Training Small Unit Leaders and Teams

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Foreword

Training small unit leaders and teams, both effectively and efficiently, is a challenge in the face of rapid Army modernization. The proliferation of new digital systems and battlefield information requirements has changed the way small units fight, forcing us to rethink the ways we have historically trained our junior leaders and their units. This Special Report summarizes a comprehensive research program ARI recently completed in the area of small unit leader and team training. Jointly conducted by scientists at our research units at Fort Benning, GA and Orlando, FL, the program encompasses 27 separate lines of investigation across five broad research areas: new and emerging systems, desktop simulation, automated tools, simulation technology assessment, and high performance tasks.

While highlighting the major findings from this body of research, this Special Report also illustrates the variety of ways our research has positively impacted the Army. From providing timely information to Project and System managers to the development of improved simulation software and automated training tools, the payoffs from this research program have been substantial and varied. Collectively, this research program has allowed training modernization to catch up to the pace of system and equipment modernization efforts. I encourage readers wanting more detailed information about a particular line of research to explore the ARI publications referenced in this report.

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Director

Training Small Unit Leaders and Teams

table of contents

Training Small Unit Leaders and Teams
table of contents (continued)

Introduction and Overview

This Special Report provides concise descriptions of 27 separate lines of investigation related to training small unit leaders and teams.

As the U.S. Army continues to modernize its equipment and forces, small unit leaders will encounter a variety of new digital systems and operational concepts. They will be challenged to make timely decisions based on increasingly large amounts of unprocessed information, as current and future battlefields are characterized by rapidly changing situations, by new kinds of threats that are difficult to define, and by multiple rules of engagement.

Although emerging technological solutions may address some of our future training requirements, unforeseen training problems invariably accompany the introduction of new technology. Realizing the full benefit of emerging information, weapons, and training systems will require a multifaceted approach to understand and remedy the unique problems faced by Soldiers in the current operational environment. To directly address the problems associated with training small unit leaders and teams, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) launched a three-year research program in Fiscal Year 2006.

ARI's research program on training small unit leaders and teams encompassed 27 separate lines of investigation across five broad areas:

- New and emerging systems
- Desktop simulation
- Automated tools
- Simulation technology assessment
- High performance tasks

The **new and emerging systems** section of this Special Report covers reduced exposure firing with the Land Warrior system, Land Warrior's training impact, the development of a new laboratory to conduct training experimentation with prototype system concepts, the battlefield information requirements of squad leaders, interactive methods to train digital map displays, training plans for teaching the digital skills associated with computer-based Soldier systems, and training lessons learned and confirmed from an eight-year period between 1997 and 2004.

The section on **desktop simulation** describes our research into the training value of electronic games, software to improve the situational awareness of Infantry platoon leaders, game-based simulation that enables Soldiers to learn and practice cultural skills, massively multi-player game-based technology for asymmetric mission training, and a new desktop application for training rapid decision making.

Training Small Unit Leaders and Teams

introduction and overview

Next, the *automated tools* section covers the development of easy-to-use scenario generation tools for Army trainers, aids for conducting after action reviews with the future Ground Soldier System, improved methods for training Soldiers to conduct effective after action reviews, software for assessing Soldier skills in virtual environments, and an automated tool for conducting after action reviews in simulation training applications.

The section on *simulation technology assessment* highlights instructional interventions for training in virtual environments, the importance of measuring *presence* in virtual environments, the evaluation of a virtual system for training skills associated with urban operations, and the results of three mixed reality experiments.

Finally, the *high performance tasks* section presents training and technology issues associated with the Objective Force Warrior system, research to identify the characteristics of adaptive leaders, five factors essential for successful decentralized training, training products to instill Warrior Ethos, a job performance

aid to improve troop leading procedures, and the results of a survey of 187 veterans of operations in Afghanistan and Iraq.

Readers wanting more detailed information about a particular line of research are encouraged to explore the ARI publications listed in the numerous **Additional Information** subsections of this report. Directions for downloading our technical publications are presented at the end of the report.

Land Warrior Reduced Exposure Firing

Land Warrior's helmet-mounted display and optical systems can reduce a Soldier's exposure to the enemy by 75%, with only an 18% reduction in hit probability.

Problem. With the Land Warrior system, Soldiers can observe and engage targets while exposing very little of their bodies and weaponry to the enemy. This reduced exposure firing capability is made possible by a computer link from either of the two Land Warrior weapon-mounted sights, the daylight video sight (DVS) or the thermal weapon sight (TWS), to its helmet-mounted display. However, the relative lethality of reduced exposure firing compared to conventional direct view firing was unknown.

Approach. Live-fire experimentation using the Land Warrior v1.0 system was conducted over the course of four weeks with 17 Soldiers having a wide variety of military occupational specialties and differing levels of military experience. During daylight, reduced exposure firing with the DVS was compared to direct view firing with the Close Combat Optic. At night, the TWS in its standard direct view mode was compared to the TWS in the reduced exposure mode. Data were collected on probability of hit, round dispersion, target acquisition, and Soldier exposure to the enemy.

Results. Over all test scenarios, a 75% reduction in bodily exposure to the enemy was obtained with reduced exposure firing. Hit probability was reduced by 18% and round dispersion was slightly higher as well.

The critical skills needed to effectively fire in the reduced exposure mode were identified. The ability of each Soldier to establish a stable position, tailored to their own physique and firing preferences, was found to be especially critical. A sling was found to be needed when firing from hasty positions. A training plan for reduced exposure firing was developed to support the acquisition of these critical skills.

Payoff. The results of this investigation were provided to the TRADOC Systems Manager-Soldier, the Project Manager-Land Warrior, and the G3 of the U.S.

Training Small Unit Leaders and Teams
new and emerging systems

Army Infantry School for use in making design decisions regarding the Land Warrior system. The lethality and survivability databases generated from the investigation were provided to the Army Materiel Systems Analysis Activity for use in future constructive and virtual simulations. Needed improvements to the DVS were provided to the Land Warrior Weapons Integrated Product Team and were used to modify the follow-on version to that sight. In addition, the results of this investigation represent a sound basis for the development of training and performance standards for reduced exposure firing with the Land Warrior system.

Additional Information.

Dyer, J. L., Salvetti, J. D., Vaughan, A. W., Beal, S. A., Blankenbeckler, P., & Dlubac, M. (2005). *Reduced exposure firing with the land warrior system* (ARI Research Report 1834). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA435129)**

Training Small Unit Leaders and Teams

new and emerging systems

Land Warrior Training Impact

Four Land Warrior fielding alternatives were analyzed to compare their relative impacts on the training base.

Problem. A Land Warrior training impact analysis was performed to support the TRADOC Analysis Center-White Sands Missile Range's (TRAC-WSMR) requirement to conduct an analysis of alternatives prior to the Joint Requirements Oversight Review of the Land Warrior Block II system.

Approach. A base case and four fielding alternatives were analyzed as part of the training impact analysis. The base case specified that Soldiers receive equipment in the Stryker Brigade Combat Team plus rapid fielding initiative equipment. The first alternative specified that each Soldier also have a radio. The three other alternatives varied the Land Warrior Block II system's basis of issue, down to either squad leaders, team leaders, or all Soldiers. The impact on institutional training was examined for each alternative.

In conducting the training impact analysis, three types of training information were identified and examined: required individual tasks, critical individual tasks, and the prerequisite skills needed for each fielding alternative. Next, the resources required to train the identified

tasks to different levels of proficiency were estimated. The major training resources examined were number of instructors, training time, ammunition, and number of Land Warrior systems. The impact of each alternative was further analyzed according to whether it occurred before or after the midpoint in the overall Land Warrior fielding process.

Results. The fielding alternative where all Soldiers had the Land Warrior system was found to have the greatest impact on

Training Small Unit Leaders and Teams
new and emerging systems

training. For example, if this alternative were selected, an estimated 6,275 Land Warrior systems would be needed to conduct Infantry One Station Unit Training alone. This number fell to 976 systems if issued down to team leaders and 592 systems if issued down to squad leaders.

Two tasks were found to have a major impact on training time: land navigation and marksmanship. Training time was high for these tasks because of the relatively high proficiency levels that needed to be achieved and because of constraints on Soldier throughput imposed by restrictions in the size of ranges and training areas.

The Land Warrior system's greatest impact was centered on the youngest and least experienced Soldiers. Compared to non-commissioned officers (NCOs) and officers, these Soldiers were least likely to have the prerequisite military knowledge and skills required by the system.

Payoff. The results of the Land Warrior training impact analysis were provided to TRAC-WSMR and incorporated into their analysis of alternatives briefing to the Land Warrior Analysis Study Advisory Group in February 2005. These results can also provide a sound analytic basis for estimating future institutional training impacts should the Land Warrior system ever be modified.

Additional Information.

Dyer, J. L., Centric, J., & Dlubac, M. (2006). *Training impact analysis for Land Warrior Block II* (ARI Research Report 1846). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA443795)**

Warfighting Experimentation Lab

A new ARI laboratory at Fort Benning enables training research with new systems to begin, without waiting for early prototypes to become available.

Problem. It has generally been thought that most training development research involving new systems cannot proceed until those systems have at least reached their prototype stage. One potential way to avoid this dilemma would be to develop an experimental laboratory in which selected characteristics of new and developing systems could be simulated, allowing training development research with Soldiers to begin on a limited scale, without waiting for systems to be prototyped.

Approach. A training development research facility, called the Warfighting Experimentation Lab, was built and tested. The lab consists of 10 desktop computers, networked together through a central hub. Four of these computers serve as Soldier stations, while the remainder serve as control stations. A simulated radio system, a capability to control semi-autonomous forces, and a system to record and retrieve Soldier performance data were also built into the lab.

The lab's design offers a variety of potential simulation capabilities at the

squad, platoon, and company level, including the flexibility to integrate new applications such as organic robots and enhanced fire support features. In addition, tactical functions and teams can be tailored to incorporate evolving developmental concepts, organizational structures, and enhanced equipment capabilities.

A user's guide was also developed for research scientists, scenario developers, and military personnel involved in the operation of the lab. A test to evaluate the performance of the lab and its equipment was conducted in late 2004, with Soldiers serving as either platoon or squad leaders at each of the four Soldier stations.

Results. A variety of hardware and software integration issues surfaced as the lab was built and tested, though these were all resolved satisfactorily. For

Training Small Unit Leaders and Teams
new and emerging systems

example, the whole system ran rather slowly when complex battle scenarios were being used. This problem was resolved by limiting the number of battlefield entities in a scenario to no more than 100. Additionally, the user's guide was found to be useful in introducing new personnel to the features and operational constraints of the lab.

continues to be used in evaluating new desktop simulation applications.

Additional Information.

Livingston, S. C., Root, J. T., Mast, R. L., & Gilbert, P. A. (2005). *Surrogates for future force warrior (FFW) training research* (ARI Technical Report 1156). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA433353)**
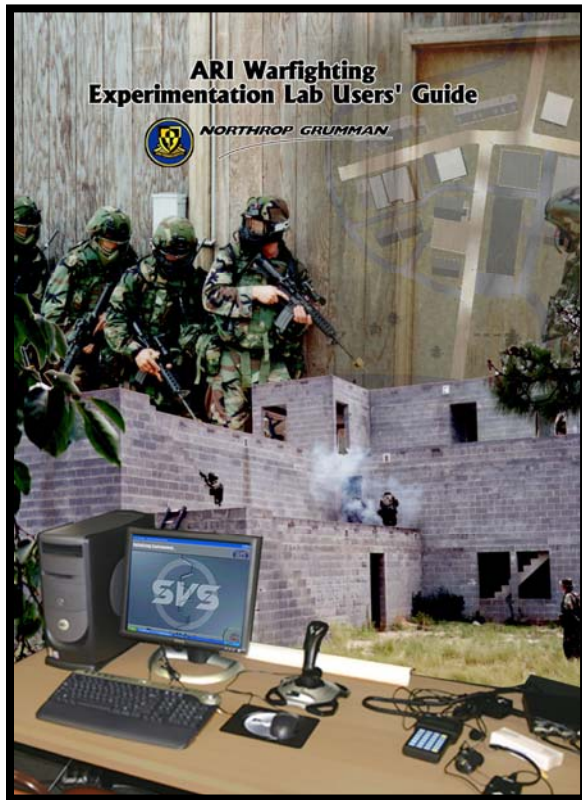
Payoff. The Warfighting Experimentation Lab allows researchers and training developers to get an early jump in developing training strategies, recommended tactics, and revised doctrine as new and emerging systems, like the Future Force Warrior system, are tested and fielded. In addition, the lab

What Squad Leaders Want to Know in Battle

Over 100 combat-experienced squad leaders identify the kinds of information they most want to know, and least want to know, in battle.

Problem. Soldiers and leaders are likely to encounter a much higher volume and a greater variety of information on future battlefields. Squad leaders, in particular, may be less able to manage a high volume of information when they are actively engaged with the enemy. In designing information systems for these leaders, one should know what they consider to be the most important types of information in different tactical situations.

Approach. A panel of five retired military subject matter experts identified 88 different types of battlefield information of potential interest to squad leaders. They attempted to define the universe of potential information, without regard to particular combat situations or to the technological feasibility of delivering that information currently.

Next, the Battlefield Information Questionnaire was developed to gauge the relative importance of these different types of information to squad leaders in four tactical situations: planning before an operation, assaulting an objective, consolidating and reorganizing on the objective, and defending the objective from counterattack.

The questionnaire was administered to 106 NCOs having combat experience as squad leaders. It asked the NCOs to select the 10 types of information they thought were most important and the 10 they thought were least important in each of the four chosen situations. Importance was defined by how much the information contributed to mission success, by how frequently it was needed, and by how readily available it needed to be.

Results. Though there were some notable exceptions, the results obtained were remarkably consistent over the four tactical situations. Averaged across situations, the 10 types of information squad leaders thought were most important and the 10 types they thought were least important are shown in the accompanying inserts.

Ten Most Important Kinds of Information

1. Location of threat personnel, vehicles, and weaponry.
2. Casualty collection point location.
3. Ammunition remaining.
4. Location of personnel in my squad.
5. Location of units in contact with enemy.
6. Personnel location in adjacent friendly units.
7. My location relative to other personnel.
8. Location of mines, obstacles, booby traps, and improvised explosive devices.
9. Availability of supporting fires (mortars and artillery).
10. Direction of movement for enemy personnel.

Training Small Unit Leaders and Teams

new and emerging systems

Ten Least Important Kinds of Information

1. Guidance for interacting with media.
2. Cultural norms of civilians in my area of operation.
3. Current time of day.
4. Elapsed mission time.
5. Civilian leaders in my area of operation.
6. Mission-oriented protective posture level.
7. Notes on specialty skills of each squad member.
8. Current weather conditions (temperature, humidity, wind speed, wind direction).
9. Weather forecasts (BMNT, EENT, moon phase and rise).
10. Range cards and sector diagrams.

intended users should promote the development and fielding of systems that are more effective, easier to use, and less costly to train.

Additional Information.

Evans, K. L. (2006). *What squad leaders want to know in battle* (ARI Research Report 1860). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA457179)**

Payoff. Knowing what experienced squad leaders want to know in various tactical situations should be a guiding force behind the design and development of information delivery systems for those leaders, particularly the user interfaces to those systems. For those hardware and software developers who lack a military background, and may be unaware of the information preferences of their target audience, the findings of the present investigation should help to eliminate that knowledge gap.

As a guide to the information preferences of experienced squad leaders, the results were provided to those responsible for manpower and personnel integration (MANPRINT) issues on the Future Force Warrior project. Having an informed understanding of the information needs of

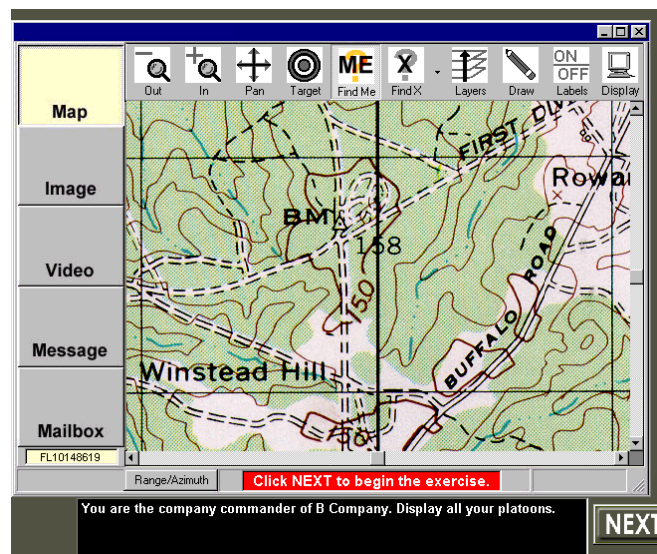# Interactive Approaches for Training Digital Map Displays

Giving the same training to all is not the most efficient, nor the most effective, nor the most motivating.

Problem. Due to increasing digital capabilities in the Army's combat systems, using some form of computer-based training (CBT) for digital skills is becoming relatively common. While CBT has been shown to be an effective method of teaching, most of the Army's digital systems are supplied to Soldiers of various ranks and experience with the expectation that these Soldiers will all master the same software. The research reported here examined how CBT could be designed to be effective for the broad military target audience that operates and employs these tactical systems.

Approach. Five CBT approaches for learning digital skills were compared using 85 One-Station-Unit Training (OSUT) Soldiers and 67 Infantry Officer Basic Course (IOBC) Soldiers. The five approaches included a pure map exploration condition, a traditional lesson followed by exercise condition, an explore via map exercise with no lesson condition, a lesson followed by map exploration condition, and a condition where Soldiers could select their modes of training in any order (lesson, exercises, map exploration), all of which centered on learning functions associated with a digital map interface.

The experiment was divided into two phases. In the first phase, all Soldiers were given the symbol training necessary to identify the icons on the map display. A final exam was given following the training. In the second phase, all Soldiers were randomly assigned to and completed one of the five conditions followed by a final exam on map functions. The main concern of this research was whether the scores of the map function exams would differ across the training conditions, so all Soldiers were given the same amount of map training time and map exam time.

Results. A comparison of exam scores showed that the explore via map exercises condition was an effective training method for both groups of Soldiers. In addition, all Soldiers performed well under the traditional lesson followed by exercise condition. The remaining three conditions allowed Soldiers varying degrees of control over their training and provided less formal feedback.. Overall, the pure map exploration condition yielded the lowest exam scores. When enabled to select the modes of training, the IOBC Soldiers appeared to employ more consistent techniques than OSUT Soldiers. OSUT Soldiers performed best under structured conditions that provided performance feedback.

Payoff. The findings show that Soldiers of varying backgrounds do not react and perform similarly to all methods of training. Additionally, CBT was shown to be capable of producing various methods of training to accommodate students with differing experience. This research report can be used to tailor training to Soldiers when the target population is diverse but common skills and knowledge must be attained.

Additional Information.

Dyer, J. L., Singh, H., & Clark, T. L. (2005). *Computer-based approaches for training interactive digital map displays* (ARI Research Report 1842). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA440171)**

Bridging the Gap Between Digital and Non-Digital Systems

Two new training plans demonstrate how to teach the digital skills associated with new computer-based Soldier systems.

Problem. Training plans were needed to develop the new digital skills that dismounted Soldiers and leaders will need to master in order to use the computerized systems they take with them to combat. Training Soldiers on equipment that incorporates new features and capabilities is always a challenge. To bridge the gap between digital and non-digital forces, new training plans were needed to teach the digital skills associated with computer-based systems and to relate those skills to the non-digital procedures used without those systems.

Approach. Training plans for two sets of skills were developed. The first set was related to map functions. This set described the functions themselves and provided an explanation of how they enhance capabilities on the battlefield. The training plan for map functions included assessing Soldier status on the specified prerequisites, such as terrain association and distance measurement, and training exercises in which they applied the learned skill or completed a task using both paper and digital maps. Teaching points for each map function

were identified. A highly recommended training technique was to compare how map navigation tasks are accomplished with and without digital systems. The exercises increased in difficulty and were put in the context of mission execution. They ended with a field training exercise.

The second set included the collective task of conducting a passage of lines as a stationary unit. In this set, the advantages of the new digital skills were presented, and prerequisite skills, such as using an overlay and conducting a passage of lines, were again assessed. The training plan integrated and tested the individual skills previously learned, and ended with a unit field training exercise.

Training Small Unit Leaders and Teams
new and emerging systems

Results. The two training plans that were developed demonstrate the need for digital and non-digital skills to be linked across future Soldier systems, and build on the acquired skills to obtain the needed expertise. With collective tasks, it became apparent that additional training was needed to integrate the input from multiple individuals.

Payoff. These products should help Soldiers learn and retain the new digital skills and retain the associated non-digital skills required to perform the same tasks. The plans provide guidelines for training on the specific skills needed to use computerized systems, and provide insights regarding training that can be generalized to other computer-based systems.

Additional Information.

Blankenbeckler, P. N., Livingston, S. C., Dlubac, M. D., Riffe-Seckinger, N. C., Swinson, D. N., & Dyer, J. L. (2006). *New skills training plan for map functions and passage of lines on a Soldier system* (ARI Research Product 2006-09). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA452855)**

Training Lessons Learned and Confirmed

Given the limited resources of the Army today, effective training cannot be approached from a trial-and-error process.

Problem. In response to changing times, the Army is transforming into a more strategic, mobile, and lethal force. Because of this transformation, new equipment is continually being developed. Although the Army is currently faced with severe resource limitations, new equipment training remains an essential component of a successful force. The Army's challenge is to determine how it can make both present and future training effective, as well as more efficient.

Approach. Research was examined over an eight year period, from 1997 through 2004, during which numerous evaluations of training methods and content were made. Specifically, training was examined in instructor-led classroom settings, in settings where interactive courseware was incorporated, and in live, virtual, and constructive training environments.

Lessons learned from this examination process were compiled and divided into five training categories:

- *Instructional System Design (ISD)* – the basic process for training development and evaluation within the Army. ISD begins with a training requirement and goes through five steps (analyze, design, develop, implement, evaluate) to reach completion.
- *Live Training* – field training with equipment used to simulate combat conditions.
- *Virtual Training* – training in computer-generated battlefields.
- *Constructive Training* – training on decision-making and other command/staff functions using computers and/or simulators.
- *Other Training* – any training not fitting into the previous four categories.

Results. Overall, the examination process resulted in a total of 38 lessons learned. New lessons were found in each category, as were lessons that were not new, but were proven to be still applicable to current technologies and Soldiers. Knowing the entry level of Soldiers and standardizing their assessment, specifying details for practical exercises, providing feedback under differing conditions of training and media, and allowing for sufficient training time for tasks were all found to be essential in each training category. In addition, techniques for making training material more interesting for Soldiers, for sequencing training, and for blending individual and collective training were suggested, along with concerns over training with simulations.

Training Small Unit Leaders and Teams
new and emerging systems

Lessons Learned Examples by Category

ISD Lessons
- Recognize and accommodate diverse backgrounds in the target audience.
- Involve trainers in the design stages of new equipment.

Live Training Lessons
- Train tasks in specific steps only when specific steps are required and train multiple ways to accomplish a task when they exist.
- Identify cues and skills that will facilitate transfer; recognize when transfer will not necessarily occur.

Virtual and Constructive Lessons
- Be aware of distractions or potential sensory overload in virtual environments.
- Realize and accommodate strengths and limitations of using virtual environments to train Soldiers.

Other Training Lessons
- Trainers need to be trained to identify and use the appropriate training approaches.
- Have sufficient time for AARs and conduct AARs at all levels.

for the battlefields of the future, through the development and presentation of higher quality training programs.

Additional Information.

Wampler, R. L., Dyer, J. L., Livingston, S. C., Blackenbeckler, P. N., Centric, J. H., & Dlubac, M. D. (2006). *Training lessons learned and confirmed from military training research* (ARI Research Report 1850). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA446697)**

Payoff. If Soldiers cannot be properly trained to operate and employ systems efficiently and effectively, the systems will not be as beneficial as needed on the battlefield. The lessons found in this research can be used by Army trainers and training developers in any environment, to better prepare Soldiers

Training Small Unit Leaders and Teams
new and emerging systems

Do Games Have Training Value?

Three electronic games with military themes were examined for their potential value in U.S. Army training programs.

Problem. Many have wondered if the electronic games that Soldiers play for fun might also have some value as vehicles for the delivery of Army training. At the request of the Program Executive Office for Simulation, Training, and Instrumentation (PEO-STRI) and the U.S. Army Research, Development, and Engineering Command's Simulation Training Technology Center (RDECOM-STTC), ARI helped to evaluate three training games developed specifically for dismounted light infantry leaders.

Approach. Three training games were examined: Full Spectrum Command (FSC), the Rapid Decision Trainer (RDT), and Full Spectrum Warrior (FSW). First, 54 Captains in the Infantry Captains Career Course used FSC in an attempt to improve their ability to adapt to changing tactical conditions and emerging threats. Next, 195 Lieutenants in the Infantry Officer Basic Course used the Rapid Decision Trainer to rehearse squad and platoon live-fire exercises, initiate critical tasks, and make decisions essential to mission accomplishment. Lastly, 140 Soldiers in the Basic NCO Course and 90 Soldiers in the Primary Leadership Development Course used FSW to practice squad tactics and decision making in simulated urban operations.

In addition to these training evaluations, interviews were conducted with game producers and developers, as well as with leaders and instructors from the U.S. Army Infantry School (USAIS). The latter served as subject matter experts while the games were being developed.

Results. The collective results from the three evaluations indicated that the most effective training experiences occurred when a game was developed to address specific training objectives and needs. Compared with a stand-alone trainer, perceived training value was greater when instructors were present to offer performance feedback during mission execution and after action reviews.

In addition, leaders reported that the use of sophisticated graphics did not improve

Training Small Unit Leaders and Teams
desktop simulation

the perceived training value of a game. In fact, training with games for fun and personal entertainment was less important than learning and practicing a variety of leader tasks and skills. Leaders also suggested the ability to modify games over time was necessary to maintain their training relevancy.

Payoff. These results have been used to guide the implementation of training game exercises in a variety of USAIS courses. The results were also presented to senior USAIS and RDECOM-STTC personnel during a series of briefings held in 2004 and 2005.

Additional Information.

Beal, S. A. (2005). *Using games for training dismounted light infantry leaders: Emergent questions and lessons learned* (ARI Research Report 1841). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA438042)**

Beal, S. A., & Christ, R. E. (2004). *Training effectiveness evaluation of the full spectrum command game* (ARI Technical Report 1140). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADB419670)**

Beal, S. A., & Christ, R. E. (2005). *Soldier perceptions of the rapid decision trainer.* (ARI Research Report 1835). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA436993)**

Centric, J. H., Beal, S. A., & Christ, R. E. (2004). *Train-the-trainer package for the full spectrum warrior game* (ARI Research Product 2005-02). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA428443)**

Infantry Situation Awareness Training

New desktop software for Infantry platoon leaders allows them to develop and hone a variety of situation awareness skills.

Problem. Based on the results of an instructor survey, four kinds of situation awareness (SA) skills were found to be lacking in many new platoon leaders. These skills were time management, task prioritization, communications, and contingency planning.

Approach. In an attempt to improve the SA skills of Infantry platoon leaders, SA Technologies developed two CD-based training modules. The first module, the SA Planner, consisted of exercises to improve time management and task prioritization skills. The second module, the SA Trainer, focused on the development of cognitive schema, while incorporating instruction in the areas of communications and contingency planning.

Using a series of realistic mission-based scenarios, the SA Trainer features a graphical image window, access to operations orders and maps, troop organization icons, and real-time instructional feedback. Preliminary usability testing was conducted with cadets and instructors at the U.S. Military Academy. This was followed a limited field test of the SA Trainer that was conducted in Norway with 80 cadets from the Royal Norwegian Naval Academy.

Results. Most cadets found instruction delivered by the SA Trainer to be useful, interesting, and informative. Although cadets only received about 2.5 hours of instruction on average, one interesting training effect was found during a realistic squad-level field exercise designed to induce high levels of cadet fatigue and stress. Near the end of this exercise, cadet squad leaders were ordered by their superiors to immediately and forcefully attack a suspected enemy special forces camp. Yet, when they arrived on the scene, the presence of civilians should have caused squad leaders to recognize it as a refugee camp. Of the four squad leaders who had received SA training, two correctly refused to attack the camp, despite repeated pressure to do so. In contrast,

Training Small Unit Leaders and Teams

desktop simulation

all four squad leaders who had not received SA training incorrectly chose to attack the refugee camp.

Payoff. The potential training benefits of both the SA Trainer and SA Planner are high. Because the presence of an external instructor is not needed, these two training modules are particularly suited for a variety of self-study training applications.

Additional Information.

Strater, L. D., Reynolds, J. P., Faulkner, L. A., Birch, D. K., Hyatt, J., Swetnam, S., Metzdorf, S., & Endsley, M. R. (2004). *PC-based training to improve infantry situation awareness* (ARI Technical Report 1146). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA425351)**

Virtual Environment Cultural Training for Operational Readiness (VECTOR)

Game-based training technology can help Soldiers prepare to interact effectively with other cultures.

Problem. In the current operating environment, Soldiers are often required to teach, negotiate, guide, work, communicate with, give orders to, and lead people from different cultures. Cultural knowledge is critical for success, but training in cultural skills is limited to briefings and tutorials, on one hand, and costly live simulations on the other, with little between to bridge the gap.

Approach. The objective of the VECTOR program was to develop new technology that would let Soldiers learn and practice cultural skills by interacting with simulated characters in a mission context using a scenario-based virtual simulation delivered on a PC. The research concentrated primarily on developing (1) a synthetic actor model (cognitive modeling) and (2) a cultural model framework that would enable significant reuse of cultural models when adapting the training to new cultures and situations. The major steps were to: build an engaging 3-D game environment utilizing a commercial off-the-shelf (COTS) game engine; integrate a cognitive model to drive behaviors of non-player characters (NPCs) that represent

an indigenous population; and use this environment to train Soldiers to understand cultural differences and to develop appropriate interaction strategies.

Results. The resulting VECTOR system is a game-based simulation in which the trainee interacts with NPCs in order to gain information on the whereabouts of persons of interest. The trainee is free to move about a simulated village and interact with NPCs at will. Trainee actions influence the emotional state of the NPCs: appropriate actions and dialog make subsequent interactions easier, while inappropriate actions and dialog make subsequent interactions more difficult. In order to be successful, the trainee must identify situational cues

Training Small Unit Leaders and Teams

and apply cultural knowledge appropriately. NPC actions are guided by an overall scenario story-arc. Cultural rules were encoded and mapped to scenario-specific NPC dialog and behaviors using a cognitive model architecture and a generic scripting language. This provides a set of virtual NPCs with which the trainee can interact.

Additionally, the NPC model contains an emotion model that modifies NPC dialog and actions based on trainee actions and dialog. NPC emotional states can propagate to other NPCs in the same community, enabling actions taken toward a single individual to have far-reaching impacts on a scenario. These models are integrated with a COTS game engine.

Payoff. This project has demonstrated the feasibility of integrating an executable cognitive architecture with a COTS game engine. This is significant because game engines typically utilize rather primitive artificial intelligence mechanisms. Since the conclusion of this effort, additional follow-on work has been accomplished to make it easier to author new VECTOR scenarios.
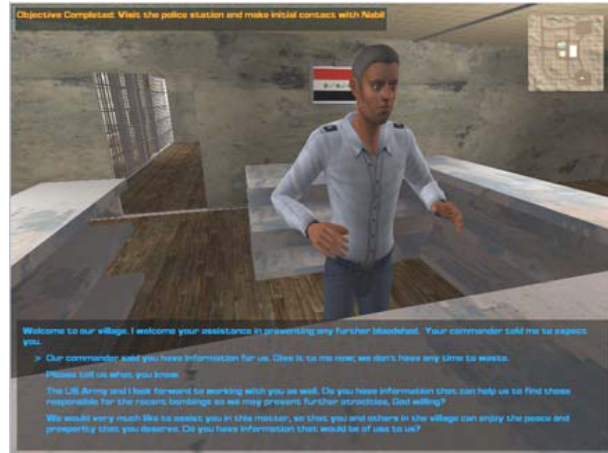
Additional Information.

Deaton, J., Santarelli, T. P., Barba, C. A., & McCollum, C. (2006). *Virtual environment cultural training for operational readiness (VECTOR)* (ARI Technical Report 1175). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADB315125)**

Massively Multi-Player Persistent Simulation for Asymmetric Warfare

Massively multi-player game-based training technology can help Soldiers train for a wide variety of asymmetric missions.

Problem. In the current operating environment, Soldiers and their leaders must respond to unpredictable asymmetric threats. The skills and experience required to do this can only be developed through realistic training. Current training technology often cannot be adapted rapidly enough to meet changing requirements and cannot always provide training for sufficient numbers of personnel.

Approach. Our research objective was to develop Asymmetric Warfare-Virtual Training Technology (AW-VTT) that would let Soldiers learn and practice new tactics, techniques, and procedures (TTPs) in a large and distributed virtual simulation on desktop computers. This research concentrated on adapting an existing commercial system and developing tools for trainers to create, manage, and review training exercises. The Army Research, Development, and Engineering Command Simulation Training Technology Center led the development effort. ARI supported that effort by planning and conducting formative evaluation exercises.

The AW-VTT environment is scalable, enabling the development of terrain as needed and supporting large numbers of trainees within a single environment. It is also persistent – meaning that when an individual returns to the environment, the environment maintains all user changes, and reflects changes other users have made while that individual was not there. The AW-VTT supports real-time verbal communications and non-verbal gestures through avatar representation of every individual. Both face-to-face and radio communications use voice over internet protocol (VOIP). The system currently imports behaviors from the Army's OneSAF Objective System. The AW-VTT can record training for replay and After Action Review (AAR).

Training Small Unit Leaders and Teams
desktop simulation

Results. Two formative evaluations, one with an Army National Guard unit and the other with an active Army unit, each took one day to complete. Sessions started with an overview of the AW-VTT system and training on its use, including hands-on practice with the interface. This was followed by a series of presentations covering AW-VTT system features and tools. The presentations were followed by questionnaires and structured discussions about system aspects and features previously addressed. Soldiers then performed a checkpoint operations mission. Soldiers operated the checkpoint while live role-players (some remotely connected) acted as opposing forces and civilian bystanders. After the mission, Soldiers conducted an AAR, completed final questionnaires, and reviewed the exercise and system capabilities.

Although the AW-VTT was developed for dismounted small unit training and rehearsal, the opportunity arose to evaluate whether it could successfully drive a battalion staff exercise without troops in a pre-deployment reconnaissance mission. This evaluation took three days to complete. Day 1 was dedicated to using the virtual simulation for staff information collection, and Days 2 and 3 were used to develop courses of action, including revisiting the simulation for additional information. Results of these evaluations have provided information that has been and is being used to shift sequences and prioritizations in ongoing AW-VTT development efforts.

Payoff. A flexible simulation system that can support dismounted Soldier training and rehearsal, as well as staff exercises, would be a valuable addition to the Army's training arsenal. Feedback from Soldiers and trainers, while subjective, has clearly indicated the AW-VTT can already provide effective training in specific situations.

Additional Information.

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Training Rapid Decision Making

A new desktop simulation, SimFX, has been developed to enhance the decision-making skills of small unit leaders in the Future Force.

Problem. As new information and communication technologies are being transitioned into the Future Force, small unit leaders must learn to make accurate and timely decisions while immersed within an information-rich operating environment.

Approach. The Simulated Field Exercise (SimFX) tool was developed to address this problem. Rather than focusing on the particular capabilities and specifications of each new technology as it is fielded, SimFX provides training in a set of general decision making skills that are independent of the exact information systems with which a unit is equipped. Specifically, SimFX provides computer-based scenarios that force leaders to resolve ambiguous or contradictory input from remote sensors, fuse disparate sources of information, filter information, and manage resources.

SimFX can provide decision training with either branching storylines or with stand-alone choice points for more deliberate and repetitive practice. Separate user guides and tutorials were developed for

both players (trainees) and authors (trainers and training developers).

Results. A series of beta tests was conducted to gauge SimFX usability and training potential, as well as to make needed software revisions. After the last test, a questionnaire was administered to a representative group of 30 likely users at Fort Benning, GA. Questionnaire results were largely positive, suggesting SimFX training would be useful for both training and training development purposes.

Payoff. SimFX has the potential to improve training for both present and future small unit leaders, by teaching them to make faster decisions while fusing information from multiple sources. Its authoring capabilities allow all important instructional decisions to be

Training Small Unit Leaders and Teams
desktop simulation

made by local training developers, instead of by remote software engineers who may be less aware of target audience needs.

Additional Information.

Archer, R., Brockett, A. T., McDermott, P. L., & Warwick, W. (2006). *Simulated field exercise (SimFX) tool* (ARI Research Product 2006-06). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADM202059)**

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Beal, S. A. (2007). *Assessment of two desk-top computer simulations used to train tactical decision making (TDM) of small unit infantry leaders* (ARI Research Report 1869). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA468772)**

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Scenario Generation Tools

A new tool set makes it easy to generate multiple scenarios to train and assess the leadership skills needed to support future Army systems.

Problem. Future Platoon Leaders and Company Commanders must be proficient in employing available capabilities and technology to achieve success in operational missions that are becoming increasingly complex. A major problem in preparing small unit leaders to maximize the capabilities of future systems is knowing what to train, how to train it, and how to measure success in training.

Approach. This report documents the development of a tool set that can be used by trainers to create both constructive and virtual simulation scenarios in support of leadership skill training with new and emerging systems. The scenario generation tool set contains all the necessary components, such as map boards and operations orders, to create 48 different scenarios among two different terrain areas, two offensive missions, three possible force structures, two distinct sets of enemy forces, and two contrasting conditions of weather and time. Even more flexibility can be achieved by using a multitude of optional events to change the battlefield situation and alter the rules of engagement.

Results. In addition to supporting the training and evaluation of leadership skills, the scenario generation tool set can be used to gauge the potential impact of new organizational structures, equipment, and capabilities on the performance and decision-making abilities of small unit leaders. Critical scenario components can be systematically altered to isolate and examine key aspects of leader performance.

For example, a series of scenarios could be developed that employed the same friendly force structure and enemy situation, but varied the equipment available to accomplish the mission (e.g., digital communication systems or robotic devices with multiple sensors). A comparison of leader performance across scenarios would reveal how the introduction of new equipment altered each mission planning and execution process.

Training Small Unit Leaders and Teams
automated tools

Payoff. Shortly after it was developed, the scenario generation tool set was transitioned to the Future Force Warrior project for their use in developing training media for leader planning and small unit rehearsal. These tools can also be used by training developers, researchers, and leader education programs to discover new ways to prepare Platoon Leaders and Company Commanders for future operations.

Additional Information.

Wampler, R. L., Blankenbeckler, P. N., & Dlubac, M. D. (2004). *A scenario-generation package for assessing and training leader skills* (ARI Research Product 2004-04). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA426014)**

AARs with the Ground Soldier System

Operational capabilities in the future Ground Soldier System can be tapped to provide aids for trainers to use in After Action Reviews.

Problem. The After Action Review (AAR) is central to the Army's training process. ARI has devoted a substantial amount of research to developing a variety of automated aids to support AARs in virtual and constructive simulations. These automated aids are generated by the computer systems underlying the training simulations themselves. With the advent of wearable computers being incorporated into the design of advanced combat systems like the future Ground Soldier System, there was a need to examine how the system's computer capabilities could be used to generate AAR aids for live training environments.

Approach. The military training and doctrine literature was reviewed, as was research on automated AAR tools used in constructive and virtual simulations. These concepts were examined for their potential application to live training and the execution of operational missions. Literature on creating effective graphical displays was reviewed to identify design principles for AAR display development.

Interviews were then conducted with 10 observer/controllers (O/Cs) from the Joint Readiness Training Center (JRTC) who had observed a Land Warrior-equipped platoon as part of the Joint Contingency Force Army Warfighting Experiment in 2000. These O/Cs were asked to identify what issues they stressed in AARs, how they would use features of a computer-based system like the Land Warrior to assist them in conducting AARs, and their reactions to two-dimensional graphics illustrating what aids might be possible if specific AAR features were embedded in the Land Warrior system.

Results. Existing automated AAR aids typically do not support mission planning and preparation, areas the JRTC O/Cs found to be extremely important. Yet, it appears the anticipated operational capabilities of the future Ground Soldier System could be used to provide AAR

Training Small Unit Leaders and Teams
automated tools

aids supporting a trainer's discussion of mission planning and preparation, as well as some aspects of mission execution.

The O/Cs also identified ways the Land Warrior system could help them in their AARs. For example, they could use the system's helmet-mounted display to track individuals on the map or they could monitor exchanges of information via radio nets and digital messaging systems. Additional embedded capabilities of the future Ground Soldier System could potentially expand the pool of automated AAR aids to approximate those available in current training simulations.

Payoff. These findings will help guide training developers in designing training support packages for AARs based on the capabilities of the future Ground Soldier System. Additionally, these findings provide multiple alternatives for training developers and engineers to use in addressing the embedded training requirements for AARs contained in the Ground Soldier System Capability Development Document.

Additional Information.

Dyer, J. L., Wampler, R. L., & Blankenbeckler, P. N. (2005). *After action reviews with the ground Soldier system* (ARI Research Report 1840). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA438040)**

Training Small Unit Leaders and Teams

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Reviewing the After Action Review

After Action Reviews were examined at the Joint Readiness Training Center, leading to improved methods of training new observer/ controllers.

Problem. At the request of the Joint Readiness Training Center (JRTC), the After Action Review (AAR) process at company level and below was examined, as was their training program for new observer/controllers (O/Cs). The chief concern of JRTC's Operations Group leadership was that some O/Cs, particularly new and less experienced ones, were being too directive during unit AARs, where they tended to critique unit performance in a lecturing style. In particular, the leadership wanted O/Cs to be less directive and more reflective in their approach to AARs, allowing unit personnel to discover and redress their own problems.

Approach. Following an extensive review of the AAR research literature, 40 recent company or platoon AARs were observed at JRTC, either in person or via audiovisual recording. The AARs were compared to each other, and most importantly, to the Army standard found in Training Circular 25-20, *A Leader's Guide to After-Action Reviews* (Department of the Army, 1993). To supplement these observations, interviews were conducted with current and former O/Cs.

The instruction given to new O/Cs at the JRTC O/C Academy was also observed. After comparing current observations to the results of previous AAR research, a prototype AAR rating scale was created, covering 23 characteristics of effective AARs.

Results. Most O/Cs appeared to understand the basic requirements of an AAR, as the steps in the AAR process are well detailed and available in a variety of source materials. The observed O/Cs were enthusiastic and clearly interested in helping units improve their performance. Some O/Cs conducted extraordinary AARs that were nearly textbook perfect. Units benefited from the shared experience and were appreciative.

In other instances, even some of the most proficient O/Cs tended to err on the side of providing too much information, turning the AAR into a critique or lecture instead of a discussion. This was sometimes due to being overly reliant on preformatted and prepared slides. Some O/Cs covered all of the material they had available, whether it was relevant or not.

Training Small Unit Leaders and Teams

automated tools

Others failed to ask probing and thought provoking questions of unit personnel, to reduce the "fog or war" through a replay of mutually experienced events. It was evident that facilitating a dialogue instead of providing a critique is a skill that must be developed and reinforced in O/C training and on-the-job practice if units are to receive maximum benefits from their AAR experiences.

Payoff. These results were briefed to JRTC's Operations Group, including the Senior O/Cs from each of its divisions, in September 2006. Shortly thereafter, the Operations Group developed an action plan to improve the AAR training of new O/Cs and periodically monitor their AAR performance in the field. Central to this plan was their in-house production of an O/C training DVD, using archival JRTC footage of actual small unit AARs. It will demonstrate both desirable and undesirable aspects of O/C behavior during AARs, as reflected in the 23-item AAR rating scale developed for the project.

Additional Information.

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Training Small Unit Leaders and Teams

automated tools
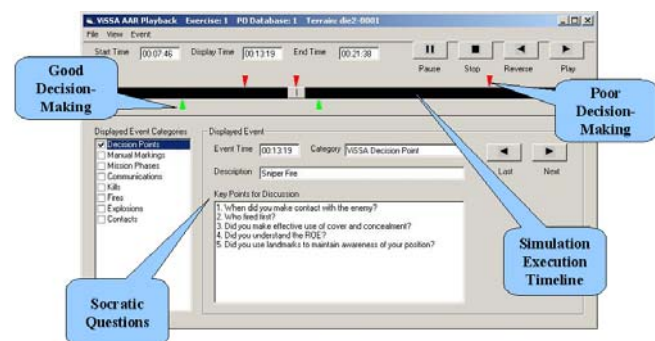
Assessing Skills in Virtual Environments

A new tool can automatically detect, log, and play back significant events in virtual exercises so they can be used during After Action Reviews (AARs).

The ViSSA system is designed to assess warfighter skills, decision making, and situational awareness. In planning and staging a virtual training exercise, instructors can define event, condition, and action rules to be consistent with Army doctrine.

Problem. Due to the complexity of most virtual environments, instructors are forced to spread their attention across many competing areas of interest during a collective training exercise. Instructors need automated support in these kinds of training environments in order to maximize Soldier learning.

Approach. The Virtual Soldier Skills Assessment (ViSSA) prototype software system was developed for use in a variety of virtual environments. It automatically detects significant events in virtual exercises, logs all Soldier movement and behavior, and has a playback module to assist instructors in highlighting these events during AARs.

Results. An initial performance evaluation of the ViSSA prototype system was conducted in the Soldier Battle Lab at Fort Benning, GA. Results of this testing demonstrated the system could easily achieve the demanding performance requirements of multiple entities operating in a virtual environment. Further, capabilities assessments by system operators and support personnel at the Soldier Battle Lab indicated the ViSSA system supported the evaluation of decision making skills in small unit infantry leaders. At the present time, audio communications can be recorded and tracked, but the technical solution does not, as yet, allow for automated

Training Small Unit Leaders and Teams
automated tools

assessment of message content. A human in-the-loop is required to make these kinds of assessments.

Payoff. The ViSSA system has been installed and operating at the Soldier Battle Lab in a variety of applications. In particular, their staff uses it on a regular basis to log and monitor virtual exercises and produce statistical performance data. In short, ViSSA provides an efficient and cost-effective way to monitor and assess training in virtual environments, while greatly easing the burden on instructors. This research project received a 2004 Quality Award from the Small Business Innovation Research (SBIR) program.

Additional Information.

Gately, M. T., Watts, S. M., Jaxtheimer, J. W., & Pleban, R. J. (2005). *Dismounted infantry decision skills assessment in the virtual training environment* (ARI Technical Report 1155). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA432164)**

# Dismounted Infantry Virtual After Action Review System (DIVAARS)

An automated tool for conducting After Action Reviews (AAR) was developed specifically for use in simulation training applications.

Problem. Virtual simulations and games have the potential to provide small dismounted units with the opportunity to practice tactical skills. In order to be maximally effective, the simulations must include an AAR capability to help trainees determine what happened, why it happened, and how to sustain or improve their performance.

Approach. DIVAARS is a product of ARI and the University of Central Florida Institute for Simulation and Training (IST). It is designed to meet two needs. The first is to provide trainees with a common understanding of what happened during an exercise and why it happened, so that they can identify ways to improve their performance. Determining what happened during an exercise is particularly difficult in an urban environment, where buildings and other structures break up the visual field and limit the portion of the battlefield that can be observed by any one person. The second need is to facilitate data analysis, in order to support training feedback, as well as research and development.

Results. DIVAARS software runs on a PC connected to a network of individual dismounted Soldier simulators and captures and records all exercise data. DIVAARS capabilities include:

- Primarily plan view display with multiple viewpoints
- Point-and-click interface
- DVD-like replay system
- Jump to marked event, time, or viewpoint
- Variable speed play, pause, etc.
- Graphic enhancements
- Movement tracks
- Individual Soldier identifiers
- Selection of building floors for viewing
- Field of view display
- Digital recording and synchronization of audio communications
- Tabular and graphic data presentation
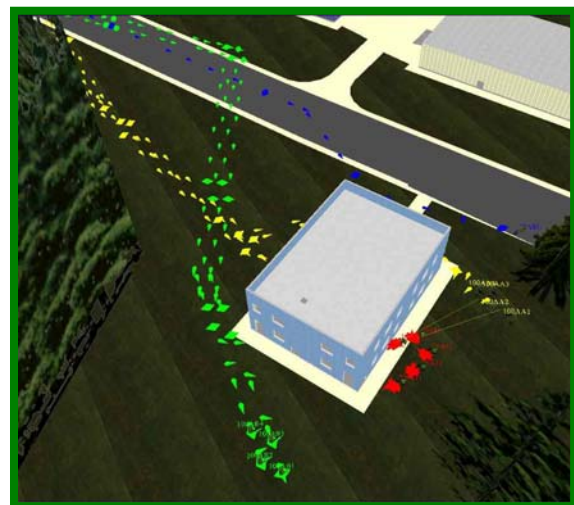
Training Small Unit Leaders and Teams
*automated tools*

DIVAARS uses Distributed Interactive Simulation communication protocols, and therefore is compatible with a variety of other dismounted Soldier simulation products, such as the Soldier Visualization Station and Dismounted Infantry Semi-Automated Forces.

During an exercise, the AAR leader can move freely through the simulated environment in a stealth mode, teleport to pre-selected viewpoints, mark events (times) and viewpoints for use during the AAR, zoom in and out, capture "snapshots" for later viewing, and toggle on and off information such as traces of movement paths and Soldier identifiers. Individual floors of multi-story buildings can be selected for viewing. During an AAR, the operator can do all of those things, while changing viewing speed or location and jumping forward or backward to marked events or times. A variety of exercise data can be shown in either tabular or graphic form.

Payoff. DIVAARS was used in the Virtual Integrated MOUT Training System Program, and the Office of Naval Research Virtual Technologies and

Environments (VIRTE) Multi-purpose Operational Team Training Immersive Virtual Environment (MOT2IVE) program. It has been provided to the DARPA RealWorld program, America's Army, and the U.S. Marine Corps Distributed Virtual Training Environment program for review.
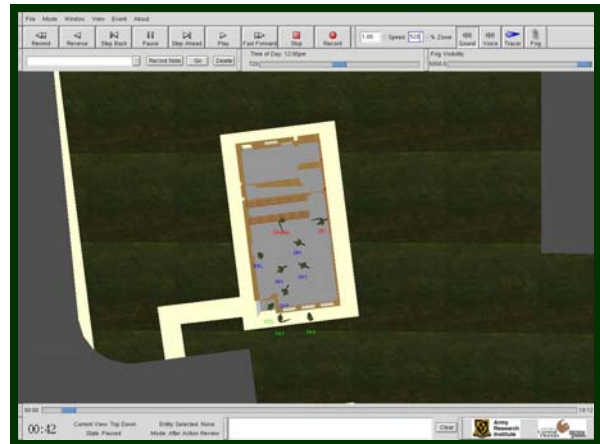
Additional Information.

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Instructional Interventions in Virtual Environment-Based Training

Skill rehearsal logically comes after skill learning, but research is needed into how to best support initial skill acquisition by using instructional interventions during simulated exercises.

Problem. In current training, Soldiers typically are provided with classroom and text-based instruction, followed by map-based or sand-table rehearsal and field exercises. Skill and experience develop through realistic training. With ever-changing asymmetric threats, and decreasing capability for realistic field exercises, the use of virtual environments is a focus of current training technology development. Training in these environments can easily be augmented in ways that are not possible in live exercises. However, little is known about the kinds of interventions that are most appropriate to use and how to apply them most effectively and efficiently.

Approach. Two experiments were conducted to investigate the training effect of instructional interventions in virtual environments during training of representative Soldier tasks. Analysis of the research literature suggested that coaching interventions and attention direction techniques would be the most appropriate intervention techniques for initial investigation. Both experiments addressed initial skill acquisition for three exemplar dismounted Soldier tasks. The tasks were to plan and mark a bounding overwatch movement through a virtual environment, to identify and correctly mark a helicopter landing zone (LZ), and to select observation and firing positions that would secure the marked LZ.

In both experiments, participants were initially trained using an instruction booklet and the training conditions were administered during several repeated exercises. After Action Reviews (AARs) followed each exercise. A fourth "test" mission without intervention or AAR was then conducted as a final measure. Performance measures and times were recorded for analysis.

Training Small Unit Leaders and Teams

simulation technology assessment

Results. Performance data from the first experiment indicated that a form of interrogative coaching (asking questions based on performance rules when an error was committed) led to a significant improvement in performance on the bounding overwatch task, but not the LZ task. Contrary to expectations, the use of attention-directing arrows did not aid learning, and actually delayed performance improvement over trials. Coaching initially delayed performance on the bounding overwatch task, but led to more rapid performance over trials.

Performance data in the second experiment indicated that direct, corrective coaching also improved performance over repeated training sessions. The primary effect was found with the LZ task.

Payoff. The results of these two experiments indicate that simply injecting more information in virtual environment based training exercises does not necessarily result in improved learning for all types of tasks. Detailed analyses must be conducted prior to selecting and implementing adjunct information cues for use during training.

The results are in line with perceptual and cognitive task analysis guidance, in that any aiding information should be provided on perceptual channels that are not already maximally loaded during the learning or performance of the task.

Additional Information.

Singer, M. J., Kring, J. P., & Hamilton, R. M. (2006). *Instructional features for training in virtual environments* (ARI Technical Report 1184). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA455301)**

Training Small Unit Leaders and Teams

simulation technology assessment

Importance of Measuring Presence in Virtual Environment-Based Training

A sense of "Presence" affects both performance and simulator sickness in virtual environments.

Problem. Virtual environments are computer generated artificial worlds that enable users to train or practice highly variable, difficult to master, cognitively difficult, or dangerous tasks in a safe, cost effective environment. One important issue for training effectiveness is the degree to which the training received in the virtual environment transfers to the real world. A costly way to approach this problem would be to create a virtual world that models exactly the same experience as in the real world. However, even if that were possible the user still might not accept the virtual world as real.

Presence is a measure of the user's acceptance of the virtual world as real, the degree to which they react to it as if the sensations were real, and the degree to which the controls and interface are not distracting. Two important aspects of presence are involvement and immersion. Involvement engages the user with activities and events in the computer generated world. This interaction draws the attention and focus of the user away from the limitations of the simulation. Immersion involves the envelopment of the user and the extent to which they are perceptually surrounded by the computer generated world. Sounds, graphics, motion tracking, removal of outside stimuli, and natural user movement and actions all contribute to the immersion of the participant.

Because presence is an internal, psychological construct, it is difficult to measure objectively. The Presence Questionnaire (PQ) was developed to allow users to rate their psychological state of "being there." The degree of presence experienced depends on the fidelity of the environment's sensory components, the nature of the required interactions and tasks, the focus of the user's attention/concentration, and the ease with which the user adapts to the demands of the environment.

Approach. We collected and analyzed data to test the validity of the PQ and to refine its structure. We have also used the PQ to investigate various virtual environments, as well as other factors

Training Small Unit Leaders and Teams

involved with the virtual environment experience, such as simulator sickness, immersive tendency, and task performance.

Results. Analyses of PQ data from 325 individuals exposed to immersive virtual environments suggested four factors contribute to a sense of presence: Involvement, Adaptation/Immersion, Sensory Fidelity, and Interface Quality. The results further suggested a sense of presence in virtual environments has a direct causal relationship upon virtual task performance. Immersive tendency and simulator sickness had an indirect relationship with virtual performance, both fully mediated through presence.

Other analyses were performed to determine whether an interaction existed between presence and simulator sickness. Results of these analyses provided evidence of an interaction (i.e., at different levels of presence, simulator sickness increased at different rates over time). In particular, high presence led to less of an increase in simulator sickness over time than low presence.

Payoff. The results of these analyses indicate that presence, as a psychological effect of a virtual environment, can be reliably and validly measured. Presence ratings can also reveal important aspects about training in virtual environments that can be used to tailor the virtual environment and associated training material for optimal training effectiveness. For example, virtual environment simulators with high presence ratings

could be expected to support longer exposure times without suffering a drastic increase in simulator sickness among its users.

Although much research has been done with the PQ, showing it to be reliable and valid, further research needs to be done to investigate whether presence measures correlate directly with success in real world tasks after training in a virtual environment.

Additional Information.

Witmer, B., Jerome, C. J., & Singer, M. (2005). The factor structure of the presence questionnaire. *Presence, 14*(3), 298-312.

Virtual-Integrated MOUT Training System (V-IMTS) Evaluation

The effectiveness of virtual simulators for dismounted Soldier training was assessed.

Problem. In 2004 the Defense Acquisition Challenge Program funded a short-term project to speed the transition of virtual simulation technology for dismounted Soldiers to the training environment. This project, the Virtual-Integrated MOUT Training System (V-IMTS), was managed by the Product Manager- Ground Combat Tactical Training (PM-GCTT), a component of the Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI), and executed by the U.S. Army Research, Development, and Engineering Command, Simulation and Training Technology Center (RDECOM STTC) and ARI. The project included a training technology assessment, based on Soldier use in realistic training situations.

Approach. A shelter containing nine virtual simulators was deployed at the Cassidy Combined Arms Collective Training Center, Fort Campbell, KY. Twenty-seven Soldiers from three squads completed two live scenarios separated by two, three, or six virtual scenarios. The scenarios consisted of multiple variants of two missions: Search and Cordon a Building, and Attack/Assault a Building. At the conclusion of their training, Soldiers completed

questionnaires to provide information about how well they could perform combat activities in the simulators, the effectiveness of the After Action Reviews (AARs), side effects, and perceived training effectiveness.

Results. The activities which Soldiers indicated they could perform best in the simulators included outdoor movement, identification of types of people (civilians, non-combatants within a room, enemy Soldiers), identification of tactically significant areas (sectors of observation and responsibility), and individual

weapons use (but not grenades). Poorly rated activities included maneuver indoors (close to others, past furniture, close to walls, around objects, past other personnel, around corners, through doorways, up and down stairs), and

Training Small Unit Leaders and Teams

simulation technology assessment

identifying the source and type of fire (enemy or friendly), either by auditory or visual cues.

The Soldiers and their platoon leadership believed they received effective training. Both squad and fire team leaders and the Soldiers reported about the same amount of overall improvement, although the skills on which they reported the most improvement differed. Leaders reported the greatest improvement on: control of squad/fire team movement during the assault, assess the tactical situation, plan a tactical operation, and coordinate activities with your chain of command. Soldiers reported the most improvement on: plan a tactical operation, coordinate activities with your chain of command, and communicate with members of your team or squad.

The top priority item for improvement identified was precision movement. Generally, neither body movement in confined areas nor weapons aiming could be performed well. Second, a method needs to be developed to transmit and capture voice communication, both face-to-face and radio. Third, battlefield sounds need to be represented. With these improvements, it should be possible to investigate the issue of training effectiveness more rigorously.

Virtual simulation technology is sufficiently mature to provide a valuable addition to the dismounted Soldier training mix. It can provide additional practice in urban operations to
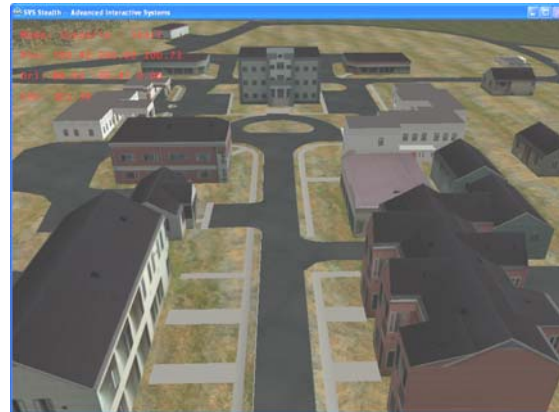
supplement the use of a live MOUT site. It appears to be best suited for training mission planning, situation assessment, and communication and coordination. The primary advantages of virtual simulation, relative to live simulation, are the variety of training environments and locations that it can represent, and the reduced time that is required to prepare for and conduct exercises.

Payoff. The results of this effort will be used to guide the development and application of future dismounted Soldier simulation capabilities, such as the Soldier Combined Arms Tactical Trainer.

Additional Information.

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Experiments in Mixed Reality

Three experiments reveal new mixed reality technologies are not yet ready for prime time.

Problem. Mixed reality (MR) refers to the use of wearable computers, see-through helmet mounted displays (HMDs), headphones, and vibratory displays to overlay a live environment with computer-generated information. MR could add virtual buildings, vehicles, and people (enemy and civilian) to training facilities, overlay situational awareness information (enemy and friendly locations, control measures, building or street names) during operations, or present a visual model of an operational area for mission rehearsals.

In order to make these concepts a reality, MR systems must both perform well technically and accommodate Soldier capabilities and constraints. Making a virtual target appear in a real window requires calculations based on the precise location and orientation of both the viewer and the window. Visual displays need to present the virtual information clearly without interfering with the view of the real world. Situation awareness information needs to be presented without overloading Soldiers. Moreover, we need to know that Soldiers can apply the spatial information provided to the real world.

Approach and Results. ARI conducted three experiments to learn how well current MR systems perform with regard to the aforementioned issues. The first experiment compared people's estimates of the distances to real and virtual objects viewed through an MR system. Estimation errors were greater for virtual objects than for real objects, and they were greater when providing verbal estimates than when "driving" a remote-controlled robot to the object.

The second experiment examined the effects of different types of supplementary cueing on performance in a simulated tactical setting. Trainees in a simulated courtyard shot at computer-generated enemy targets (but not friendly targets) while receiving visual, auditory, or haptic cues to their location. They responded more accurately and rapidly to haptic and auditory cues than visual cues, and to the

Training Small Unit Leaders and Teams
simulation technology assessment

combination of haptic and visual cues when compared to visual cues alone.

The third experiment investigated how well a complex route could be learned in MR. Trainees practiced a route through an office area using one of three different methods: drawing the route on a paper map, walking through the actual office space, or walking through a virtual model of the office space. The "walkers" performed better on a transfer test in the actual space than participants in the paper map or MR condition. However, the trainees in the MR condition did improve over the course of their practice trials, indicating that they were learning the route.

Payoff. MR technology is not yet mature, and there are practical problems limiting its use. With continued development, however, MR systems might one day demonstrate the potential for effective use.

Additional Information.

Jerome, C. J. (2007). *Effects of spatial and non-spatial multi-modal cues on orienting of visual-spatial attention in an augmented environment* (ARI Technical Report 1215). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA475115)**

Jerome, C. J., and Witmer B. G. (2007). *The perception and estimation of egocentric distance in real and augmented reality environments* (ARI Technical Report 1230). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Savage, R. (2007). *Training wayfinding: Natural movement in mixed reality* (ARI Technical Report 1214). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA474915)**

Objective Force Warrior

High performance is rooted in being able to perform basic tasks quickly and accurately, and not just in having access to the latest high-tech equipment.

Problem. The Army has seen a major increase in the number of digital Soldier systems being developed for use on the battlefield. Although they come with the promise of greatly enhancing the effectiveness of dismounted warriors and small units, the potential of these new technologies will not be entirely met unless Soldiers, units, and leaders are trained to properly and fully exploit their advertised capabilities.

One digital system attracting the Army's interest in recent years was the Objective Force Warrior (OFW), which later became known as the Future Force Warrior system. Central to the OFW system was a wearable computer that allowed Soldiers to receive, process, and share information from a wide array of battlefield information sources. The primary aim of the present research was to investigate successful training approaches and procedures usually associated with Special Operations Forces (SOF) to determine which might have potential applicability to training OFW-equipped dismounted combatants and small units.

Approach. Nine senior active duty and recently retired NCOs were chosen to participate in this research based on their high levels of overall combat experience, instructor tenure, and specialized SOF experience. A questionnaire was administered to each of these NCOs to identify their individual and collective thoughts on current and future training technologies, procedures, issues, and potential obstacles. Supplemental

Training Small Unit Leaders and Teams
high performance tasks

interviews were then conducted, focusing on new training approaches for the performance of complex individual, team, and leader tasks. Each NCO was asked to describe training techniques that would prepare Soldiers for successful task accomplishment under stressful conditions, to provide insight into their training philosophy and methods, to give examples of methods they have seen other successful trainers employ, and to describe techniques used by SOF units to train various specialized skills.

Results. Seven basic training and technology issues were identified in the NCO interview sessions. These issues were time management, task sequencing, skill mastery, combat-focused training, visualization, repetition, and technology aids. Though they do not represent completely new ideas, they still highlight important concerns that must be repeatedly addressed in the development of training programs for a wide variety of new systems. Solutions and methods for avoiding training obstacles were also solicited from each interviewee.

Because of their extensive SOF experience, the NCOs were able to identify training techniques applicable to OFW in six specialized areas: weapons, breaching, fire control, combat life saving, mobility, and operations and intelligence. Personal examples and vignettes were obtained in each of the six areas in order to illustrate potential payoffs for OFW training.

Payoff. Lessons learned from this research were provided to training developers in the U.S. Army Infantry School, the OFW Technology Program Office, and the OFW Lead Technology Integrator supporting the train-up for the OFW Advanced Technology Demonstration.

Additional Information.

Zipperer, E., Klein, G., Fitzgerald, R., Kinnison, H., Graham, S. E. (2003). *Training and Training Technology Issues for the Objective Force Warrior* (ARI Research Report 1809). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA419873)**

Searching for Adaptable Leadership

Adaptable small unit leaders not only demonstrate changes in behavior in response to altered situations, but also achieve successful results.

Problem. The Army's current operational environment is unprecedented. Battles are characterized by complex military operations and asymmetrical warfare described as unconventional, unrestrained, and marked by the use of human shields and suicide bombers. As the Army continues to engage in non-traditional warfare, the performance of small units is being seen as the key to success in battle. These dynamic conditions require leaders and their units to constantly maintain environmental awareness and to adapt during any situational changes. Adaptive behavior has become an increasingly important factor in the workplace, requiring employees to be flexible and responsive to changing, competitive circumstances. The Army is no exception to this trend.

Approach. Research was conducted to determine behaviors associated with adaptive performance in junior Army leaders, and to provide methods for enhancing adaptive capabilities. A previously developed nine-dimension model of adaptive performance was applied to leader behaviors exhibited in operational and training contexts in order to determine whether this specific model was appropriate for use in describing adaptive behaviors in current military settings.

Interviews were conducted with two groups of Army leaders (40 combat veterans from the Infantry School and 24 trainers from the Joint Readiness Training Center). Most of the combat veterans had previously been deployed to either Iraq or Afghanistan. Specifically, each leader was asked to describe incidents in operational or training contexts in which they and/or their unit had to respond adaptively to a situation, as well as the approach they and their unit took in response to the situational change. After all data were collected, each incident was coded according to the following nine adaptability dimensions:

- Deals with Uncertain and Unpredictable Work Situations
- Handles Emergencies or Crisis Situations
- Solves Problems Creatively
- Learns Work Tasks, Technologies, and Procedures
- Handles Work Stress
- Demonstrates Cultural Adaptability
- Demonstrates Interpersonal Adaptability
- Leads an Adaptable Team
- Demonstrates Physically Oriented Adaptability

Training Small Unit Leaders and Teams
high performance tasks

Results. Overall, it was found that the nine-dimension model used to code interview responses sufficiently addressed all of the adaptive capabilities that were described, though not all nine categories were represented and some were represented more than others. Combat veterans generally provided examples in the *Deals with Uncertain and Unpredictable Work Situations* and *Handles Emergencies or Crisis Situations* categories, while the trainers mostly provided examples in the *Solves Problems Creatively* and *Leads an Adaptable Team* categories.

The findings suggested future training programs for leaders should focus on ways to develop an adaptive team. During the interviews it was suggested that training programs should attempt to help leaders learn to delegate tasks to the lowest level, which would involve including subordinates in the planning process, listening to their ideas, and allowing them to make decisions in the absence of a leader. The ability to communicate was seen as a vital tool, especially in promoting a shared vision of the commander's intent to team members.

Additionally, the findings suggested that future training programs should attempt to develop skills for handling unpredictable events. This type of training would strengthen a leader's ability to effectively perform when the mission or environment changes. Many interviewees believed that simulations or realistic field exercises would provide opportunities for leaders to safely practice planning, prioritizing, and decision making as environmental and

mission changes occur. Creative problem solving skills might also aid in developing adaptive responses to unforeseen events.

Payoff. The findings of this research should prove useful to training developers in identifying the adaptive requirements of specific duty positions. Further, the training recommendations presented in the report offer useful guidance for the development of leader education and training programs that will maximize the adaptive performance of junior Army leaders.

Additional Information.

Tucker, J. S., Gunther, K. M., Pleban, R. J., Goodwin, G. A., & Vaughan, A. W. (2007). *The Application of a Model of Adaptive Performance to Army Leader Behaviors* (ARI Research Report 1870). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA469726)**

Training Small Unit Leaders and Teams
high performance tasks

Decentralized Training

A decentralized training strategy is sometimes superior to the centralized training found in most Army units today.

Problem. Based on lessons learned from ongoing operations in Iraq, the need for more decentralized training has become increasingly evident to many commanders. Decentralized training is defined as training that is initiated, planned, and executed at the platoon level or below, without requirements or guidance from a higher headquarters. In contrast, centralized training is directed, planned, and executed at the company level or above.

Approach. A literature review was conducted to determine the relative emphasis placed on decentralized and centralized training in the Army since the 1970s, in order to better understand why centralized training is the more commonly used form of training at present. To identify the best ways to successfully execute decentralized training, structured interviews were conducted with 14 leaders from the Opposing Force (OPFOR) at the Joint Readiness Training Center (JRTC), who use a decentralized approach for much of their training.

Results. Interview results indicated both centralized and decentralized forms of training are necessary, as they complement one another. Further, tasks best suited to each form of training were identified. For example, individual skill tasks, small-unit operations, and topics that do not require a technical expert are good candidates for decentralized training.

Five factors were found to be essential to a successful decentralized training program. These factors are shown in the accompanying insert.

> *Five Essential Factors to Successful Decentralized Training*
>
> 1. Select tasks appropriate for decentralized training.
>
> 2. Use qualified trainers.
>
> 3. Create an environment conducive to decentralized training.
>
> 4. Develop assessment procedures applicable to the decentralized training process.
>
> 5. Provide the necessary training support resources.

Payoff. Decentralized training can be used to prepare and mentor Soldiers for higher levels of responsibility and for the

Training Small Unit Leaders and Teams
high performance tasks

decentralized nature of operations that characterize current operating environments. Additionally, a decentralized approach to training can help to make the most of available time while Soldiers are deployed and involved in larger operations.

Additional Information.

Dyer, J. L., Centric, J. H., & Wampler, R. L. (2007). *A case for decentralized training* (ARI Research Report 1866). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA462739)**

Instilling Warrior Ethos

I will always place the mission first. I will never accept defeat. I will never quit. I will never leave a fallen comrade.

Problem. During the transformation from citizen to Soldier, the instilling of Warrior Ethos is a major goal of the Army. The significance of the concept is clear in Army literature, briefings, and speeches, all of which provide abundant references to Warrior Ethos. While the importance is evident and few Soldiers have trouble recognizing the meaning of the concept itself, or historical deeds in which Warrior Ethos are displayed, the conditions that would promote Warrior Ethos are not typically encountered in basic training. As a result, the present research sought to generate innovative methods and materials to assist Drill Sergeants in training Warrior Ethos.

Approach. Initially, the four previously established tenets of Warrior Ethos (Mission First, Never Quit, Never Accept Defeat, Never Leave a Fallen Comrade) were broken down into eight attributes that were then linked to specific behaviors exhibited during Army Battle Drills. The attributes were linked to positive Warrior Ethos behaviors, and to examples of possible obstacles that would impede the demonstration of those behaviors.

Warrior Ethos Attributes

- Perseverance
- Prioritization of tasks
- Making tradeoffs in the application of tactics, techniques and procedures
- Adaptability
- Acceptance of responsibility for others
- Acceptance of dependence on others
- Motivation by a sense of calling

Next, the attributes of Warrior Ethos were linked to specific basic training events. Train-the-trainer materials were then developed to support enhanced Warrior Ethos training. The new training materials were assessed in the existing Teamwork Development Course (TDC), an obstacle course conducted at all basic training locations. The TDC consists of six work stations. At each station, a Drill Sergeant read the mission aloud to a group of trainees and showed the available mission resources. The trainees made attempts to complete each mission, and then participated in a combined After Action Review (AAR) led by the six Drill Sergeants. The Warrior Ethos training materials were then revised following interviews with and observations of Drill Sergeants and trainees in the TDC.

Results. This research resulted in two training products for Warrior Ethos: the Teamwork Development Training Support Package (TSP) and a Train-the-Trainer

Training Small Unit Leaders and Teams
high performance tasks

Compact Disc. The Teamwork Development TSP included a discussion of Warrior Ethos tenets and attributes, on-site guidance to Drill Sergeants, lessons on the basics of Warrior Ethos, lessons concerning how Warrior Ethos is related to teamwork development, and methods for the enhancement of Warrior Ethos during TDC. For each of the TDC work stations, a full description of the supplies needed was provided, as well as problem solutions for each obstacle.

The Teamwork Development TSP also included a section designed to help Drill Sergeants conduct mission-focused AARs in order to highlight observed Army Values and Warrior Ethos Attributes. This AAR material included a Warrior Attribute Checklist for Drill Sergeants. The checklist was designed to jog their memory, organize thoughts, and note changes in the display of Warrior Ethos behaviors at each work station. The Warrior Attribute checklist can also be used as a stand-alone document in support of other Army training programs.

The Train-the-Trainer Compact Disc combined Army Values with the Warrior Ethos tenets and attributes to enhance Drill Sergeants' understanding of Warrior Ethos. It included data, photos, and videos taken during data collection to further reinforce their understanding of this important Army concept.

Payoff. The Warrior Attribute Checklist appeared to be an effective tool in facilitating AARs by assisting Drill Sergeants in their AAR preparation. Furthermore, the Teamwork Development TSP and the Train-the-Trainer Compact

Disc may be useful in various other training environments, due to the ease with which the eight attributes may be linked to other Army tasks.

Additional Information.

Klein, G., Salter, M., Riccio, G., Sullivan, R. (2006). *Enhancing warrior ethos in Soldier training: The teamwork development course* (ARI Research Product 2006-12). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA457418)**
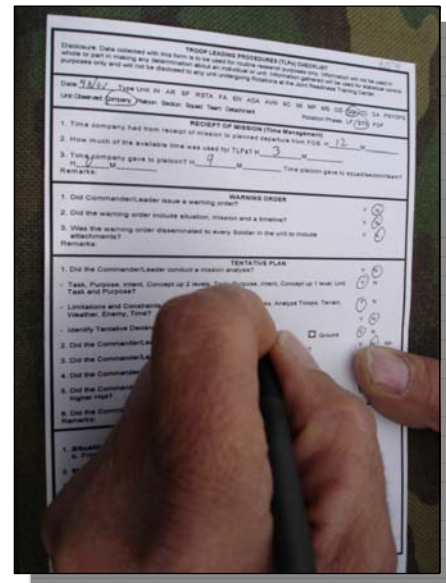
Improving Troop Leading Procedures at JRTC

Small unit leaders can improve their troop leading procedures with the help of a simple job performance aid.

Problem. Troop Leading Procedures (TLPs) are an eight-step process used by small unit leaders to plan and prepare for operations. A frequent topic of discussion in After Action Reviews (AARs) of unit performance at the Joint Readiness Training Center, TLPs were identified by observer/controllers as one of the most common and widespread of all leader problems they encounter.

Approach. O/Cs measured the quality of TLPs performed by each small unit leader with a checklist developed specifically for this project. Printed on the front and back of a 5 X 7" card, the TLPs Checklist had ten sections: unit and mission information, receipt of mission (time management), warning order, tentative plan, issue order, rehearsal, refine/supervise, mission preparation, mission execution, and overall remarks. Most checklist items asked O/Cs for a Yes or No response.

The TLPs Guide was then developed as a job performance aid to be used by small unit leaders during the mission planning process. It contained six laminated pages in a trifold layout that could easily fit in a uniform pocket when folded. The guide summarized and highlighted

doctrinal material about TLPs found in Field Manual 5-0, *Army Planning and Orders Production* (Department of the Army, 2004).

The performance of small unit leaders who were given a TLPs Guide, the experimental group, was compared to the performance of leaders who did not get this job aid, the baseline group. Baseline performance data were drawn from 327 checklists collected by O/Cs during five consecutive rotations at JRTC in 2005. Experimental data were then drawn from 396 checklists collected during three later rotations that year. Across the three experimental rotations, approximately 3,400 TLPs Guides were distributed to

Training Small Unit Leaders and Teams
high performance tasks

small unit leaders, down to the team leader level.

Results. Though they spent a smaller percentage of their available time actually conducting TLPs, leaders in the experimental group had better TLPs performance than leaders in the baseline group on 34 of 39 measures. Group differences were statistically significant on 8 of those measures.

The effectiveness of the TLPs Guide was particularly apparent in the third step of the TLPs process, making a tentative plan. In fact, half of all statistically significant group differences were related to that step, perhaps because more than 25% of the TLPs Guide layout was devoted to information about making tentative plans.

Payoff. These findings were briefed to members of the JRTC Warrior Leadership

Council in January of 2006. Based on the results obtained, both the TLPs Checklist and the TLPs Guide were recommended for further use. Some Operations Group divisions at JRTC have indicated they will continue to use the TLPs Checklist as an effective means of gathering supporting material for use in AARs.

The Council also thought a TLPs job performance aid should be introduced to small unit leaders during institutional leader development courses. There they can use it as a memory jogger, course reference, and a tool they can take to their first unit assignment.

Additional Information.

Evans, K. L., & Baus, E. A. (2006). *Improving troop leading procedures at the Joint Readiness Training Center* (ARI Research Report 1852). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADA450444)**

Surveying Training and Leadership Insights

Veterans of Afghanistan and Iraq (2003-2004) provide valuable training and leadership insights from their deployment experiences.

Problem. With the onset of combat operations in Afghanistan and Iraq, large numbers of Army personnel have gained valuable combat experience. We sought to identify and document the wealth of knowledge about training and leadership gained by small unit leaders during these combat operations.

Approach. A total of 187 veterans of Afghanistan and Iraq were surveyed while they attended either the Infantry Captains Career Course, the Advanced NCO Course, or the Basic NCO Course at Fort Benning, GA. The survey included questions about pre-deployment training, including the types of training conducted, where the training occurred, and the resources available for training. Also included on the survey were questions about training during deployment.

Interviews were then conducted with 20 officers and 20 NCOs who had completed the post-combat leader survey. During these interviews, they were asked to clarify and elaborate on their responses to the survey. They were also asked to discuss the most beneficial training they had, leadership challenges they faced in

theatre, how they trained replacements, their adaptability, the adaptability of their units, and memory aids they used.

Results. Training gaps for a variety of small unit tasks were identified. For example, many leaders were asked to perform tasks for which they received little training. This was especially true for conducting Improvised Explosive Device (IED) patrols, distributing supplies to civilians, convoy escort, and VIP escort duty.

Nevertheless, training shortcomings did not appear to impair operational performance, as only a few tasks were rated as difficult to perform by more than 5% of the survey respondents. Most leaders felt they were able to develop effective procedures on their own and pass their knowledge along to new

Training Small Unit Leaders and Teams
high performance tasks

replacements. Most believed their skills and abilities improved throughout their combat tours even without formal training.

Dealing with the stress and complacency of unit members was found to be a consistent leadership challenge. Memory joggers were also found to be helpful, particularly the nine-line format to request a medical evacuation.

Payoff. These findings were briefed to the leadership of the NCO Academy and the Combined Arms and Tactics Directorate at Fort Benning, GA. They found the results to be informative and hoped follow-on surveys could be conducted with those deployed more recently.

The survey results also provided insights into how adaptability could be defined and improved through scenario-based training and contingency planning methods. Finally, the information that was obtained about the use of memory joggers has already served as the basis for selecting the memory joggers for the Future Force Warrior development program.

Additional Information.

Goodwin, G. A., Dyer, J. L., & Centric, J. H. (2006). *Training and leadership insights from veterans of Iraq and Afghanistan: 2003-2004* (ARI Research Report 1863). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. **(ADB232299)**

Training Small Unit Leaders and Teams

high performance tasks

Downloading ARI Publications

With few exceptions, the ARI publications cited in the **Additional Information** sections of this report can be viewed and downloaded as pdf files from the Defense Technical Information Center (DTIC) website:

http://www.dtic.mil/dtic/

The DTIC search function allows you to locate a particular report by entering its DTIC identification number, which is shown in bold type at the end of each ARI publication cited in this report (e.g., **ADA123456**).

A link to the DTIC website is also provided on ARI's website (see FAQ tab), where selected publications of current interest can also be downloaded as pdf files. Please visit:

www.ari.army.mil

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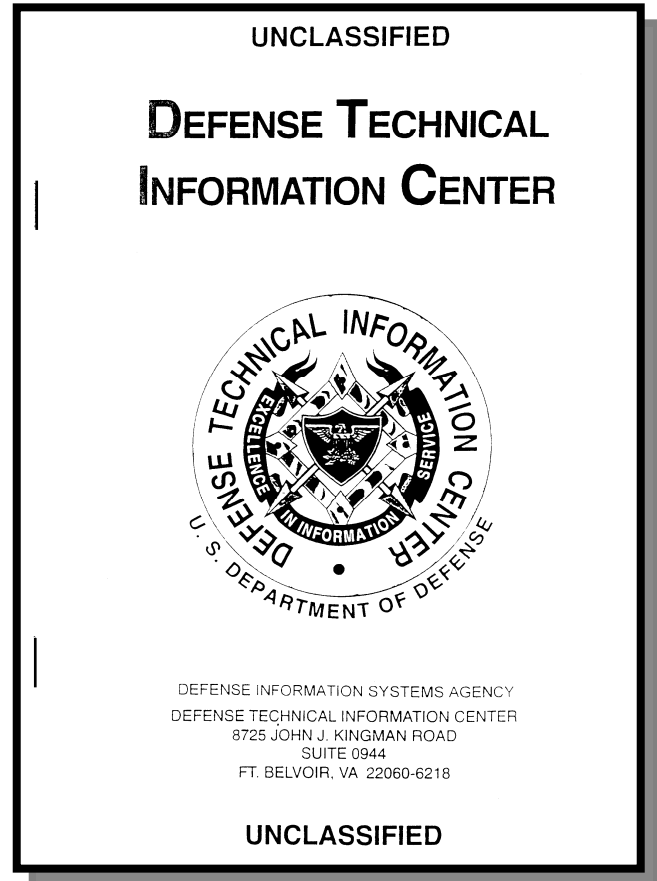
List of Acronyms

AAR	After Action Review
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
AW-VTT	Asymmetric Warfare-Virtual Training Technology
BMNT	Beginning Morning Nautical Twilight
CBT	Computer Based Training
CD	Compact Disk
COTS	Commercial Off The Shelf
DARPA	Defense Advanced Research Products Agency
DIVAARS	Dismounted Infantry Virtual After Action Review System
DTIC	Defense Technical Information Center
DVD	Digital Video Disk
DVS	Daylight Video Sight
EENT	Ending Evening Nautical Twilight
FAQ	Frequently Asked Question
FFW	Future Force Warrior
FSC	Full Spectrum Command
FSW	Full Spectrum Warrior
HMD	Helmet Mounted Display
IED	Improvised Explosive Device
IOBC	Infantry Officer Basic Course
ISD	Instructional System Design
IST	Institute for Simulation and Training
JRTC	Joint Readiness Training Center
LZ	Landing Zone
MANPRINT	Manpower and Personnel Integration
MOT2IVE	Multi-purpose Operational Team Training Immersive Virtual Environment
MOUT	Military Operations in Urbanized Terrain
MR	Mixed Reality

Training Small Unit Leaders and Teams

for more information

NCO	Non-Commissioned Officer
NPC	Non-Player Character
O/C	Observer/Controller
OFW	Objective Force Warrior
OPFOR	Opposing Force
OSUT	One Station Unit Training
PC	Personal Computer
PDF	Portable Document Format (Adobe)
PEO-STRI	Program Executive Office for Simulation, Training, and Instrumentation
PM-GCTT	Product Manager-Ground Combat Tactical Training
PQ	Presence Questionnaire
RDECOM	U.S. Army Research, Development, and Engineering Command
RDT	Rapid Decision Trainer
SA	Situation Awareness
SAF	Semi-Automated Forces
SBIR	Small Business Innovation Research
SimFX	Simulated Field Exercise
SOF	Special Operations Forces
STTC	Simulation Training Technology Center
TDC	Teamwork Development Course
TDM	Tactical Decision Making
TLPs	Troop Leading Procedures
TSP	Training Support Package
TTPs	Tactics, Techniques, and Procedures
TRAC-WISMR	TRADOC Analysis Center-White Sands Missile Range
TRADOC	U.S. Army Training and Doctrine Command
TWS	Thermal Weapon Sight
USAIS	U.S. Army Infantry School
VECTOR	Virtual Environment Cultural Training for Operational Readiness
V-IMTS	Virtual-Integrated MOUT Training System
VIP	Very Important Person
VIRTE	Virtual Technologies and Environments
ViSSA	Virtual Soldier Skills Assessment
VOIP	Voice Over Internet Protocol

Training Small Unit Leaders and Teams

for more information

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Subject Matter POC: Dr. Ken Evans

14. ABSTRACT *(Maximum 200 words)*:

The Special Report summarizes a recently completed ARI research program in the area of small unit leader and team training. The program involved 27 separate lines of investigation organized into five broad research areas: new and emerging systems, desktop simulation, automated tools, simulation technology assessment, and high performance tasks. While highlighting the major findings from this body of research, the report also illustrates the various ways the research program has benefitted the Army, from providing timely information in support of Project and System manager decision making to the development of new automated training tools and improved software for simulation training.

15. SUBJECT TERMS

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