

Workload and Stress Sub-TAG, May 4, 2010

1. **Number of members present: 27**
2. **Organizations represented:** OSD DDR&E BioSystems, Sandia National Laboratories, US Naval Aerospace Medical Institute, SA Technologies, Inc., NASA Ames Research Center, US Air Force, US Navy, US Army
3. **Agenda covered:** yes
4. **Abstracts of each presentation:** below

### **Physiological Indicators of Skill Acquisition**

*Dr. Chris Forsythe, Sandia National Laboratories*

With simulation-based training, objective measures of student performance provide an observable means to assess competency. However, it would be beneficial to be able to look inside the student's head to determine whether a successful exercise was accomplished with relative ease, or required the student to muster every resource. Likewise, in comparing student to expert performance, physiological profiles provide a complementary measure to objective assessments. In particular, where experts exhibit low levels of arousal, yet students exhibit high levels while producing criteria levels of performance, it may be that the student has not truly mastered the required skills and their learning will be brittle when placed in a stressful situation. In contrast, where experts exhibit high levels of arousal and students low, it may be that the student does not appreciate critical facets of a task or they have been overwhelmed and have largely given up. This presentation summarizes work by St Petersburg State University and funded through ONR-Global to investigate physiological indicators developed and deployed in Russia to address these issues. Results will be presented from a recent study that found statistically significant better performance for students trained using physiological arousal measures to target training to individual needs.

### **Internal Process Strategies for Stress Mitigation**

*LT Antonio Anglero MSC USN, Naval Aerospace Medical Institute*

Stress mitigation strategies are at the forefront of human performance research. A great deal of investigation is being done to find technological tools that can help the person achieve optimal levels of performance. However, there are cognitive strategies that should not be overlooked. The field of sport psychology has yielded strategies to enhance performance of athletes who are expected to compete with only protective gear and limited equipment. Military personnel, much like professional athletes, are constantly looking for an edge, something that will assist them in achieving their current mission objectives. Internal Process Strategies (IPS) for stress mitigation will discuss one conceptualization of how stress affects performance, common strategies used to obtain and maintain optimal performance, a measure used to quantify the effects of such techniques, and the use of Visual Motor Behavior Rehearsal (VMBR) as a strategy. When cognitive approaches are combined with technological advances we will not only see a war-fighter that is consistently operating at optimal levels, but we can expect to see a shift up in the Yerkes- Dodson Curve.

### **Multitasking Performance and the Prediction of Flight Training Success**

*LT Jefferson D. Grubb MSC USN, Naval Aerospace Medical Institute*

Naval Aviators and Naval Flight Officers are commonly required to perform multiple perceptual, cognitive, and psychomotor tasks simultaneously and under stressful conditions. As such, the ability to do so is a defining characteristic of a good aviator. In principle, a test that can measure how well an individual can simultaneously perform multiple tasks that mimic common aviation tasks should be able to predict how likely that individual is to succeed in aviation training. In this talk, I present the results of a validation study of the PBM test, a psychomotor and multitasking test that will be part of the next version of Naval Aviation's Aviation Selection Test Battery. Although different metrics in the PBM predict flight school grades for Student Naval Aviators and Student Naval Flight Officers, interaction effects that were expected to specifically index multitasking ability in high workload situations were not significant. I discuss these results in terms of challenges for developing tests to predict how well candidates can cope with high workload situations.

### **SA-oriented Training in Virtual Reality and Games: Improving Cognitive Readiness Through SA measurement and Feedback on Results**

*Dr. Jennifer M. Riley, SA Technologies, Inc.*

The increasing complexity of military operations requires that warfighters acquire more knowledge and complex skills and that training is implemented quickly, easily, and flexibly - anytime and anyplace. Virtual reality and game-based technologies facilitate practice in high fidelity simulated environments that engage trainees and promote a sense of virtual presence while they learn. While commonly accepted as valuable tools for learning, there are important research and design challenges that exist with regard to ensuring transfer of training from simulations to real operations. Researchers have highlighted specific limitations, for example, the failure to include instructional elements that relate to key skills of the training domain (Salas and Cannon Bowers, 1997) and the lack of valid and objective measures of human performance (Wright et al., 2004). SA Technologies has conducted ongoing research with ARI on training SA through feedback in after-action reviews following virtual and game-based military training exercises. This presentation will introduce the Virtual Environment Situation Awareness Review System (VESARS) which is designed to promote situation awareness (SA), a core competency in many military and civilian operations, through comprehensive measurement of SA and meaningful feedback on SA results. Training of SA can help to build key SA skills and abilities, making it easier for warfighters to develop and maintain SA in real operations, and as such reduce the cognitive load and stress associated with SA in complex and dynamic operations. Feedback can link behaviors to outcomes and help trainees understand where shortfalls in knowledge or skills occurred. In order to improve SA, trainees need to receive feedback on the quality of their SA. The VESARS method assesses trainee SA in three areas: (1) a behavioral rating tool that assesses individual and team actions for situation assessment/analysis, (2) a rating tool that evaluates team communications for promoting SA, and (3) a SA query tool that facilitates direct objective assessment of SA. The training tools are developed from cognitive task analysis conducted in a specific domain. This ensures that the key cognitive components that promote SA are integrated in the SA feedback system. Each component can be used individually for focusing on a specific SA skill or they may be employed together for comprehensive SA assessment and training. VESARS includes a review application that supports training instructors in presenting SA results to trainees, helping them provide standardized feedback to link SA behaviors and processes to situation outcomes. The tool presents results in tabular and graphical form to help trainees understand where

breakdowns in their SA and performance occurred. VESARS has been applied to multiple contexts, including squad-level MOUT training, Marine FiST training, NASA mission controller training, and law enforcement training. The proposed presentation will (1) describe the SA training through feedback approach and its utility for supporting SA in military training (e.g., Army infantry squads and Marine FiST), (2) present the tool design and functionality, (3) illustrate SA results that support post-trial training, and (4) provide information on how the tool can support learning in virtual or live training exercises.

### **Linking Real-Time Operator Behavior to Subjective Workload Ratings: Houston, We Have a Problem!**

*Dr. Robert S. McCann, NASA Ames Research Center*

On next-generation deep-space missions, astronauts are going to have to perform many more operations autonomously than they do in today's missions, where ground support is available virtually instantaneously. The workload associated with these operations will have to be carefully controlled in order to avoid overload and underload situations that can compromise crew performance. I discuss issues relating to associating workload with real-time task performance measures, such as task accuracy, task latency, and number of information acquisition activities, with the goal of being able measure workload empirically, in real time, as opposed to with after-the-fact subjective ratings.

#### **5. Bottom line and useful information from each presentation:**

Forsythe: Experts and novices display different physiological patterns in response to task loading. As novice performance improves, their physiological patterns begin to resemble those of experts. Preliminary data indicate that divergence of novice physiological patterns from those of experts can be used to streamline training by allowing instructors to better identify training points that the student is struggling with.

Riley: A person's SA is typically more informative than his or her level of workload, but measuring SA in a continuous, dynamic environment has typically been difficult. Riley presented an approach to SA measurement and SA-specific training and showed data from an Army MOUT exercise that indicates that SA measurement in such a situation is both practical and useful for training.

Anglero: Cognitive and behavior based training can be effectively used to improve performance of world-class athletes under stressful game situations. These lessons should be directly applicable to warfighters. Thus, in addition to technological efforts to mitigate stress and workload in warfighters, effort should also be focused in developing and deploying cognitive and behavioral based techniques.

McCann: Time delays in communication with spacecraft in interplanetary space mean that astronauts on future long-duration space missions will not be able rely on assistance from mission control. Better methods to automatically assess astronaut workload in real time are needed to ensure that missions can be performed without immediate ground-based assistance.

Grubb: The addition of multitask tracking to the ASTB significantly improves the Navy's ability to predict applicant success in flight training. However, multitask performance correlates so highly

with pure psychomotor performance on the test that it is difficult to tell which factor accounts for this increase in predictive validity.

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

Three co-chairs proposal made by CAPT Schmorrow to better represent Army, Navy, Air Force. Members will attempt to draft colleagues from Air Force and Army or other sister organizations. Jeff Grubb will be the POC to find these if anyone would like to volunteer.

There was a suggestion to pull something from this Sub-TAG for SBIR topics in the future.

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

Elected for co-chairs: Jeff Grubb nominated

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

**9. Name and phone number of chairperson: *Co-Chairs: Dr. Julie Stark & CAPT Dylan Schmorrow MSC USN; Session Organizer: LT Jefferson Grubb MSC USN***