeromedical Institute
33	31 Oct - 3 Nov 1994	Orlando, FL	Dr. Joe McDaniel	Army Research Lab Field Element and Army Research Institute
34	1 - 4 May 1995	Colorado Springs, CO	Dr. Joe McDaniel	USAF Academy
35	6 - 9 Nov 1995	Monterey, CA	Dr. James C. Geddie	Naval Postgraduate School
36	6 - 9 May 1996	Houston, TX	Dr. James C. Geddie	NASA - Johnson Space Center
37	4 - 7 Nov 1996	Baltimore, MD	Dr. Robert Smillie	US Army Research Laboratory, Human Research Engineering Directorate
38	5 - 8 May 1997	San Antonio, TX	Dr. Robert Smillie	Armstrong Laboratory, Brooks AFB
39	3 - 6 Nov 1997	Kissimmee, FL	Dr. Grant McMillan	Naval Air Warfare Center – Training Systems Division
40	11 - 14 May 1998	Alexandria, VA	Dr. Grant McMillan	Federal Aviation Administration

MTG	DATE	LOCATION	CHAIR	HOST
41	16 – 19 Nov 1998	Waltham, MA	Mr. Richard Armstrong	US Army Soldier and Biological Chemical Command, Natick
42	10 – 13 May 1999	Alexandria, VA	Mr. Richard Armstrong	N/A
43	1 – 4 Nov 1999	Albuquerque, NM	LCDR Russell Shilling	Air Force Operational Test and Evaluation Center and the Safety Center, Kirtland AFB
44	1 – 4 May 2000	Arlington, VA	LCDR Russell Shilling	Office of Naval Research
45	6 - 9 Nov 2000	El Paso, TX	MAJ Scott Smith	ARL-HRED Ft. Bliss Field Element
46	14 – 17 May 2001	Colorado Springs, CO	MAJ Scott Smith	Air Force Space Command, Peterson AFB
47	29 April – 2 May 2002	San Diego, CA	Dr. James C. Geddie	Space and Naval Warfare Systems Center
48	4 - 7 Nov 2002	Alexandria, VA	LCDR Sean Biggerstaff	N/A
49	May 12-15, 2003	Augusta, GA	LCDR Sean Biggerstaff	Ft. Gordon Signal Center
50	3 - 6 November 2003	Tempe, AZ	Dr. James C. Miller	Air Force Research Laboratory
51	10 – 13 May 2004	Atlantic City, NH	Dr. James C. Miller	FAA
52	1-4 November 2004	Alexandria, VA	Ms. Dawn Woods	N/A
53	23-26 May 2005	Panama City, FL	Ms. Dawn Woods	Naval Surface Warfare Center
54	7-10 November 2005	Baltimore, MD	Ms. Maureen Bergondy-Wilhelm	ARL-HRED
55	15-18 May 2006	Las Vegas, NV	Ms. Maureen Bergondy-Wilhelm	Air Combat Command, Nellis AFB, NV

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