ARI Newsletter

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

Volume 13 May 2003 Number 1

Maximizing 21st Century Noncommissioned Officer Performance (NCO21)

Are we prepared to meet the needs of the Objective Force? Do our junior soldiers have the knowledges, skills, and attributes (KSAs) required for success as leaders in the transformed Army? How can the Army manage noncommissioned officers (NCOs) to ensure high quality NCO leadership in this era of change? The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) initiated the NCO21 Project in FY99 to address these issues by examining the junior NCO promotion system to make recommendations to the Army.

The NCO21 research focuses on mid-career promotions, E4 through E6, in order to achieve the greatest span of influence on the NCO corps. Under the current system, promotions are based on common soldier knowledge, general skills, and training with little emphasis on leadership potential or MOS-specific knowledge. The recommended future-oriented promotion system adapts the current common soldier model to include additional measures and better predict performance in current and future environments.

Identification of Future Job Requirements

For most civilian or military occupations, the first step to redesigning the promotion system is a traditional job analysis. This approach involves interviewing employees to identify the tasks they perform and the KSAs required to perform these tasks. Because we were interested in the KSAs soldiers need for future

Continued on page 3

IN THIS ISSUE

Telephone Directory

Director
703.617.8636 • DSN: 767.8636
E-mail: ARI_DIR@ari.army.mil

Acting Technical Director
703.617.8275 • DSN: 767.8275
E-mail: ARI_TECHDIR@ari.army.mil

Advanced Training Methods Research Unit
703.617.5948 • DSN: 767.5948
E-mail: ARI_ATMRU@ari.army.mil

Armored Forces Research Unit (Ft. Knox)
502.624.3450 • DSN: 464.3450
E-mail: ARI_AFRU@ari.army.mil

Army Personnel Survey Office
703.617.7803 • DSN: 767.7803
E-mail: ARI_APSO@ari.army.mil

Army Trends Analysis Group
703.617.0364 • DSN: 767.0364
E-mail: ARI_ATAG@ari.army.mil

Fort Bragg Scientific Coordination Office
502.624.0874 • DSN: 236.0874
E-mail: ARI_BRAGG@ari.army.mil

Infantry Forces Research Unit (Fort Benning)
502.624.2362 • DSN: 895.2362
E-mail: ARI_IFRU@ari.army.mil

Leader Development Research Unit (Fort Leavenworth)
913.684.9758 • DSN: 552.9758
E-mail: ARI_LDRU@ari.army.mil

Occupational Analysis Office
703.617.8857 • DSN: 767.8857
E-mail: ARI_OAO@ari.army.mil

Research & Advanced Concepts Office
703.617.8866 • DSN: 767.8866
E-mail: ARI_RACO@ari.army.mil

Research Support Group
703.617.8622 • DSN: 767.8622
E-mail: ARI_RSG@ari.army.mil

Reserve Component Training Research Unit (Boise)
208.334.9390 • DSN: 464.9390
E-mail: ARI_RCTRU@ari.army.mil

Rotary-Wing Aviation Research Unit (Fort Rucker)
502.624.2834 • DSN: 558.2834
E-mail: ARI_RWARU@ari.army.mil

Selection and Assignment Research Unit
703.617.8275 • DSN: 767.8275
E-mail: ARI_SARU@ari.army.mil

Simulator Systems Research Unit (Orlando)
407.384.3980 • DSN: 970.3980
E-mail: ARI_SSRU@ari.army.mil

TRADOC Scientific Coordination Office
757.788.5623 • DSN: 680.5623
E-mail: ARI_TRADOC@ari.army.mil

From the Director

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is responsible for research and development in support of U.S. Army personnel, leader development, and training. We also conduct the Army's operational attitude and opinion surveys and are responsible for providing the U.S. Army with occupational analysis tools. We have always been an agency that supports personnel performance and training transformation. For example, past ARI research has led to the development of enlisted aptitude testing, the after action review (AAR) system, training support packages (TSPs) for use with the Close Combat Tactical Trainer (CCTT), and MANPRINT concepts. In this issue you will find a sample of ongoing research efforts that can influence the people aspects of Army transformation: improved forecasting of NCO's future performance, development of aircrew coordination training to increase safety, use of virtual reality for training Objective Force dismounted soldiers, techniques for developing adaptive leaders, and a first look at requirements for the training of future teams.

We are in the process of redesigning our website, www.ari.army.mil, to make it easier to use and to provide increased access to our research products and findings. Look for that sometime this summer.

Zita M. Simutis

Dr. Zita M. Simutis

Maximizing 21st Century Noncommissioned Officer Performance (NCO21)

Continued from page 1

missions, we could not use traditional job analysis techniques. In lieu of the traditional approach, we conducted a future oriented job analysis including (1) reviewing future-oriented documents, (2) interviewing military planners and futures experts, and (3) analyzing existing jobs believed to be similar to future jobs. Over 400 written sources including official military documents and contractor reports were reviewed for pertinent information.

Interviews were conducted with more than 300 subject matter experts (SMEs) and soldiers in future-like jobs, e.g., digital force soldiers, signal soldiers, military police, and special operation forces. This approach identified the KSAs and performance components expected to be important in Objective Force jobs.

Once the potential KSAs and performance components were identified, two expert panels assembled to complete the analysis. The first panel consisted of senior NCOs and officers from many different MOS who had in-depth knowledge about future military conditions and jobs. These experts reviewed information about future expectations, revised the list of performance components and KSAs, and ordered the KSAs based on expected importance to future job success. A second panel of personnel specialists also ordered the KSAs, and the results from the two panels were combined. The most important KSAs, listed in Table 1, were earmarked for possible assessment.

The Future-Oriented Promotion System

The primary goal of this project has been to identify improvements for the junior NCO promotion system. Using the data gathered from the future-oriented job analysis, we had the information needed to compare the current NCO promotion system with what would optimally be measured in the future promotion system. The soldier's commander and the battalion promotion board make recommendations for considering soldiers for promotion. In addition to the recommendations by the commander and the

Continued on next page

Why change the promotion system?

Table 1. Measurement Methods by KSA

	Measurement Techniques					
KSA	PFF21	ExACT	SJT (X)	AIM	BIQ	SSI
Adaptability				✓		✓
Cognitive Aptitude						✓
Conscientiousness/Dependability				✓	✓	
Effort and Initiative		✓				✓
Emotional Stability				✓		
General Self-Management					✓	
Integrity/Discipline	✓				✓	
Knowledge of Interrelatedness of Units			✓			
Leading of Individuals		✓	✓	✓	✓	✓
Management of Battlefield Functions						
Need for Achievement				✓		
MOS/Job Specific Knowledge/Skill						✓
Oral Communication						✓
Physical Fitness	✓					
Problem Solving/Decision Making			✓			
Self-Directed Learning				✓		
Supervising Subordinates	✓	✓				
Training Others		✓	✓			✓
Writing Skill		✓				

Note. PFF21 = Personnel File Form 21. ExAct = Experiences and Activities Record. SJT (X) = Situational Judgement Test and Situational Judgement Test-X. AIM = Assessment of Individual Motivation. BIQ = Biographical Information Questionnaire. SSI = Semi-Structured Interview. ASVAB = Armed Services Vocational Assessment Battery. Table adapted from Knapp et al., 2002 (Table 8-1, 124-125).

Maximizing 21st Century Noncommissioned Officer Performance (NCO21)

promotion board, the soldier's score is determined by (1) awards, decorations, and achievements, (2) military education, (3) civilian education, and (4) military training.

The future-oriented promotion system adapts the current common soldier model to include additional measures and better predict performance in current and future environments. The future oriented system is designed to tap those KSAs identified in the future oriented job analysis, but are unmeasured in the current junior NCO promotion system.

Seven measurement techniques were used to assess the current and future-oriented KSAs (see Table 1). The self-report *Personnel File Form 21 (PFF21)* measured the selection components of the current promotion system: (1) awards, decorations, and achievements; (2) military education; (3) civilian education; and (4) military training. Future-oriented KSAs were assessed with the remaining measures. The *Experiences and Activities Record (ExAct)* measured how frequently junior soldiers engage in tasks such as training others, acting as supervisors, and working with computers. The *Situational Judgment Test (SJT)* measured several KSAs including leadership and decision making by presenting several brief scenarios and asking the soldier to identify the best and worst possible actions. A second situational judgment test *(SJT-X)* used longer scenarios to measure the futuristic KSA "knowledge of interrelatedness of units." The *Assessment of Individual Motivation* (*AIM*) assessed leadership, adaptability, and interpersonal characteristics by asking soldiers to describe themselves. Similarly, the *Biographical Information Questionnaire* (*BIQ*) assessed leadership, conscientiousness, and interpersonal skills by asking soldiers to answer questions about their attitudes and past experiences. The *Semi-Structured Interview*, conducted with E4s and E5s, was used to evaluate an alternative to the traditional format for asking questions during the promotion board. Senior NCOs, E7 to E9, were trained how to ask questions, write questions, take notes, and score respondents answers.

Together, these measures allowed us to represent the current promotion system through the PFF21 and the future oriented promotion system through the remaining measures. We were able to compare how much we can gain by measures of some or all of the future oriented KSAs to the current promotion system.

Conclusions

The relationship between the promotion system measures (current and future oriented) with supervisor ratings of performance was analyzed. Two different types of supervisor ratings were collected: ratings of current performance and ratings of performance under future conditions. We used a two-step process to examine how much we could gain by adding the future-oriented measures to the current promotion system measures. First, we examined the relationship between the supervisor ratings and the PFF21. Second, we added a future-oriented measure into the equation and looked at the gain we achieved. The results of these analyses are presented in Figures 1 and 2 for sergeants (E5). The dark gray portion of each bar represents the relationship between the PFF21 and the supervisors' ratings. The pale gray portion of the bar indicates how much the future-oriented measure increases prediction of performance above and beyond the PFF21. For sergeants' current performance and performance in future environments, the SJT, interview, AIM, and BIQ had a large gain on performance over and above the PFF21. Addi-

Continued on next page

Maximizing 21st Century Noncommissioned Officer Performance (NCO21)

tionally, the PFF21 had a large impact on current performance, but a smaller impact on performance in future environments.

The results differed slightly for staff sergeants (see Figures 3 and 4). For current performance, the SJT, and SJT-X, showed gains in addition to the PFF21. Likewise for performance in future environments, the SJT and SJT-X, showed moderate gains. Additionally, the AFQT showed small gains for predicting performance in future environments.

Recommendations

The NCO21 project was designed to compare the future-oriented promotion system to the current promotion system to see if there is any improvement in predicting performance. The research strongly supports a realignment of the semi-centralized promotion system to take a holistic view of the potential NCO. Using aspects of the future-oriented predictor measures, a Leadership Assessment Test has been derived. Working with our sponsors in the Army G-1, we are investigating this measure in a longitudinal and more realistic environment. We are also investigating the Leadership Assessment Test as a response to one of the Army Training and Leader Development Panel's recommendations for NCOs.

This research used supervisor ratings to determine a soldier's performance in future conditions but most supervisors have not seen their soldiers under these types of conditions. To provide a direct assessment of performance in future conditions, we developed a computer simulation of a humanitarian aid mission in which the soldier must lead a unit of soldiers in a complex environment. Data collection using the computer

Continued on next page

Figure 1. Current performance prediction for sergeants using traditional promotion system (dark) and increases for new predictor measures (pale).

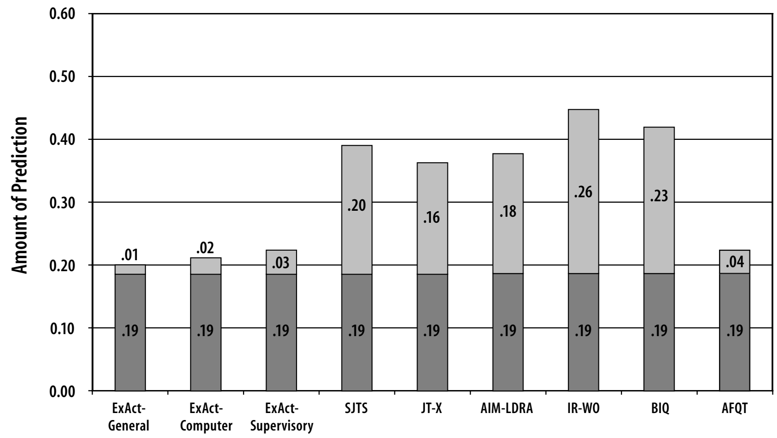
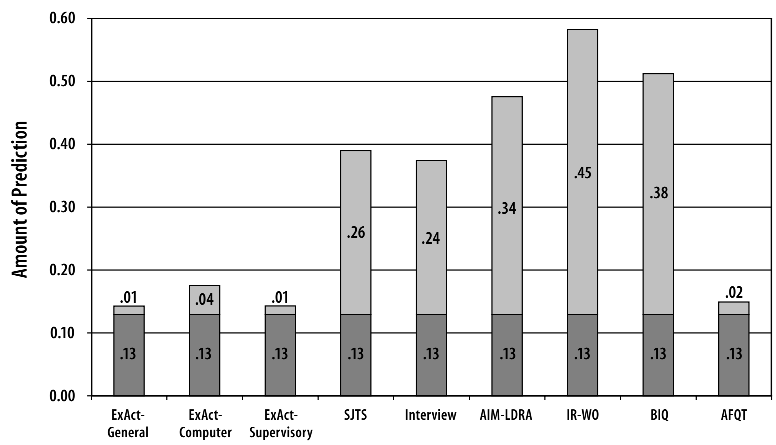


Figure 2. Prediction of performance in future environments for sergeants using traditional promotion system (dark) and increases for new predictor measures (pale).



Maximizing 21st Century Noncommissioned Officer Performance (NCO21)

Figure 3. Current performance prediction for staff sergeants using traditional promotion system (dark) and increases for new predictor measures (pale).

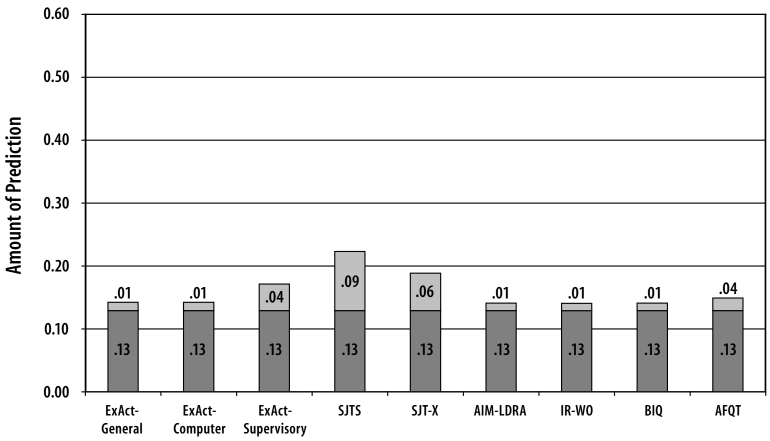
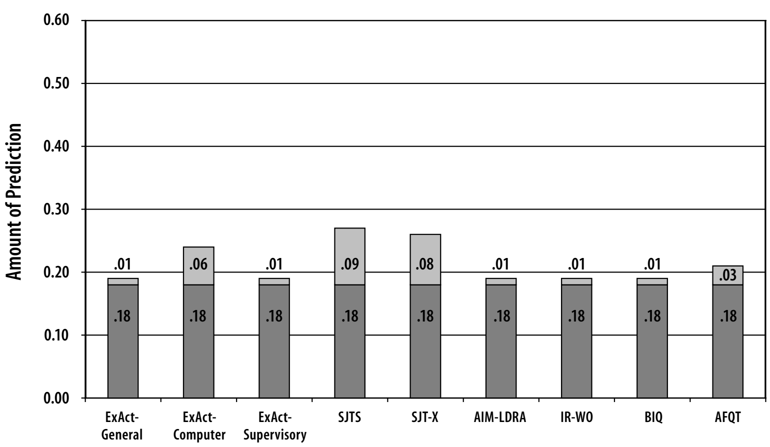


Figure 4. Prediction of performance in future environments for staff sergeants using traditional promotion system (dark) and increases for new predictor measures (pale).



simulation was completed in FY02 and results will be available by the end of 2nd quarter, FY 03.

One unexpected finding in our research is the difference between sergeants and staff sergeants. The pattern of relationships between the measures and supervisor ratings are similar, but the relationships are much stronger for sergeants. This difference may reflect a vastly different rating approach used by supervisors given their expectations of soldiers at the different levels. The computer simulation may reflect more light on these results and clarify if real measurement differences exist.

In summary, these results suggest we reconsider the current junior NCO promotion system. There may be measures that can be added which will strongly increase our ability to select the best possible leaders for the soldiers. Further, we may want to consider slightly different assessment techniques for sergeants and staff sergeants.

For additional information, please contact Dr. Tonia S. Heffner, ARI—Selection and Classification Unit, SARU@ari.army.mil.

Intelligent Tutoring Systems for Command Thinking Skills

Command thinking behaviors will help leaders to develop their adaptive-thinking skills.

The Adaptive Thinking Challenge

Future U.S. Army commanders face a demanding set of challenges: complex missions that develop suddenly, unpredictable enemies that attack asymmetrically, full spectrum mission requirements using equipment, tactics, techniques, and procedures that are in flux. Providing commanders and key battlestaff officers with training of sufficient depth and breadth so that they can effectively visualize, describe, and direct under demanding mission conditions will be an extraordinarily difficult if not overwhelming task for the Army. FCS planning documents address this issue—the training challenge—by stating a requirement for adaptive and flexible leaders. In short, the officers must overcome a lack of specific training by being able to think their way through novel and complex situations. Moreover, they must do this thinking "on their feet," i.e., during execution of the mission. No amount of hoping, positing, or demanding will produce an adaptive thinking competency in officers. There is no easy shortcut to developing that skill; it requires training. Furthermore, the training is neither simple nor certain. The road to excellence in adaptive thinking will involve lengthy and effortful work on the part of students, trainers, and training developers alike.

Recently ARI developed a program to train adaptive thinking and has successfully applied it in several schools of the U.S Army Training and Doctrine Command, including command preparation courses at the brigade, battalion, and company levels. While the training has been shown to be effective—the officers display **significant** performance gains—it requires a very skillful instructor to deliver **the training**. Current research indicates that the instructor, acting as an expert mentor, is an essential part of the training method. Limits on the availability of skilled instructors, therefore, place a constraint on access to the adaptive thinking training. Additionally, developing skill in adaptive thinking is not so much a matter of acquiring new knowledge as it is ingraining good thinking habits. Under stress, decision makers will revert to their best-practiced habits. Low frequency practice with little feedback is insufficient to develop good adaptive thinking capabilities; considerable practice over a broad range of content area is required. The requirement goes well beyond the limited amount of training time available in the classroom. To address both the training limitations based on availability of skilled instructors and the practice limitations based on availability of classroom time, ARI has undertaken an effort to develop automated programs of instruction to train effective command thinking skills using intelligent tutor technology.

Intelligent Tutors and Battle Command Training

Intelligent tutors are a form of computer-based training. Typically, the student performs a task in simulation, for example, a radio troubleshooting and repair task. The computer "observes" the student's actions, compares it to a model of correct performance, and then provides instructive feedback. By attending to the types of errors the student makes, the intelligent tutor system can

Continued on next page

Intelligent Tutoring Systems for Command Thinking Skills

diagnose areas of weakness and provide practice examples specifically chosen to address those deficiencies. Researchers at ARI have found that an intelligent tutor system can provide better training than a conventional training technology.

Several significant research and development challenges must be overcome in order to apply intelligent tutor technology to the training of battlefield thinking. First, in traditional intelligent tutor applications, the student performs the task in simulation and the computer monitors the student's actions. Battle command and the adaptive thinking associated with it are cognitive tasks. They are covert behaviors, and therefore are difficult for an automated coach to observe. Second, battle command situations do not always have a clearly defined best solution; experts can disagree in their evaluation of possible courses of action. Thus, evaluation of student actions is not straightforward. Third, intelligent tutors have usually been applied to tasks that are structured according to a clearly defined set of procedural rules. Thinking is a complex behavior that is not easily specified as a set of procedural rules; furthermore, an attempt to proceduralize thinking may degrade it. In order to develop effective automated training in adaptive thinking, the ARI research effort must devise and evaluate methods to overcome these obstacles.

Vignette-Based Training—Is it an answer?

Training based on the use of vignettes presents a potential solution to the problems associated with automated intelligent training of battlefield thinking. The envisioned tutoring system is one in which a brief tactical situation is presented to the student, and then a conversation between the student and an automated mentor ensues. The students have the opportunity to understand, critique, and discuss proposed courses of action in a Socratic mode, as they would with live expert mentors. Socratic instruction is a kind of teaching interaction typically applied in high-level professional education (e.g., law and business) and most often characterized by its external form: the mentor asks a lot of questions, and the student answers. The question-and-answer format keeps the student engaged, but lets the mentor lead. The questions are posed in a sequence that leads the students to reconstruct the logic of expert situation analysis and decision-making for themselves.

The state-of-the-art in artificial intelligence methods is not so advanced that a system could be built that would work well in such a complex domain as battle command thinking. However, by confining the discussion to a specific vignette, it may be possible to build an automated system that could contain enough "knowledge" to conduct a meaningful conversation. That is, the machine would not be an expert in battle command generally, but could be very knowledgeable about the specific and restricted situation facing the student in the vignette. In this way, the challenges discussed in the previous section may be overcome. If sufficient expertise can be incorporated in the automated tutor to support a useful Socratic conversation between human and machine, then that conversation can stand in place of simulated task performance and make the student's thoughts more evident. The computer can then compare the answers the student provides to typical responses and make a diagnostic model of the student's battle command performance.

The Research Project Pays Early Returns.

A research project was initiated by ARI in conjunction with the Office of the Secretary of Defense. Four Department of Defense Small Business Innovative Research Phase I awards were initiated in 2000 to test feasibility of the concept. After evaluating rapid prototypes, two

Continued on next page

Intelligent Tutoring Systems for Command Thinking Skills

companies, Stottler-Henke Associates and CHI Systems, were chosen to pursue development. The companies have developed the vignettes and are programming modules to incorporate the required expert models, question trees, student evaluation programs, language analyzers, authoring tools, and other components of the system. Throughout 2003, the developing system will be tested with U.S. Army officers to evaluate its effectiveness. The targeted date for completion of the system is 30 September 2003.

As part of the development of expert strategy, researchers have observed several high-level military experts as they conducted vignette-based training sessions for a large number of mid-level officers. The researchers analyzed the methods of the expert tutors in order to study their techniques for incorporation into the automated system. They noted the types of actions the expert mentors used. Sometimes the mentors requested the student to state the facts of the vignette, for example, "What is planned to occur at 1500 hrs?" and sometimes they probed deeper—"Why did you do that?" or "Why are you worried about protecting your left flank?" At times, based on an assessment of the conversational flow, the mentor changed topics, saying for example, "Okay, let's take a different approach." Sometimes the mentors modeled the correct behavior. "Here is how a good commander might give the order to a subordinate." The mentor demonstrates and then says, "Now you try it." The data collected on how a good mentor controls the flow of the session is providing a wealth of insight into the process of mentoring battle command.

Can an automated system provide quality training in such a domain? Will the training value approach that of a live expert? Will it be accepted by the students? Will it be cost-effective to develop new vignettes to keep the training up-to-date? These are key issues ARI is addressing as it seeks an effective, efficient, and affordable solution to a significant Army training challenge. While it remains to be seen whether the effort will be successful in these areas, the research project has already paid some valuable dividends.

For additional information, please contact Dr. James Lussier, ARI—Fort Knox, James.Lussier@knox.army.mil.

The *ARI Newsletter* is produced by the
U.S. Army Research Institute for the Behavioral and Social Sciences
Dr. Zita M. Simutis, *Director and Chief Psychologist of the U.S. Army*

The *ARI Newsletter* is mailed and/or delivered routinely to active duty Army units and individuals.
You may make corrections to your mailing label and send it to us for revision.

U.S. Army Research Institute for the Behavioral and Social Sciences
John S. Kay, *Communications* • E-mail: news@ari.army.mil
Web site: www.ari.army.mil

Training Adaptive Leaders

"train a performance – a thinking performance"

U.S. Army Future Combat System of Systems (FCS) planning documents specifically call out the requirement to "develop, through training and experience, thinking, confident, versatile, adaptive, and seasoned leaders at the tactical level required for the digitized, rapidly deployable objective force" (TRADOC PAM 525-3-90/O&O, 22 July 2002). Leaders must be trained to think clearly and accurately in future dynamic battlefield environments that will place high demands on their mental agility. If we are to routinely prepare leaders for future operations we must greatly improve upon today's leader training and development methods. One solution that appears to be very promising is focused, deliberate practice in the area of battlefield thinking. When that training method was tested at TRADOC schools, students made dramatic gains in basic tactical thinking.

Adaptive Thinking

After years of study and reading, Army officers typically develop a good understanding of the elements of tactical decision-making. However, that knowledge alone, no matter how extensive, is not sufficient to produce good adaptive thinking. Thinking is an active process; it is a behavior one does with his or her knowledge; it is not the knowledge itself. To produce good military adaptive thinkers one must train a performance – a thinking performance – in much the same way that one trains any skilled, well-rehearsed, and extensively practiced behavior to enable expert performance.

In military terms, adaptive thinking has been used to "describe the cognitive behavior of an officer who is confronted by unanticipated circumstances during the execution of a planned military operation (Lussier, Ross, & Mayes, 2000)." The conditions in which the thinking task must take place are an essential and defining ingredient. The thinking that underlies battlefield decisions does not occur in isolation or in a calm reflective environment; it occurs in a very challenging environment. Commanders must think while performing: assessing the situation, scanning for new information, dealing with individuals under stress, monitoring progress of multiple activities of a complex plan. Multitudes of events compete for their attention.

Deliberate Practice and Adaptive Thinking

It is a common belief that "practice makes perfect." In almost any task, initial performance is characterized by inefficient and ineffective behavior. Repetitive performance causes behavior to become automatic; it is performed more smoothly with less effort and attention. In a complex activity like battle command, expert performance levels cannot be attained without relying on the automaticity resulting from past performance; battle command is far too complex to "think your way through it from scratch" under tough battlefield conditions.

But practice alone will only increase the level of automaticity of the tasks; it will not efficiently perfect the manner in which they are performed. It is also important that the behaviors that become ingrained conform to those of an expert - that they are the right behaviors. Thus, in deliberate practice, one must pay attention to how one performs and actively correct the manner of performance. A key component is quality coaching, as subject matter experts observe and guide students with regard to the expert behaviors. Practice must be repetitive enough so that the behaviors remain in the correct form, even when one stops consciously attending to them. Thus, while practice certainly tends to improve performance, the performance gains expected depend heavily on the composition of the training environment, the use of effective coaching, and the quality of feedback.

The study of tactical experts by ARI researchers has revealed a number of common elements to the framework of their thinking, called Themes of Battlefield Thinking. They represent the core of our adaptive thinking training. The themes are not intended to be a checklist, rather they are designed to support the deliberate practice

Continued on next page

of tactical thinking. It is not sufficient to simply memorize the eight themes and learn the questions that commanders must ask. In fact, the eight themes are already well known to officers at the tactical level. Despite that, the behaviors described by the themes are often not exhibited during realistic tactical field exercises. It is a performance that must be trained, not knowledge.

Themes of Battlefield Thinking

- Keep a Focus on the Mission and Higher's Intent
- Model a Thinking Enemy
- Consider Effects of Terrain
- Use All Assets Available
- Consider Timing
- See the Big Picture
- Visualize the Battlefield
- Consider Contingencies and Remain Flexible

Think Like A Commander and the Armor Captains Career Course

The U.S. Army Research Institute developed a training program called Think Like A Commander (TLAC). It uses cognitive battle drills to apply deliberate practice training concepts to battlefield thinking skills and allows officers to model their battlefield understandings, plans, visualizations and decisions after expert tacticians' thinking patterns. A computer-based version of TLAC, the Captain's Edition, was developed by ARI-Fort Knox and implemented in the Armor Captain Career Courses (ACCC) at Fort Knox to develop thinking habits in U.S. Army captains, and reduce the amount of time it takes to achieve higher competency levels of battlefield thinking.

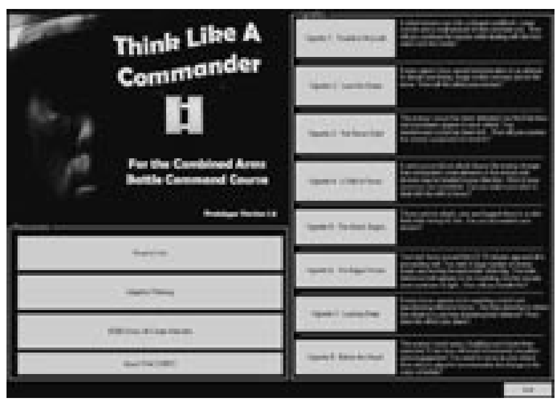
The ACCC is responsible for training and professionally developing adaptive, self-confident combined arms leaders to command and perform battle command tasks in a full spectrum environment in an Army transforming to an Interim and Objective Force.

Captains in the ACCC received the adaptive thinking training using seven TLAC vignettes. Vignettes included probes that cue participants to critical pieces of information that support decision making. The goal is not just to develop a correct solution or decision, however, it is also to focus on the thinking and decision making process (i.e., how to think).

Development of Think Like A Commander for the Armor Captain's Career Course

The program was developed using sound instructional design practices and included current students and instructors in the development process. All materials were developed with small group instructors from the ACCC and included a user jury with students.

Figure 1. Think Like A Commander Main Screen



Students were asked to think about the situation presented and note items that should be considered before making a decision. After each student makes a list of key considerations, the small group instructor facilitates a class discussion and actively monitors performance, assessing adequacy and mentoring students with regard to the expert habits. During the class discussion, students are required to discuss and/or defend considerations. Class members discuss the second- and third-order effects related to actions students suggest. The final phase of the training meth

Continued on next page

Training Adaptive Leaders

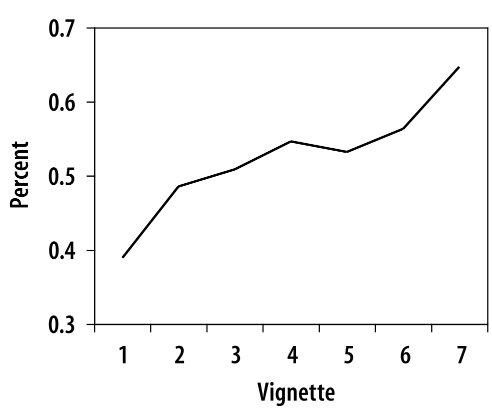
odology allows students to evaluate their own performance. The students are shown a set of 10 to 16 indicators of expert thinking. The indicators are unique to each vignette. They are the critical components that expert battle commanders determined are important in the portrayed situation. The self-evaluation provides feedback on student performance and focuses the students' thinking on subsequent vignettes.

Evaluation of the Training

The training program provides for automated data collection of student responses and records the amount of time students spent on tasks. Performance data was collected for 24 students to determine: 1) if the amount of relevant information considered improved over repeated trials and 2) if the amount of information considered increased as time decreased over repeated trials.

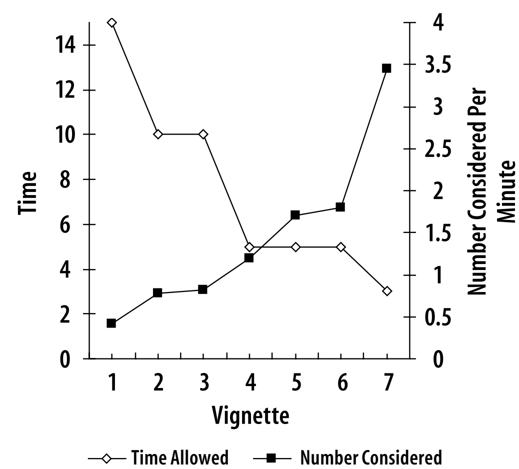
The results? Students identified significantly more critical information as they progressed through the training. Figure 2 depicts the linear pattern for the percent of critical information identified for each vignette. As the figure indicates, the participants identified more of the key considerations as they progressed through the seven TLAC vignettes.

Figure 2. Percentage of Indicators Identified for Each Vignette



Remarkably, students were able to demonstrate the increase in performance under increasingly more difficult time constraints (see Figure 3).

Figure 3. Percent of Information Considered Per Minute



Conclusions

Experience implementing the adaptive thinking training in the ACCC course curriculum suggest that adaptive thinking training is feasible and can provide a valuable learning environment for students. The data analysis suggests that the TLAC training application can accelerate tactical leader development in U.S. Army Captains. Further research will continue to improve the training and will examine whether the gains transfer to battle command performance in full-task tactical exercises.

For additional information, please contact Dr. Shadrick, ARI—Armored Forces Research Unit, AFRU@ari.army.mil.

Training of Future Teams

An approach to Objective Force Training

The U.S. Army has initiated transformation to an Objective Force designed to be responsive, deployable, versatile, lethal, survivable, and sustainable to meet dynamic future requirements. The training of soldiers and leaders is key to the success of this transformation, particularly the training of teams. Objective Force teams likely will be more dispersed geographically than teams of today, during both training and operations. They will rely heavily on information networks and common operating pictures to conduct full-spectrum operations. They will employ robots and sensors as well as manned elements and they will need to integrate information rapidly from these and other sources. The training of Objective Force teams will truly be a challenge.

The ARI Armored Forces Research Unit at Fort Knox, KY completed an initial research and development project addressing the training of Objective Force teams. This project, entitled "Approach to Future Team Training," focused on command groups to provide the underpinnings for future research and development efforts. Command groups are analogous to today's staff elements, but they are expected to be smaller than legacy force staffs and they include vertical teams of leaders across echelons.

Future Command Group Training Requirements

The ARI project staff combined expertise in subject matter and training methods while reviewing extensive materials to identify training requirements for Objective Force command groups. One aspect of this involved the identification of differences between legacy and future forces. Examples include the need for future forces to share information seamlessly and effortlessly, increasing reliance on collaborative planning, and the need to accomplish command and control on the move.

Project staff also identified future considerations that apply to training in general. A key consideration is that more and more training will be supported and delivered through embedded training using actual operational systems. This will enable units to train anywhere, anytime, while on the move or deployed as well as while stationary or at home station. Embedded training will provide access to synthetic environments allowing training exercises to be conducted at all levels, from individual soldiers to multi-echelon or joint task forces, while minimizing resource requirements. For example, training support systems will have the capability to use intelligent agents to simulate realistically the actions of individuals and units not actually participating in an exercise.

In addition to examining how training likely will occur in the future, project personnel also identified tasks that future command groups likely will perform at various echelons. Table 1 shows an example of anticipated command group tasks at platoon level. At this level the focus is on executing tasks that are directly related to placement and movement of the platoon's elements, control of its sensors, targeting and engaging threat forces, and communicating information to higher and adjacent units. Note that some of these tasks are similar to platoon tasks of today (e.g., develop fire plans) and some are not similar (e.g., control targeting and engagement at extended ranges).

A Training Approach

Previous ARI efforts have shown that the training of collective tasks, such as those performed by command groups, is best accomplished through the conduct of structured sets of exercises designed to ensure practice of the tasks selected for focus in each exercise. The structure provides a systematic process in which exercises become progressively wider in scope in terms of the number of participants and overall context as skills are acquired. Initial exercises may involve a single individual performing tasks at his or her echelon only, while later exercises may involve numerous individuals and units performing tasks in concert at multiple echelons.

Continued on next page

Training of Future Teams

Table 1. Platoon Command Group Tasks

Plan

- Conduct intelligence preparation of the battlefield (IPB)
- Conduct collaborative planning and decision-making
- Plan intelligence, reconnaissance, and surveillance (ISR) operations
- Develop fire plans
- Develop orders
- Plan force protection operations

See

- Develop and maintain a common operating picture
- Develop the situation using ISR assets (out of direct contact)
- Control sensors and process information

Understand

- Communicate and display information (ISR handover)
- Communicate and display decisions and orders
- Develop and maintain situational awareness
- Conduct mission rehearsals
- Collect and report battle damage assessment (BDA)

Act

- Command and control (C2) the platoon
- Control placement and movement of subordinate elements
- Control targeting and engagement at extended ranges
- Act without or beyond the scope of orders
- Monitor combat service support (CSS) operations

Plan, Execute, and Assess Training

Implementation of a structured exercise-based approach to collective training for the Objective Force will require a sophisticated training exercise support system. As is illustrated in Figure 1, such a system must be a part of an overall training support system that includes other training environments, such as institutions and distance learning. Training support in turn must be part of a total performance enabling system that includes non-training solutions to performance problems, such as selection of personnel for specific duty assignments and integrated performance support (i.e., job aids or other "help" tools).

The training exercise support system likely will include centralized and distributed components, linked through a global information grid. This will allow commonly used training support packages to be downloaded through Objective Force networks for delivery on weapons platforms and small hand-held devices. Software tools for managing training exercises and tailoring support packages to units' needs will be included in the system. Linkages ("reach") will operate in two directions, so that units can upload information, such as modified training materials, lessons learned, and new tactics, techniques, and procedures, back into the training support system. This will allow training materials to be updated with feedback from units.

Continued on next page

Training of Future Teams

Figure 1. The total performance enabling system.

<table>
<tr><td colspan="2"></td><td>Combat Training Centers</td><td>Institutions</td><td>Army Distance Learning</td><td>Reimer Digital Library</td><td>Training Exercise Support System</td><td>Others</td></tr>
<tr><td>Selection System</td><td>Integrated Performance Support System</td><td colspan="6">Training Support System</td></tr>
</table>

Future Research Issues

A host of research and development issues must be addressed in designing the capability for command groups and other teams to practice task performance in structured exercises conducted anywhere, anytime, with any number of participants. A key area of interest is the development of techniques for embedding training, to the maximum extent possible, in operational equipment and small devices with which units will deploy. This area involves much more than the integration of training software with operational hardware; an even bigger issue is techniques for designing, developing, and delivering embedded training in as effective and efficient a manner as possible. For example, techniques are needed for measuring performance and providing soldiers with immediate feedback, while also extracting appropriate performance results for archival in information repositories. Another key area is the development of intelligent agents to represent realistically the actions of individuals and elements not available to participate in a training exercise. And yet another key area is the management and distribution of training support packages, updated in response to near-continuous feedback and performance results from users.

The development of innovative training methods for full-spectrum operations requires a full-spectrum research approach. Based on initial efforts such as that summarized above, ARI is addressing Objective Force training issues in a variety of ways, ranging from development of small-scale demonstrations of selected Objective Force functions to observation of simulations of Objective Force operations. If training capabilities such as those described above are to be embedded fully in Objective Force systems, training research and development must be conducted hand-in-hand with systems development.

For additional information, please contact Dr. Billy L. Burnside, ARI—Armored Forces Research Unit, AFRU@ari.army.mil

AH-64A BUCS Training

"pilots need training in the detection and diagnosis of flight-control problems"

Unlike other fielded Army helicopters, the AH-64 Apache has an emergency back up, electro-hydraulic, fly-by-wire system available to the crew in the event of a jammed or severed flight control. This back up control system (BUCS) allows the crew to bypass damaged mechanical flight controls and safely land the aircraft. The BUCS can be found on both A- and D-model Apaches.

Recognize Problem

In the AH-64A normal flight control inputs from the pilot or copilot/gunner (CPG) are relayed to the hydraulic servo-actuators, which control the flight surfaces, using mechanical linkages (push-pull tubes, bellcranks, etc.). If this mechanical system is jammed or severed by combat damage or maintenance problems, the BUCS will recognize the problem and enable fly-by-wire control of the affected axis.

The BUCS uses linear variable differential transducers (LVDTs) to signal flight-control position, and shear-pin-actuated decouplers (SPADs) to separate flight controls from the mechanical linkages. Eight LVDTs are located in the cockpit to sense flight-control positions from the pilot and the CPG. Other LVDTs transmit the servo-actuator positions to the Digital Automatic Stabilization Equipment Computer (DASEC). Among its other functions, the DASEC recognizes problems with the mechanical control system and enables the BUCS. SPADs are located at the base of each control axis (cyclic longitudinal, cyclic lateral, collective and pedals) for each crew station. There are eight SPADs in all.

When a jam occurs, either crewmember can decouple, or "break out," of the jammed axis by pushing hard on the affected flight control and breaking the SPAD on that axis. As soon as the SPAD is broken the BUCS is enabled. All other undamaged axes will continue to function normally using mechanical linkages. The crew can safely land the helicopter.

In the event of a severed control linkage, the DASEC recognizes the mistrack between the flight-control position and the position of the hydraulic servo-actuator. With sufficient mistrack (17.5 percent, or approximately two inches of control movement), the DASEC automatically enables the BUCS for the defective axis. All other undamaged axes will continue to function normally using mechanical linkages. The crew can safely land the helicopter.

Safety Concerns

In response to a series of incidents and mishaps involving the AH-64A, the Army determined that pilots need training in the detection and diagnosis of flight-control problems and correct operation of the flight controls when the BUCS is engaged. It is precisely this kind of training that cannot be performed in the helicopter for reasons of safety and cost. Apache pilots now receive training using the only AH-64A simulator currently in the Army inventory capable of simulating the BUCS.

The simulator is located at the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) at Fort Rucker, Ala., and it's called the Simulator Training Research Advanced Testbed for Aviation (STRATA) training device. The purpose of the training is to familiarize Apache aviators with the conditions that require the use of the BUCS, how such conditions can be detected and, most importantly, what must be done to control the aircraft and get it safely on the ground.

A memorandum of agreement among the Apache Product Manager's Office (PMO) at Redstone Arsenal, Ala., the Aviation Training Brigade (ATB) at Fort Rucker and ARI established the formal mechanism whereby BUCS training is delivered to every student in the Apache Aviator Qualification Course (AQC). The PMO provides funding plus Apache expertise, while the ATB provides students and instructor pilots (IPs). ARI provides simulator time, engineering expertise, operations and maintenance, and expertise in the Apache BUCS.

Continued on next page

AH-64A BUCS Training

The back up control system (BUCS) allows the crew to bypass damaged mechanical flight controls and safely land the aircraft.

As of August 2002, 440 Apache AQC students, 78 IPs, and 31 students from the AH-64A Maintenance Test Pilot (MTP) course have received BUCS training. The AQC unit supported is Company D, 1st Battalion, 14th Aviation Regiment. The MTP unit supported is Co. A, 1st Bn., 223rd Avn. Regt. To date, no student has missed training as a result of simulator failure, power outage, or personnel unavailability.

Simulator

The STRATA training device is a fixed-base, full-mission simulator for the A-model Apache. The pilot and CPG cockpits were taken from aircraft 83-23789, the rest of which was scrapped. CAE Corp. designed, built, operates and maintains the Apache research simulator at the STRATA facility. The simulator, which boasts a modular design capable of software modification, uses the hydraulic CAE digital control loading system to simulate all of the flight-control characteristics of the AH-64A, including BUCS.

A G-seat and active five-point shoulder harness provide acceleration, deceleration, and motion cues. All controls, instruments, and displays are functional and integrated with each other. Both cockpits are provided with three 100-inch, rear projection visual displays providing each station with a 176-degree horizontal by 45-degree vertical out-the-window field of view. What the aviators see out their windscreens is a highly detailed, geo-specific terrain database rendered by three CAE MedallionTM image generators, which are capable of presenting 16,000 polygons per frame at a rate of 60 frames per second.

BUCS Training Procedures and Strategy

Currently, BUCS training is "familiarization" training only. There are no recorded tests of performance. AQC students are provided with BUCS instruction in order to expose them to potential flight-control malfunctions and the accompanying corrective procedures. Students arrive for the BUCS training after having already logged time in both the Cockpit Weapons and

Emergency Procedures Trainer (CWEPT) and the actual helicopter. They also receive classroom instruction in the BUCS from ATB academic instructors. This prerequisite flight line and classroom experience is important, allowing the students to concentrate on the detection of a malfunction and the appropriate course of action, while continuing to fly the aircraft.

Each BUCS training period lasts 90 minutes and "stick buddies" train together. They first perform a standard, by-the-book BUCS test. Then each student in turn picks the aircraft up to a hover and "flies" a traffic pattern to a landing. This is done to familiarize students with the simulator and get them into a flight-oriented frame of reference. Next, each student is given an opportunity to operate the simulator with Digital Automatic Stabilization Equipment (DASE) turned off. This shows students how the aircraft performance qualities are degraded, but still flyable, with all BUCS axes engaged. When the BUCS is engaged on an axis, there is no DASE on that axis.

After the warm-up, students participate in a series of instructional scenarios during which all the training points required by the ATB program of instruction are presented. Training points include jammed controls, severed controls, crew contention, hydraulic system malfunctions, related warning indicators, operator actions,

Continued on next page

AH-64A BUCS Training

and feedback for both cockpits. In all, the crew performs 46 tasks in both the pilot and CPG stations. All AQC instruction is provided by an ATB IP who has been trained on the BUCS in the STRATA device at ARI. Michael Couch provides instruction of the IPs and the MTP students.

The STRATA training device is a fixed-based, full-mission simulator for the A-model Apache.

The instructional strategy used is the classic "crawl, walk, run." At the beginning of the training period, the IP alerts the crew to what malfunction is going to be invoked, describes its identifying features, describes what should be done and in what order, and then, after invoking the malfunction from the instructor interface console, walks the crew through it step by step. Verbal instructions are provided before and during the training event. Feedback is provided after the event, along with the opportunity for questions.

Instruction proceeds in this fashion, training point by training point. As the crew's mastery of the BUCS improves, the pace speeds up, the instructor scaffolding is thinned and the criterion level of performance expected by the IP rises. By the end of the training period, the IP merely invokes malfunctions of whatever kind, at will and with no warning, and the crew detects the malfunction and reacts appropriately with a minimum of instructor interference. The pacing of instruction depends upon the speed at which the crewmembers demonstrate through cockpit performance that they understand what they are being taught. Crews that are quick to learn may receive additional practice or increased flight training.

Future Directions

BUCS training currently takes place during virtual daylight using flight instruments and visual flight techniques. Future plans call for providing BUCS training during virtual night missions using the Apache's forward-looking infrared (FLIR) sensor systems. Specifically, these are the Pilot Night Vision System (PNVS) and the Target Acquisition and Designation Sight (TADS) FLIR.

In 2001 the Army awarded a contract to the team of TRW/CAE to upgrade seven Apache Combat Mission Simulators (CMSs) worldwide. As a part of this contract CAE has proposed upgrading them to support BUCS training. The Directorate of Training Doctrine and Simulation (DOTDS) at Fort Rucker asked ARI for detailed information about the current program of BUCS training. ARI has provided engineering information, instructional content, instructional strategy, and acceptance test procedures in order to implement a BUCS simulation and training capability in the CMSs that meets or exceeds the training currently provided in the STRATA device. If funded, Apache aviators in CMS simulators worldwide will be able to receive BUCS training.

For additional information, please contact Dr. David M. Johnson, or Michael Couch (Former Apache instructor pilot); ARI—Rotary-Wing Aviation Unit. RWARU@ari.army.mil.

Aircrew Coordination Training Enhancement (ACTE)

The safety of a rotary-wing aircrew and the ability of that crew to accomplish its mission largely depend upon the crew-members' ability to coordinate actions through clear communication. As described in the Winter 2001 ARI Newsletter, the United States Congress asked the ARI Rotary Wing Aviation Research Unit (RWARU) to conduct research and development towards enhancing the Army's Aircrew Coordination Training (ACT) program.

A Three-Phase Master Plan

The Master Plan for the new program focused on revitalizing ARI's original, paper-based, exportable training package fielded in the mid-90s. The goal was to bring ACT into the 21st Century by developing an interactive, realistic and relevant, computer-based training system capable of being tailored to the needs of a particular unit and to the changing needs of the Army over time. An Aircrew Coordination Working Group (ACWG) consisting of key personnel from the U.S. Army Aviation Center, U.S. Army Safety Center, and other subject approved RWARU's three-phase concept.

Phase One of the enhancement was completed in March of 2002, and will be discussed here in detail. Its objective was the development, demonstration, and evaluation of core aircrew and instructor courseware. Phase Two, launched in September 2001, is designed to tailor training scenarios for specific aircraft and missions and to integrate the program into all aspects of training and operations. Phase Three will establish a plan for recurring modernization and team applications beyond aviation.

Training scenarios for specific aircraft and missions.

Courseware Development

Phase One began with an analysis of current aircrew coordination training programs from a total systems perspective, in the Army as well as all other branches of service, including Active Duty and National Guard components. This review indicated the need to streamline performance evaluation, to move from a rating of 13 "basic qualities" to a behaviorally-anchored assessment of five "Crew Coordination Objectives": 1) establish and maintain team relationships; 2) plan and rehearse mission; 3) establish and maintain workload levels; 4) exchange mission information and; 5) cross-monitor performance. The review also pointed to the need for focused, scenario-based training and evaluation methodologies that exploit state-of-the-art instructional technologies, including facilitated interaction as well as computer-based components.

The prototype aircrew and instructor training modules were evaluated and approved at each stage of development by the RWARU-chaired Courseware Review Committee. The 8-hour course designs include a mix of computer-based (CB) self-paced lessons and instructor-facilitated (IF) modules:

Aircrew Training

Intro (CB)	ACT Principles Review (CB)	Modernized Aircraft Case Study (IF)	Problem Solving Exercise (IF)	Conclusion (CB)	Simulator/Flight Mission

Instructor Training

Intro (CB)	Instructor Mission Setting (IF)	Evaluation Tools & Techniques (IF)	Observe & Evaluate Exercise (IF)	Facilitation Skills Exercise (IF)	Conclusion (CB)

Continued on next page

Aircrew Coordination Training Enhancement (ACTE)

Usability assessments of both courses were conducted with 10 aircrew members (CW2 through LTC) and 8 instructor pilots. Their ratings of content, pace, delivery, and training effectiveness averaged 4.0 to 4.6 on a 5-point scale. Sample comments included: "I enjoyed the interaction of the problem solving exercises. I think this is where the real learning takes place", "The length of the course is good and the information is current and effective", and "This is an update that the U.S. Army has been in need of."

Suggestions made by usability assessment participants were implemented. A field study was designed to compare performance of aircrews from the 4th and 9th Battalion-159th Aviation Brigade (Assault) before and after receiving the training. Instructor Pilots (IPs) were trained as Observer Evaluators to rate crewmember participants on: Aircrew Coordination Training Behaviors, Aviation Training Manual Task Performance, Mission Effectiveness, and Crew-related Errors. Eight aircrews conducted pre-training simulator missions (rated by the IPs), then completed the ACTE Course, and then completed post-training evaluated simulator scenarios, course critiques, and exit interviews. Results are presented below:

Measurement Area	Pre-training	Post-training	Change
Mean ACT Behavioral Ratings *(Scale 1: Below standards-7: Exceeds standards)**			
Establish and Maintain Team Relationships	4.3	5.0	+18%
Mission Planning and Rehearsal	4.3	4.3	NC
Establish and Maintain Workload Levels	4.0	4.8	+19%
Exchange Mission Information	3.9	4.8	+23%
Cross-Monitor Performance	3.9	4.4	+13%
All ACT Behaviors	4.1	4.6	+14%
Crew-Related Error Ratings *(Scale 0: Unsat, 1: S-, 2: Satis, 3: S+, 4: no errors)**			
Mission Threatening Error Rating	1.2 (S-)	2.4 (S)	+30%
No. of crews receiving S+ or S ratings	4/8	7/8	+37%
No. of "crashes"	3	1	-67%

**Mean ratings obtained from five Observer Evaluators before and after training*

Mean Ratings of Aircrew Course (on 5-point scale)

- Tutorial effectiveness: 4.3
- Content realistic and relevant: 4.4
- Functions logical and understandable: 4.6
- Amount of information, pace, and timing: 3.0 (with 3.0 optimal)
- Instructor knowledge, preparation, and clarity: 4.8
- Performance Evaluation System, Aircrew Guide: 4.3
- Effectiveness as refresher to previous ACT: 4.6
- Effectiveness and impact on unit operations: 4.3

The Instructor Course was field tested by 5 Instructor Pilots and 3 Non-rated Crewmember Instructors. On a 5-point scale, the mean effectiveness ratings ranged from 3.8 to 4.2. Sample comments included, "It provides a solid foundation for all ACT Instructors to work from. It should standardize how ACT is trained and evaluated throughout the Army", and "Good refresher on instructing fundamentals and evaluating techniques."

Future Directions

Phase Two efforts are underway to develop a parallel training program for Non-rated Crewmembers (such as flight technicians) and a Train-the-Trainer Course to facilitate continuity of instruction within units. Refresher Training Support Packages are being developed to respond to the particular needs of specific aircraft and missions. Finally, the training methodology provided through these efforts are being considered for implementation with other military teams, such as ground crewed systems. These efforts will contribute to ARI's position at the forefront of team training research and development in the Army.

For additional information, please contact
Dr. Larry Katz, ARI—Rotary Wing Aviation Research Unit, RWARU@ari.army.mil

Pay Retirement and Job Security

Results on the following are from the Sample Survey of Military Personnel from spring 1993 through spring 2002:

- Basic pay
- Retirement benefits
- Job security

1993-2002 Trends

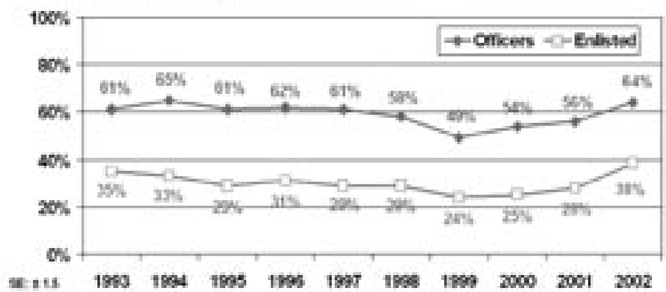
In the 1990s, three of soldiers' concerns were the amount of pay, retirement benefits, and job security.

- Recent higher levels of pay raises and changes in the retirement system approved by the U.S. Congress in 1999 have led to increased levels of satisfaction.
- Following the drawdown in Army strength to 480,000 in the mid-1990s, changes in Army policies have led to increased satisfaction with job security.

Satisfaction with Basic Pay

The same question (with a 4-point scale) is asked in the Spring and Fall SSMP:

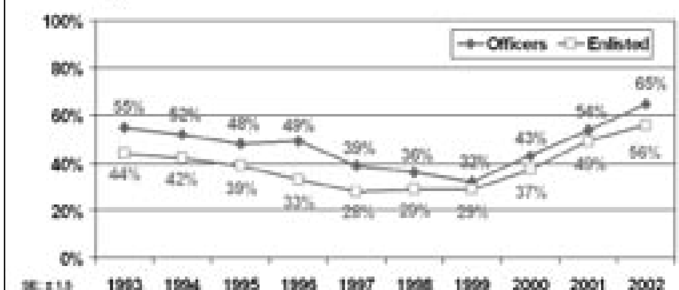
Based on your Army experience, how satisfied or dissatisfied are you with the following? - Amount of pay (basic)



Satisfaction with Retirement Benefits

The same question (with a 4-point scale) is asked in the Spring and Fall SSMP:

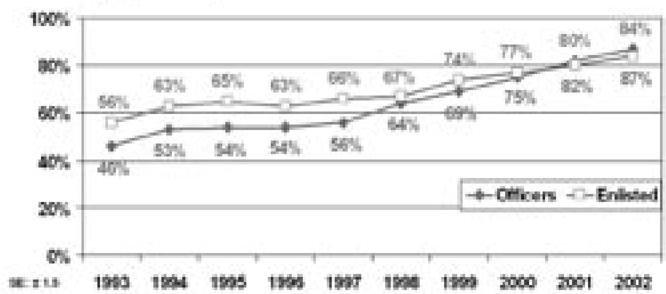
Based on your Army experience, how satisfied or dissatisfied are you with the following? - Retirement benefits



Satisfaction with Job Security

The same question (with a 4-point scale) is asked in the Spring and Fall SSMP:

Based on your Army experience, how satisfied or dissatisfied are you with the following? - Job security



Sample Survey of Military Personnel (SSMP)

Army offices and agencies submit questions on topics to be addressed by the SSMP. The population for the SSMP consists of all permanent party, Active component Army personnel (commissioned officers, warrant officers, and enlisted personnel [excluding all PV1 and those PV2 soldiers in Europe and Korea]). Samples of about 10% of officers and 2-3% of enlisted personnel are drawn using the final 1 or 2 digits of soldiers' social security numbers. Since spring 1993, the data bases have included approximately 4,000 each for officers and enlisted personnel. Data at each rank level are weighted up to Army strength at the time each survey is conducted. The Spring 2002 SSMP was conducted from about 15 April to 7 August 2002. Responses were received from 4,216 officers and 4,489 enlisted personnel. Inquiries for additional information should be directed to Chief, Army Personnel Survey Office, U.S. Army Research Institute, 5001 Eisenhower Avenue, Alexandria, VA 22333-5600, Commercial (703) 617-7801, DSN 767-7801, or email ARI-APSO@ARI.Army.Mil.

"Training in Virtual Environments: Instructional Features."

Organized methods for providing training and tools to support instructional strategies

The Objective Force Warrior (OFW) system for dismounted combatants is being developed as an integral part of the Objective Force. The OFW concept incorporates a wearable computer, head-mounted display, global positioning system, and digital communications capabilities. The OFW system will provide dismounted combatants with unprecedented information technology capabilities supporting command, control, communication, intelligence, surveillance, and reconnaissance.

The information technology will require intensive training for optimal use, but also provides new training capabilities, especially embedded training. The concept for OFW embedded training is still immature, but likely components will use virtual environment and augmented reality technologies. Virtual environments technology present computer-generated graphics in a computer-generated environment, while augmented reality overlays computer-generated graphics in the real world. Potential uses of augmented reality include inserting targets for engagement simulation, overlaying situation specific tactical information, and providing instructional features or cues to aid learning.

Instructional Strategies are organized methods or tactics for providing training. Instructional Features are the tools used to support and implement instructional strategies. These features can be categorized based on major characteristics and applications. **Temporal** features change the speed of stimulus flow, for example speeding up or slowing a simulation. **Adjunct/Augment** features change the physical nature of the stimuli used. For example, increasing the brightness of a task-relevant light that requires a response would be augmenting that stimulus. An additional or adjunct cue is something that does not normally occur during the activity, but that adds information to ease acquisition of knowledge or skill. Control features provide a wide range of capabilities that can be used to control, measure, and conduct a simulation. Instructional features are difficult to use in real world or live training, but are used frequently in simulations. They have also been used to aid instruction in Virtual Environment (VE) simulations.

The **Adjunct/Augment** category is most relevant to augmented reality and VE-based training. Developing an adjunct/augmenting instructional feature also raises the major issues that must be addressed to use instructional features effectively. These issues include identifying which cues to change or add, and when to change cues for most effective training. Once introduced, artificial stimuli must be returned to normal, enabling practice in as task-representative a simulated environment as possible. This prevents a crutch effect, in which the learner becomes dependent on the artificial stimuli providing extra information for the activity. How the instructional feature is added, used, or removed is important, as manipulating cues changes the task environment in which the trainee is learning to respond efficiently. Research findings about the training benefits of adjunct or augmented cues should apply equally well to VEs and augmented reality systems.

We selected two common activities of small unit leaders as an area in which to investigate the design and effects of adjunct visual cues, These are identifying threats based on OCOKA (Observation, Cover, Obstacles, Key Terrain, and Avenues of approach), and selecting fighting positions or movement patterns (ARI Combat Leaders' Guide, 1994). They require applying knowledge and developing awareness of potential enemy locations and capabilities in planning small unit movements and establishing tactical positions. These tasks are complex, requiring visual inspection and analysis of terrain and environment. Developing this task-based inspection and analysis skill requires integrating factual knowledge with performance situations. For example, a leader learns movement procedure rules through field manuals and instructor lectures. This knowledge is then integrated and used when the leader actually practices planning and conducting movement techniques

Continued on next page

"Training in Virtual Environments Instructional Features."

during field exercises. Proficiency requires practice in acquiring visual cues from the general environment rapidly, projecting threat probabilities, and making movement, team placement, and resource decisions within the context of the immediate mission goals. These critical elements can be trained in a single-person VE system, allowing the investigation of instructional features effect on learning.

We have developed the position-linked arrow instructional feature, shown in Figure 1, as an attention direction adjunct feature that indicates specific locations. The arrow can be used to highlight information normally available in the task environments. Using the instructional feature during training should improve trainee understanding of important cues, which should in turn produce better decision making.

The goal of the research is to develop and evaluate an innovative training approach that improves the consistency and speed of recognition of critical situational stimuli affecting the small unit leader activities discussed above. The simple instructional strategy of coaching (information-based and administered only when errors are made) provides a framework for the simulation-based training. By exercising the trainee in a single person simulation, the critical nature of certain classes of stimuli, and judgements based on those stimuli, can be pointed out by the arrow feature during training and practice. A two-phase approach, with a usability analysis with subject matter experts followed by an experiment with novice trainees, will be conducted to investigate the effects of the arrow instructional feature and performance-based coaching.

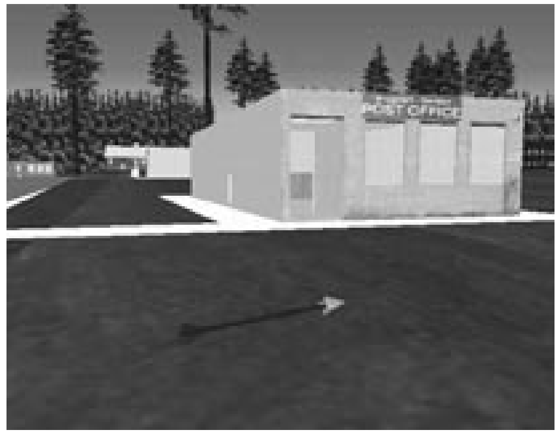


Figure 1. Directional Arrow Instructional Feature

The usability analysis results will provide initial guidance for implementation of this type of instructional feature in VE-based and augmented reality training and rehearsal systems. The experiment should provide further information on the usefulness of an adjunct stimulus as an attention direction mechanism. There are a wide range of tasks that are based in visual inspection of the environment, and that can potentially be improved through training and rehearsal. As VE technologies improve, migrate to augmented reality, and become the basis for embedded training within high technology soldier ensembles, knowing how training tools affect learning will continue to increase in importance.

For additional information, please contact Dr. Michael Singer, ARI—Simulator Systems Research Unit, SSRU@ari.army.mil.

U.S. Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

OFFICIAL BUSINESS