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

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RETURNING SERGEANTS (E-5) TO DRILL SERGEANT DUTY

In 1997, Army leaders decided to limit Drill Sergeant assignments to the ranks of Staff Sergeants (E-6) and Sergeants First Class (E-7). With only a few exceptions, Sergeants (E-5) were no longer able to serve as Drill Sergeants. This decision was made primarily to ensure that Drill Sergeants had the maturity and leadership skills necessary for success in leading and training young men and women in the Initial Entry Training (IET) environment. However, over the last several years, many Sergeants have been deployed and now routinely serve successfully as small unit leaders in combat. In addition, there is an overall shortage of more senior noncommissioned officers who are available for Drill Sergeant duty. As a result, senior Army leaders have been reconsidering the policy that prohibits Sergeants from serving as Drill Sergeants.

In the fall of 2003, the U.S. Army Training and Doctrine Command (TRADOC) decided to conduct a three-site pilot program to determine the advisability of returning Sergeants to Drill Sergeant duty. Three training sites were selected for the pilot program to cover the different types of IET: Fort Jackson, provides gender integrated Basic Combat Training; Fort Benning, provides male-only One Station Unit Training; and Fort Gordon, provides Advanced Individual Training for a variety of Military Occupational Specialties. This article presents the results of an evaluation of the pilot program requested by TRADOC as part of ARI's Research-based Personnel and Training Analysis program. The focus of the study was to determine, (1) whether Sergeants could effectively serve as Drill Sergeants, and (2) how well the Sergeants serving as Drill Sergeants handled stress and managed anger when on the job.

Drill Sergeant Behaviorally Anchored Rating Scales

To conduct this study we developed a set of Behaviorally Anchored Rating Scales (BARS) that were specifically focused on Drill Sergeant performance (see Figure 1). The scales contained 32 items, covering three broad areas: *(1) Knowledge of Program of Instruction and Initial Entry Training Philosophy, (2) The Drill Sergeant as a Role Model, and (3) Attitudes toward Drill Sergeant Duty and Peers.*

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MESSAGE FROM THE DIRECTOR

ARI's strength is its people. Recently ARI recognized three individuals for their past contributions to Behavioral and Social Sciences research for the U.S. Army.

Our Headquarters library in Arlington is named in honor of Dr. Robert Yerkes. Dr. Yerkes, a World War I veteran and former president of the American Psychological Association, was instrumental in developing the Army Alpha and Beta tests which were used to determine the mental fitness of recruits. By the end of World War I, he had presided over the administration of the tests to 1.75 million men.

Our two conference rooms are named in honor of a former ARI Technical Director and a former ARI Field Unit Chief.

Dr. Julius (Jay) Uhlaner, is a former Chief Psychologist of the U.S. Army and its first Technical Director. His greatest contribution was his role in developing the Army's Aptitude Area System for differential classification. This system remains today as the key element in the Army's classification and assignment process.

George M. Gividen, a West Point graduate, was posthumously inducted into the Ranger Hall of Fame in 2004 for his contributions to the Army, particularly his acts of heroism during the Korean War. He is the recipient of a Silver Star and a Distinguished Service Cross. He also received the Soldier's Medal for rescuing a victim from drowning. After retirement from the Army, he served as Chief of the Army Research Institute Field Unit at Fort Hood Texas.

These individuals, recognized for their scientific achievements, personal attributes, and contributions to the U.S. Army, serve as role models for ARI scientists and administrative staff.

This newsletter provides some highlights from the research our current scientists are conducting and illustrates our consistent efforts to contribute to science and to the institutional and operational Army.

Zita M. Simutis
Director and Chief Psychologist
of the United States Army

Developing Real World Solutions for the Army's Human Capital Challenges

RETURNING SERGEANTS (E-5) TO DRILL SERGEANT DUTY

Each of the BARS consisted of a nine point scale, with ratings of 1-3 indicating "Low" performance, 4-6 indicating "Moderate" performance, and 7-9 indicating "High" performance.

Figure 1. Example of BARS Rating Scales

Knowledge of Program of Instruction and Initial Entry Training Philosophy:

To what extent does this Drill Sergeant motivate Trainees?		
Relies on punishment or threats to influence Trainee behavior; yells/curses at Trainees when they fail to meet standards; uses mass punishment for individual infractions.	Occasionally resorts to yelling at Trainees; has a repertoire of several kinds of disciplinary actions in addition to simply dropping Trainees for push-ups.	Recognizes effort as well as accomplishments; creative in designing corrective actions that are relevant to the infraction and creates true learning opportunities.
LOW	MODERATE	HIGH
1 2 3	4 5 6	7 8 9

The Drill Sergeant as a Role Model:

To what extent does this Drill Sergeant set a good example for Trainees with respect to military bearing?		
Often fails to display proper military bearing; fails to display proper military customs and courtesies.	Usually displays good military bearing; generally a good role model for how a Soldier should act and conduct him/herself.	Consistently maintains excellent military bearing; sets outstanding example by maintaining standards regardless of the situation.
LOW	MODERATE	HIGH
1 2 3	4 5 6	7 8 9

Attitudes Towards Drill Sergeant Duty and Peers:

How effectively does this Drill Sergeant relate to and work with peers?		
Tends to be rude, selfish, and disrespectful to peers; generally fails to provide assistance to others; seldom accepts guidance or advice from others.	Usually tactful and respectful when dealing with peers; provides assistance to other DS, especially when there is a clear need to do so.	Always treats peers in a tactful and respectful manner; offers needed assistance without waiting to be asked; asks other DS for guidance and advice in difficult situations.
LOW	MODERATE	HIGH
1 2 3	4 5 6	7 8 9

RETURNING SERGEANTS (E-5) TO DRILL SERGEANT DUTY

These were new scales developed from our research experience and through interviews with TRADOC, Drill Sergeants, and subject matter experts. These scales had high face validity and were well received by the Drill Sergeants. In some of the Initial Entry Training battalions, the leaders were using the scales as tools for general counseling of all their Drill Sergeants.

Study Design

Our design centered on comparing the academic and on-the-job performance of Sergeants (E-5) to Staff Sergeants (E-6) who were serving as Drill Sergeants. We began by comparing the performance of the two groups in Drill Sergeants School. We then collected supervisory ratings of both groups as they performed their Drill Sergeant duties in their Initial Entry Training units.

The study focused on the 50 Active Duty Sergeants who graduated from Drill Sergeants School and went on be Drill Sergeants in Initial Entry Training Units. The ratings on the BARS were supplemented with interviews and observations of the Drill Sergeants in school and in the training units. We also interviewed all leaders in the Drill Sergeants' chain of command up through brigade commanders. Additional interviews were conducted with Drill Sergeant School cadre, Human Resource Command personnel, former and incumbent Drill Sergeants, and attendees at the Nominative Sergeants Major Conference.

Drill Sergeant School Performance

The graduation rate of Sergeants in Drill Sergeant School was comparable to other ranks with graduation rates of 86%, 87%, and 86% for Sergeant, Staff Sergeant, and Sergeant First Class, respectively. Academic performance for the various course modules, e.g., Drill and Ceremony, Counseling, and Leadership, was also similar across ranks.

Drill Sergeant Performance in Initial Entry Training Units

The Sergeants serving as Drill Sergeants were rated multiple times by company and platoon leaders using the Drill Sergeant BARS. From these ratings we calculated a mean rating for each Drill Sergeant. We also collected additional BARS ratings for 28 Staff Sergeants who were Drill Sergeants during the period of the study.

As seen in the table below, the overall mean rating for Staff Sergeants was slightly higher than for Sergeants. While this difference is statistically significant, the difference is relatively small, namely 0.6 on a nine point scale. More importantly, the mean values for both groups are in the "High" range, i.e., greater than "7." And none of the participants received low ratings (1-3). We also examined the ratings of the Sergeants and Staff Sergeants on the separate BARS scales.

Overall BARS Ratings (Means) by Rank

Rank	N	Overall Mean BARS Rating	Number Receiving Moderate Ratings (4-6)	%	Number Receiving High Ratings (7-9)	%
SGT	50	7.2	19	38%	31	62%
SSG	28	7.8	4	14%	24	86%

While the Staff Sergeants were rated slightly higher on all of the scales, only on 9 were they rated significantly higher. Plus the ratings for the

Returning Sergeants (E-5) to Drill Sergeant Duty

Sergeants on 19 of the 32 scales were in the "High" range. Particularly noteworthy are the many items on which the Sergeants and Staff Sergeants received similarly "high" ratings; these are listed below.

Items On Which Both Sergeants And Staff Sergeants Received Similar High Ratings

Adheres to policies on fraternization

Works well with persons of diverse cultural and social backgrounds

Follows regimens of the Buddy system

Demonstrates understanding of diverse cultural and social backgrounds

Demonstrates behavior consistent with Army values

Follows and enforces Initial Entry Training rules

Demonstrates respect for trainees

Manages stress

Handles potentially volatile situations

These items directly address many of the major concerns about reinstating Sergeants as Drill Sergeants, e.g., respect for trainees, ability to handle stress and conflict, and ability to deal with diversity in gender, race, and social backgrounds.

Conclusions

We found no systematic evidence that should preclude Sergeants from returning to Drill Sergeant status. The Staff Sergeants in our study were rated slightly higher than the Sergeants, but they had additional experience in the Army and as Drill Sergeants that would likely explain these higher ratings

Overall, the ratings of the Sergeants were consistently high. Frequent comments from the senior personnel interviewed indicated that the Sergeants were energetic and enthusiastic, and eager to learn their job. They paid attention to the rules, and generally caused few problems. In addition, the Sergeants were not afraid to ask for help, and the chain of command ensured they got the help they needed.

Most of the senior leaders who were interviewed agreed that it is extremely important to maintain the standards set for selecting Soldiers for Drill Sergeant positions, whatever the rank of the candidates. They commented that true leadership time and experience, e.g. as a Team Leader, is important, and a complete background check on all candidates is imperative. All concurred that in the selection process, the Commander's recommendation is critical, and that the Commander recommending a Drill Sergeant candidate should actually know and have personal experience with the person being recommended.

The Sergeants were readily accepted and integrated into Drill Sergeant School and their Initial Entry Training Units. It was often cited by both Fort Benning and Fort Jackson senior personnel that "we set them up for success." That is, all of the new Drill Sergeants, regardless of rank, were mentored and coached by their unit leadership.

Interim results of the study were provided to TRADOC in Nov 2004. Shortly thereafter, the TRADOC Commander recommended to the Chief of Staff of the Army that the policy that prohibits Sergeants from serving as Drill Sergeants be changed. In Feb 2005, the Chief of Staff directed that Sergeants be reinstated as eligible for Drill Sergeant duty.

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THE CIVILIAN LEADER IMPROVEMENT BATTERY (CLIMB)

Most people think John has the potential to be a terrific supervisor. He's hard-working, ambitious, socially skilled, and calm under pressure. However, he never seems to fulfill his potential. He keeps trying to apply old solutions to new problems, and persists in doing this even when it's obvious that his solutions are not working.

In the example above, John is low on a temperament we call "cognitive flexibility." Unless he can identify this blind spot and do something about it, he will keep making the same mistakes and will never fulfill his potential as a leader.

ARI has created a leader development tool called the Civilian Leader Improvement Battery (CLIMB) to help John and other civilian leaders, or those aspiring to leadership positions, reach their full potential. The CLIMB measures a variety of leadership temperaments that our extensive research in leader development and assessment has linked to the job performance of Department of the Army (DA) civilians in their leadership positions. Because the CLIMB measures temperaments that are demonstrably related to the job, the feedback that employees, like John, receive after taking the CLIMB provides the information that will help them make real improvements in their job performance.

When the CLIMB becomes operational on the web, it will be readily and conveniently accessible to large numbers of civilians in the Departments of the Army and Navy. Individuals will be able to receive automated personalized feedback immediately after completing the survey-making the CLIMB an efficient, cost effective, and useful tool for civilian leader development.

What does the CLIMB look like, and what does it measure?

The CLIMB is a 20-minute survey that asks multiple-choice questions about previous work experiences. Unlike other, more general temperament scales, it measures the *job-related* aspects of several temperaments – focusing on giving one's best effort *at work*, instead of giving one's best effort at activities in general. This makes the CLIMB more meaningful in terms of diagnosing work-related problems and providing strategies useful for improving on-the-job performance.

Temperaments Measured by the CLIMB	
Work Motivation	Willingness to give one's best effort and to work hard to achieve work objectives.
Cognitive Flexibility	Willingness to entertain new approaches to solving problems. Enjoys formulating new plans and ideas. Accepts change and innovation.
Peer Leadership	Willingness to assume the role of leading one's peers. Seeks positions of authority and influence. Comfortable being the person responsible for the group's performance.
Stress Tolerance	Being calm and worry-free. Able to maintain composure under pressure.
Social Perceptiveness	Being perceptive about the feelings and agendas of others, and taking this information into account to work more smoothly with coworkers.
Team Orientation	Being tactful and diplomatic. Willingness to work well with others. Able to establish supporting and trusting relationships with coworkers.

THE CIVILIAN LEADER IMPROVEMENT BATTERY (CLIMB)

How do we know that the CLIMB temperaments are important to civilian leader performance?

A multi-year research effort to identify tests that predict leader job performance was conducted by ARI. This research included DA civilian supervisors, managers, and Senior Executive Service (SES) leaders serving in a wide variety of jobs and measured the job performance of these leaders using off-the-record, confidential evaluations provided by the leaders' immediate superior or superior-once-removed. Under these conditions, candid ratings of the leaders' job performance were obtained. Administrative indicators of performance (e.g., letters of commendation) were also collected.

A diverse and widely dispersed sample of over 2,500 civilian leaders at approximately 60 CONUS locations took the CLIMB survey. Across studies, scores on the CLIMB predicted both (1) confidential evaluations of the leader's job performance made by their supervisors, and (2) administrative indicators of on-the-job performance. Figure 1 provides an example of the validity of a CLIMB scale for predicting job performance.

What feedback will civilians receive when they take the CLIMB?

When individuals take the CLIMB, it will immediately provide individualized automated feedback on the validated measures related to job performance. This will help civilian leaders focus their self-development activities in areas that are most likely to have a high payoff in terms of improving their job performance. The automated feedback includes a graph illustrating their score on each CLIMB temperament scale (see Figure 2) and tailored narratives describing their particular strengths and weaknesses, with practical recommendations for improving areas of weakness.

Who will be able to use the CLIMB?

The U.S. Navy is currently funding the web-enablement of the CLIMB for use by Army and Navy civilian personnel. However, the tool is an excellent candidate for use in leader development across other departments and agencies because the CLIMB temperaments are closely linked to several Office of Personnel Management (OPM) leadership competencies.

Figure 1. Example of the Validity of a CLIMB scale

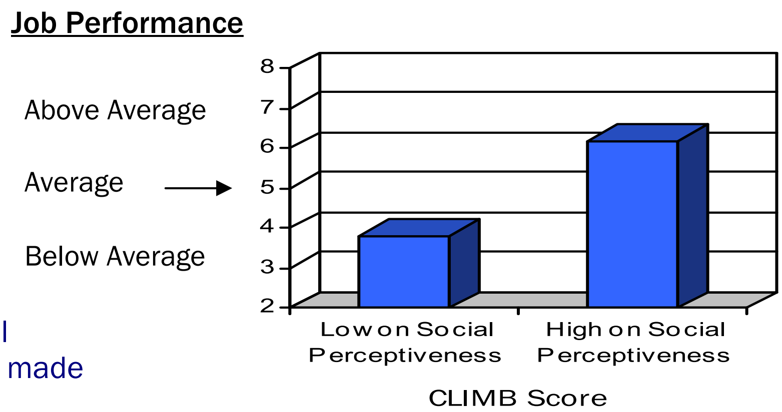
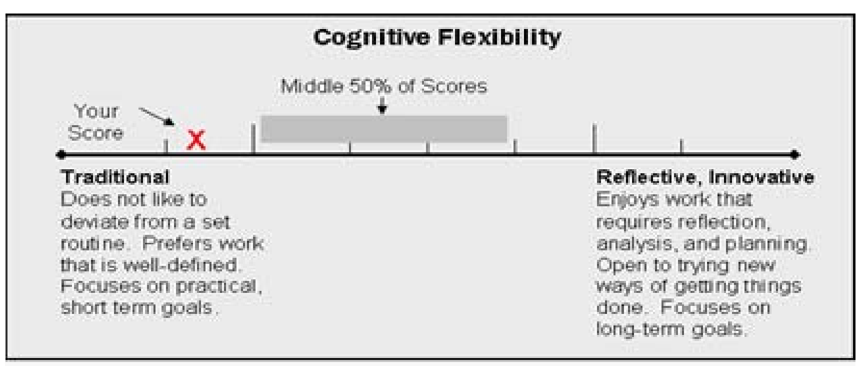


Figure 2. Sample Graph illustrating CLIMB Score



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Using Games for Training Army Leaders: Summary Of Questions and Lessons Learned

"We feel that training games will make us better prepared to train and win future fights."

...A Team Leader from the Infantry Captains Career Course

This statement recently appeared in the press....

"U.S. Army Sim game dazzles judges; wins two major prizes."

The prizes were awarded by the 2003 Electronic Entertainment Expo in Los Angeles, California.

The quote and press release shown above underscore the belief that video-type games can contribute to the training and development of Army leaders. Consistent with this view, the U.S. Army Infantry School at Fort Benning, Georgia, has made efforts to exploit the use of desk-top simulations and game-based technologies for training Infantry leaders.

To examine the effective use of games for Army training, ARI was asked by the Infantry School to evaluate three games: *Full Spectrum Command, The Rapid Decision Trainer, and Full Spectrum Warrior*. These three games were developed specifically for training dismounted Infantry leaders -- company commanders, platoon leaders, and squad leaders, respectively. Two Newsletter articles appeared earlier this year describing our evaluation of the Rapid Decision Trainer and a Symposium we sponsored on the topic of using games for military training. The current article expands on these to summarize the questions that emerged during all three evaluations and the lessons learned while conducting them.

Three Training Games Developed for Dismounted Infantry Leaders:

The three games that we evaluated for the Infantry School, *Full Spectrum Command, Rapid Decision Trainer, and Full Spectrum Warrior* are *described* in the table located at the bottom of this page.

Summary of Evaluation Questions and Lessons Learned: The questions and lessons learned summarized in this article are based not only on the results of the specific game evaluations, but on ARI's overall training research with Infantry leaders and specific findings from:

- Interviews with military training games producers, developers, and Army leaders from the Infantry School,
- Discussions with Infantry leaders who participated in our evaluations
- Several years of observations of Infantry leaders as they trained with games.

Full Spectrum Command	*The Rapid Decision Trainer*	*Full Spectrum Warrior*
A computer-based training game designed to train prospective company commanders	A computer-based game for platoon leaders	A tactical decision and action game designed to be used by squad leaders
Presents a simulated urban environment in which a captain commands a light Infantry Company engaged in offensive operations. The objectives of the game are to let captains who attend the Infantry Captains Career Course (ICCC) conduct mission analysis and planning, experience simulated mission execution, and improve their ability to adapt to emerging conditions on the simulated battle field.	Developed to allow all lieutenants attending the Infantry Officer Basic Course (IOBC) to serve as squad and platoon leaders during simulated attack missions. It was also intended to prepare them for the tasks and decisions required to complete successful Infantry live-fire exercises during IOBC training.	Contains more commercial game qualities than either Full Spectrum Command or the Rapid Decision Trainer. Full Spectrum Warrior simulates Infantry squad-level operations in urban and suburban environments. The player acts as an Infantry squad leader who directs and controls the actions of two, four-man fire teams. Players focus on movement through complex simulated terrains, fire distribution and control, reaction to enemy contact, and room clearing exercises.

Using Games for Training Army Leaders

The lessons learned are in rank order, starting with what we believe are the most important in terms of their impact on games development and effectiveness for training dismounted Infantry leaders.

QUESTION I. Can training games be used as "stand-alone" trainers?

The idea that games can be used as stand-alone trainers is based on the following general assumptions:

- Soldiers will train with games on their own time because they already play commercial games
- Using games as stand-alone trainers can be a valuable training experience
- Guidance of a qualified instructor is not always necessary for effective training

Lesson Learned #1: Not all Infantry leaders are proficient with games and computers.

Infantry leaders' proficiency with games and computers varies widely. Results from our research showed that more than 70% of the captains in the Full Spectrum Command evaluation indicated that they had to focus on computer control devices and functions rather than on the experiences created by the simulation. Similar results emerged during the Full Spectrum Warrior and the Rapid Decision Trainer evaluations. These results suggest that the majority of leaders who train with games will need sufficient time to learn the systems and functions before using the game for its intended purpose. In general, there is a tendency to overestimate leaders' proficiency with game consoles and personal computers and underestimate the time required for an effective training experience.

Lesson Learned #2: The guidance of qualified instructors is essential.

Our evaluations did not investigate the extent to which using games as stand-alone trainers predict Infantry leaders' performance to standard; that is part of our longer term research program. However, based on our observations and discussions, leaders seemed to reap the most training benefits when their instructors provided the following:

- Instruction about the purposes for which they were using a game
- Demonstration of game functions and limitations
- Explanation of tactical and functional shortfalls of game software
- Examples of effective mission execution.

We also asked leaders to rate the importance of an instructor's evaluation of their performance, coaching and feedback, and guidance during after-action reviews. The ratings demonstrated that most leaders believed the effectiveness of training with games was determined in large measure by the role of qualified instructors.

Developers of military training games have not been particularly successful at implementing effective automated coaching, feedback, and after-action review processes. Modeling the human cognitive skills required for effective feedback during mission execution and critical thinking during after-action reviews has proven very difficult. This may explain, at least in part, why leaders expressed the importance of the role of live instructors for games training. As an aside, ARI is investigating this very difficult and complex issue of automated coaching and feedback in their current training and leader development research programs.

QUESTION II. How important to training game effectiveness is a clearly defined training objective?

Clearly defined training objectives are critical to training effectiveness. Training games developers should define specific training objectives before software development begins. Training objectives are determined, in part, by the knowledge, skills and abilities of the Soldiers who will use the game, standards of performance that Soldiers are expected to achieve, the training conditions under which the game will be used, and what the Soldiers are expected to learn from the training.

Using Games for Training Army Leaders

Lesson Learned # 3: Games developers need continuing interaction with military subject matter experts.

Military subject matter experts can ensure that games development proceeds correctly to accomplish Army goals by answering the following questions:

Who will use the training game?

At what level or echelon is the game intending to train?

Under what conditions will the training game be used?

What specific training objectives will the game address?

Subject matter experts can also ensure that tactics, techniques, and procedures are presented accurately, and that leaders can apply them appropriately during simulated mission execution. Infantry leaders who use games to practice decision making and other skills need to experience realistic consequences for their actions. Military subject matter experts can guide the development of tactical scenarios and computer-generated forces so they act and respond according to military doctrine; this will allow leaders using the games to learn the correct actions and responses from the training.

According to a senior training games producer, developers cannot determine if a training game is proceeding appropriately until they can assess the first playable versions. However, by the time the first versions are playable, up to 70% of the project budget will have been spent. This underscores the importance of input from subject matter experts prior to and throughout the entire games development process.

Subject matter experts from the Infantry School indicated that their capacity to guide games development was a function of the time they had available for this task; and this time was often limited by their demanding schedules. In addition, to make a real difference in the final game versions, they not only needed the time, but they need the authority to direct changes to software development based on their military knowledge, experience, and expertise.

QUESTION III. How important are sophisticated computer graphics to effective training?

It is often assumed that the use of sophisticated computer graphics is important to training because they:

Heighten realism

Increase and sustain believability

Create positive Soldier perceptions of their training experiences

Improve Soldier skills and performance.

Prior to our research, there was little, if any, evidence supporting or refuting these assumptions, nor was there empirical research underway examining how such things as graphics, fidelity, realism, or animation influence the training value and actual learning taking place when using games.

Lesson Learned #4: Sophisticated graphics are neither necessary nor sufficient for a valuable training experience.

In our evaluations, Infantry leaders gave Full Spectrum Warrior high ratings on four dimensions of fidelity:

Physical: Do Soldiers look like real Soldiers? Does the terrain look realistic? Do trees and vehicles look real?

Psychological: Were you involved in your role as a squad leader during mission execution?

Friendly force: Does the friendly force react according to doctrine? Does it react in a timely manner?

Enemy force: Does the enemy force react as you would expect an enemy to react?

However, leaders' ratings for the overall training value of the game did not parallel their ratings of fidelity and realism. These findings indicated that sophisticated graphics alone were not sufficient to have a marked impact on the way leaders perceived the game's overall training

USING GAMES FOR TRAINING ARMY LEADERS

In contrast, developers of the Rapid Decision Trainer utilized relatively low-fidelity graphics in the game. As a result, we expected leaders' ratings of the Rapid Decision Trainer to be low. However, their overall high ratings of the game, along with their written and verbal comments, suggested that they recognized the game's potential training value in spite of low fidelity graphics. Findings from both evaluations suggest that while sophisticated graphics can be used to improve a training game's level of perceived realism, they are neither necessary nor sufficient to make an impact on the perceived training value of the game.

QUESTION IV. Do training games for Infantry leaders have to be fun?

It is often assumed that if games are fun and entertaining, then individuals will spend more time playing them and better training will result.

Lesson Learned # 5: Leaders were more motivated by learning leader skills than by having fun.

In our evaluation, Infantry leaders rated the following reasons for training with the Rapid Decision Trainer:

- Learn combat skills
- Make rapid decisions
- Prepare for live-fire and field exercises
- Have fun and for personal entertainment.

They gave high ratings to learning combat skills, making rapid decisions, and preparing for live-fire exercises as important reasons for using the Rapid Decision Trainer. Only a small number of leaders believed that fun and personal entertainment were important. We found that leaders who are serious about using games for training want to use them to learn leader tasks and skills; they are less motivated to use them for fun.

The success of commercial games is determined by the extent to which consumers perceive them as fun and entertaining. However, we did not find that fun was a key factor in Infantry leaders' perceptions that games were effective trainers. Instead, we found that the success for military training games is, in part, measured by how well they meet intended training objectives. Success is also measured by how well games help leaders learn the skills that help them perform to standard in required training exercises and courses.

Conclusion

Leaders and instructors at the Infantry School continue to explore game technologies, as do other leaders, trainers, and instructors across the Army, in an effort to have tools that help them accomplish their mission – to train Soldiers and leaders to meet the requirements of the current, fast-paced environment and to remain trained and ready as the future unfolds. *If effective*, game technologies could be a viable method to sustain skills and provide hands-on refresher training when time and resources for more cost-intensive training exercises are limited.

To address the "If" in this last statement, and to ensure that games are effective tools, the empirical research to understand when and how games can be best used, and to investigate the elements within a game that are critical components for actual learning to take place, are essential. Researchers have opportunities to guide current and future training games by providing this empirical data to inform both the design phase and the development phase so that games will, indeed, be effective training tools. There is still much to be learned about the effective use of games for training. The current lessons learned from our evaluations and the training and leader development research being conducted across ARI are important steps in this process.

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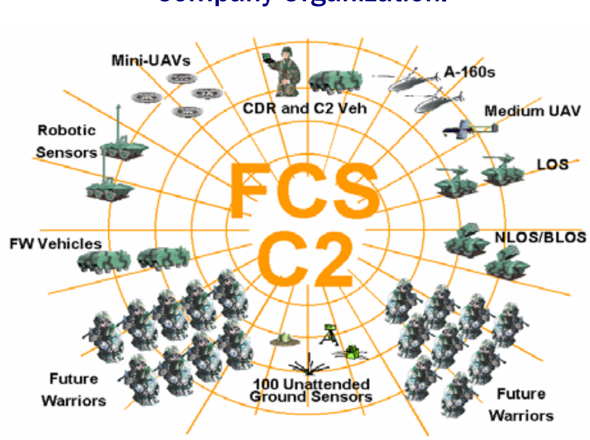
A Near-Term Approach To Embedded Training: Embed Systems and Settings

Providing embedded training (ET) is a key goal in the Army's ongoing effort to develop and field Future Combat Systems (FCS). The ET objective is to provide performance-based training embedded into actual operational systems. Achieving that objective, however, will be a difficult task. For nearly two decades, the Army has mandated that developers consider ET in all Army acquisition programs, yet there are few, if any, successful ET applications. A sustained research effort is required to attain ET for the Future Force as well as interim training solutions for the Current Force. ARI has been conducting this research, and one recent result is an innovative training approach developed to raise the fidelity and availability of training for the Current Force.

To provide a working example of this new approach, ARI developed a product called *Battle Command Visualization (BCV) 101* to train many of the basic skills required for employing networked sensors to "see" the battlefield.

Background: Previous research by ARI found that these basic visualization skills are difficult to acquire. Our previous research included a series of DARPA-led experiments with a command group of four Army lieutenant colonels equipped with notional Future Combat System (FCS) assets in which 13 of their 16 operational platforms were unmanned and interdependent systems, as shown in Figure 1.

Figure 1. Notional Future Combat System Company Organization.



Most of these unmanned systems were air and ground sensors dynamically linked by an information network that enabled sensor tasking, sensor cross-cueing, and automated sensor-shooter engagements.

Despite the high level of battle command experience represented in the experimental command group – well beyond what can be expected in future lower-echelon units – the lieutenant colonels continued to report serious concerns about their ability to employ their assets adequately even after two months of practice and over forty battle runs in a high-fidelity simulation environment. Today, the training problem is substantial and it will grow as the Army fields and relies on more unmanned sensors. In the future, smaller FCS organizations down to platoon level will have organic sensors, but limited experience and personnel for exploiting sensor assets. Thus, in the context of skills that are both hard to acquire and increasingly critical to the Army, ARI research is examining ways to develop and demonstrate innovative approaches to advance current training capabilities and build toward the goal of fully embedded training for FCS.

BCV 101 Training Design

The design of BCV 101 training is based on the proven training principles identified in Table 1 on the next page. Such principles improve performance above the level attained by mere practice (the repetition of performance without adequate control, guidance, feedback, and assessment). Many of these principles also underpin the Conduct of Fire Trainer (COFT) that has provided high-fidelity gunnery skills training for over twenty years. However, COFT is an institutional training device and Soldiers can use it only if they have access to a simulation facility. In addition, COFT is not ET; it is not gunnery training onboard an operational system.

A Near-Term Approach to Embedded Training

Table 1. Training Principles for BCV 101

Training Principle	COFT	BCV 101
Structure training in matrix of progressive and gated exercises	✓	✓
Provide instructional control, guidance, feedback, and assessment	✓	✓
Use high-fidelity operational systems and operational settings	✓	✓
Ensure interactive conditions, behaviors, and outcomes	✓	✓
Relate trainee performance to outcomes on simulated battlefield	✓	✓
Target conceptual skills with an integrated scenario framework		✓
Deliver high-fidelity training anytime and anywhere		✓

Building on the successful basic design of COFT, BCV 101 features a structured set of exercises nested in a training matrix. The matrix controls and certifies systematic skill progression by assessing proficiency in a series of criterion or "gate" exercises. BCV 101 emphasizes short-duration (5-10 minute) exercises to maintain a close link between tasks, conditions, and standards as well as to provide immediate feedback and the opportunity for repeated performance.

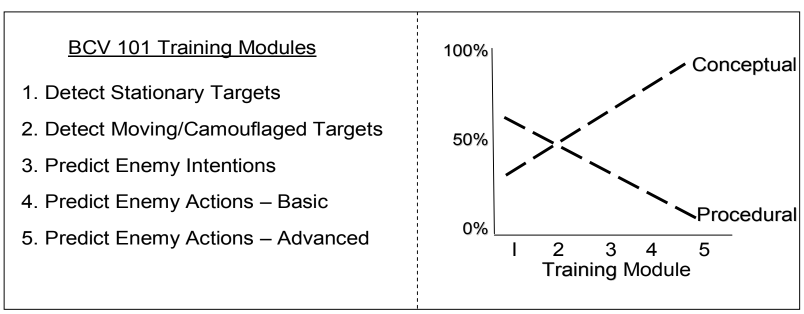
Unlike COFT, with a matrix of discrete and mainly procedural gunnery skill exercises, the BCV 101 exercise matrix comprises an integrated tactical framework focused on conceptual skills. Each of the 94 exercises in BCV 101 represents one of the tasks specified in a sensor-tasking matrix designed to support a small unit commander's Priority Intelligence Requirements (PIR) in a realistic tactical scenario. In addition, an integrated set of Reconnaissance and Surveillance (R&S) overlays visually maps how each exercise supports the overarching PIR framework. The training focus on conceptual skills emerges across exercises in the five BCV 101 modules, as shown in Figure 2.

Training Fidelity

The last BCV 101 training principle listed in Table 1 (shown on the left) advocates the availability of high-fidelity training. Training fidelity is key to the Army's "train as you fight" ET objective. However, there is usually an *inverse* relationship between training fidelity and availability. For example, the availability of full-fidelity ET is limited to Soldiers actually onboard operational systems. Full-fidelity ET requires configuring each system to ensure that the ET mode "...uses all instruments, controls, menus, and screens used in the operational mode." For instance, fire controls that normally cause actual weapons to fire in the operational mode must alternatively cause simulated weapons to fire in the ET mode. Full-fidelity ET also requires dynamic links between systems and settings that provide updates fast enough to portray system and setting interactions accurately (e.g., target destruction) to all participants in a distributed training environment.

Attempts to embed even some training of procedural skills into operational systems, such as COFT-like gunnery into the M2A3 Bradley, have found it to be a very difficult task. The current FCS

Figure 2. Focus on conceptual skill emerges across training modules.



A NEAR-TERM APPROACH TO EMBEDDED TRAINING

timeline anticipates full-fidelity ET at the Unit of Action (UA) level in 2014. Achieving this will be a daunting challenge, particularly for training the more complex skills such as exploiting networked sensors to see the battlefield.

The BCV 101 approach takes a step toward meeting this challenge by adapting existing Interactive Multimedia Instruction (IMI) methods to raise the fidelity of training available anytime and anywhere. The term IMI describes a wide range of computer-based training characterized by four levels of interactivity: passive instruction, limited participation, complex participation, and real-time participation. In practice, most IMI training examples are at the first two levels and provide a low-fidelity approach that fails to provide realistic systems and settings to, or demand realistic performance by, the training participants.

Embedding Systems and Settings into Training

To raise training fidelity at IMI Levels 1 and 2, the BCV 101 approach stresses the application of technology to embed realistic systems and settings into training. The working definition of high-fidelity training is training that represents the look and interactive performance of operational systems and operational settings. However, a high-fidelity environment *without* training principles and methods is not sufficient for performance improvement. The BCV 101 approach builds in the basic training principles and methods to convert IMI "high tech" page turners (Level 1) and tedious tutorials with multiple choice questions (Level 2) into interactive systems and settings that dramatically relate training participant performance to outcomes on a simulated battlefield.

The BCV 101 approach is distinguished by the use of high-fidelity source materials, namely a prototype C2 system linked to virtual simulation, to generate accurate models of system and setting interactions for training. The C2 interface is important because the networked nature of FCS will elevate an operational C2 sub-system to *supra*-system. For future command groups, a C2 interface will be the primary means of interacting with unmanned platforms, including networked sensors and shooters. Simulation is important because visualizing and controlling battlefield dynamics, the time and space interactions of operational systems and settings, is essential to seeing and understanding the battlefield.

The source materials are created by recording an expert trainer performing sensor deployment exercises on a C2 interface linked to simulation until all IMI Level 1 and 2 exercises in the BCV 101 sensor-tasking matrix are recorded. The resulting recordings depict the human-computer interactions that are required to employ networked sensors and all simulated entity interactions (e.g., sensor tasking and sensor cross-cueing) on a dynamic battlefield.

Next, IMI technologies transform the recorded exercises into "live" exercises to be observed (IMI Level 1) and then performed (IMI Level 2) by a training participant. Training principles are applied through IMI augmentation of the video files. Computer software manipulates and enhances each exercise's video file with instructional graphics, text, and audio. It also manages how participants progress through BCV 101 exercises and learning gates as well as their subsequent remediation or advancement through the training matrix.

IMI Level 1 exercises initially demonstrate correct task performance, at either a task step-by-step level or full task auto play. IMI Level 2 exercises then track and manage each training participant's performance of similar tasks via invisible "hot spots" on the C^2 interface. When performance errors occur, corrective textual feedback first appears, as shown in Figure 3 on the next page, followed by a re-demonstration of correct performance if the error persists. Figure 4, also on the next page, presents a sample Module Map used by training participants to advance and monitor their progress across the five BCV 101 modules.

A Near-Term Approach to Embedded Training

Figure 3. Sample of Corrective Textual Feedback

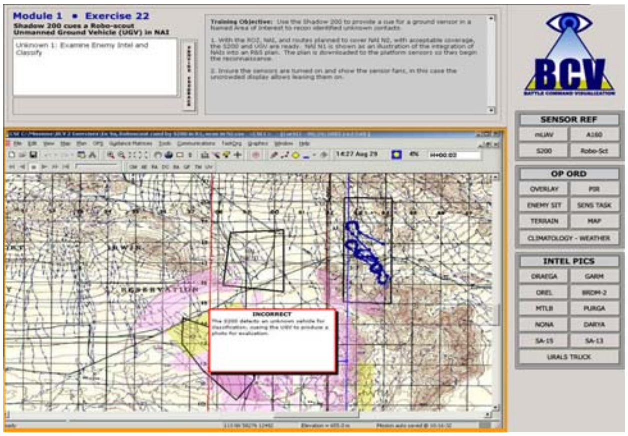
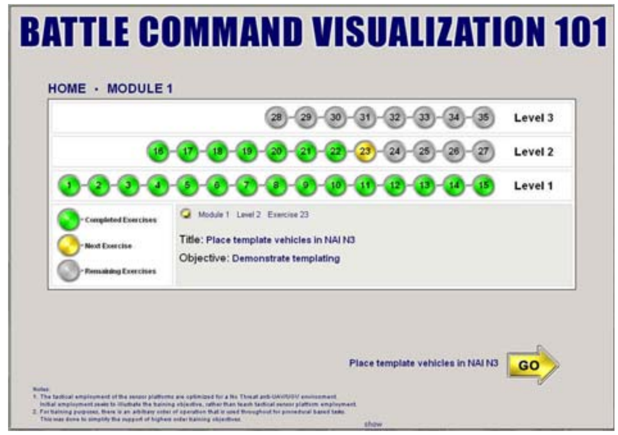


Figure 4. Sample Module Map



A key feature of BCV 101 is automated and objective performance feedback and assessment. Table 2 provides some notable examples of BCV 101's ability to provide simulation-based feedback and trainer-based feedback on the process and outcomes of sensor employment. In addition, the BCV 101 learning management system captures the human-computer interactions of training participants and their progress by step, task, and gate throughout IMI Levels 1 and 2.

Table 2. Feedback Examples for BCV 101

Sensor Employment	*Simulation-Base Feedback*	*Trainer-Based Feedback*
Process	Show dynamic sensor footprints Auto check sensor inter-visibility Estimate time to complete task	Provide training road map Visually demonstrate tasks Textually document tasks
Outcome	Auto alert sensor detections Auto alert images "received" Aid target recognition	Assess learning with quizzes Control progress with gates Direct remediation, as required

Training Availability

The BCV 101 approach greatly expands the availability of high-fidelity training at IMI Levels 1 and 2. More specifically, the BCV 101 approach provides principled training with high-fidelity source materials for computer-based or web-based delivery almost anytime and anywhere. In contrast, high-fidelity Army training generally requires a technical infrastructure that severely limits training availability, such as the simulation facilities required for COFT-type training or the actual operational systems required for fully embedded training.

Summary

The Army's far-term ET solution is to embed ***training into*** operational systems and settings for the Future Force. BCV 101's near-term solution embeds realistic operational systems and settings ***into training*** for the Current Force. The BCV 101 approach readily extends to a wide range of Army training requirements at IMI Levels 1 and 2 for conceptual as well as procedural skill acquisition. As a near-term complement to the ET of tomorrow, the BCV 101 approach can deliver high-fidelity training today on computers at home, at home station, or onboard the operational systems of the Current Force wherever deployed. ARI is developing a multi-media product to illustrate the BCV 101 approach and particularly to provide lessons learned and training implications for ET training developers, system developers, and decision makers.

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Estimating the Effectiveness of Training Technologies

Training for the Army's complex operational systems and environments involves a variety of technologies, such as training aids, devices, simulators, interactive multi-media, and training games. Analytic procedures that provide estimates of the training effectiveness of these technologies before they are built and fielded can be valuable. These procedures can help guide training developers to improve the training technology design during development and to avoid costs associated with redesign after the technology is fielded. Recently, ARI modified and improved one such analytic estimation procedure they had developed in the 1980s. We call this modification the *Training Technology Evaluation Tool*, and it is referred to as the Tool in this article.

The training-estimation evaluation procedure that was developed by ARI in the 1980s was the Device Effectiveness Forecasting Technology (DEFT). The DEFT provided an analytic procedure that estimated the effectiveness of training devices and simulators. With the modified Tool (i.e., the Training Technology Evaluation Tool), the analytic tool can address training simulations such as training games and interactive multi-media, as well. Although the Tool was modified to be more user-friendly than the DEFT, it still requires subject matter experts (SMEs) who understand the skills and tasks to be trained, as well as the characteristics of the training technology.

Dimensions Used to Estimate Training Effectiveness

The Tool estimates the effectiveness of a training technology from two primary dimensions, called *Acquisition* and *Transfer*. Scores on these two dimensions are used to derive a final *Total Effectiveness* score. The *Acquisition* and *Transfer* scores are computed from SME ratings on several component and subcomponent dimensions as shown and summarized in Figure 1. The *Acquisition* dimension provides an assessment of the training challenge and the extent to which the technology addresses this challenge. The *Transfer* dimension evaluates what remains to be learned after the Soldier has been trained with the training technology.

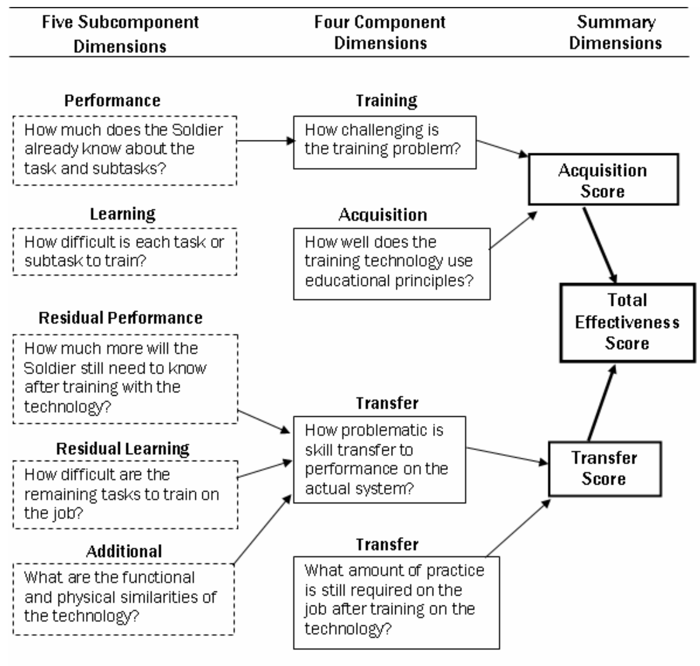

Figure 1. Relationships among the dimensions that estimate training effectiveness.

Major Features of the Tool

The Tool, as is the case with DEFT, has three levels of analysis in order to evaluate training technologies that are at different stages of development: the design phase (Level I), the prototype phase (Level II), and the full production and fielded phase (Level III). Each analysis level requires a different depth of knowledge about the training domain and the training technology. The Level I analysis requires the least knowledge, and the Level III analysis requires the greatest knowledge. Correspondingly, both the number of questions and the question content vary with the level of analysis. This multiple-level approach enables an estimation of the feasibility and potential value of fully developed and existing technologies. In addition, it can make these estimations for emerging technologies.

To illustrate the three levels of analysis, examples of questions asked under the *Learning Difficulty* subcomponent dimension in Figure 1 are shown below.

LEVEL I	**Rate the difficulty the typical Soldier will have in acquiring the required skills and knowledge needed to meet the training objective.**
LEVEL II	**Rate the difficulty the typical Soldier will have in learning to perform each subtask on the training technology.**
LEVEL III	**Six questions are presented that must be answered for each of the subtasks. Two of the questions are:** **Are job/memory aids used in the training technology?** **Must steps be performed in a definite sequence?**

Enhancements to the Tool

As indicated, the Tool was built on the DEFT concept, but was modified to allow estimation of the training effectiveness of other technologies, to include interactive multi-media instruction and virtual simulations such as training games. In addition, the data entry and analysis processes were automated using Microsoft Excel®, making it very user-friendly and easily understandable.

After the expert responds to all the questions, the Tool automatically provides scores for all the dimensions, and generates a scoring guide to help the expert better understand the results. The automation features and scoring guide ensure that the Tool can be applied by individuals with a variety of backgrounds, including researchers, military training developers, and military SMEs. Lastly, the questions in the Tool were modified from those in DEFT to be applicable to a wider-target audience of SMEs.

Applying the Tool

We used the Tool to estimate the effectiveness of four training technologies:

Gunnery simulator – Levels II and III

Individual weapons simulator – Levels I and II

Interactive multi-media instruction on map reading – Levels I, II and III

Games for training – Level III

As we applied the Tool to these four technologies, we focused some attention on evaluating the Tool itself. We considered four primary issues:

- ✓ The face validity of the scores,
- ✓ the agreement among raters for a given technology,
- ✓ the value of the subcomponent score data, and
- ✓ the implications of using a specific level of analysis.

As a whole, the results provided positive feedback regarding the new Tool.

With respect to face validity, we examined the extent to which the scores were consonant with well-known device characteristics. For the training technologies that were well-established - *the gunnery and individual weapons simulators* - the results resonated with known design characteristics. For example, the gunnery simulator was specifically designed to replicate the gunner's station. Appropriately, the scores were very high on the *Additional Deficits* subcomponent (see Figure 1), which reflects

ESTIMATING THE EFFECTIVENESS OF TRAINING TECHNOLOGIES

Physical and functional similarities. Transfer ratings to the actual equipment were high as well.

Second, we examined the level of agreement among different raters for the same technology. In general, the results showed that the SMEs tended to differ even when using the same level of analysis, but that a given SME was relatively consistent across the levels of analysis. These differences were attributed to variations in the SMEs' prior experience with the tasks and subtasks being rated, and to their experience with Soldiers performing the tasks. The differences appeared to impact the SMEs' ratings of task and subtask difficulty, and their perception of the adequacy of the training standard incorporated in the training technology. It is recommended that multiple raters be used when applying the Tool.

Third, we compared the utility of the data at the different levels of specificity (the component and subcomponent dimensions in Figure 1). The assessments of the Tool indicated that the most important information on the relative strengths and weaknesses of a training technology was derived from the component and subcomponent scores, not the summary dimensions. For instance, these scores reflected whether the technology incorporated sound training principles, whether there were major elements of the task that still must be trained in the operational environment or on the operational equipment after using the technology, and whether the remaining tasks to be trained were perceived as being easy or difficult.

Finally, we examined the different levels of analysis. Choice of the level of analysis depends on what is known about the technology and the tasks to be trained. In fact, Levels II and III cannot be applied to a training technology that is in the design phase. Since all the technologies we examined when testing the Tool actually existed, a Level III analysis was appropriate. Yet, we examined the other analysis levels since it was important to determine how results from the three levels might differ. No problems were encountered in applying the Level I and II analyses to the diversity of training technologies examined.

However, we concluded that it is advisable for the SME to list the tasks being considered when conducting a Level I analysis, in order to enhance the consistency and objectivity of the ratings across the dimensions of the Tool. Recommendations were made regarding increased flexibility in the Level III analysis to accommodate the wide variety of tasks addressed by current training technologies.

Conclusions

Application of the Tool takes from 30 to 60 minutes. This is a minimal investment given the potential insights that can be gained about a training technology's strengths and weaknesses, and what might be done to improve the training effectiveness of the technologies.

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