

**Abstract Proceedings for  
Midyear Symposium March 7<sup>th</sup>-8<sup>th</sup>, 2002**

**Contemporary & Emerging Issues in Human Factors,  
Engineering, and Military Psychology**

**Sponsored by the American Psychological Association's**

**Division 21: Applied Experimental and Engineering Psychology**

**Division 19: Military Psychology**

**And**

**The Potomac Chapter of the Human Factors & Ergonomics Society**

**Symposium Location: Fort Belvoir Officers Club, Fort Belvoir, Virginia**

**Multidisciplinary University Research Initiative (MURI):  
Optimizing Cognitive Readiness Under Combat Conditions**

**Peter A. Hancock  
Department of Psychology, and Institute for Simulation and Training  
University of Central Florida, Orlando, FL 32816**

The present work describes a program of research to evaluate the effects of stress, workload, and fatigue upon operator performance. The program consists of a group of University research laboratories that are interlinked electronically in order to collectively attack the problem collaboratively on a number of fronts. Initially, we have identified a number of theoretical issues that require resolution before we are able to identify the specifics of mitigation strategies. Among these theoretical issues are the systematic distortion of perceptual space-time under stress, the depletion of attentional resources as well as the prevention of their regeneration under stress, and the differential failure of different orders of performance as stress, fatigue, and workload increase. Resolution of such issues indicates a number of strategies to reduce adverse stress effects and even to use stress as a motive force to improve critical performance. Among these the conception of adaptive, stress-mediated interfaces for task allocation and task restructuring holds great potential promise. Knowledge garnered from the present program can be used to augment performance modeling procedures and advise design specifications for optimal performance under stressful conditions.

## **Viking Development of an Infantry Scenario Multi-Task Environment**

**Wayne C. Harris**  
**University of Minnesota**

**Raja Parasuraman and Marla Zinni**  
**Catholic University of America**

**Peter A. Hancock**  
**University of Central Florida**

**Scot C. Harris**  
**US Army Research Lab-Human Research & Engineering Directorate**  
**Picatinny Arsenal, NJ**

As component size and cost decrease, advanced technology is being introduced into new environments, including infantry command and control. The complexity of these environments is such that system efficiency may be compromised without the use of automation to support the human operators of these systems. Advanced communication/information systems for soldiers are likely to present different configurations of demands than have been examined in previous studies that have focused on aircraft or vehicles. Developing principles that predict performance in complex, multi-task systems requires an experimental platform that includes appropriate subtasks that are relevant to the infantry domain. We have developed such a platform, called Viking, which is a modification of the Multi-attribute Task Battery (MAT; Comstock & Arnegard, 1992). The MAT presents subtasks that are analogous to tasks performed by flight-crews and it was developed to examine aircraft workload issues. Viking modifies the original MAT interface to present monitoring and strategic/cognitive tasks in an infantry scenario. Furthermore the tracking task that was related to aircraft control was dropped, and two, infantry related decision-making tasks were added. Finally, the ability to implement automation support of the operator for information management and decision-making has also been added. Viking provides an appropriate environment to examine issues such as the effects of stress on complex task performance of infantry personnel and the potential for adaptive automation to mitigate the deleterious effects of stress and fatigue.

## **Sensor to Shooter: Task Development and Empirical Evaluation of the Effects of Automation Unreliability**

**Ericka Rovira and Raja Parasuraman  
Cognitive Science Lab  
The Catholic University of America**

The complexity of modern military systems necessitates the use of automated support of the battlefield commander. Automation can be applied at different stages, beginning with analysis of sensor data, progressing to situation assessment and decision making, and can also include execution of actions. We developed a simplified simulation of a battlefield environment in which automation can be applied at each of these four stages, as in the Sensor-to-Shooter system (STS). The STS simulation, which runs on a standard PC, was designed for empirical studies of human performance. Results of an initial empirical evaluation of the effects of automation unreliability on operator performance are reported. Participants were required to identify a target as an enemy or as a friendly unit and to make a corresponding decision to engage the target in combat or not. Automation support was provided at one of four levels: 1) complete list of options, 2) prioritized list of all options, 3) selection of the top three choices, and 4) one best choice. Automation reliability was varied by manipulating the proportion of trials (60%, 80%, and 100%) on which a correct assessment or decision was provided. Dependent variables included the accuracy and speed of decision selection and subjective measures of trust and workload. Preliminary results suggest that operators may compensate for unreliable automation by adjusting their reliance to the system reliability, with this effect being more prominent at increasingly higher levels of automation support. The implications of these results for the design of aiding systems and for evaluating the influence of automation reliability on system performance are discussed.

Supported in part by Grant DAAD17-00-P-0366 from the Army Research Laboratory, Ft. Huachuaca, AZ, and in part by a MURI sub-contract from the University of Central Florida.

## **The Influence of Stress and Individual Differences on Subjective Time**

**Jeanne L. Weaver, Valerie K. Sims, H.C. Neil Ganey,  
Peter A. Hancock and Krystal Bradley  
University of Central Florida**

Unlike many areas of research, the investigation of subjective time, or protensity, has been conducted from the perspective of a number of different disciplines (e.g., philosophical, biological, psychological). This study signals the beginning of a systematic line of research that would ultimately have real world application, utilizing a simulated driving task that allows greater generalizability of results and thus, more immediate application. The purpose of the current study was to establish the degree that time perceptions are influenced by stressors and individual differences in a simulated driving environment. Participants in the study were given scenarios that portrayed varying levels of time pressure. They were then asked to interact in the environment. At one point during the task, they were stopped and asked to estimate how long a stoplight remained red. Results indicated that high self-control persons were more accurate than low self-control persons, and low need for cognition persons were also more accurate than high need for cognition individuals. Finally, the most accurate time estimates were given by high self-control/low need for cognition individuals. In general, participants underestimated the amount of time passage, although there was also a great deal of variability across participants.

**Training and Performance Outcome: Advanced technologies, realistic graphics, and increased stimulation may not be contributors**

**Christina S. Morris  
Institute of Simulation and Training  
University of Central Florida**

**Ronald W. Tarr  
Institute of Simulation and Training  
University of Central Florida**

**Ed C. Shirkey, Peter A. Hancock, and Mustapha Mouloua  
Department of Psychology  
Institute of Simulation and Training  
University of Central Florida**

A recent focus of US DoD is on determining which training technologies, simulations, and advancing features actually affect operator performance outcome for adequate return on investment. How necessary is motion base, complete mock-up, large screens, HMD's, versus low cost pc based simulations in actually influencing training based performance outcome. Surprisingly, relatively little research exists on the topic and many government dollars are devoted to advanced technologies that may not be meeting or enhancing needs as expected. This paper will describe results of two studies regarding influence of technology-enhanced features on training and outcome performance. The first study examined multiple pc-based games under evaluation for military training. Analyses of features such as graphical quality, sound effects, immersion, and realism indicated no significant differences in subjective responses regarding exercising cognitive skills. The second study introduced situational relevant stress via war like intense graphics and sound effects from recent movie prior to training and performance outcome measurement that also indicated no effect on all dimensions of training outcome. Theory based conclusions regarding the human ability to immerse themselves may account for this phenomenon. Implications for advanced research, applicable technologies, ROI, applying validation models, and guidelines for selecting advanced training features were discussed.

## **Challenges and Considerations in the Development of a Team-Based Testbed to Examine the Impact of Stress on Cognitive Readiness and Team Performance**

**Clint A. Bowers, Kia Asberg, C. Shawn Burke, and Eduardo Salas  
University of Central Florida**

Our military forces are facing an increasingly complex environment. Often, battles are no longer fought in wide-open spaces, but in the close quarters of urban areas. This occurs against a background of threat that ensures that acute and chronic forms of stress are a constant presence for military personnel. In order to promote the cognitive readiness of our military forces, it becomes paramount to understand how the stressors present impact cognitive readiness and the corresponding performance of teams. In response to this need, the MURI program at UCF has begun the development of a testbed that will allow researchers to conduct basic research on several of the issues that are relevant to military teams operating in urban environments. In our proposed presentation, we will outline the challenges confronting researchers trying to perform this type of research as well as some of the elements of our testbed that respond to these challenges. We will also describe some of the ancillary issues (e.g., training, measurement) that are incumbent in this type of research.

## **The Impact of Stress on Team Adaptability Within Military Forces**

**C. Shawn Burke, Laura M. Milham, Eduardo Salas,  
Clint A. Bowers, and Jennifer Fowlkes  
University of Central Florida**

Team adaptability is becoming a hallmark of effective team performance for military forces operating within the 21<sup>st</sup> century. This requirement for team adaptability is reflected in the need to: (a) respond to asymmetric warfare, (b) fight unconventional enemy forces, (c) fight in urban environments, (c) work with multi-national forces, and (d) switch from peace-keeping to war-fighting duties. Furthermore, within the already dynamic and complex battlefield, technological advances are increasing the complexity and amount of information available to military teams. It is within this environment, also characterized by several acute and chronic stressors, that our military forces have to adapt to be successful.

Although researchers are just beginning to investigate team adaptability, it becomes paramount to not only understand team adaptability at a general level, but to understand how battlefield stressors may impact the team's ability to be adaptive. As such, the purpose of this paper will be to present an organizing framework for how various battlefield stressors (e.g., fatigue, time pressure, workload) may impact team adaptability. This framework will culminate in a set of research propositions to be tested.

## **Training and Design to Enhance Adaptability in Military Teams**

**Jennifer Fowlkes, C. Shawn Burke, Katherine Wilson,  
Laura Milham, and Eduardo Salas  
University of Central Florida**

The requirement for adaptability can be found in most every aspect of military operations, from the requirement for rapid deployment and the diverse missions that must be performed, to the variety of threats that must be faced. Adaptability is a defining characteristic of effective teams and underlies success in many dynamic situations. Thus, it is imperative that a science of training adaptability for military teams be developed. The purpose of this paper is to outline an approach to the development of training, system design, and organizational guidelines to increase adaptability in military teams. The approach entails the delineation of military requirements for adaptability; development of a concept of adaptability based on a review of the literature, military documentation, and observations of military teams; and the development of preliminary training, design, and organizational guidelines for enhancing adaptability. While the guidelines are theoretically driven and, in addition, are based on observations of military teams, the next step is validation of the guidelines through a combination of field and laboratory research.

## **Contemporary and Emerging Technologies for Meeting Night Vision Training Needs**

**John W. Ruffner and Jim E. Fulbrook  
DCS Corporation, Alexandria, VA**

The ability to operate safely and effectively at night is critical for achieving warfighter readiness and operational superiority. Technological advances in night vision devices (NVDs), such as night vision goggles (NVGs) and thermal imaging systems, have greatly increased their potential for improving readiness and safety for greater combat effectiveness. However, achieving this potential requires a systematic, integrated approach to training. Research findings and operational experience suggest the majority of the problems NVG users experience can be attributed to a lack of appreciation for NVG limitations and perceptual problems. Furthermore, NVG knowledge and skills are highly perishable and require frequent practice to maintain proficiency. Because NVG knowledge and skill requirements are heterogeneous and complex, NVG training must consist of a mix of training technologies. These include traditional/contemporary technologies, such as classroom instruction, hands-on training, simulation, and in-vehicle/aircraft training, as well as emerging technologies, such as computer-based training (CBT), web-based training (WBT) and Advanced Distributed Learning (ADL), whose goal is to provide suitable training any time and any place. In this presentation, we discuss contemporary and emerging NVG training technologies, provide military and civilian examples from the dismounted, driving, watercraft, and aviation environments, and discuss future human factors applications and developmental innovations.

## **Technical advancements in the Night Battlefield**

**Glen Nowak**  
**Land Warrior Display Engineer**  
**U.S. Army Project Manager for Soldier Systems Office**  
**Fort Belvoir, VA**

The battlefield is a different place at night. Technical advancements in image intensifiers, thermal imaging, and lasers over the past two decades have engendered major advances in fighting techniques in today's battlefield. This presentation described the attack scenario that recognizes that these technologies for the dismounted soldier are not only compatible, but necessary to win today's battle. These technologies led the way and have provided the potential for the U.S. Army's Land Warrior electronically equipped infantry fighting system. It is clear these technologies and the Land Warrior advancements in wearable computers and head-mounted visual displays result in increased situational awareness, and this, says LTC (P) Scott Crizer, U.S. Army Product Manager for Soldier Electronics, "will increase the lethality of every soldier while increasing his survivability."

Mr. Nowak and Mr. Chris Royale, of PM-Soldier Systems demonstrated three different night image intensification systems as Army night vision goggles (NVGs) and two different thermal (IR) weapon sights, at night for the conference attendees to get a look through them out over the Potomac River.

**Poster 1.****Sound Localization Using the Land Warrior System Earpiece:  
The Effect of Physiological Arousal on Comprehension  
and the Ability to Localize Sound**

**Angela F. McConnell and Shimul S. Patel**  
**Department of Behavioral Sciences and Leadership**  
**United States Military Academy**

The ability to localize sound is critical to a soldier's survivability. The present study examined the effect of physiological arousal on two competing tasks while using the Land Warrior (LW) system earpiece: comprehension and sound localization. Researchers hypothesized that if participants were physiologically aroused (i.e., their heart rates were elevated to 50-75% of maximum) then their abilities to localize sound and comprehend speech would adversely be affected. Twelve participants sat in a twelve-speaker, 360° sound ring. They listened to a tactical operation order through the LW earpiece while attempting to localize the sound emitted from one of the twelve speakers. All participants were included in both the stressed and unstressed conditions. The dependent variables were comprehension (for the listening task) and response accuracy (for the localization task). The results of the experiment showed no significant difference between the stressed and unstressed conditions on sound localization performance and comprehension. The implications of these findings are discussed with respect to previous research on sound localization while wearing LW equipment.

**Faculty Advisor: COL Lawrence G. Shattuck, Ph.D.**  
**United States Military Academy**

**Poster 2.****Understanding Target Detection Performance  
When Receiving Visual or Auditory Cues****David C. Cibik and Erich W. Meyerhoff  
Department of Behavioral Sciences and Leadership  
United States Military Academy****Note Bene: This poster presentation won the Best Student Poster Award  
sponsored by Division 19**

Since 1991, the Army has been developing Land Warrior (LW), a combat system for the individual soldier. This experiment analyzes the use of audio and visual cues in target detection and applies these results to the LW system. Fifteen participants were presented with photographs in which targets were either cued or uncued. In the cued conditions, three methods of cueing were utilized: an audio cue, a visual cue, or both. Length of time to locate the target was measured and compared across conditions. Results indicate that use of only audio cues produced significantly longer target detection times than no cue, visual cues, or visual and audio cues. This research has important implications for designing a target detection system for Land Warrior. Future research should examine whether the findings reported herein can be replicated if the visual display is a HUD.

**Faculty Advisor: COL Lawrence G. Shattuck, Ph.D.  
United States Military Academy**

**Poster 3.**

**Physiology and Cognition:  
An Evaluation of the Physiological Effects of Cognitive Tasks**

**Michael Block and Stacey Cotner  
Department of Behavioral Sciences and Leadership  
United States Military Academy**

The Army is currently developing Land Warrior (LW), a system that improves the lethality and survivability of soldiers' by providing them with a wearable computer, a global positioning system, a state-of-the-art communication system, and a weapon system that integrates thermal and video technology. The excessive weight and limited duration of the batteries soldiers must carry to power LW has driven researchers to seek alternative ways to manage power requirements. One approach is to assess the soldiers' physiological state and use the results to power up certain system components. In this experiment, twelve participants were subjected to three different cognitive tasks of varying levels (easy, medium, and hard). The researchers collected systolic and diastolic blood pressure, heart rate, and saliva. Results indicate that there were no significant differences between the physiological factors for the three levels of cognitive tasks. These findings suggest that physiological measures should not be used as a means to reallocate power among the LW system components.

**Faculty Advisors: COL Lawrence Shattuck, Ph.D., and Jennifer K. Clark, M.A.  
United States Military Academy**

**Poster 4.****Multitasking Effects on Comprehension of Battlefield  
Communications Radio Traffic**

**Mark D. Juntunen and Simon A. Boyd  
Department of Behavioral Sciences and Leadership  
U.S. Military Academy**

Recent and widely publicized research points to a ubiquitous and decremental effect of multitasking on task performance. The current study extends the study of the effects of multitasking to a military relevant task. Eighteen U.S. Military Academy cadets enrolled in a general psychology course were asked to listen to a tape of battlefield radio transmissions, either without distraction or while playing a computer game. The results indicated that cadets who did both tasks simultaneously performed significantly and substantially poorer on the comprehension task compared to those who listened to the radio transmissions alone. Implications for tasking commanders and other battle staff are addressed.

**Faculty Advisor: Dr. Michael D. Matthews, U.S. Military Academy**

**Poster 5.****Effects of Mode of Presentation on Text Comprehension**

**Jennie M. Hattmann and Michelle N. Kracht  
Department of Behavioral Sciences and Leadership  
U.S. Military Academy**

Text comprehension and reading rates were compared as a function of mode of presentation. Forty-two U.S. Military Academy cadets enrolled in a general psychology course read a selection from an Army leadership manual. The material was presented either in standard paper format or on a computer screen. There were no differences between the groups in reading rate, but cadets who read the material on the computer screen showed statistically marginally better comprehension than those viewing the material in the paper format. Because past research showed an advantage for paper-presented material, the question is raised whether today's young adults may be better prepared to comprehend computer presented material than their predecessors. The results are important because of the growth of distributive learning both in the Army the society at large.

**Faculty Advisor: Dr. Michael D. Matthews, United States Military Academy**

**Poster 6.****The Effects of Voice-Picture Desynchronization  
on Message Comprehension**

**Miguel A. Martinez and John D. Selby**  
**Department of Behavioral Sciences and Leadership**  
**U.S. Military Academy**

Video teleconferencing is increasingly common in the military and other settings. However, the audio-video link is often flawed, resulting in desynchronization between the video and auditory links. The current experiment compared message comprehension as a function of type of desynchronization. Thirty-three U.S. Military Academy cadets enrolled in a general psychology course were viewed a video tape of a Army officer giving a operations order. For the control group, the audio and video were synchronized. The delay group heard the audio 0.5 seconds after seeing the video. The precede group heard the audio 0.5 seconds prior to seeing the video. Results indicated a non-significant trend of better comprehension in the control group, and the poorest comprehension in the precede group. Implications for video teleconferencing are discussed.

**Faculty Advisor: Dr. Michael D. Matthews, U.S. Military Academy**

**Poster 7.****An Evaluation of the Practicality of Personal Digital Assistants**

**Joseph F. Mitek and Kelly J. Schachtler**  
**Department of Behavioral Sciences and Leadership**  
**U.S. Military Academy**

The current study compared the personal digital assistants (PDAs) and a paper daily planner on three different tasks: data input, data transfer, and data retrieval. Participants were also surveyed on their preference for using PDA or paper planners. Twenty-four U.S. Military Academy cadets enrolled in a general psychology course were tested. The results indicated that data entry using the PDA took over four times as long to accomplish compared to the paper planner. There were no differences between the two time to complete data transfer or retrieval. Survey data revealed that 83 percent of the sample preferred to use the paper planner for organizing their activities. Implications for the use of PDA technology in military and academic settings are discussed.

**Faculty Advisor: Dr. Michael D. Matthews, U.S. Military Academy**

**Poster 8.****Land Warrior Monocle: Use of Dominant Versus  
Non-Dominant Eye in Task Performance**

**Dennis D. Scott and Kevin Smith**  
**Department of Behavioral Sciences and Leadership**  
**U.S. Military Academy**

The Land Warrior system allows information to be presented to a soldier through a monocle. The current study examined if wearing on the monocle on the dominant versus non-dominant eye affected the ability of subjects to complete a simple report while engaging a target presented on a video screen. Ten U.S. Military Academy cadets enrolled in a general psychology course were assigned to one of two groups. One group completed the tasks while wearing the monocle over the dominant eye, while the other group completed the same tasks with the monocle placed over their non-dominant eye. The results indicated no difference between the groups in sending a report through the Land Warrior system. However, subjects using the non-dominant eye performed better than those using the dominant eye, a difference that approached statistical significance ( $p = .07$ ). Further studies, using a large sample and other tasks should be conducted to more thoroughly examine this question.

**Faculty Advisor: Dr. Michael D. Matthews, U.S. Military Academy**

**Poster 9.****User Preferences for Two Individual Combat Load Systems: MOLLE vs. LCE**

**Chris P. Trombetta and Ian J. Vargas**  
**Department of Behavioral Sciences and Leadership**  
**U.S. Military Academy**

The current study compared the Modular Lightweight Load-Carrying Equipment (MOLLE) system and the Load Carrying-Equipment (LCE) system with respect to user ratings of heat, overall comfort, usability, and easy of use. In addition, water consumption rates were compared for the two systems. Using a within subjects design, seventeen cadets enrolled in a general psychology course at the U.S. Military Academy wore the MOLLE and LCE while performing a variety of physically exerting tasks. Results indicated that cadets were able to consume significantly more water using the MOLLE hydration system than from the canteen used with the LCE. In addition, the MOLLE system was rated as more comfortable, easier to use attachments, and easier to adjust than the LCE.

**Faculty Advisor: Dr. Michael D. Matthews, U.S. Military Academy**

**Poster 10.****“Fair” Upper Body Muscular Strength-Endurance Testing For Men**

**Chris Johnson**  
**Department of Physical Education**  
**United States Military Academy**

Upper Body muscular strength-endurance tests are administered both here at USMA and also in units throughout the Army. These tests play an important role by assessing fitness levels of individuals and units and determining the effectiveness of unit physical training. In the Army, specifically on the Army Physical Fitness Test, performance standards are based only on age and sex. USMA’s PE310 incorporates only gender in the “Male Upper Body Strength/Endurance Test.” The components of this test are the chest press, with resistance of 175 pounds, and cadence pull-ups, with 5-second pauses between repetitions.

The purpose of this study is to determine whether USMA’s PE310 “Upper Body Strength/Endurance Test” is an accurate measure of strength for males. In interpreting the “fairness” of this criterion-based fitness test, it analyzes the effect body mass has on performance to determine whether body mass creates an unfair bias. According to the statistical analysis of recent data, body mass does bias both events. For the chest press, higher mass corresponds to higher performance. On the contrary, for cadence pull-ups, higher mass corresponds to lower performance. Analyzing the sum of reps for both tests, there still appears to be some bias due to body mass, but it lacks statistical significance ( $r^2 = .04$ ). Research to date suggests that the “Male Upper Body Strength/Endurance Test;” combining both the chest press and cadence pull-ups, is a fair and accurate measure of strength for males. All research was done in conjunction with the Department of Physical Education and the Department of Mathematical Sciences.

**Faculty Advisors: Todd A. Crowder, Ph.D., Department of Physical Education, and LTC Steve Horton, Department of Mathematical Sciences, United States Military Academy**

**Poster 11.****Assessing the Upper Body Muscular Strength-Endurance for Women**

**Jessica L. Chapman**  
**Department of Physical Education and Mathematical Sciences**  
**U. S. Military Academy**

Success on the battlefield demands an individual possess technical and tactical competency, but also the muscular strength and endurance to get the job done. Physical fitness is a vital necessity to military personnel. But, how does one measure the true muscular-strength and endurance of soldiers? What about female soldiers? Should the same test for assessing strength levels of males be used to assess females? This study examined whether the 70-lb Bench Press Test, in conjunction with the In-Cadence Pull-up Test, both upper body muscular-strength requirements of the Cadet Fitness Challenge, create a 'fair' muscular-strength endurance assessment of female cadets.

Many factors affect an individual's muscular-strength. This study focused on the relationship between an individual's body mass and performance on both the 70-lb bench press and in-cadence pull-up test. The current assertion is that by including *both* tests, one of which is negatively impacted by body mass (pull-ups) and the other is positively impacted by body mass (bench press), an overall 'fair' assessment is made of an individual's true muscular-strength and endurance. The criteria for a 'fair' assessment was such that the graph of the combined tests versus body mass would yield a completely horizontal line, implying a cadet's performance on the two events *combined* would negate the influence of body weight. An additional criterion for a 'fair' assessment was a correlation coefficient value as close to zero as possible.

The data showed a significant positive and negative impact of body mass on performance on each test, but the resulting line of the *combined* test scores versus body mass still demonstrated a *slight* upward trend, suggesting the test is not a completely unbiased assessment. Consider the correlation coefficient values of .203, .185, and .095, respectively. Although only slightly influenced by body mass, requiring both the 70-lb bench press and in-cadence pull-up tests, the Cadet Fitness Challenge begins to provide an overall 'fair' assessment of true muscular-strength and endurance levels of female cadets. Future work will explore these issues to determine if a 'weight' assigned to the score of either test event, will help 'balance out' the influence of body mass, thereby creating a completely horizontal line.

**Faculty Advisors: Todd A. Crowder, Ph.D., Department of Physical Education, and LTC Steve Horton, Department of Mathematical Sciences, United States Military Academy**

**Poster 12.****Checklist Performance on the Commercial Flightdeck**

**Melanie Diez,  
Human Factors & Applied Cognition  
George Mason University**

The proper execution of checklists on the flightdeck is critical to the successful completion of any flight or mission. This paper describes the preliminary results from an ongoing observational study of checklist performance on the commercial flightdeck. Four researchers observed checklist performance on forty-three revenue-generating flights of a major commercial carrier. Observations were conducted on two types of aircraft: the Airbus A-320 and the Bombardier CRJ. Checklist performance was recorded for Cruise, Pre-Descent, In-Range, and Before-Landing checklists. Performance was measured according to two criteria: 1) whether or not each item was annunciated, and 2) the order in which the items were annunciated.

Preliminary results suggest that flightcrews frequently fail to annunciate checklist items, and sometimes fail to annunciate entire checklists. Furthermore, certain checklists appear to be more vulnerable to omitted annunciations than others. However, the order of execution appears to be quite robust with very few items called out of order. The results are interpreted with respect to pilot role (pilot-flying vs. pilot-not-flying), pilot rank (captain vs. first officer) and phase of flight. These findings provide a quantitative baseline of checklist performance during line operations. In addition, they offer some insight towards possible support devices and checklist design.

**Faculty Advisors: Deborah A. Boehm-Davis and Robert W. Holt**

**Poster 13.****Information and Decision Uncertainty: Effects of Unreliable Automation on Multi-Task Performance and Workload**

**Ericka Rovira and Marla Zinni**  
**Cognitive Science Lab**  
**The Catholic University of America**

While automation provides many advantages, high reliability cannot always be assured, especially in dynamic environments. Unreliable automation can add to uncertainty and thereby degrade performance. At least two forms of uncertainty are important, *information* uncertainty, in which the appropriate information sources relevant to problem solving are not known or present only incomplete data, and *decision* uncertainty, where the selected option may not be clear and the time required to verify the selection may be limited. In the present study, we examined the relative benefits and costs of two forms of automation ("information" automation and "decision" automation) and investigated the effects of automation unreliability. Participants were either provided with a support aid that transformed raw signals into system status information ("information" automation) or provided them with a recommendation for action ("decision" automation) for the system-monitoring sub-task of the Multi-Attribute Task Battery (MAT). Automation reliability was varied over two levels (75% and 50%). Dependent variables included accuracy and speed of fault detection performance and subjective measures of trust and workload. Preliminary results suggest that while automation support enhanced monitoring performance when reliable, unreliable automation led to a performance cost. Operator fault detection when the automation failed was poorer than under manual performance. There was also a trend towards greater performance costs for decision than for information automation. Implications for automation design are discussed.

Supported in part by Grant DAAD17-00-P-0366 from the Army Research Laboratory, Ft. Huachuaca, AZ, and in part by a MURI sub-contract from the University of Central Florida.

**Faculty Advisor: Raja Parasuraman, The Catholic University of America**

**Poster 14.****An Ordering of Secondary Task Display Attributes**

**Christa M. Chewar and Ali Ndiwalana**  
**Virginia Polytechnic Institute and State University**

We found that established display design guidelines for focal images cannot be extended to images displayed as a secondary task in a dual-task situation. This paper describes an experiment that determines a new ordering guideline for secondary task image attributes according to human cognitive ability to extract information. The imperative for alternate guidelines is based on the difference in an image's ability to convey meaning, which decreases when moved from a focal to a secondary task situation. Secondary task attribute ordering varies with the level of degradation in the primary task.

**Faculty Advisors: D. Scott McCrickard and Chris North**

**Poster 15.****Visual Search for Two Identical Targets:  
The Role of Ecological Validity****Derek D. Diaz  
University of Central Florida**

Recent investigations regarding the role of memory during visual search indicate that the use of memory-based processes for previously seen items can improve performance. A method successfully applied to preclude the use of memory is to repeatedly move elements of the visual search to random locations. This method, however, does not accurately reflect observations of natural environments. The present study extends prior research in this area by examining conditions that specifically employ targets that obey ecologically-valid rules. Participants had to determine if two identical targets were present among 15 elements where at least one target was always present. Stimuli consisted of soldiers displayed in a 3 dimensional virtual environment. To assess the utility of memory processes, both static and dynamic scenes were included, where the dynamic condition presented soldiers following random movement trajectories. In order to examine the effect of stress on search behavior, half of the participants heard white noise. Results indicate that, under the conditions used here, memory based processes did not fail as has been observed in previous findings. Stress was related to a decrease in response time. The findings suggest that memory processes used during visual search tasks appear to be inherently robust when natural movement is observed, even when the search elements adhere to random patterns.

**Faculty Advisors: Valerie K. Sims and Peter A. Hancock**

**Poster 16.****The Effect of Time Stress on Mission Performance  
in a Virtual Combat Mission****Adams Greenwood-Ericksen and H.C. Neil Ganey.  
University of Central Florida**

In infantry combat, soldiers routinely operate in highly stressful conditions while simultaneously making decisions under time pressure. The purpose of this ongoing study is to examine the effects of time stress on the performance of participants engaged in a simulated mission environment. To date, ten undergraduate subjects have undergone hour-long training courses in the use of a soldier simulator based on a commercially-available video game, and then completed a simulated POW rescue mission under one of two time-pressure conditions. In the control condition participants experienced no time stress, while participants in the experimental condition performed the same mission under time pressure. Dependent variables fell into two categories, subjective and objective. Subjective DVs consisted of self assessments by the participant of the time pressure they experienced, their performance on the task, and the difficulty of the task. Objective DVs were participant shooting accuracy, number of enemy kills, number of "hits" taken, number of hostages rescued, and time taken to complete mission objectives. At this time, only the subjective data have been analyzed, and these indicated a successful manipulation of time pressure and a reduction in self-perceived performance on the primary task under higher time pressure. During the planning and execution of this study, the following lessons regarding the design of studies of this type were learned. Investigators should be certain to train participants to asymptote in order to reduce between-subject variability, use participants who resemble the target population as closely as possible in order to maximize generalizability, and exaggerate the strength of phrasing and tone of voice in order to convey urgency in high time pressure briefing conditions.

**Faculty sponsors: Jeanne L. Weaver, Peter A. Hancock, and Mutapha Mouloua**

**Poster 17.****Reducing Driver Error to Enhance Transportation Safety and Efficiency**

**Krystal A. Bradley and Jennifer E. Thropp**  
**University of Central Florida**

Aggressive driving and road rage are on the rise according to a 1996 report by AAA. Consequently, researchers in various countries are attempting to better their understanding of the factors related to aggressive driving and road rage. As a result of these efforts, a number of useful measurement instruments have been developed. For example, the Driver Behavior Inventory (DBI) assesses factors related to stress and driving, while the Driver Behavior Questionnaire (DBQ) assesses driving errors and violations. Past research has explored the relationship between the above mentioned measures, age, and personality, among others. Another approach to studying errors in driving has involved differences in attributional styles, although this research has been limited. Specifically, research has explored the attributions made by actors (drivers) versus observers for particular vehicular incidents. A separate line of research has investigated self-reported failures in perception, memory, and motor function. Thus, the purpose of the current study was to explore the relationship between attributional styles operationalized as attributional complexity, cognitive failures, and their relationship to the DBI, DBQ, and the Driving Anger Scale. The results of this study indicate that persons who are more attributionally complex tend to commit fewer driving violations than those who are less so. The results also indicate that persons with more cognitive failures tend to experience more errors (misjudgments and failures of observation) and lapses (absent-minded behaviors), and are involved in more accidents than those with fewer cognitive failures. The results of this study produced other correlations of interest. Persons with more cognitive failures tend to experience more stress when driving than those with fewer cognitive failures. Persons with more cognitive failures are also more prone to be aggressive while driving. Finally, attributionally complex persons tend to be more alert while driving. These findings have implications for driver training as well as for increasing our understanding of the factors that influence driver error and safety.

**Faculty Sponsors: Jeanne L Weaver, Peter A. Hancock, and Mustapha Mouloua**

## **Time Course of Cognitive Performance After Ascent to 4300 Meters**

**Louis E. Banderet<sup>1</sup>, Ph.D., Robert L. Kane<sup>3</sup>, Ph.D., and Stephen R. Muza<sup>2</sup>, Ph.D.**

**US Army Research Institute of Environmental Medicine  
Military Performance Division<sup>1</sup>  
Thermal and Mountain Medicine Division<sup>2</sup>  
Natick, MA 01760-5007**

**VA Maryland Health Care System<sup>3</sup>  
Baltimore, MD 21201**

In many civilian and military situations, the time course of an acute disorder greatly influences its impact upon those affected. We used laptop computers to assess the within-volunteer, cognitive performances of 9 men and 2 women volunteers (U.S. Army Soldiers) 0.5, 2, 4, 12, and 24 hours after ascents to 30 meters (control) or 4300 meters simulated altitude. We administered a test battery (WinSCAT, a subset of ANAM), designed to be a mental status monitor for astronauts on the International Space Station. Cognitive impairments (task accuracy, relative response rate, or throughput), compared to control values, were evident on all of the tasks. Impairments were concentrated on the Running Memory and Code Substitution Tasks, immediately after ascent. Impairments on these tasks were greatest at 4 hr. (statistically significant from control,  $p \leq 0.05$ ) and most impairments recovered subsequently. Accuracies on the two tasks affected less at altitude (Mathematics and Matching) were statistically different from control values from 0.5 to 4 hr. Further studies must be conducted to determine if bold, pretreatment strategies (such as rapid acclimation) can prevent impairments in cognitive performance at high altitude. If this is possible, some very advantageous operational strategies in U.S. Army flight operations could become possibilities.

**Changes in Salivary Amylase and Self-reported Fatigue  
across Three Increasingly Intense Bouts of Exercise**

**Ava J Walker, Wayne C. Harris, Arthur S. Leon,  
University of Minnesota  
and  
Peter A. Hancock  
University of Central Florida**

This study provides intensive laboratory observations of changes in salivary amylase and markers of physiological fatigue across three treadmill work intensities in active and reserve military personnel. Ten active duty or active reserve soldiers (3 females, 7 males), mean age  $24.4 \pm 6.24$  years, volunteered to performed a  $VO_{2max}$  test walking 3.4 mph while carrying a 35 lb ruck sack on their back. Metabolic measures were monitored, as well as heart rate and RPE. Participants returned to the lab to perform a treadmill walk test at 3.4 mph at increasingly steeper grades until HR matched values associated with 30%, 60% and 90% $VO_2$  values. Participants reached steady state at each level then responded to the ANAM test battery while they continued to walk. Saliva samples were obtained and RPE was recorded just before the last test in the battery at each level for analyses of salivary amylase. The POMS was administer pre- and post-testing. Preliminary results show strong % change scores for the POMS fatigue score (243.4%) and the mean percent change salivary amylase values (548.9%,  $p < 0.004$ ). Results indicate salivary amylase is a valuable physiological marker of stress with perhaps enough sensitivity to provide a dose-response analysis between physical work and fatigue.

**Salivary amylase as a marker of increasing physiological stress  
during a 5-mile treadmill road march.**

**Ava J. Walker, Heidi L. Bolgren, Kathryn G. Nichols, Arthur S. Leon,  
University of Minnesota  
and  
Peter A. Hancock  
University of Central Florida**

The purpose of this analysis is to investigate the sensitivity of salivary amylase to provide a dose-response indicator of physiological stress during a prolonged intense bout of physical activity. Ten active duty or active reserve soldiers (3 females, 7 males), mean age  $24.4 \pm 6.24$  years, volunteered to performed a  $VO_{2max}$  test walking 3.4 mph while carrying a 35 lb ruck sack on their back. Metabolic measures were monitored, as well as heart rate and RPE. Participants returned to the lab to perform a treadmill walk test at 3.4 mph at 75% $VO_{2max}$  values carrying the 35 lb ruck sack. Participants reached steady state at then responded to the ANAM test battery at 20 min intervals while walking (5 administrations). Saliva samples were obtained and RPE was recorded just before the last test in the battery at each time interval for analyses of salivary amylase. Values for salivary amylase increased significantly across time (165.9%) even as the relative workload remained constant, perhaps as an indicator of increasing physiological stress. However, self-reported values RPE did not prove to be as sensitive a measure and were not significantly different after the first 20 min time period ( $p = .559$ ).

## **The Effect of Physical Workload on Cognitive Performance**

**Wayne C. Harris, Ava J. Walker, Arthur S. Leon**

**University of Minnesota**

**and**

**Peter A. Hancock**

**University of Central Florida**

The relationship between physical exertion, mental effort, and stress and operational performance deterioration has proven difficult to study. Participants mask cognitive deficits and performance changes, and performance changes are caused by the complex interaction between physiological effort, psychological demands, and stress. The current study repeatedly assessed cognitive performance during carefully calibrated physical exercise. This limited the potential cause to the immediate physiological demands and decreased the likelihood of increased motivation due to assessment novelty.

The exertion level, and cognitive performance of ten Reserve Officer Training Corps cadets were assessed while they were walking on a treadmill. Exertion was assessed by maximum oxygen volume uptake ( $\text{maxVO}_2$ ). Cognitive performance was assessed by seven sub-tests of the Automated Neuropsychological Assessment Metric at three levels of exertion; 30%, 60% and 90%  $\text{maxVO}_2$ .

Cognitive performance accuracy did not change with exercise level and responses were faster at higher exercise levels. The lone exception to this pattern was the spatial processing task, which was less accurate at high exercise levels. A similar pattern of accuracy changes was noted during a simulated 5-mile march. The accuracy of all tasks except spatial processing was stable. Spatial processing declined as the march progressed. Response time was stable during the march.

The results indicate that exercise at the studied leveled did not produce cognitive performance changes with the exception of spatial processing. Spatial processing accuracy declined at higher levels of exercise and with longer periods of exercise.

## **Demonstration of the U.S. Army's Land Warrior System**

**Mark Hanna, Gerald P. Krueger, and SFC Alton Stewart**  
**Program Executive Office: Project Manager for Soldier Systems**  
**Fort Belvoir, VA**

These three gentlemen showed the audience the Version 0.6 prototype Land Warrior infantry fighting system as it was configured for deployment by 50 soldiers from Fort Bragg, NC to Fort Polk, LA in August 2000 as part of a joint advanced warfare technology and training readiness demonstration. The Land Warrior capabilities described and selectively demonstrated, included: a modular load carrying system (MOLLE), and Interceptor personal body armor (which did so well in protecting our soldiers from injuries in Afghanistan recently), a belt-worn computer and its connecting hubs and communications capabilities, including providing a wireless LAN radio and digital linkage among infantry squad members, a Global Positioning System antenna and connection, a thermal weapon sighting mechanism, and a daylight video camera sight. The three men then described the numerous changes made since the year 2000 to prepare the Land Warrior system for the Army's rigorous developmental test (DT) and operational test (OT) process. Much of the commentary revolved around the combined government and industry partnership design team's efforts to ensure sufficient soldier user inputs to design via exercising computer user juries to critique the Graphic User Interface and by conducting "fightability assessments" on the ground with soldiers actually performing most of the maneuvers an infantryman would while wearing the Land Warrior equipment ensemble. The focus was on human factors engineering, ergonomics, visual psychology, and health hazards assessments discussion points in demonstrating the now improved version 1.0 of the Land Warrior system. A lengthy question and answer period about the Land Warrior technologies ensued.

## **Evaluation of the Effectiveness of GoArmy.com**

**Daniel L. Berryhill, Harry Geiseeler,  
Brian N. Stone, and Eric M. Wigley  
Department of Behavioral Sciences and Leadership  
United States Military Academy**

Two studies analyzed the effectiveness of the Army's recruiting website, GoArmy.com. Each study utilized high school students as participants, as those individuals are the target audience for this site. The first study observed and recorded ten participants' navigation through the website. Researchers engaged in a cued retrospective analysis with the participants to determine their underlying thought processes with respect to selecting and then leaving each web page. Results from this study indicate that interest in subject matter, and not sequential presentation of information, influenced the behavior of the participants. The second study utilized eye- and head-tracking equipment to determine which areas of the web pages drew participants' attention. Sixteen participants were presented with five web pages and their eye movements were recorded while viewing each page. Results from this study indicate that individuals spent more time viewing information in the center of the screen. Information gained from each of these studies was utilized to make suggestions for improvement in both website content and design.

**Faculty Advisor: COL Lawrence G. Shattuck, Ph.D.  
United States Military Academy**

**Synchronized and De-Synchronized Video Communications:  
Factors Affecting User Comprehension**

**Joshua G. Morino, Erika Reiner,  
Christina Canelli, and Anna Feliz  
Department of Behavioral Sciences and Leadership  
United States Military Academy**

**Note Bene: This presentation won the Best Student Presentation Award  
sponsored by Division 19**

Use of telepresence in both military and civilian settings has increased with the availability of technology. However, computer and bandwidth limitations make audio and video de-synchronization common. Two studies analyzed user comprehension of information presented in various conditions of video and audio synchronization and de-synchronization. The first study utilized a total of eighty participants and compared comprehension between four groups: synchronized audio and video, audio only, and two de-synchronized conditions where audio was followed by video or video was followed by audio. Researchers found no significant differences between any of the groups, negating the opinion that comprehension increases with the presence of video. The second study, with a total of ninety participants, compared comprehension of both native and non-native English-speaking individuals in videotapes that were either synchronized or de-synchronized. Results indicated that there is a significant decrease in user comprehension when a person is presented with de-synchronized audio and video from a non-native English speaker. Implications of these findings are discussed. Additional research is proposed to determine whether or not the results reported herein generalize to tasks other than comprehension.

**Faculty Advisor: COL Lawrence G. Shattuck, Ph.D.  
United States Military Academy**

**Video Versus Written Manual Instructions:  
An Evaluation of Multi-Modal Job Training**

**Reid Finn and Laura Schroeder  
Department of Behavioral Sciences and Leadership  
United States Military Academy**

The present research examines the use of video technology in training soldiers to perform preventive maintenance checks and services (PMCS) on Army High Mobility Multipurpose Wheeled Vehicles (HMMWV). Current training methods utilize a written manual that is difficult to understand. Researchers hypothesized that individuals trained using video instruction would perform a PMCS more quickly and more accurately than individuals trained using the current written manual. A total of twenty-four individuals were randomly assigned to groups where they either studied a manual or watched a video. They then completed a PMCS on a HMMWV where the completion time and number of errors were recorded. The difference between the two groups in time for completion was not significant, however the participants who watched the video made significantly fewer errors than participants who studied the manual. Use of video training for tasks performed by soldiers is discussed as an effective alternative to written manuals.

**Faculty Advisor: COL Lawrence G. Shattuck, Ph.D.  
United States Military Academy**

## **Intelligent Warfighter-Robot Interface Design: Challenges and Objectives in the Area of Human-Robot Integration**

**Mary L. Lozano**  
**Raytheon Company, Falls Church, VA**

The challenge is to provide technologies and methods to ensure that the military's most critical resource—the warfighter—is trained, equipped, and technically supported to perform as effectively and safely as possible. A desirable technology is a robotics design that (1) provides coordinated interaction and (2) meets the warrior's cognitive demands. The objective is to include the combatant as an integral part of the system.

A warfighter-centric vision involves the design, development, and fielding of robotic systems. The development of software technologies to program the operation of autonomous, mobile robots will enhance military operations by a) reducing the cost of maintaining and sustaining military systems, b) expanding military hardware capabilities, and c) redefining the development and employment of future military systems. With regard to robots in the battlefield, the warrior is expected to engage with teams of robots, that is, clusters of homogeneous or heterogeneous robots (e.g., teleoperated, semi-autonomous, fully autonomous, air, or ground robots).

Also considered in this presentation are features of an effective heterogeneous multi-robot interface like multi-modal feedback and input devices for the operator, as well as situation awareness and a decision-support system that permits adaptive human-robot interaction. Emphasis is placed on technologies and standards, which need to be created to enable combatants to interact with robots or teams of robots in an intuitive and consistent fashion, rather than require human operators to acquire new operational skills whenever new robotic designs are developed or fielded.

Key words: warfighter-centric, intelligent interface, adaptive human-robot interaction, levels of robot autonomy, robot control architecture

## **What Constitutes An Effective Decision Aid? – The *RapidOps* Prototype**

**Jerry L. Harbour, Heather L. Hunting and Susan G. Hill  
Human Factors Department  
Idaho National Engineering and Environmental Laboratory  
Idaho Falls, ID**

What makes an effective decision aid? An initial survey was conducted to better identify and understand the important decision aid elements. Three questions were asked: Is the aid useful, is it usable, and finally, is it actually used? Those decision aids scoring high marks to all three questions exhibited a common set of characteristics: a well-structured and embedded knowledge base; a simple and easy to use, yet powerful, tool base; and an application-specific domain base. Additionally, many of the decision aids also supported problem exploration and increased problem understanding. To begin to translate these findings into potentially usable design criteria, a computer-based decision aid named *RapidOps* is being developed. *RapidOps* is a field-deployable, computer-based system for planning and analyzing time-critical missions, including military direct action-type missions. It can also be used for conducting vulnerability assessments, such as those represented by assessing the vulnerability of physical assets to a terrorist attack. The system links time and probability modeling in a graphical, intuitive, easy to use, and field-deployable computer-assisted work environment. Insights gained in the design of such effective decision aiding systems will be discussed via demonstrating differing features of the *RapidOps* prototype system.

**Job Analysis and Cognitive Task Analysis of Air Traffic Controllers**  
**Rosemarie Reynolds**  
**University of South Florida**  
**and Kelly Neville**  
**CHI Systems, Inc., Orlando, Florida**

Although cognitive task analysis has been widely used in human factors and instructional design, it remains a largely unknown technique in industrial psychology. We compared a job analysis and a cognitive task analysis of air traffic controllers to determine if the cognitive task analysis added useful information to that provided by the job analysis. Primary differences were (1) whether job attributes were described in the context of task performance and (2) whether cognitive principles influencing performance were identified. We concluded that cognitive task analysis did provide additional information beyond that of the job analysis, and specified applications for which this additional information might be most useful.

## **Making Touch Screen Interfaces Effective for Military Command and Control Applications**

**Maureen B. Scully**  
**Raytheon Company C3I Systems, Falls Church, VA**

Human Factors research on Human System Integration (HSI) explores touch screen applicability to next-generation multi-model Command and Control (C2) workstations for Unmanned Aerial Vehicles (UAV). Touch screen technologies are discussed. This study explores effective touch screen control capabilities and ergonomics for design and Human System Integration (HSI) of command controls. Successful design elements are identified for effective touch screen control. Remote control environments and the role of HSI for decision-making applications are explored. User interface design theories provide the basis of a touch screen's measurement of effectiveness (MOE). Designers and evaluators are guided through taxonomies of user tasks, predictive models of performance, and explanatory theories. MOE for command and control complexities are eventually mapped to ergonomic touch screens designs and are explained in connection with Fitts Law, the Steering Law and Goals, Operator, Methods, and Selection rules (GOMS). The Global Hawk UAV HSI baseline is implemented with proposed ergonomic touch screen designs. These proposed next generation UAV C2 workstation designs present a different look and feel. This new look and feel display health and status for command resources mapped to wire-frame models. All these human factor concepts under development or consideration intend to minimize human intervention, improve efficiency, and improve the UAV interoperability with other systems.

## **Supporting Higher Unmanned Vehicle to Operator Ratios Using Dynamic Task Allocation**

**Regan H. Campbell  
Applied Systems Intelligence, Inc. (ASI)  
Roswell, GA**

One of the major questions involving the control and supervision of unmanned vehicles (UVs) is the determination of how many vehicles one operator can successfully manage. Some programs posit a 1:1 ratio (e.g., Tactical Control Station (TCS)) whereas others have suggested up to a 10:1 ratio (e.g., Control of Multiple Unmanned Systems (CMUS)). In order for these higher ratios to become a reality, operators need decision aiding, as well as the ability to shed tasks during high workload phases. In theory, ASI's associate technology, a decision aiding system, when utilized in concert with dynamic task allocation, can support the management of multiple UVs. Dynamic task allocation is when tasks are redistributed based on workload and/or system performance. Issues related to this proposed system will be examined, including when to switch levels of autonomy (using either a model-based or performance-based metric), how to measure workload, which levels of autonomy to employ, and how to measure attention and situation awareness. A proposed experimental design to further elucidate these issues, which simulates a single operator in controlling multiple UVs on an Intelligence, Surveillance, and Reconnaissance (ISR) mission, will also be discussed.

**Evaluations of HMD Ownship Status Symbology  
for Maintaining Situation Awareness**

**Paul R. Havig, Joseph C. Jenkins, Eric E. Geisleman, and Eric L. Heft  
U.S. Air Force Research Laboratory  
Wright-Patterson AFB, Ohio**

Recent technological advances allow symbology to be displayed on the pilot's visor. A major benefit of this is that the pilot will be able to take this information with them when they look off-boresight. Several studies will be discussed looking at factors related to the maintenance of situation awareness via off-boresight attitude symbology. One specific question that arises when looking off-boresight is what is the best orientation or, frame of reference, for attitude symbology against the horizon (i.e., forward or line-of-sight) in order to maximize interpretation and performance. In most of the studies, five different symbologies (standard HUD, visually coupled acquisition and targeting symbology, arc segmented attitude reference, theta ball, and non-distributed flight reference) of which three have both forward and line-of-sight orientations, are tested. Overall, results indicated that performance is better when the symbology is forward as opposed to line-of-sight referenced. Further, performance is usually the best when the non-distributed flight reference is used. These results are discussed in terms of implications for helmet-mounted display symbology design.

## Social background characteristics and performance of West Point cadets

**2LT Ariel A. Jones, CPT Timothy S. Allison-Aipa, and LTC Paul T. Bartone**  
**Leader Development Research Center**  
**Department of Behavioral Sciences & Leadership**  
**United States Military Academy**

The identification, selection and training of young men and women who will make good future leaders and officers is a critically important task for military organizations. Studies have investigated the social origins of military academy cadets, usually relating such factors to major historical and economic trends (Moelker & Soeters, 1998). But the possible influences of social background variables on performance have not been much studied. The present research explores the relation of several social background characteristics to performance in a recent (1998) class of West Point cadets. Preliminary results confirm that the U.S. Military Academy continues to be broadly representative of the general U.S. population (34% upper class, 56% middle class, 10% lower class based on father's occupation). Examining social class, family income, race, gender, and political ideology, few differences were found in cumulative scores across the three domains of academic, military, and physical performance. However, higher family income is related to better performance, and there is also some evidence that white and Hispanic cadets perform better overall. Additional analyses will consider the combined (simultaneous) effects of social background variables on performance.

## **Web-based Learning Exercise for Army Training**

**James Belanich**

**U.S. Army Research Institute for the Behavioral and Social Sciences**

**Kara L. Orvis**

**George Mason University and Consortium Research Fellows Program**

**Robert A. Wisher**

**U.S. Army Research Institute for the Behavioral and Social Sciences**

The U.S. Army Research Institute conducted research at three Army schools on a collaborative, web-based question-writing program (TEAMThink). As the military increasingly depends on Web-based modes of training to instruct geographically dispersed learners, the establishment of web-based collaborative training tools are needed. Social constructivist theory suggests that students learn through collaboration, rather than simply learning from an instructor and/or textbooks alone. The TEAMThink program fosters collaboration while students develop course-related questions. Students are split into teams, write questions on learning content, and then comment on questions written by team members. After reviewing the comments from team members, students are prompted to revise their questions. Instructors then review the questions to determine if the questions and answers adhered to Army doctrine. Students are subsequently tested with all of the questions developed by other teams. The purpose of the research was to assess the utility and validity of the program when used as an instrument to foster deeper understanding of course content in conjunction with Army instruction. Of the 336 questions generated by 199 students, 77% of the questions were considered doctrinally correct. In addition, the results suggested that the collaborative development of questions produced a limited but inconclusive learning effect; an increase in scores of approximately 7% was found, which was not statistically significant. Also, the majority of comments made during the collaboration process were constructive in nature, indicating the usefulness of the student-student collaboration.