DTIC FILE COPY

AD-A210 606

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

Research Report 1521

Evaluation of a Low Fidelity Battle Simulation for Training and Evaluating Command, Control, and Communications (C^3) Skills for the Armor Platoon Leader

Donald R. Lampton
U.S. Army Research Institute

May 1989

89 16

U.S. ARMY RESEARCH INSTITUTE

FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction
of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Technical Director

JON W. BLADES
COL, IN
Commanding

Technical Review by

Donald W. Bessemer
Milton E. Koger

NOTICES

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS --
2a. SECURITY CLASSIFICATION AUTHORITY -- 2b. DECLASSIFICATION / DOWNGRADING SCHEDULE --	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
4. PERFORMING ORGANIZATION REPORT NUMBER(S) ARI Research Report 1521	5. MONITORING ORGANIZATION REPORT NUMBER(S) --
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Research Institute Field Unit-Ft. Knox 6b. OFFICE SYMBOL (If applicable) PERI-IK	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences
6c. ADDRESS (City, State, and ZIP Code) Fort Knox, KY 40121-5620	7b. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600
8a. NAME OF FUNDING / SPONSORING ORGANIZATION -- 8b. OFFICE SYMBOL (If applicable) --	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER --
8c. ADDRESS (City, State, and ZIP Code) --	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 63744A PROJECT NO. 795 TASK NO. 412 WORK UNIT ACCESSION NO. H1

11. TITLE (Include Security Classification)
Evaluation of a Low Fidelity Battle Simulation for Training and Evaluating Command, Control, and Communications (C^3) Skills for the Armor Platoon Leader

12. PERSONAL AUTHOR(S)
Lampton, Donald R.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 87/01 TO 87/10	1989, May	79

16. SUPPLEMENTARY NOTATION
--

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Armor training; Training simulation; Low fidelity training; Performance measurement

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report describes an investigation of the use of Simulation for Combined Arms Training (SIMCAT). SIMCAT is a low cost, low fidelity battle simulation developed for the Army Research Institute to train and evaluate tactical skills for leaders of small armor units. SIMCAT uses networked microcomputers, videodisc technology, and voice recognition and playback to symbolically represent critical variables needed to practice armor platoon C^3 skills.

Twenty officers served as platoon leaders for Army Mission Training and Evaluation Plan (AMTEP) Field Training Exercises adapted for use with SIMCAT. Each exercise contained a tactical roadmarch, passage of lines, and movement to contact. AMTEP standards checklists were used to evaluate selected tactical tasks. Officers were tested on one exercise, received additional practice on that exercise, and then tested on a different

(Continued)

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Donald R. Lampton	22b. TELEPHONE (Include Area Code) (502) 624-4932 22c. OFFICE SYMBOL PERI-IK

DD Form 1473, JUN 86 — Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

ARI Research Report 1521

19. ABSTRACT (Continued)

exercise. The officers were Armor Officer Basic graduates. Half had field leadership experience since graduation; half had no postgraduate experience. Scores for the experienced officers were significantly higher than for those lacking field experience, and both groups showed improvement with practice. Officers' ratings of the training effectiveness of SIMCAT were favorable.

Research Report 1521

Evaluation of a Low Fidelity Battle Simulation for Training and Evaluating Command, Control, and Communications (C^3) Skills for the Armor Platoon Leader

Donald R. Lampton
U.S. Army Research Institute

Field Unit at Fort Knox, Kentucky
Donald F. Haggard, Chief

Training Research Laboratory
Jack H. Hiller, Director

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel
Department of the Army

May 1989

Army Project Number
2Q263744A795

Training and Simulation

FOREWORD

Small unit armor leaders must make tactical decisions rapidly, often under fire. The intensity and lethality of the modern battlefield demand that these leaders be well trained before entering battle. Unfortunately, cost, safety considerations, and the restricted availability of suitable training areas limit the amount and realism of field training.

Computer-driven battle simulations may provide a needed complement to field training. In addition to saving of fuel and ammunition, simulations may provide unique perspectives for providing performance feedback. The Army Research Institute (ARI) has established a research program to identify simulation requirements for training and evaluating tactical skills. As part of this effort, ARI has developed a prototype low-cost battle simulation, Simulation in Combined Arms Training (SIMCAT).

This report describes a preliminary evaluation of the use of low fidelity simulation such as that represented by SIMCAT for training and evaluating platoon level tactical skills. The effort is part of the Fort Knox Field Unit's research program to apply new technology to Armor skills training. A Memorandum of Agreement covering the application of training methodology to Armor skills training, "Establishment of Field Training Technology, Fort Knox, Kentucky," was signed by Headquarters, Training and Doctrine Command (TRADOC), U.S. Army Armor Center (USAARMC), and ARI on 28 March 1987. The SIMCAT device, and the results of SIMCAT-based research, have also been briefed and demonstrated for Commanding General, TRADOC and the Commanding General, USAARMC. Frequent coordination/briefings have also been held for the Technical Director, USAARMC, throughout this effort. The findings have been used to develop both training and testing methods for application to related training technologies. The device itself has been further modified to support the simulation of weapon system parameters in the development of new weapons technology.

EDGAR M. JOHNSON
Technical Director

EVALUATION OF A LOW FIDELITY BATTLE SIMULATION FOR TRAINING AND EVALUATING COMMAND, CONTROL, AND COMMUNICATIONS (C^3) SKILLS FOR THE ARMOR PLATOON LEADER

EXECUTIVE SUMMARY

Requirement:

Classroom instruction and terrain board exercises cannot prepare leaders of small armor units for the time pressure and command and control problems that are encountered in the field and cost, safety considerations, and restricted availability of suitable training areas greatly limit the number and variety of exercises that can be conducted to provide training in Command, Control, and Communications (C^3) and tactics at the platoon level. Further, when resource intensive field exercises are conducted, the performance of individual platoon leaders is difficult to measure and performance evaluation, diagnosis, and rapid and precise feedback are limited.

Computer driven battle simulations may provide a needed complement to field training. Compared to field training, simulated combat is inexpensive, safe, and can use terrain that is theoretically unlimited. In addition to providing extensive training opportunities, battle simulations may allow more precise measurement of tactical performance than can be obtained in the field.

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has established a research program to identify simulation requirements for providing C^3 and tactical training for modern and future battlefield conditions. As part of this effort, ARI has developed a prototype platoon-level battle simulation, Simulation in Combined Arms Training (SIMCAT).

SIMCAT allows four participants to serve as Platoon leader, Platoon Sergeant, and two Tank Commanders of a four-tank armor platoon by individually controlling simulated tanks. SIMCAT functions as an automated terrain board for which the system computers, in near-real time, control vehicle movement rate, resolve the outcome of direct and indirect fire, and perform line-of-sight calculations to determine vehicle inter-visibility.

This study evaluated the use of low fidelity simulation, such as represented by SIMCAT, to train and evaluate C^3 skills for armor platoon leaders. Two issues were addressed: "Does practice with SIMCAT lead to improved performance?" and "Can SIMCAT be used to distinguish different levels of tactical skill?"

Procedure:

Twenty officers served as platoon leaders for tactical exercises conducted with SIMCAT. The officers were Armor Officer Basic graduates. Ten had served as platoon leaders since graduation and were assigned to a group labeled "experienced." Ten had no additional field experience and were assigned to a group labeled "inexperienced." Field Training Exercises outlined in the Army Mission Training and Evaluation Plan (AMTEP) were adapted for use with the SIMCAT terrain data base. Each exercise contained a tactical roadmarch, a passage of lines, and a movement to contact. AMTEP standards checklists were used to evaluate selected tactical performance. Time to report the time between when an event occurred and the officer initiated a report of that event was also recorded.

Each officer served as platoon leader for three tactical exercises. Experienced noncommissioned officers (NCOs) filled the other platoon positions, and a field grade armor officer acted as the chief controller for the exercises. During the first exercise, the pretest, the chief controller, acting as the company commander, provided no information to the officer other than that which would be provided by a commander during a combat mission. During the second exercise, the chief controller was free to stop the exercise at any time to offer immediate feedback and advice. The third exercise, the posttest, used a tactical scenario that differed from that used for the first two exercises. Sequence of scenario presentation was counterbalanced across officers. The third exercise used the same format as the first, that is, the chief controller provided no information to the officer other than that which would be provided by a commander during a combat mission. After-Action Reviews were conducted after each exercise and officers completed questionnaires concerning the effectiveness of SIMCAT.

Findings:

The percentage of standards met and promptness of reporting improved from the pretest to the posttest for both the experienced and inexperienced officers. This result indicated that training conducted with SIMCAT produces improved platoon leader performance and that the training generalized across the tactical situations represented by the two different scenarios.

The officers with previous platoon leadership experience scored better than the officers lacking experience. Confirmation of the expected effect of experience level gives credence to the validity of the scoring procedure. SIMCAT was capable of representing tactical situations so that appropriate actions could be performed and evaluated.

Officers rated favorably the training effectiveness of SIMCAT. They also indicated that they would use SIMCAT to train their own units if such a device were available.

Utilization of Findings:

The findings of this study will guide the development of training simulations and simulator-based training programs. These findings will also be used to develop simulator-based methods of evaluating tactical performance, including alternatives to traditional measures of tactical performance.

EVALUATION OF A LOW FIDELITY BATTLE SIMULATION FOR TRAINING AND EVALUATING COMMAND, CONTROL, AND COMMUNICATIONS (C^3) SKILLS FOR THE ARMOR PLATOON LEADER

CONTENTS

LIST OF TABLES

LIST OF FIGURES

EVALUATION OF A LOW FIDELITY BATTLE SIMULATION FOR TRAINING AND EVALUATING C^3 SKILLS FOR THE ARMOR PLATOON LEADER

INTRODUCTION

This report describes a preliminary investigation of the use of a low fidelity simulation, Simulation in Combined Arms Training (SIMCAT), to train and evaluate command, control, and communications (C^3) and tactical skills for armor platoon leaders. Information derived from this study will guide the design and development of subsequent training simulations and simulation-based training programs.

Computer driven battle simulations may provide a needed complement to field training. Compared to field training, simulated combat is inexpensive, safe, and can use terrain that is theoretically unlimited in extent and variety. In addition to providing extensive training opportunities, battle simulations may allow more precise measurement of tactical performance than can be obtained in the field.

Although there is a solid history of using computer-based simulations for military training, the use of computer simulations for training tactics and C^3 skills for small unit armor leaders is a relatively new area. Just as the battlefield role of armor is unique, armor training may require different types of simulators and different training approaches.

The U.S. Army Research Institute (ARI) has established a research program to identify simulation requirements for providing C^3 and tactical training for modern and future battlefield conditions. As part of this effort, ARI has developed a prototype platoon level battle simulation, SIMCAT.

SIMCAT allows participants to serve as the Platoon Leader, Platoon Sergeant, and the two Tank Commanders of a four-tank platoon by individually controlling simulated tanks. SIMCAT can be thought of as an automated terrain board for which the system computers control vehicle movement rate, resolve the outcome of direct and indirect fire, and perform line of sight (LOS) calculations to determine vehicle intervisibility.

SIMCAT can be characterized as low fidelity simulation. That is, there is no attempt to produce a physically realistic representation of a battlefield or an accurate mockup of the inside of an operational tank. Instead, SIMCAT seeks to symbolically represent the critical combat variables needed to practice armor C^3 skills. SIMCAT is a research device. No attempt was made to formally evaluate SIMCAT as a training device. Rather, this is an attempt to evaluate the potential of low fidelity simulation for training small unit leaders. (The present version of

SIMCAT is unsuitable for use as a training device because of problems in controlling vehicle movement and firing, the slow speed of the system update cycle, and the unreliability of the system network. An enhanced version of SIMCAT is being developed. This improved version is called the Platoon Level Battlefield Simulation (PLBS). PLBS will incorporate improvements in technology that have occurred since the construction of SIMCAT to provide improved graphics and station controls, and faster update cycles).

BACKGROUND

Training Challenge

Based upon observations at the National Training Center (NTC), Word (1987) emphasized that the key to success at NTC is centered around platoon level training. He points out that even for large scale operations platoon performance is often the critical element in determining mission success and urges that training resources be focussed at the platoon level.

Hannaman (1984a) has emphasized that armor platoon leaders must make tactical decisions rapidly, often while on the move and under fire. They must execute C^3 procedures, under tremendous time pressure and stress, on a battlefield which is so complex and variable that no known set of rules or guidelines can guarantee combat success or even survival. The intensity and lethality of the modern battlefield demand that armor platoon leaders be well trained in tactics and C^3 skills before the first battle begins.

Henricksen, Jones, Sergeant and Rutherford (1984) noted that small unit armor leaders must develop information processing and tactical decision making skills to a level exceeding that required by most military or civilian occupations. They state that triumph in combat requires extensive practice of a cross-section of tactical situations under realistic battlefield conditions.

Limitations of Traditional Training Methods

Several factors limit the amount, variety, and realism of training which can be conducted for platoon leaders to develop C^3 and tactical skills. Traditional nonfield training methods, such as sand table exercises and combat games using terrain boards, do not fully present the time pressure and problems of command and control which are encountered during field exercises (Henricksen, Jones, Sergeant & Rutherford, 1985). For most combat games, procedures regulating movement and fire resolution result in slow play, critical events do not occur in real time, and therefore rapid decision making is not forced. Game participants often inappropriately receive information that would not be available in the field about terrain and the location and status of other vehicles. Standard communication procedures are seldom employed. Some of these shortcomings could be overcome or reduced by appropriate game design and exercise development (Bessemer & Lampton, 1985). However, one of the most important shortcomings of terrain board gaming, the inability to represent combat events in real time, can not be entirely overcome.

These shortcomings of traditional nonfield training methods lead to problems when trainees move from classroom instruction to field training (Henriksen et al., 1984). Trainees have difficulty in applying basic C^3 principles in the field environment. Eberts and Brock (1984) suggested that the performance of trainees is often limited not by a lack of knowledge but by an inability, due to information overload, to use knowledge that they already possess.

Although recent improvements in field training devices and techniques, such as Multiple Integrated Laser Engagement System (MILES), have increased training realism, the amount and variety of field training is greatly limited by cost, safety considerations and the limited availability of suitable training areas (Brown, 1983). The number of exercises that can be conducted is greatly limited by operation and maintenance costs. The limited availability of suitable training areas constrains the scope of field exercises. Small training areas impede the tactical exercise of the speed and range of modern tanks such as the Ml Abrams. Safety considerations limit training realism in many ways, for example, incoming artillery is difficult to effectively represent.

Wheaton and Boycan (1982) pointed out that although large scale MILES exercises season and harden trainees by exposing them to the realities and rigors of (simulated) combat, the complexity of action during these exercises make it difficult for individual platoon leaders to recognize how their specific actions, and inactions, contribute to total mission outcome. Solick and Lussier (1986) emphasized that during tactical exercises inappropriate decisions and actions may sometimes lead to success and appropriate actions may occasionally result in failure. For example, a platoon may suffer losses, during a MILES exercise, because of lack of proper overwatch by adjacent forces despite all standards being met within the platoon. Therefore, the intrinsic feedback provided during an exercise must be supplemented. Indeed, standard training procedures require an experienced armor leader to conduct an After Action Review (AAR), that is, to discuss the exercise with the participants. The performance feedback presented to platoon leaders is therefore almost always delayed and is frequently imprecise. Feedback is delayed because it is impractical to stop a large scale exercise in order to critique the performance of an individual platoon leader. A limit on the precision of feedback is the difficulty of providing to the evaluators a battlefield perspective allowing observation of all critical events.

In summary, traditional training methods are hard pressed to provide adequate tactical training for small unit armor leaders. Nonfield training, classroom instruction and terrain board exercises, do not create the time pressure and command and control problems that are encountered in the field. For field training, cost, safety considerations and the limited availability of suitable training areas greatly limit the number and variety of exercises that can be conducted to provide training in C^3 and tactics at the platoon level. When these resource intensive field exercises are conducted, the performance of individual platoon leaders is difficult to measure, therefore limiting performance evaluation, diagnosis and rapid and precise feedback.

Evaluation of Tactical Performance

Scott (1984) listed many of the problems in producing accurate descriptions of C^3 and tactical performance. One of the basic problems is to determine what to measure. Although exchange ratios and percent of mission accomplishment seem to be reasonable measures when applied to large scale exercises, these measures at the platoon level can be easily biased by factors unrelated to the unit's performance. OPFOR skill and motivation level, environmental factors, terrain, and force ratios may determine outcome as much as unit proficiency.

The AMTEP (Tank Platoon ARTEP Mission Training Plan, 1984) suggests the use of casualty and outcome measures in evaluating platoon performance, but recommends that the heaviest evaluation weighting be given to the standards found in the Soldiers' manuals and the AMTEP Training and Evaluation Outlines (T&EOs). These standards are checklists of procedures believed to improve the chance of success in combat. Scott (1984) points out that the major problem associated with the standards checklists is their number. That is, the checklists were developed to pinpoint specific problems in highly complex situations and there are, therefore, an awkwardly large number of standards to score and interpret within an evaluation exercise.

Allen, Johnson, Wheaton, Knerr, and Boycan (1982), suggested that the individual standards can be used for diagnostic purposes, identifying particular problem areas in platoon performance. For evaluation or qualification purposes, these measures could be aggregated to produce some indicator of overall unit competence.

Advantages of Simulator-Based Training

Hannaman (1984b) recommended the use of computer driven battle simulations to provide a low cost complement to field training. Training based on computer simulated combat would avoid many of the expenses associated with field exercises. Simulated ammunition and fuel would be free and unlimited.

Safety considerations that limit many aspects of field training would not limit simulated combat. Close combined arms operations, conducted on hazardous terrain during limited visibility conditions, could be safely simulated. Tactical decision making under extreme stress, such as during prolonged sleep deprivation, could be safely measured.

Simulated terrain is theoretically unlimited in extent and variety. Terrain representing specific geographic areas could be simulated to allow mission rehearsals for areas that otherwise would be unavailable for training.

In addition to providing extensive training opportunities, battle simulations may allow more precise measurement of tactical performance than can be obtained in the field. The use of simulated combat may not eliminate the necessity of having an experienced observer conduct an AAR, but could improve the accuracy and usefulness of the AAR.

Advantages of Low Fidelity Simulation

Jones, Hennessy, and Deutsch (1985) noted that the term fidelity is usually intended to refer to the realism and comprehensiveness of a simulator. Realism is a function of how closely a simulation represents or seems like the "real thing." Comprehensiveness relates to the number of critical variables that are represented in a simulation.

Jones et al. (1985) pointed out that high fidelity was a traditional goal in simulator design, due mainly to the common sense notion that the more realistic the simulator the better the training. This assumption that high fidelity is always to be preferred in training simulations is now being challenged. For example, there is evidence that low fidelity simulators may be especially useful for teaching skills that are based more on information processing than equipment operation.

Su (1984) points out that high fidelity training devices usually cost more than low fidelity devices and that therefore simulators that incorporate only those features that are necessary to train for a given task have the greatest potential for cost-effectiveness. Su notes that many researchers share the conclusion that transfer of training is more a function of how the simulator is used rather than the degree of simulator fidelity.

In general it would seem that low fidelity simulators, compared to high fidelity devices, should be less expensive to design, produce, operate and maintain. Less clear is the relationship between level of fidelity of a simulation and the cost of modification of the simulation.

Development of SIMCAT

For years simulation-based trainers have provided a valuable medium for air combat training. In many ways air combat and armor combat field training needs are similar. Both involve equipment that is expensive to build, operate and maintain and, for both, safety considerations limit training realism. However, just as the battlefield role of armor is unique, armor training may require different types of simulators and different training approaches.

Computer supported battle simulations for armor training have been available for some time, for example, the Combined Arms Tactical Training Simulation and the Army Training Battle Simulation System. However, these simulations are geared to support command and staff training for higher command levels, battalion and above. A detailed representation of ground level combat is not required for training at those levels. Only recently has the technology become available to provide affordable visual displays having the speed and resolution necessary to represent ground level combat to support armor training for small units (Bessemer & Lampton, 1985).

In a survey of a broad array of emerging technologies, conducted by Henriksen et al. (1985), microcomputers, interactive videodisc media, voice recognition and synthesis devices, and high resolution graphics were identified as technologies having great potential to support training for small unit armor leaders. The capabilities of these technologies are expanding and costs are decreasing. Used together, these options may provide an economical method of representing the wide range of combat variables needed in an effective platoon level training simulation.

The U.S. Army Research Institute (ARI) has established a research program to identify simulation requirements for providing C^3 and tactical training for modern and future battlefield conditions. As part of this effort, ARI has had developed a prototype platoon level battle simulation, Simulation in Combined Arms Training (SIMCAT).

SIMCAT was developed for ARI by the Human Resources Research Organization. Perceptronics served as subcontractor. A wide variety of training documents, task inventories, and tactical scenarios were examined to identify the variables needed to be simulated in order to allow the practice of platoon level C^3 skills. SIMCAT design was not the result of long term study to determine the combat factors to be represented and the method of representation. Rather, the initial design of SIMCAT was based on the "best guesses" of a panel of armor SMEs and computer system development specialists. In addition, system cost was an overriding factor in determining the variables and methods of representation.

SIMCAT was not designed to be a gunnery or crew trainer (Hannaman, 1984b). Gunnery is represented only to the extent necessary to allow the Tank Commander (TC) to practice the C^3 aspects of main gun engagements. That is, the TC can select a target to be engaged, issue a fire command, and observe and report engagement outcomes (Lampton & Koger, 1987).

Functional Description of SIMCAT

SIMCAT contains seven networked IBM personal computers (PCs). Six of the PCs are connected with color monitors and videodisc players to provide stations for displaying the terrain and vehicles of a simulated battlefield. Four of these stations allow the participants (trainees) to serve as TCs, individually controlling the movement, firing, and communication of a simulated tank. Stations are also provided for an exercise controller and an opposing forces (OPFOR) controller. The seventh PC is used as a file server to pass information from station to station so that activities initiated at one station can be represented at all the other stations.

Tank Commander Station. Each of the TC stations contains a terrain display, a communications control box connected with a standard Combat Vehicle Crewman (CVC) helmet, and a touch sensitive control panel. Other than the communication box and CVC helmet the TC stations are not mock-ups. No attempt is made to physically represent the inside of a tank turret.

The terrain display presents a "bird's-eye" view of the battlefield. That is, an overhead, "downward looking," perspective of the terrain and vehicles is used. The terrain display is provided by photographs of sections of a U.S. Geological Survey 1:24,000 topographic map. The photographs are stored on a videodisc and are presented on the station color monitor. Three levels of terrain display are available. The 600 m x 450 m view is referred to as close range. Mid range is 3000 m x 2250 m and long range is 6600 m x 4950 m. The TC may use the control panel to shift from one level of view to another at any time during an exercise.

The SIMCAT terrain display is offset approximately 22 degrees counterclockwise from north. This "tilt" was intentionally built into the SIMCAT terrain display so that the "top" of the display screen does not represent "north." Participants in SIMCAT exercises are therefore required to orient their lap maps to the terrain display.

Vehicles are represented by computer generated icons superimposed on the terrain display. The vehicle being controlled from a particular station is depicted with a green turret. Other vehicles are displayed at a station only if they would be in line of sight with the vehicle under control by that station.

The vehicle icons are loosely modeled after standard military symbology for tanks and infantry fighting vehicles (IFVs). The tank icon consists of a rectangle, representing the tank hull, containing a smaller circle, the turret, from which extends a line, the gun tube. The IFV differs in that it has a diamond shaped hull. Icon color is used to indicate alignment; friendly vehicles are blue, enemy vehicles are red.

Moving vehicles appear to cross the map display. As a vehicle approaches the edge of the monitor screen the display is briefly blacked out. A new map section is then displayed with the moving vehicle icon reappearing near the center of the screen. As a vehicle moves up and down hills other vehicles pop in and out of view as line of sight is gained and lost. In order to estimate his current field of view the TC must interpret the map contour lines.

Each TC station is equipped with a voice recognition board to allow the TC to control the movement and firing of his tank by issuing orders aloud into the microphone of his CVC helmet. For example, the TC can say "driver, move out" and, after a brief delay, the tank icon will begin moving across the screen. Eighteen different driving commands, such as "ease out," "speed up," "turn left," and "steady on" are available to allow the TC to control the direction and rate of tank movement.

For main gun engagements the TC must issue doctrinally correct fire commands. For example, the TC can say "Gunner SABOT Tank" to alert the gunner, instruct the loader to load SABOT, and specify the type of target. The system will then respond "Ammo Up," using digitized voice playback, to simulate the role of the loader. If a target is within twenty degrees of the aiming point of the gun tube the system will simulate the TC to gunner "target handoff." That is, a digitized voice will announce "Identified" as the gun tube slews to point directly at the target. When the TC calls "Fire!" the gunner announces "On the Way" as a firing signature icon appears at the end of the gun tube, a line extends from the gun tube to the target, and an explosion icon appears on the target. When a target is damaged so that it has lost fire power and movement its icon changes into a "junk pile," a mass of twisted black lines.

The communication boxes at the TC stations and the exercise controller station are networked to simulate the platoon and company radio nets. Because the stations are separated by partitions the TCs are forced to use the radio nets to contact each other.

A touch sensitive control panel allows the TC to input commands that are not under voice control. These are; map view selection, turret orientation, hand and arm signals selection, and tank status. The hand and arm signal command causes the vehicle icon to be briefly replaced by a graphic representation of a standard hand and arm signal.

OPFOR Station. The OPFOR station contains a terrain display identical to the TC station display. Two types of vehicles can be represented, tanks and IFV s. The tanks and IFVs can fire anti-tank main gun ammunition and the IFVs can also launch anti-tank missiles. The missile has a distinctive launch signature, a cloud of smoke, and is represented as a red arrow that flies across the terrain. These vehicles and weapon systems were chosen to represent enemy threats that are likely to be encountered on the battlefield.

The OPFOR controller can also bring in indirect fire, artillery. Impacting artillery appears as an irregular pattern of explosion icons superimposed on the terrain display.

Exercise Controller Station. The exercise controller station contains a terrain display, monochrome monitor with keyboard, and a communications control box.

The exercise controller initiates a training exercise by selecting an initial conditions file. This file determines the starting location, hull orientation, and turret orientation of each of the friendly and enemy vehicles and the location of minefields. As many as thirty such files can be available at any one time.

During an exercise, the controller selects views to monitor platoon performance and to support the AAR. The controller may select to view at his station the terrain display that is being presented at any one of the TC stations or the OPFOR station. The controller may select a special view that is not available at any of the other stations. This "World" view displays the location of all vehicles without regard to line of sight. This world view also contains control graphics such as phase lines and boundary lines to help the controller evaluate platoon performance.

At any time during an exercise the controller may bring in indirect fire by entering grid coordinates of the intended target area. Minefields can also be selectively deactivated during an exercise.

The communications control box allows the controller to represent the company commander and the Fire Support Team (FIST) on the company radio net. The controller can also monitor the platoon net. Any of the nets can be jammed, flooded with white noise, to represent enemy electronic warfare.

At one minute intervals SIMCAT stores a "snapshot" of the current battlefield situation, including the location and status of each vehicle. The controller may elect to stop an exercise and go "back in time" by selecting a stored snapshot, to allow the platoon a second chance at some critical part of an exercise.

SIMCAT Software

The simulation software contains over 52 modules comprising 40,000 lines of Modula-2. Many of the modules are duplicated at each of the TC stations and the OPFOR station. For example, each of these stations has modules for line of sight determination, vehicle movement control, and resolution of direct fire engagements. In this manner the processing requirements are distributed among the station computers.

The SIMCAT terrain data base represents a 6X20 kilometer area of actual terrain running northwest (Brandenburg, KY) to southeast (Fort Knox Military Reservation). This area is not ideal tank country and presents many C^3 challenges.

Each 30 meter square section of terrain is coded for elevation and surface type, such as woods, paved road, or water barrier. Elevation code is used to determine line of sight between vehicles. Surface type determines the maximum speed at which an area can be crossed. Surface type also affects line of sight--vehicles can hide in a woodline.

Direct fire engagements are resolved on a shot-by-shot basis. Range, ammunition type, and movement by the weapon platform and/or target are taken into account in determining if a target is hit and damaged. A hit may cause no damage, loss of firepower, loss of mobility, or total destruction. The probabilities of hit and damage can be varied for each combination of range category, target type, and weapon system.

SIMCAT Hardware

The SIMCAT hardware consists of off-the-shelf standard computer equipment. Total hardware costs for the entire SIMCAT system were less than $60,000. The following technical description of the SIMCAT hardware is from Campbell (1985).

Each of the TC stations is equipped with an IBM PC (640K), a color monitor, a local disk drive (1.2MB), an 8087 math coprocessor, a graphics board, a Votan VPC 2000 voice board, a Polytel Keyport, and a videodisc player.

The OPFOR and exercise controller stations both have an IBM PC (640K), a color monitor, a monochrome monitor, a local disk drive (360K), a device controlled disk drive (1.2MB), an 8087 math coprocessor, a graphics board and a videodisc player. The OPFOR station also contains a Polytel Keyport.

The system file server consists of an IBM PC (256K), a single disk drive (360K), and an 8087 math coprocessor. The file server is connected to an XCOMP 31.5MB hard disk drive running the X-NET LAN.

SIMCAT Operational Problems

Initial testing with SIMCAT revealed several problems in using SIMCAT for training research. These problems, described below, are not inherent to low fidelity simulations in general or to the general design of SIMCAT in particular. These problems are assumed to be easily corrected, or avoided, in subsequent simulator designs. These problems are detailed below only because they had considerable influence on the design and conduct of the present experiment.

SIMCAT was originally designed to allow the TC to control the movement and firing of his tank by issuing orders aloud. That is, as the TC speaks orders into the microphone of his CVC helmet, voice recognition capabilities within the TC station would convert the TC's speech into the appropriate system command.

Several considerations made voice control a desirable feature for a training research simulation. One, voice control allows the trainee to practice the same type of behavior as is required in the field, that is, issuing orders aloud to the driver and the gunner. Two, speaking is natural, trainees are not required to learn to operate some control device such as a joystick. Three, voice control does not require the trainees to look away from the terrain display in order to input a command.

Initial work with SIMCAT uncovered three potential problems with using voice input for vehicle control. One, at least twenty minutes is required for voice enrollment. For extended training with SIMCAT the twenty minutes needed for enrollment could be justified. However, for limited training with SIMCAT, or for brief experimental sessions, the twenty minutes enrollment session takes up too much of the total available time. (Voice enrollment is the process by which the computer "learns" to recognize a set of specific words spoken by an individual. During voice enrollment the user speaks, several times, each of the words to be recognized. The system extracts and stores voice pattern information for only those words and for only that individual).

The second problem was that during the actual exercises the participants become excited and their voices show signs of stress. That is, they yell and have intonation patterns that differ from those used during the voice enrollment. In some ways these signs of stress are welcome. They indicate that SIMCAT is creating at least some of the pressure experienced during field exercises. However, the result is that the voice recognition device fails to accurately recognize the commands spoken under stress and therefore the TC loses the ability to control his vehicle. A possible solution to this problem may be to induce stress during the enrollment period.

The third problem associated with the use of the voice input mode was the lack of an "intelligent driver" in the simulation. The simulation could only execute simple commands such as "turn left" or "speed up." Instead of being able to say "driver, stay on this road" as he could do in a real tank, the voice input mode required the TC to issue guide or turn commands at every bend or turn in the road. In effect, the TC was not required to issue realistic commands to his driver, but rather was required to drive, vocally, the tank himself. This required the TC to do an inordinate amount of talking.

A short term solution was adopted to overcome the problems associated with voice input. The touch sensitive control panel, initially designed to input nonvoice commands such as the selection of map view range, was modified to include all of the driving and firing commands. This modification allowed the vehicle to be controlled by pressing labeled areas on the touch panel. Unfortunately, this input mode, interacting with factors discussed below, often led to problems in controlling the tanks.

A number of factors contributed to the difficulty of controlling the movement and firing of the simulated tanks. Use of the touch sensitive control panel required that the operator look away from the terrain display in order to find the appropriate command on the panel.

Another problem was that after an appropriate command was entered there was often a long delay before there was a noticeable corresponding effect in the simulation. For example, after pressing the "MOVE OUT" command a few seconds would elapse before the operator would observe movement of the tank under his control. Some of this delay was purposely built into the simulation to correspond to the performance of an actual tank. However, added to this planned delay was an unwanted delay caused by the slow system update cycle. Gunnery seemed especially slow because several commands, each requiring several seconds to be processed, had to be given in proper sequence.

An additional problem with SIMCAT gunnery involved the software rules used to simulate the target handoff from the TC to the gunner. If the intended target was destroyed, by the firing of another tank, just as the fire command was given, the simulated gunner would sometimes slew the gun tube to the next closest target, which could be a friendly tank. The "gunner" would then engage the friendly tank before a cease-fire command could be given. In this manner fratricides could occur, not as a result of error on the part of the platoon leader or TC, but rather as an unintended effect of the gunner simulation.

Finally, a major problem with SIMCAT was the reliability of the station networking system. On several occasions the networking failed, so that either the system completely crashed or actions at individual stations were no longer being passed to the other stations. At least 12 minutes were required to restart the system after a crash.

Battlefield Perspective

A critical issue in the training effectiveness of SIMCAT is the appropriateness of the "top down" or "bird's eye" perspective of the battlefield. With SIMCAT, the TC does not view the battlefield from the perspective of looking out the vision blocks of his own tank. Rather, he sees the battlefield from an overhead perspective, looking down at the vehicle which he controls and the surrounding terrain. (Ground-to-ground perspectives of the battlefield are more difficult to generate than the air-to-air or air-to-ground perspectives that are used in flight simulators. Only recently has affordable technology been developed that allows the generation, in real time, of ground-to-ground displays suitable for armor training). The bird's eye perspective was selected for SIMCAT to avoid the expense associated with generating a ground-to-ground battlefield perspective.

Eckles (1985) argues that a bird's eye perspective may offer training advantages over ground-to-ground displays. He proposes that the armor leader should learn to "see the battlefield," that is, to go beyond the terrain he can see from his position and to develop a mental picture of the battlefield as if viewed from an overhead perspective. Eckles proposes that for early stages of tactical training the armor leader should be given a display that presents the location of friendly and threat forces even if these forces would not be within his line of sight from ground level. As the trainee gains experience the amount of information in the display could be reduced, so that finally the trainee could develop an overall picture of the battlefield based only on information that would actually be available in the field.

Thus, Eckles points out that for some stages of tactical training, simulations should be designed not to be as realistic as possible, but rather to produce an abstract representation of the battlefield.

RATIONALE AND PURPOSE

Computer driven battle simulations, such as SIMCAT, may provide a needed complement to armor field training. Compared to field training, simulated combat is inexpensive, safe and can use terrain that is theoretically unlimited in extent and variety. In addition to providing extensive training opportunities, battle simulations may allow more precise measurement of tactical performance than can be obtained in the field. However, the critical factor in the evaluation of the worth of a training simulator is transfer of training. That is, "Does training with the device lead to improved performance under operational conditions or for other stages of training?"

The purpose of this study was to evaluate the use of low fidelity simulation, such as represented by SIMCAT, to train and evaluate C^3 skills for armor platoon leaders. Initial work with SIMCAT revealed several problems with the system, primarily related to the control of the simulated combat vehicles. The problems, detailed above, do not relate to low fidelity simulation in general but rather are specific to the initial design and implementation of SIMCAT. These problems are assumed to be easily corrected, or avoided, in subsequent simulator design. Therefore, a goal of this study was to work around the shortfalls that had already been detected in the present version of SIMCAT in order to test the general concept of low fidelity simulation represented by SIMCAT.

APPROACH

Eventually the question of transfer may be addressed by testing whether practice with SIMCAT leads to improved performance for field exercises, such as the Armor Officer Basic (AOB) "ten day war" or for missions at the National Training Center.

However, field transfer tests are resource intensive and present many problems in controlling critical variables. Therefore, a within-device transfer design was used for this study. With this type of design subjects are given an initial test (pretest), practice on the training device, and then are tested again (posttest). All testing and practice occur on the device. Different forms are used for the pretest and posttest to ensure that the subjects are not merely memorizing some pattern of responses. That is, measurement is made of the transfer from pretest and the practice conditions to the new conditions represented on the posttest.

The use of a within-device transfer design provides an inexpensive method to test the adequacy of training methods and materials. Until training on the device itself can be demonstrated it makes little sense to attempt an expensive field transfer study. However, a problem with within-device transfer designs is the question of validity. That is, "To what extent does practice on the device improve the target skills, for this study armor C^3 skills, as opposed to the extent that the trainees are learning skills specific to the device itself"?

To address the question of validity two groups of officers, with differing levels of experience, were tested. One group was made up of recent AOB graduates with no experience as platoon leaders other than that received during the AOB program of instruction. The second group comprised AOB graduates who had at least one rotation at NTC, or an ARTEP equivalent, as a platoon leader. In this manner a test was made for the effects of skill level upon SIMCAT performance. That is, "Do the officers that would be expected to do better on field exercises, the experienced officers, also do better on SIMCAT"? If SIMCAT provides a valid test of armor C^3 skills then we would expect the experienced officers to score higher on SIMCAT. If, however, success on SIMCAT is determined by other factors, such as familiarity with video games, then no differences between groups would be expected.

Because the focus was on the difference in performance of platoon leaders as a function of experience it was desirable that the C^3 load presented by the rest of the platoon be held constant across platoon leaders. C^3 load refers to the C^3 assets and liabilities of the other members of the platoon. To ensure a constant C^3 load across platoon leaders the same individuals served to represent the other platoon positions for all of the tactical exercises conducted throughout the study. The qualifications of these individuals is described in the Procedure section.

Another factor contributed to the need to use the same individuals at the other platoon positions throughout the study. Because of the great difficulty in controlling the movement and firing of the vehicles it was necessary to provide a considerable amount of practice for those responsible for controlling the tanks. For this study an experimenter confederate served as both the gunner and the driver at the platoon leader's station. This individual was in effect a "perfect" voice recognition device. The platoon leader would issue driver and gunner commands and the gunner/driver, having had several days of practice with the SIMCAT controls, would use the touch panel to input the commands. In this way the platoon leader also had an "intelligent" driver, who could stay on a winding road or avoid obstacles, without constant direction from the platoon leader.

Determination of the number of subjects to be used for this study was not based on an estimate of statistical power of the test supported by the experimental design, but rather was determined by practical considerations. The subjects for this research project, and for most of the research conducted by ARI at Fort Knox, are scheduled through an agreement with the Fort Knox Armor Center. The number of subjects for this study, twenty, and the duration of the participation of each subject, four hours, were determined primarily by the limited availability of Armor Center personnel.

C^3 Performance Test

SIMCAT has no "built in" training program or means of evaluating performance. A terrain board with armor miniatures can be used in many different ways for training. Similarly, many different training approaches could be attempted with SIMCAT. A previous study focussed on using SIMCAT for training tank commanders (Kristiansen, 1987). The focus for this study was to examine applications of SIMCAT for training and evaluating C^3 skills for the armor platoon leader.

The tests of C^3 and tactical performance for this study were derived from Situation Training Exercises (STXs) and Field Training Exercises (FTXs) outlined in FC 17-15-1 Tank Platoon Army Training and Evaluation Program Mission Training Plan (AMTEP). The AMTEP exercise scenarios represent missions critical to all armor units.

For this study AMTEP scenarios were tailored to correspond to the road nets and significant terrain features in the SIMCAT terrain data base. Two tactical scenarios were developed. Both of the scenarios contained a tactical roadmarch, passage of lines and movement to contact. (SIMCAT capabilities were not thought to be especially suitable for representing the critical factors for a passage of lines, but a passage of lines was required by doctrine to separate the tactical roadmarch from the crossing of the Line of Departure/Line of Contact (LDLC)). During the movement to contact the platoon encountered indirect fire and

Antitank Guided Missile (ATGM) fire, and was engaged by enemy tanks. The major differences between the two scenarios were the terrain crossed during the missions and the order of events encountered during the movement to contact. The scenarios were designed to differ sufficiently so that the officers serving as platoon leaders could not memorize some series of actions from one scenario in order to accomplish the mission presented in the other scenario. However, the scenarios had to be similar enough to allow meaningful comparison of performance across scenarios.

These scenarios were designed to require the platoon leader to perform an integrated, logical mission as part of a company operation. The C^3 tasks required of the platoon leader occur naturally as part of the mission. The platoon leader must perform tactical planning and employ land navigation skills. He must control the movement, firing and communication of his tank, section and platoon. Coordination of movement and firing with the other two platoons in the company and frequent radio contact with the Company Commander and FIST were required.

For each scenario the actions of the OPFOR controller were carefully scripted. The location of OPFOR vehicles and the nature and timing of attacks were held constant within each scenario. In addition to the "red" threat vehicles the OPFOR controller also controlled two "blue" tanks. These blue tanks were used to represent the two other platoons in the company.

Three types of measures of tactical performance were considered for this study, percentage of mission accomplished, exchange ratios, and AMTEP standards. For this initial study the focus was placed on the percentage of AMTEP standards met. The standards cover many aspects of C^3 skills and could therefore provide an indication of SIMCAT training effectiveness for several different areas. Because of the limitations of SIMCAT all aspects of some of the AMTEP tasks could not be represented and therefore the standards for these subtasks could not be measured. Tasks that are specifically related to the vehicle, such as maintenance, can not be evaluated on SIMCAT because no mock-up of actual equipment is presented.

Percentage of mission accomplishment, which would have been much easier to score than the standards, was not considered to be an appropriate measure because of the possibility that a platoon could accomplish the scenario mission by using techniques that work on SIMCAT but would be inappropriate for field exercises.

The use of an exchange ratio measure was considered inappropriate because of the use of random number generation in the SIMCAT system for resolution of fire. The inclusion of a random variable would introduce a "luck" factor which would be confounded with level of C^3 skills. In fact, for this study the hit/kill probabilities for OPFOR versus U.S. forces were set to zero. This was done to ensure that the platoon leader's tank would not be destroyed during the direct fire engagement. (Subjects were not informed that their tanks could not be damaged by OPFOR fire).

Hypotheses

(1) It was hypothesized that subjects would score higher on a test of C^3 skills taken after training with SIMCAT (posttest) than scored on a similar test taken before SIMCAT training (pretest). Because different scenarios are used for the posttest and pretest, improvement on the posttest would indicate that training generalized across scenario conditions.

(2) It was hypothesized that experienced platoon leaders would score higher on the pretest than inexperienced platoon leaders. This confirmation of the expected effect of experience would support the validity of the performance measures.

(3) The possibility of a trial by experience-level interaction was considered. Experienced armor leaders might show less improvement with practice because their pretest scores would be higher. There would be less room for improvement.

(4) It was hypothesized that there would be no significant difference between the level of difficulty of the two test scenarios, A and B, and that there would be no significant sequence effect, AB versus BA. Although there was no pretesting to determine equivalency of difficulty , the scenarios were designed to present similar events.

METHOD

Subjects

Ten recent AOB graduates, Specialty Code 12 (a, b or c, Armor Officer) with no field leadership experience were assigned to a group labelled "no experience" (NEXP). Ten AOB graduates, Specialty Code 12 (a, b or c, Armor Officer), who had at least one rotation at NTC as platoon leaders, or an ARTEP equivalent, were assigned to a group labelled as "experienced" (EXP).

Apparatus

The apparatus used in this research was:

(1) Simulation in Combined Arms Training (SIMCAT) battle simulator. See description in Background section.

(2) Cassette recorder and twenty 90 minute cassettes.

(3) Stop watch.

Instruments

(1) Experience questionnaire. Structured questionnaire to determine amount of previous relevant experience. See Appendix A.

(2) Tactical exercise checklists. TO&E standards checklists were modified to match SIMCAT representational capabilities. See Appendix B.

(3) SIMCAT training effectiveness questionnaire. See Table 3.

(4) SIMCAT evaluation questionnaire. See Table 4.

Design

Five of the officers from the EXP group and six from the NEXP group performed and were tested on the two tactical exercises in the sequence AB. The other officers performed and were tested on the two tactical exercises in the sequence BA. (Problems with the SIMCAT hard disk forced a 3 day delay during data collection. When data collection resumed, after system repair, the scenarios were presented in the wrong sequence to the 18th officer. This experimenter error resulted in 11 officers receiving the scenarios in the sequence AB and 9 receiving the sequence BA).

Procedure

The officers were run as they become available over a period totaling three weeks. The order of running officers was therefore unsystematic but not random. The order of events for each officer was:

(1) Overview of the research. The experimenter read aloud the volunteer agreement (see Appendix C) as the officer read a printed copy. After being given the opportunity to ask questions about the experimental purpose and procedure the officer signed the human subject consent form (see Appendix C).

(2) The officer was given an experience profile questionnaire. Information from the questionnaire was used to confirm that the officer was assigned to the appropriate group. (Average

length of service for the inexperienced group was 6 months, the average for the experienced group was 31 months).

(3) The officer was given a SIMCAT orientation, demonstration and practice session, described below, to ensure that the officer was familiar with the SIMCAT system and the types of actions required of him during the data collection exercises.

The orientation covered map scale and map view selection, turret control, and movement and firing commands. The communication system, used to simulate the platoon and company nets, was also described.

(4) The Chief Controller then acted as platoon leader for a brief demonstration that included command to move out, change of formation, reaction to ATGM, call for indirect fire (platoon leader used the company net to call the FIST), a direct fire engagement and a spot report. During this demonstration the officer was directed to observe the appearance of enemy tanks and IFVs, direct fire engagements including main gun firing signatures and the appearance of a SAGGER in flight, and impacting artillery.

(5) The officer was then given two practice runs to act as platoon leader in performing the following tasks: issue command to move out, change formation, react to ATGM, call for indirect fire, conduct a direct fire engagement and deliver a spot report.

(6) The officer then performed as platoon leader on three tactical exercises. Warning and operations orders, and controller scripts, for each scenario are presented in Appendix D. The Chief Controller for all the exercises was an 0-4 armor officer with extensive experience as a platoon leader. The Chief Controller represented the Company Commander and FIST on the company radio net during the tactical exercises, scored checklists, and performed an After Action Review (AAR) after each exercise. The Chief Controller used the standards checklists to support the AAR. The initial plan was for the Chief Controller to also act as an independent data collector to allow interrater scoring reliability to be determined. Because of the fast pace of events during the exercises it became necessary for the Chief Controller and the data collector to work together in scoring platoon leader performance. Also, despite the GO/NO GO nature of the scoring, the civilian data collector often required assistance from the Chief Controller in determining the appropriateness of the officer's actions.

Experienced NCOs were tasked to serve as experimenter confederates during platoon exercises to represent the platoon sergeant and two TCs. These confederates had appropriate experience to serve in their assigned positions, that is, the NCO who served as the platoon sergeant during the SIMCAT exercises was an experienced Table of Organization and Equipment (TO&E) tank platoon sergeant and the TCs were experienced TO&E tank commanders. An additional confederate, a Specialist-4 familiar with gunnery and driving commands, performed the touch panel operations at the platoon leader's station, serving as the officer's gunner and driver. These confederates received two and a half days of practice on SIMCAT before data collection began. Their practice concluded with several rehearsals of the scenarios to be used during data collection.

These same individuals represented their platoon positions for all of the data collection runs, with few exceptions. (On three occasions a civilian, experienced with SIMCAT operations and the scenarios, served as a TC to replace an absent NCO). In this way all officers serving as platoon leaders dealt with equivalent C^3 loads, that is the assets and liabilities of the platoon personnel were the same for all officers.

The NCOs were instructed to avoid being overly helpful to the platoon leader but rather to represent an "average" platoon. They were instructed to follow orders from the platoon leader even if they knew the orders to be incorrect and to refrain from prompting the platoon leader if he failed to initiate appropriate action.

At the beginning of the first exercise the Chief Controller and the officer synchronized watches. During the first exercise, the pretest, the Chief Controller provided no information to the officer other than that which would be provided by a Company Commander during a combat mission. At the conclusion of the exercise, the Chief Controller conducted an AAR, in which he questioned and critiqued the officer on his performance as platoon leader and offered suggestions to improve performance.

During the second tactical exercise, using the same scenario as used for the first exercise, the Chief Controller was free to stop the exercise at any time and offer immediate feedback and advice. That is, the controller could stop the exercise at any time to conduct a During Action Review (DAR). Separate initial condition files had been created for the five critical points in each scenario. These were; move out from AA, cross the LDLC, react to indirect fire, react to ATGM, and actions on contact. By selecting one of these files the Chief Controller could skip intervening events and have the officer practice only those events not handled well during the first exercise. Because the events could vary greatly from officer to officer, the officer's performance was not scored during the second exercise.

For the third exercise, the posttest, the same format was used as for the first exercise, that is, the Chief Controller acted as Company Commander giving no additional feedback. If scenario A was used for the first two exercises then scenario B was used for the posttest, and vice versa.

(7) After the third exercise was completed the officer was again given an AAR. This AAR was not required by the experimental design but was given for the training benefit of the officer. The officer then completed questionnaires concerning the training effectiveness of SIMCAT and the effectiveness of SIMCAT for simulating combat variables.

Criterion Measures

The AMTEP standards checklists cover a broad range of platoon leader tasks. For purposes of analysis for this study the standards were grouped as five tasks; planning, tactical roadmarch, react to indirect fire, react to ATGM, and actions on contact.

Each officer's planning score was based on his oral warning order and operations order presented to the platoon (The scoring checklist for each of the five tasks is presented in Appendix B). For example, the checklist for the planning task has eight items of information, listed next to the eight check boxes, which the officer should have presented during the platoon warning order. The number of items correctly presented during the warning order was added to the number of correct items for the operations order to produce the planning score.

The tactical road march checklist allowed scoring of the officer's land navigation and map reading skills. The officer was scored for crossing each of the control points at the proper location. In addition, the proper reporting of the passage of each control point was scored. The tactical roadmarch score also included the correct crossing and reporting of the Release Point (RP) and LD/LC and whether the platoon was in proper formation for crossing the LD/LC. (An anticipated problem for scoring the tactical roadmarch was that the officer, in determining the order of march, might designate a tank other than his own to be the lead vehicle. The other TCs were instructed to require the platoon leader to direct their speed and direction of movement if the officer was not commanding the lead vehicle).

The react to indirect Fire checklist allowed scoring of the officer's command and control of his own tank and platoon (direct to close hatch and go to MOPP 4), and communication with the company commander (submit spot report or shell rep). Time to reconstitute the platoon formation after clearing the beaten area was also recorded.

Similar to react to indirect fire, the checklists for react to ATGM and direct fire (actions on contact) allowed scoring of the officer's control of his own tank and platoon, and communications with the company commander. For React to ATGM the OPFOR controller fired a SAGGER at the lead element of the platoon. The firing vehicle was hidden in woods and out of effective main gun range for the platoon. Appropriate actions for the platoon leader were to direct the platoon to launch smoke grenades and seek cover, and to contact the company commander and FIST to call for and adjust indirect fire onto the suspected SAGGER controller site. For the Direct Fire event two T72s emerged from a tree line and engaged the platoon.

The term "overall score" is used in the following sections to refer to the percentage of standards met averaged across all five of the major tasks; planning, tactical roadmarch, react to indirect fire, react to ATGM, and direct fire. The percentage of GOs (standards met correctly) for each task was determined and these percentages were averaged to produce an overall score. Percentage correct was determined for each task in order to avoid weighting the contribution of each task to the overall score by the number of standards for that task.

Some scoring of communication was conducted during each exercise to allow the Chief Controller to conduct an effective AAR. Communications were tape recorded so that more detailed and precise scoring could be performed, if necessary, after sessions were concluded. Company level communications were scored for completeness and for time to report, that is the delay between when an event occurred and when it was reported.

The term "lag" is used in the following sections to refer to the elapsed time between when an event occurred and the time that the officer initiated appropriate action. Most of the lag scores were related to reporting. For example, in the direct fire (actions on contact) event, the lag score is the time elapsed from the initial contact with enemy tanks to the officer's reporting of contact to the company commander. If no report was made then no lag score was recorded. No maximum or penalty lag score was assigned when reports were omitted. For each officer all lag scores were averaged to produce a single lag score.

The end of the direct fire engagement was the last event for which data could be collected for analysis across all officers, although the scenario scripts specified additional actions beyond this point. Several factors contributed to this. Many of the officers fell behind the time schedule in the execution of the mission. The actions on contact event was the latest event that all officers completed. Officers that were on or ahead of schedule were allowed to complete the mission, but data for these final events were not included in the overall analysis. Another problem was that the direct fire event often ended with fratricides due to the SIMCAT gunnery system. Fratricide sometimes occurred despite careful deployment and fire control by the platoon leader.

RESULTS AND DISCUSSION

Standards

A 2x2x2 (experience level by sequence of scenario presentation by trial) repeated measures analysis of variance was performed on the overall scores, that is, the standards composite scores, for the pretest and posttest. Significant effects were found for experience (experienced vs inexperienced), $F(1,16) = 7.84$, $p<.05$ and trial (pretest vs posttest) $F(1,16) = 16.85$, $p<.05$. Also significant was the interaction of experience by scenario sequence (AB vs BA) by trial, $F(1,16) = 5.63$, $p<.05$. (Means and standard deviations for the overall scores and for lag scores are presented in Table 1.)

Table 1

Means and Standard Deviations of Combined Task Scores and of Time to Report as a Function of Experience Level, Scenario Sequence, and Trial

Experience Level	Scenario Sequence		Overall Combined Score (Percent Correct)		Elapsed Time to Report (SECs)	
			Pre	Post	Pre	Post
Inexperienced	AB	M	55.8	56.9	30.16	41.34
		SD	09.5	06.6	16.11	28.72
Inexperienced	BA	M	54.2	73.5	51.72	16.28
		SD	12.0	13.1	11.03	05.95
Experienced	AB	M	67.6	75.1	38.40	26.51
		SD	09.3	12.9	24.69	24.34
Experienced	BA	M	67.3	73.3	26.05	18.95
		SD	02.8	08.8	13.30	21.29

Figure 1 presents the mean overall scores as a function of experience level and trial. Both groups showed improvement from the pretest to the posttest. The experienced group scored higher for both trials and the inexperienced group showed greater improvement across trials.

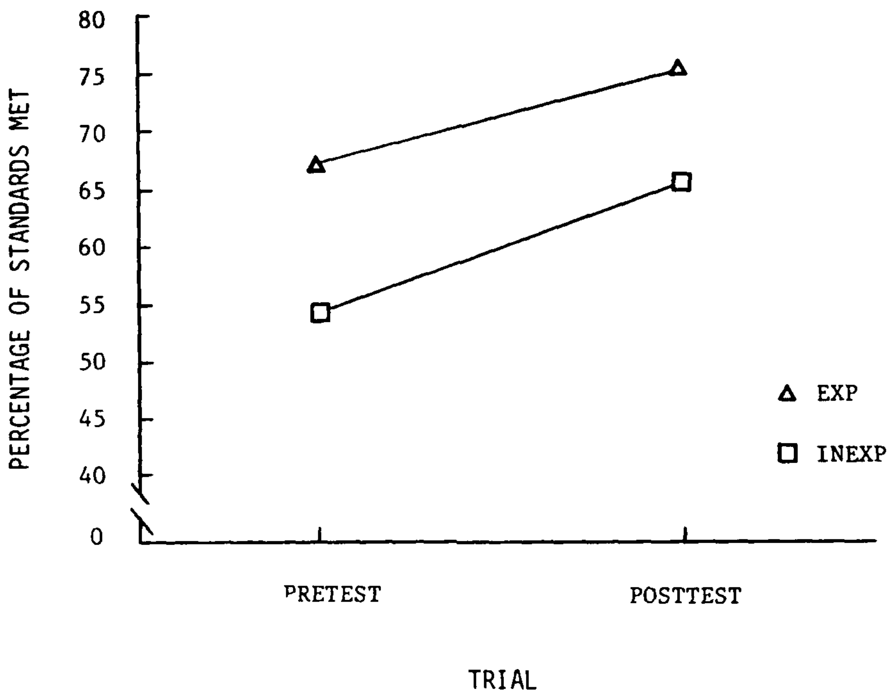

Figure 1. Mean overall percentages of standards met as a function of experience level and trial.

The significant interaction of experience by scenario sequence by trial was not predicted. To facilitate the interpretation of this interaction the means of the pre and posttests were graphed for the four groups formed by crossing the two levels of experience and the two sequences of scenario presentation. Figure 2 presents overall scores as a function of experience level, sequence of scenario presentation, and trial. This figure indicates that, of the four groups, three of the groups displayed similar patterns across trials. That is, for both of the experienced groups, regardless of scenario sequence, and the inexperienced group that received the scenarios in sequence BA, the overall scores improved from the pretest to the posttest. For the inexperienced group that received the scenarios in the sequence AB there was no improvement in scores across trials.

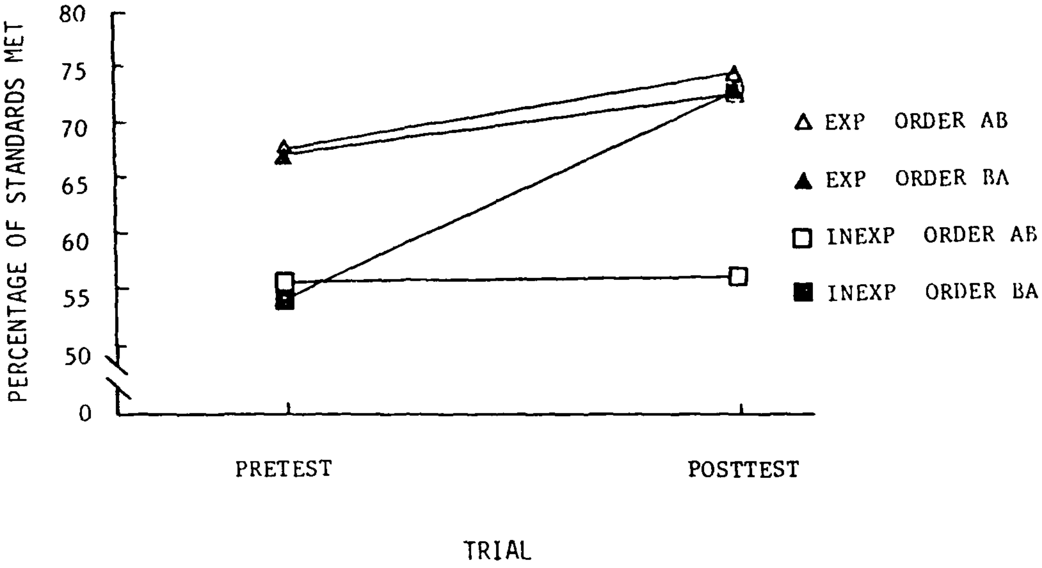

Figure 2. Mean overall percentages of standards met as a function of experience level, sequence of scenario presentation, and trial.

A separate repeated measures analysis of variance was performed for the lag scores. Significant effects were found for trial, $F(1,16) = 6.41$, $p<.05$, the scenario sequence by trial interaction, $F(1,16) = 6.00$, $p<.05$, and the experience level by scenario sequence by trial interaction, $F(1,16) = 9.06$, $p<.05$. Figure 3 depicts the lag scores as a function of experience level and trial. For lag, lower scores represent better performance, that is, a lower lag score represents more timely reporting. The experienced group had better lag scores than the inexperienced (although this difference was not statistically significant) and both groups improved across trials.

Figure 4 presents lag scores as a function of experience level, sequence of scenario presentation, and trial. Similar to the pattern found for the overall scores, three of the groups showed improvement from the pretest to the posttest. Only the inexperienced officers that received the scenarios in the sequence AB did not show improvement.

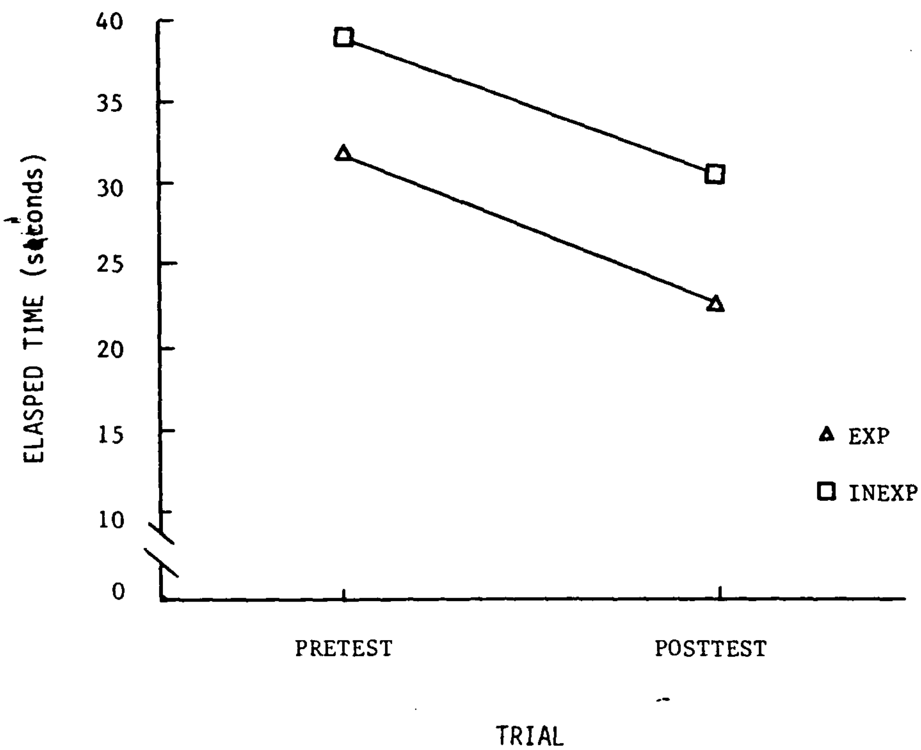

Figure 3. Elapsed time (lag) to initiate reporting as a function of experience level and trial.

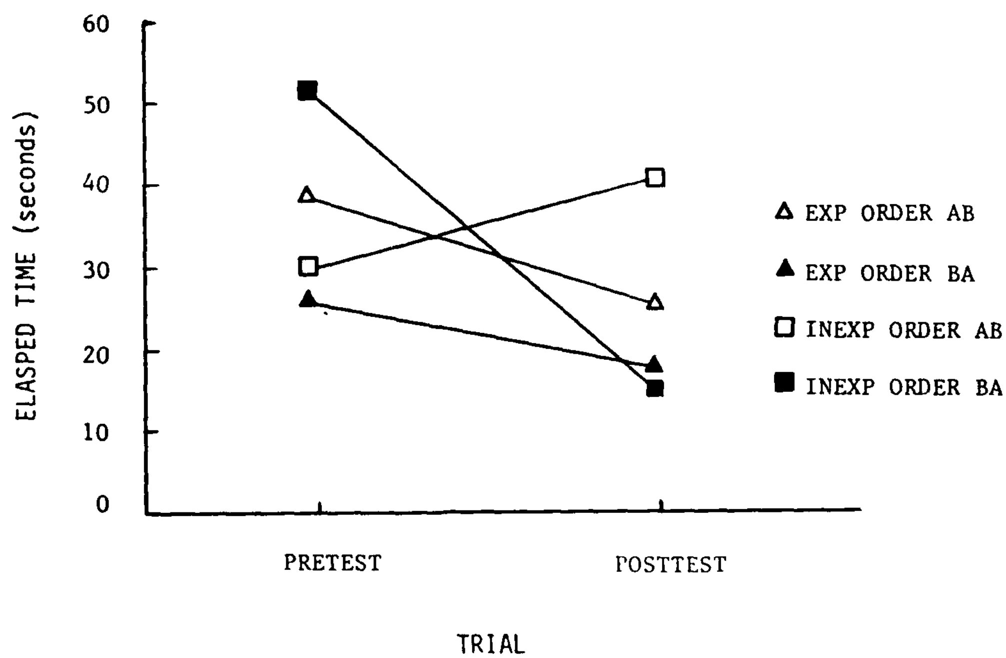

Figure 4. Elapsed time (lag) to initiate reporting as a function of experience level, sequence of scenario presentation, and trial.

This interaction of experience level and sequence of scenario presentation was not predicted for either the overall or lag scores. The scenarios were designed to be of equivalent difficulty; however, no extensive pilot testing was conducted just to confirm the equivalency of the two scenarios.

The B scenario may have been more difficult, not because of content or event pacing, but rather due to orientation problems related to the SIMCAT terrain display. For several parts of the B scenario the platoon must move to the south. With SIMCAT, traveling south involves driving toward the bottom of the monitor screen. Because of the "downward looking" perspective presented by the display left-right directions are reversed when the tank is pointed toward the bottom of the screen. For example, when a tank, driving "down screen", is turned to its right it will appear to move to the viewer's left.

Officers that received the B scenario first had few screen orientation problems when transferred to scenario A for the posttest. However, officers that went from scenario A to scenario B had to deal with the orientation problem during the posttest. Perhaps due to their greater C^3 skills the experienced officers were able to overcome the orientation problem.

Another aspect of the SIMCAT terrain display which may have resulted in the different levels of difficulty of the two scenarios is the map view offset. Because the scenarios required different movement orientations the offset may have produced more orientation problems for the B scenario.

A third factor may have contributed to the difference in the difficulty of the two scenarios. The terrain features of the objective and intervening terrain for the B scenario may not have been as distinctive as for the A scenario. For the B scenario the platoons tended to drift too far to the north and out of the assigned sector. This drift created several additional problems for the platoon leaders and resulted in several platoon leaders completely missing the objective. The question of terrain feature distinctiveness may not be solely a function of the SIMCAT terrain display. That is, it is possible that if these exercises were actually conducted in the field one scenario might present navigation challenges more difficult than those of the other scenario.

The three factors discussed above do not seem to entirely account for the observed interactions. Further research may be required to provide a more satisfactory explanation.

The C^3 performance of each officer was scored on many different variables. If separate analyses were to be performed for each variable there would be a strong chance of spuriously obtaining significant results. On the other hand, if a more conservative criterion level was adopted to correspond to the number of analyses being performed then it would be difficult to demonstrate any significant effects, especially if very strong treatment effects were not expected (see General Discussion). Therefore, the decision was made to perform analyses of variance for only the overall scores and for the lag scores. For each of the five task variables, graphs of the group (high experience versus low experience) means as a function of trial (pre versus posttest) are presented. The discussions for these variables are based upon visual interpretation of the graphs. (Means and standard deviations of the percentage of task standards met are presented in Table 2).

Table 2

Means and Standard Deviations of Percentages of Standards Met As a Function of Experience Level, Scenario Sequence, and Trial

Experience Level	Scenario Sequence		Tasks: Planning		Roadmarch		Indirect		ATGM		Direct	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Inexperienced	AB	M	67.9	73.5	72.2	69.4	33.3	25.0	30.6	50.0	75.0	66.7
		SD	15.5	05.5	20.2	24.5	12.9	31.6	16.4	10.5	29.3	23.6
Inexperienced	BA	M	73.1	75.9	75.0	87.5	18.8	62.5	50.0	62.5	54.2	79.2
		SD	11.1	04.8	09.6	16.0	12.5	25.0	23.6	16.0	37.0	25.0
Experienced	AB	M	71.1	82.2	73.3	83.3	40.0	60.0	66.7	66.7	86.7	83.3
		SD	12.9	08.8	19.0	16.7	13.7	13.7	26.4	31.2	07.5	20.4
Experienced	BA	M	76.3	80.0	86.7	96.7	30.0	40.0	63.3	63.3	80.0	86.7
		SD	06.2	04.2	07.5	07.5	11.2	13.7	07.5	21.7	13.9	21.7

(One of the reviewers of this paper, Dr. David Bessemer, recommended that separate analyses of variance be performed on the percent of standards met for each of the five task variables. Only the trial effects for planning and for react to indirect fire were significant at the .Ø5 level, unadjusted for the number of separate analyses conducted. The only significant group effect was found for react to ATGM. Dr. Bessemer recommended an additional analysis, a doubly multivariate repeated measures analysis. For this analysis, pre and posttest scores for each of the five task variables are entered for each subject. Using this approach only the trial effect was significant).

Group means for the planning scores are shown in Figure 5. For both the pre and posttests the experienced group scored higher than the inexperienced and both groups improved across trials. In some ways the planning scores are independent of SIMCAT. Each officer, after receiving company-level warning orders and operations orders with appropriate graphics, gave his own platoon operations order. The officer's planning score was based on the oral operations order presented to the platoon before move out occurred on SIMCAT. This procedure could be conducted without SIMCAT. However, for several officers, unclear or incomplete information in the operations order led to problems during the mission. In this way there was a clearer demonstration of the relation between planning and mission success than could have been obtained by critiquing the officer's operation order without actually performing the mission on SIMCAT.

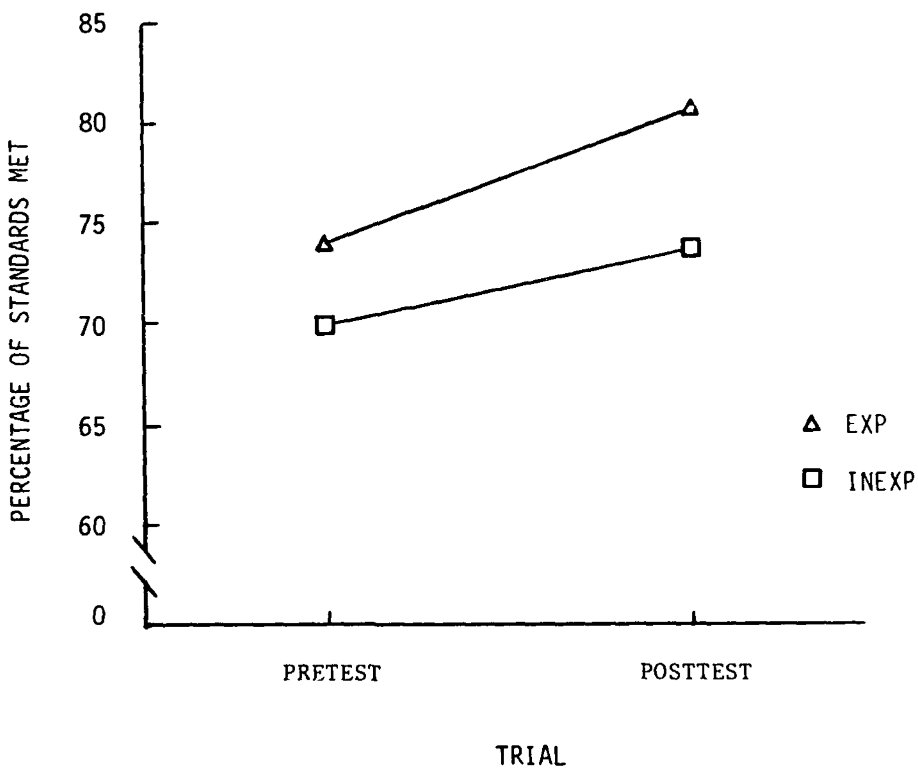

Figure 5. Mean percentages of standards met for mission planning as a function of experience level and trial.

The Tactical Roadmarch scores reflected the officer's ability to navigate and report the mission control points. Group means are shown in Figure 6. Both groups improved across trials.

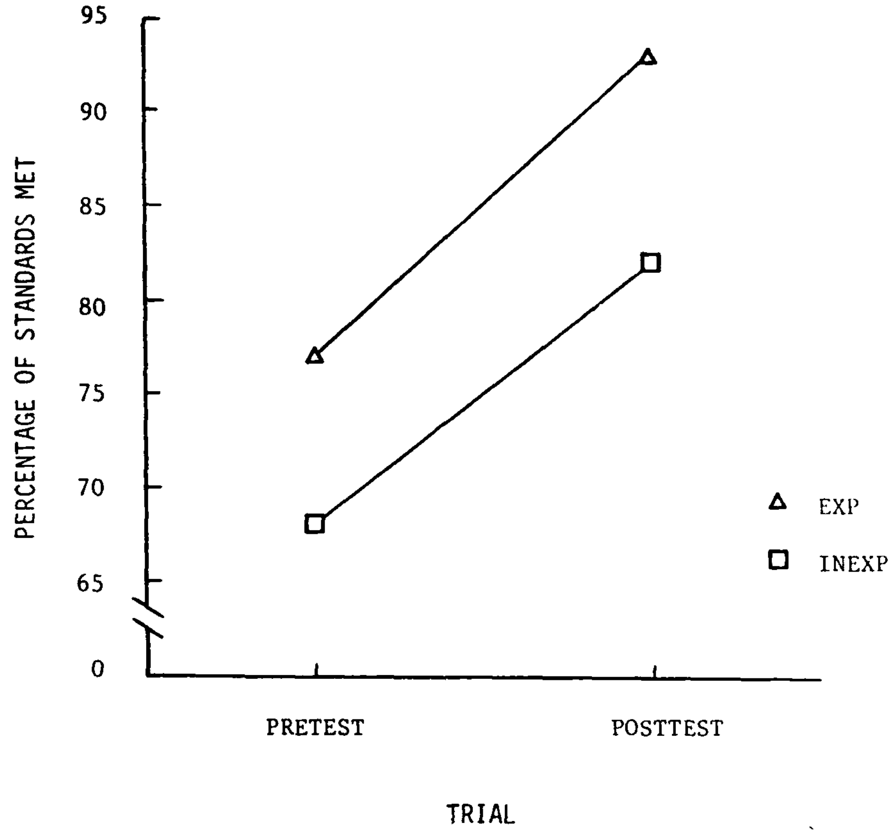

Figure 6. Mean percentages of standards met for conduct of a tactical roadmarch as a function of experience level and trial.

Figure 7 depicts the group scores for React to ATGM. The inexperienced group showed improvement across trials, the experienced group did not. This lack of improvement for the experienced group certainly can not be attributed to a ceiling effect. That is, it is not the case that the experienced group scored so high on the pretest that there was no room for improvement on the posttest. For Reaction to ATGM, low scores were probably a function of the SIMCAT graphics. The system does not reliably produce a readily observable launch signature and flight path. To score performance the data collector sat next to the chief controller station and could view a display similar to that being presented to the officer. This arrangement allowed the data collector to interact with the chief controller and to view what the officer viewed without standing over the officer's shoulder. However, for the react to ATGM event the data collector could not always determine if the officer had seen the launch signature and flight of the SAGGER. Therefore, for some officers, the failure to perform appropriate actions may not have been due to a lack of appropriate knowledge or skill on the part of the officer but rather to a failure of the SIMCAT system to produce the appropriate visual cues.

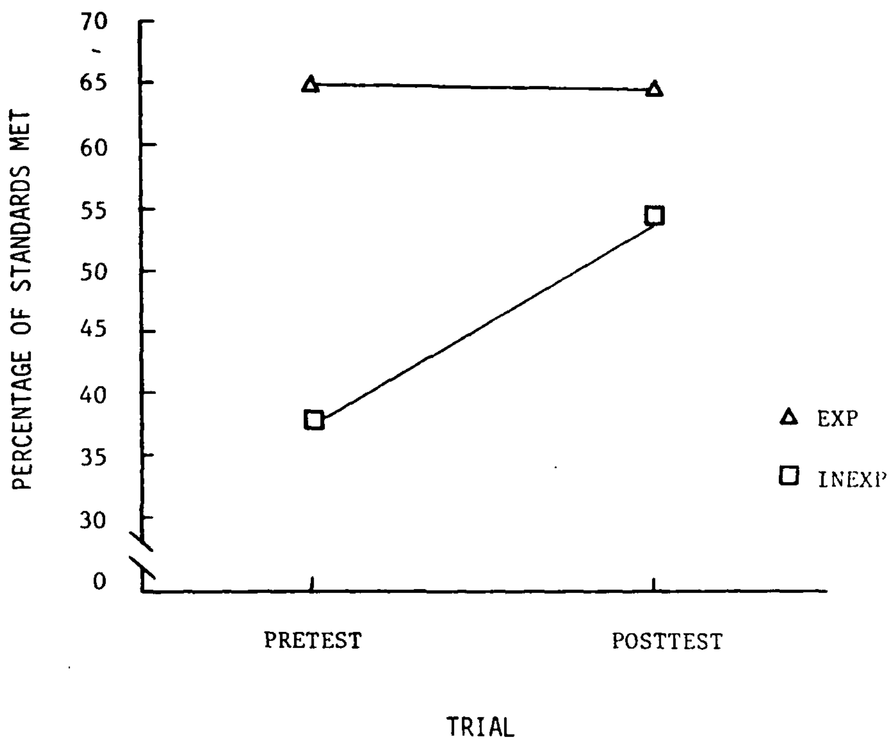

Figure 7. Mean percentages of standards met for reaction to ATGM as a function of experience level and trial.

Group scores for React to Indirect Fire are presented in Figure 8. Both groups improved across trials, but for both, scores were low. For reaction to indirect fire the lower scores were a function of an interaction between the nature of the graphics and the scenario events. Several of the officers mistook the explosion icons, meant to represent enemy indirect fire, as a misplaced friendly smoke mission. Instead of reacting to threatening indirect fire the officers would try to contact the FIST to adjust the smoke mission.

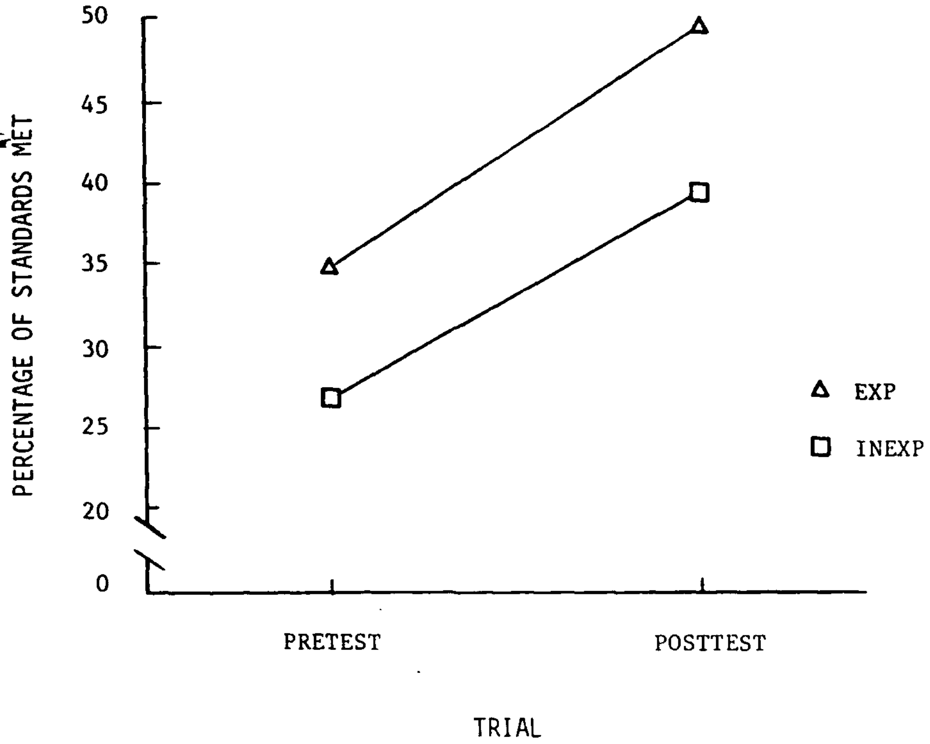

Figure 8. Mean percentages of standards met for reaction to indirect fire as a function of experience level and trial.

Another factor contributed to the low average of the react to indirect fire scores for the experienced group. Several of the experienced officers failed to direct the rest of the platoon to close hatches and assume MOPP 4 during the artillery impact. When questioned about this during the AAR they replied that those actions were SOP and need not be directed by the platoon leader.

Figure 9 presents the group scores for Actions on Contact. For both the pre and posttests the experienced group scored higher than the inexperienced. Both groups showed only minor gains with practice.

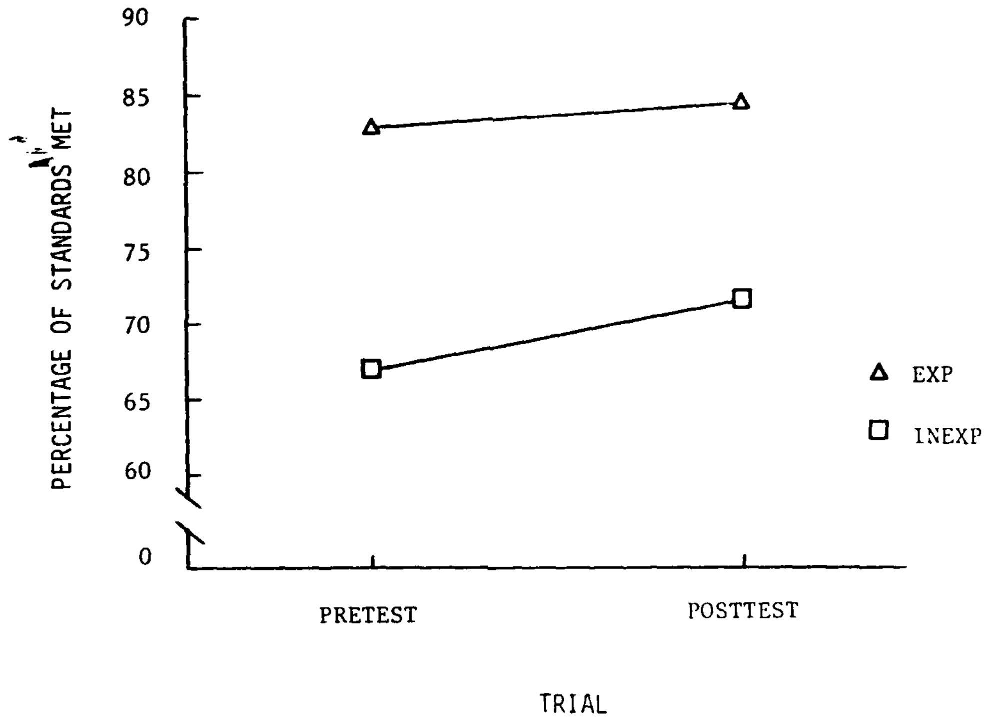

Figure 9. Mean percentages of standards met for actions on contact as a function of experience level and trial.

Subjects' Evaluation of SIMCAT

After completion of the tactical exercises the officers were given questionnaires to measure their ratings of the training effectiveness of SIMCAT and the quality of the SIMCAT representation of critical combat variables.

Table 3 presents the questions, rating scales and response frequencies for the SIMCAT training effectiveness questionnaire. Ratings were very favorable of SIMCAT's effectiveness for training command, control and communications skills. Also, SIMCAT was rated favorably as a means for preparing a platoon for field exercises. The officers also indicated that they would use SIMCAT to train their units if such a device was available. (In constructing the question about frequency of SIMCAT use, initial consideration was given to using response categories more specific than those actually used. The general categories that were used were thought to be more appropriate for the recent AOB graduates because of their lack of experience with unit training).

Table 3

SIMCAT Training Effectiveness Questionnaire

1. Does SIMCAT provide effective training for command and control skills?

combined average rating 4.4

	High %	Low %	Overall %
very ineffective			
ineffective			
in-between	10	10	10
effective	50	30	40
very effective	40	60	50

2. Does SIMCAT provide effective training for communication procedures?

combined average rating 4.45

	High %	Low %	Overall %
very ineffective		10	5
ineffective			
in-between			
effective	40	30	35
very effective	60	60	60

3. Is SIMCAT a good way to prepare a platoon for field exercise?

combined average rating 3.8

	High %	Low %	Overall %
very poor			
rather poor			
in-between	30	50	40
rather good	40	40	40
very good	30	10	20

4. Would you use SIMCAT to train platoons in your (future) unit?

combined average rating 3.6

	High %	Low %	Overall %
never			
very little	10		5
occasionally	30	60	45
frequently	40	30	35
very frequently	20	10	15

Table 4 lists the variables, rating scales and response frequencies for the officer's rating of how well SIMCAT represents selected critical combat variables. The SIMCAT representations of company and platoon level communications were rated very favorably as was indirect fire. The ratings for the other variables were less favorable, however, none of the variables, averaged across officers, received negative ratings.

Table 4

SIMCAT Combat Variable Evaluation Questionnaire

Please rate how well SIMCAT represents the following combat factors:

1. Terrain:

	Experience Level		
	High %	Low %	Overall %
very good		10	5
rather good	40	30	35
in-between	50	40	45
rather poor		20	10
very poor	10		5

combined average rating 2.75

2. Direct Fire:

	Experience Level High %	Low %	Overall %
very good	10	10	10
rather good	10	50	30
in-between	60	30	45
rather poor	20	10	15
very poor			

combined average rating 2.65

3. Indirect Fire:

	Experience Level High %	Low %	Overall %
very good	70	50	60
rather good	20	40	30
in-between	10	10	10
rather poor			
very poor			

combined average rating 1.5

4. Crew Communications:

	Experience Level High %	Low %	Overall %
very good	60	40	50
rather good		20	10
in-between		30	15
rather poor	30	10	20
very poor	10		5

combined average rating 2.2

5. Platoon Communications:

	Experience Level High %	Low %	Overall %
very good	80	80	80
rather good	20	10	15
in-between		10	5
rather poor			
very poor			

combined average rating 1.25

6. Company CO/FIST communications:

	Experience Level		
	* High %	Low %	Overall %
very good	56	9Ø	74
rather good	44	1Ø	26
in-between			
rather poor			
very poor			

combined average rating 1.26

* One subject didn't respond for this item.

7. Vehicle Movement:

	Experience Level		
	High %	Low %	Overall %
very good		2Ø	1Ø
rather good	5Ø	1Ø	3Ø
in-between	3Ø	5Ø	4Ø
rather poor		2Ø	1Ø
very poor	2Ø		1Ø

combined average rating 2.8

8. OPFOR:

	Experience Level		
	High %	*Low %	Overall %
very good	1Ø	1Ø	11
rather good	5Ø	4Ø	47
in-between	4Ø	3Ø	37
rather poor		1Ø	5
very poor			

combined average rating 2.37

* One subject didn't respond to this item.

9. Rate your ability to control the movement of your own vehicle.

	Experience Level		
	* High %	Low %	Overall %
very good	10	30	22
rather good	50	40	44
in-between		40	22
rather poor	20		11
very poor			

combined average rating 2.22

* Two subjects didn't respond to this item.

10. Rate your ability to control the firing of your own vehicle.

	Experience Level		
	*High %	Low %	Overall %
very good		20	11
rather good	20	30	28
in-between	40	40	44
rather poor	20	10	17
very poor			

combined average rating 2.67

* Two subjects didn't respond to this item.

Kendall Tau B coefficients were calculated to compare the ratings of the experienced versus the inexperienced groups. Overall response patterns were similar for the groups. (Only for the rating of Company/FIST communications was a significant difference found (Tau B = .39, $p < .05$). Most, 9 of 10, of the inexperienced subjects rated the SIMCAT representation of Company/FIST communications as "Very Good." Within the experienced group, the ratings were more evenly divided among the "Very Good" and the "Rather Good" categories).

GENERAL DISCUSSION

The tactical performance scores were primarily a function of three different factors. One, the tactical skills of the officers serving as platoon leaders. Two, the capability of SIMCAT (and the scenarios and controllers) to represent combat situations and allow the officers to perform appropriate actions.

Three, the ability of the experimenters to accurately score performance. (SIMCAT contains no data collection facilities).

The experienced officers scored higher than the inexperienced. This confirmation of the expected effect of experience level gives credence to the validity of the scoring procedure. SIMCAT was capable of representing tactical situations so that appropriate actions could be performed and evaluated.

Both groups showed significant improvement with practice on SIMCAT. Because of time constraints on the availability of officers, only a limited amount of SIMCAT practice could be conducted. A large improvement in tactical performance was not expected to result from just a few hours of practice.

Officers were assigned to groups on the basis of the amount of field experience as platoon leaders. The recent AOB graduates were assumed to have knowledge of basic C^3 procedures but to be lacking in experience in executing those procedures. Therefore, great differences in tactical performance were not expected between the two groups.

For practice with SIMCAT to be worthwhile the participants need some familiarity with basic armor C^3 procedures. Although a SIMCAT exercise might rapidly expose a trainee's weakness in a particular area, for example reporting procedures, SIMCAT does not provide an especially convenient media for the initial teaching of basic procedures. Rather, SIMCAT does seem very useful for allowing integrated practice of C^3 procedures and principles.

What SIMCAT Trains

Subjective observations of aspects of officer performance not directly measured during this study, and earlier informal trials, suggest that practice with SIMCAT leads to improvement in the ability to perform the following tasks: (a) Recognize the relationship between planning and mission outcome. (b) Display situational awareness, that is, recognize situations that call for particular responses. (c) Anticipate C3 overload. (d) Perform time-shared tasks. (e) Make C^3 decisions under realistic time pressure.

There is considerable overlap for many of these tasks. In the discussion below no order of importance is implied by the order of presentation.

Recognition of the Relation Between Planning and Mission Outcome. In giving the platoon warning and operations orders many of the inexperienced officers initially attempted to merely recite the company warning and operations orders. Even with this approach information was often omitted or presented erroneously. The officers were careful on subsequent trials to make sure that they themselves understood the mission before attempting to issue platoon orders.

In contrast to the inexperienced officers, most of the experienced officers tried to anticipate potential areas of confusion and specifically addressed these areas in their orders to the platoon. Indeed, several of the experienced officers added extra control measures to the mission graphics to enhance mission clarity and improve control.

Development of Situational Awareness. Many of the actions required of the officer during the tactical exercises conducted with SIMCAT are not directly prompted by the exercise controller. That is, the officer must recognize that certain conditions have come about and must initiate action. For example, officers must know not only how to execute various battle drills but also be able to select the appropriate drill for a given situation.

Anticipation of C^3 Choke Points. Just as there are physical "choke points" where terrain and obstacles limit maneuver options, there are C^3 choke points where the leader may be overwhelmed by conflicting demands. Initially, many of the inexperienced officers would "freeze", that is fail to make any meaningful response, when confronted with tactically demanding situations. After practice with SIMCAT officers improved in their reaction time to enemy actions and their ability to anticipate enemy actions.

Performance of Time-Shared Tasks and Assignment of Priorities to Tasks. For many situations, for example actions on contact, the officer must command his own tank, command his section and platoon, and communicate with the company commander and FIST. Inexperienced officers tended to follow this order in strict sequence, that is, own tank, then platoon, and finally company commander. Inexperienced officers would tend to get caught up in fighting their own tanks and neglect control of the platoon. Often several minutes would elapse before these officers attempted any contact with the company commander. Through practice with SIMCAT, officers learned to quickly direct platoon action and maintain contact with the company commander throughout the engagement, giving spot reports as critical information became available, not waiting until complete SITREPs could be given before any reporting was initiated.

C^3 Decision Making Under Realistic Time Pressure. SIMCAT seemed useful in representing two different aspects of time pressure. One, by enforcing realistic movement rates officers were forced to engage in "backward planning" in order to reach the various control points within an acceptable time frame. Secondly, the ability of SIMCAT to represent OPFOR actions in real time required very rapid decision making on the part of the officers.

Methodological Considerations

The use of the same individuals, experienced NCOs, to fill the other platoon positions for each of the exercises for all of the officers seemed to provide an excellent method to present equivalent C^3 loads to all the officers. Although this resource intensive approach would seem impractical for training applications it seems worthwhile for training research.

For each officer the second exercise was designated as "practice." During this exercise the controller was free to stop the exercise at any time to offer suggestions and to use the SIMCAT restart capability to allow repetition of some events and to skip others. These capabilities to easily stop and restart the exercise, and to repeat some scenario events and skip others, were seldom used. The controller occasionally questioned and critiqued the officer during the exercise. However, the controller seemed reluctant to interrupt the continuity of the mission by repeating or skipping events. Research is needed to determine the training applications of simulator capabilities to rapidly shift from one set of battlefield conditions to another.

The overall score for each officer was based on the mean percentage correct for five variables; planning, tactical roadmarch, react to ATGM, react to indirect fire, and direct fire (actions on contact). Each of these variables represents a combination of scores for several individual subtasks. Alternate combinations of individual subtasks could be considered for future research. For example, four of the five tasks require the platoon leader to communicate with the company commander on the company radio net. Each instance of company net communication contributes to the score value for the task in which it occurs. An alternate approach would be to combine, across events, the GO/NO GO scoring of all instances of company net communication.

CONCLUSIONS

1. Low fidelity simulation, such as represented by SIMCAT, seems to offer a cost-effective complement to field training and evaluation. SIMCAT would seem to be especially useful as a transition between classroom instruction and field training. (The present version of SIMCAT is unsuitable for use as a training device because of the problems of controlling vehicle movement and firing, the slow speed of the system update cycle, and the unreliability of the system network. An enhanced version of SIMCAT is being developed. This improved version is called the Platoon Level Battlefield Simulation (PLBS). PLBS will

incorporate improvements in technology that have occurred since the construction of SIMCAT to provide improved graphics and station controls, and faster update cycles).

2. Development of appropriate, objective measures of tactical performance is a problem for both field and simulation-based training and evaluation. Simulations may offer more precise control of battlefield variables and more accurate data collection than can be practically obtained with field exercises. However, the simple types of measures that can be readily recorded by a computer, such as a chronological listing of who shot who, do not provide self-evident descriptions of, or solutions to, inadequacies in tactical performance. Experienced controllers are still needed to conduct meaningful AARs.

3. Research is needed to determine the appropriate use of simulation capabilities to "freeze" action in support of DARs. The exercise controller for this study was reluctant to interrupt exercise continuity by halting the exercise to provide immediate feedback. Also, little use was made of the capability to skip over events that had been satisfactorily handled during previous exercises.

REFERENCES

Allen, T. W., Johnson, E. J., Wheaton, G. R., Knerr, C. M., & Boycan, G. G. (1982). Methods of evaluating tank platoon battle run performance: Design guidelines (ARI Technical Report 560). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A131 969)

Bessemer, D. W., & Lampton, D. R. (1985). Development of TRAX 1: A tank platoon game modifying Dunn-Kempf (ARI Research Note 85-75). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A160 509)

Brown, F. J. (1983). The use of simulation in armor unit tactical training. Presentation at NATO Armor School Commander's Conference. Saumur, France.

Campbell, J. (1985). SIMCAT. Bulletin of the Command and Control Microcomputer User's Group, 4(7). Fort Leavenworth, KS: U.S. Army Communications-Electronics Command.

Eberts, R., & Brock, J. F. (1984). Computer applications to instruction. In F. A. Muckler (Ed.), Human Factors Review. Santa Monica, CA: The Human Factors Society, Inc.

Eckles, A. J. (1985). Learning to see the battlefield (Personal communication).

Hannaman, D. L. (1984a). Intelligent computer assisted feedback (ICAF) system: An approach to satisfying tactical simulation feedback requirements (Professional Paper 1-84). Alexandria, VA: Human Resources Research Organization.

Hannaman, D. L. (1984b). Specifying battle simulation requirements: A model and case history (Professional Paper 2-84). Alexandria, VA: Human Resources Research Organization.

Henriksen, K., Jones, D. R., Sergert, L. C., & Rutherford, B. E. (1985). Media/device configurations for platoon leader tactical training (ARI Technical Report 663). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A160 509)

Henriksen, K., Jones, D. R., Sergert, L. C., & Rutherford, B. E. (1984). Assessment of tactical training methodologies (ARI Research Report 1385). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A168 938)

Jones, E. R., Hennessy, R. T., & Deutsch, S. (Eds.). (1985). Human Factors Aspects of Simulation. Washington, DC: National Academy Press.

Kristiansen, D. M. (1987). Simulation in combined arms training: A platoon-level battlefield simulation (ARI Research Report 1439). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A182 172)

Lampton, D. R., & Koger, M. E. (1987). Platoon leadership exercises for SIMCAT (ARI Research Product 87-28). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A191 628)

Scott, D. T. (1984). How to evaluate unit performance (ARI Research Product 84-14). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Solick, R. E., & Lussier, J. W. (1986). Design of battle simulations for command and staff training (ARI Technical Report 788). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A196 655)

Su, Y. L. D. (1984). A review of the literature on training simulators: Transfer of training and simulator fidelity (Technical Report 84-1). Arlington, VA: Office of Naval Research.

U.S. Department of the Army. (1984). Tank platoon ARTEP mission training plan (Field Circular 17-15-1). Fort Knox, KY: U.S. Army Armor Center.

Wheaton, G. R., & Boycan, G. G. (1982). Methods of evaluating tank platoon battle run performance: A perspective (ARI Technical Report 574). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A135 486)

Word, L. E. (1987). Observation from three years at the National Training Center (ARI Research Product 87-02). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A178 386)

APPENDIX A

EXPERIENCE PROFILE QUESTIONNAIRE
PRIVACY STATEMENT

The follow privacy statement will be read to all subjects:

DATA REQUIRED BY THE PRIVACY ACT OF 1974

AUTHORITY: Title, 1Ø, USC, Sec 45Ø3
PRINCIPAL PURPOSE: The data collected with this form are to be used for research purposes only.
ROUTINE USE: This is an experimental personnel data collection form developed by the U.S. Army Research Institute for the Behavioral and Social Sciences pursuant to its research mission as prescribed in AR 7Ø-1. When identifiers (name or Social Security Number) are requested they are to be used for administrative and statistical control purposes only. Full confidentiality of the responses will be maintained in the processing of these data.
DISCLOSURE: Your participation in this research is strictly voluntary. Individuals are encouraged to provide complete and accurate information in the interest of the research, but there will be no effect on individuals for not providing all or any part of the information. This notice may be detached from the rest of the forms and retained by the individual if so desired.

EXPERIENCE PROFILE QUESTIONNAIRE

1. Primary MOS/Specialty:______ Secondary MOS/Specialty:______

2. Pay Grade (Check One):

E-4	E-5	E-6	E-7	E-8	E-9	Ø-1	Ø-2	Ø-3	Ø-4	Ø-5
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

3. Current, or last if student, Duty Assignment:____

4. How long in current position?____month TOE or TDA (circle one).

5. Other positions with tactical experience:

Check all that apply		months	TOE/TDA (Circle one)	location
None	______	______	TOE/TDA	______
______ TC	______	______	TOE/TDA	______
Plt Sgt	______	______	TOE/TDA	______
Plt Ldr	______	______	TOE/TDA	______
Co Cdr	______	______	TOE/TDA	______
Co XO	______	______	TOE/TDA	______
other	______	______	TOE/TDA	______
other	______	______	TOE/TDA	______

6. Schools Attended

Check all that apply		date graduated
BNCOC	______	______
ANCOC	______	______
TC3	______	______
AOB	______	______
AOAC	______	______
CAS3	______	______
other	______	______
other	______	______

7. Field Experience

	How many rotations	Date of Most Recent
NTC	______	______
Plt/Co ARTEP	______	______
REFORGER	______	______

8. Served as an Instructor in tactics? YES/NO (circle one)
months ______

9. Total length of service ______ months.

APPENDIX B

STANDARDS CHECKLISTS FOR TACTICAL EXERCISES

Subject # ________
Trial ________
Scenario ________

PLANNING

________ Co Warning Order ________
(begin) (end)

Platoon Warning Order

________ begin

[] addressees
[] earliest time of move
[] mission
[] objective
[] LD time
[] time of OPORD (________)
[] instructions to ready platoon
[] questions

________ time of completion

PLANNING

Operation Orders

_______ Company OPORD _______

[] questions **
[] graphics complete **

_______ Platoon OPORD

Situation [] enemy [] friendly

Mission [] who [] where [] when [] why

Execution [] scheme of maneuver [] fire support

[] movement techniques [] sequence of action

specific instructions to each tank (circle) 1 2 3 4

[] coordinating instructions [] obstacles

MOPP _____ speed ____ ** [] PIR

[] Service Support

Command and Signal location of [] PL [] Co [] XO

[] succession of command

CEOI ____ _____ **

[] recognition signal **

[] order of march **

[] questions **

__________(end time)

** recommended measures for subsequent research

TACTICAL ROAD MARCH

[] radio check ** [] short count **

MOVE OUT ____________

crosses SP _______ reports ________ speed * _______

crosses CP1 _______ reports ________ speed * _______

crosses CP2 _______ reports ________ speed * _______

crosses CP3 _______ reports ________ speed * _______

crosses RP _______ reports ________ speed * _______

crosses LD/LC ______ reports ________ speed * _______

Proper formation [] _______________

* excluded from analysis;
because of difficulties in controlling vehicle movement
speed varied greatly independent of platoon leader direction

** recommended measures for subsequent research

REACT TO INDIRECT FIRE

_________ (start time)

accelerate* []

direct close hatch []

direct MOPP 4 []

spot report ____ or shell rep _______

reconstitute formation _____________

* excluded from analysis
  unclear if recommended by current doctrine

REACT TO ATGM

____

platoon leader sees first SAGGER [ ]   2nd Sagger [ ]

alerts platoon ______

directs action [ ]   evades [ ]   pops smoke [ ]

reports ________

reconstitutes formation _______

DIRECT FIRE (ACTIONS ON CONTACT)

______ (time of initial contact)

alerts platoon ______ contact _______ action _______

fire command own [ ] platoon [ ]

reports _______

reconstitutes formation ______

APPENDIX C

HUMAN SUBJECT CONSENT FORM AND VOLUNTEER AGREEMENT

HUMAN SUBJECT CONSENT FORM

I, ________________________________, having full capacity to consent, do hereby volunteer to participate in research entitled SIMCAT Training Evaluation under supervision of the U.S. Army Research Institute. The implications of my voluntary participation and the nature, duration, and purpose of the research, the method and means by which it is to be conducted are contained on the reverse side of this form. I have been given an opportunity to read and keep a copy of this Agreement and to ask questions concerning this research. Any such questions have been answered to my full and complete satisfaction. Should any further questions arise, I will be able to contact Don Lampton at 624-4932. I understand that I may at any time during this research revoke my consent and withdraw from the test without prejudice.

____
(Signature, Date)

I was present during the explanations referred to above as well as the volunteer's opportunity for questions and hereby witness his signature.

________________________ ________________________

(Witness) (Date)

VOLUNTEER AGREEMENT

SIMCAT (Simulation in Combined Arms Training) is a computer-based platoon-level battle simulation developed by the Army Research Institute (ARI) to conduct armor training research. SIMCAT consists of four Tank Commander (TC) stations, an Opposing Force (OPFOR) station and a Controller/Company Commander station. Each TC station consists of a communications box, a desktop computer, a videodisc player, a display monitor and a control pad. Each TC issues commands to control the movement and firing of one (simulated) M1 tank and can communicate on platoon and company nets.

During your participation in the SIMCAT Training Evaluation you will be asked to act as a platoon leader for simulated armor combat missions. You will be asked to exercise command, control and communication skills as you would during combat. Performance standards developed for field exercises will be used to evaluate your performance on SIMCAT. Your scores will be combined with other participants to produce group scores. Performance of individuals will not be reported.

The total time of your participation will be four hours and you will have a five minute break each hour. To begin we will ask you to complete a survey of your experience and education as an armor leader. Then you will serve as a platoon leader for three missions. Finally, you will be asked to complete a questionnaire concerning your evaluation of SIMCAT.

Although the primary purpose of this research is to determine better ways to provide armor training you will gain practice in the exercise of command, control and communication. The risks involved are those associated with viewing standard computer display screens.

APPENDIX D

OPERATIONS ORDERS AND CONTROLLER SCRIPTS FOR SCENARIOS A AND B

OPERATIONS ORDER FOR SCENARIO A
OPORD #1

Task Organization: 1st Plt A/1/14th AR
3rd Plt A/1/14th AR
2nd Plt A/1/13th INF

1. Situation

a. Enemy Forces. Threat forces are believed to be withdrawing in an attempt to stabilize their front. Enemy situation to the front is uncertain. Some activity has been observed in the vicinity of 787973 and 789982.

b. Friendly Forces. TF 1-14 is conducting a movement to contact.

(1) TF 1-14 is conducting a movement to contact.

(2) TM B is to our left flank conducting a movement to contact.

(3) TM C is to our right flank conducting a movement to contact.

(4) TM D will follow as TF reserve.

(5) 1-5 FA is DS to our TF.

2. Mission.

TM A will conduct a movement to contact along axis Iron to seize OBJ Bravo, be prepared to continue the attack on order.

3. Execution.

a. Concept of the Operation. (Operation Overlay - drawn on commander's map sheet).

(1) Maneuver. TM A will conduct a passage of lines (forward) with TM A 1-5. TM A will cross LD/LC at ________ hours. First platoon will use passage point 2. Third platoon 1-14 AR will use passage point 1. Second platoon 1-13 Inf will use passage point 3. TM A will conduct a movement to contact using traveling overwatch to seize OBJ Bravo. TM A will use a company/team wedge with 1st Plt in the center, third platoon the right and second platoon on the left.

(2) Fires. There will be a 5 minute mortar and artillery prep for OBJ Bravo on call. Priority of fires to 1st Plt initially.

b. First Platoon.

(1) Conduct passage of lines at Passage Point 2. I will coordinate with TM A 1-15 AR and provide information to platoon leader.

(2) Move using wedge; you will be overwatched by third and second platoons.

c. Third Platoon

(1) Conduct passage of lines at Passage Point 1. XO will coordinate with TM A/1-15 AR and provide information to the platoon leader.

(2) Move as the right portion of a company/team wedge. Overwatch first platoon who will be the point of the wedge.

d. Second Platoon

(1) Conduct passage of lines at Passage Point 3. 1SG will coordinate with TM A1/15 AR for Second platoon and Company/-Team Cbt Trains passage. 1SG will provide necessary information to Second platoon leader.

(2) Move as the left portion of a company/team wedge. Overwatch first platoon who will be the point of the wedge.

e. Coordinating Instructions

(1) ADA status is weapons tight.

(2) Report crossing and clearing all check points, passage points and phase lines.

(3) MOPP O level in effect.

(4) Report any enemy obstacles.

(5) Report reaching the objective.

4. Service Support

a. BN/TF combat trains located at 724987. Co Cbt trains will follow one phase line behind company combat units.

b. Evacuate vehicles to equipment rally point vicinity 760984.

5. Command and Signal

a. CEOI Set 1 Period 1 in effect. Listening silence in effect until start road march.

b. Cdr will move with third platoon initially. XO will move with second platoon.

c. Security of Communications Activity Level (SCALE) 1 will be used.

EXERCISE CONTROLLER/OPFOR CONTROLLER EVENT SCRIPT
FOR SCENARIO A

Scenario 1
Page 1

TIME	EVENT	CO/FIST ACTION	OPFOR ACTION	PLT LEADER REQUIREMENTS
T-40	- Company warning order issued	- Company Commander issues warning order	- None	- Receives company warning order - Alerts platoon for issue of warning order - Prepares warning order
T-38	- Platoon warning order issued	- None	- None	- Issues platoon warning order
T-35	- Company operations order	- Company Commander issues order	- None	- Receives company operations order
T-15	- Platoon operations order issued	- None	- None	- Issues platoon operations order
T-9	- Platoon starts moving	- None	- None	- Signals move out
T-9 *	- Platoon leader's wingman fails to move out *	- None	- None	- Notices and takes remedial action
T-8	- Platoon crosses SP	- Company commander acknowledges platoon report - Other voices simulate other platoons crossing SP	- None	- Reports crossing SP
T-6	- Platoon crosses CP 1	- Company commander acknowledges platoon report - Other voices simulate other platoons crossing CP1	- None	- Reports crossing CP 1

TIME	EVENT	CO/FIST ACTION	OPFOR ACTION	PLT LEADER REQUIREMENTS
T-4	- Platoon crosses CP 2	- Company commander platoon report - Other voices simulate other platoons crossing CP2	- None	- Reports crossing CO 2
T-2	- Platoon crosses RP	- Company commander acknowledges platoon report	- None	- Reports crossing RP
T-1	- Platoon conducts passage of lines	- None	- None	- Gives proper recognition signal
T-Ø	- Platoon crosses LD/LC	- Company commander acknowledges platoon report - Other voices simulate other platoons crossing LD/LC	- None	- Reports crossing LD/LC - Directs proper formation
T+3	- Platoon engaged by indirect fire	- Company commander acknowledges SPOT REP and directs platoon to continue mission	- Brings indirect fire in vicinity of platoon	- Directs platoon to button and and continue mission - Submits SPOT REP to company
T+5	- Platoon engaged by sagger	- Company commander acknowledges, directs to seek defilade until covered by artillery	- Fires sagger at platoon - if no response from platoon leader w/first missile, fire a second, other platoon members respond	- Alerts platoon - Directs reaction - Reports
T+8	- Platoon is directed to	- Commander directs continue mission - FIST continues artillery fire	- None	- Directs platoon to move
T+1Ø	- Platoon is engaged by direct fire	- Acknowledges plt report	- Engages left flanks tanks	- Directs reaction - Reports to company

TIME	EVENT	CO/FIST ACTION	OPFOR ACTION	PLT LEADER REQUIREMENT
T+11	- FRAGO #1	- Commander issues company FRAGO directing 2nd Plt to assault while overwatched by other two platoon	- Continues to engage - Moves tanks into view as platoon approaches	- Issues FRAGO to Platoon
T+15	- FRAGO #2	- Commander issues company FRAGO directing company to take up overwatch positions with 1st Plt oriented toward 6, 2nd toward 13 and 3rd toward 7.	- None	- Issues FRAGO to Platoon - Responds with "SET" when in position

OPERATIONS ORDER FOR SCENARIO B
OPORD #2

Task Organization: 1st Plt A/1/14th AR
3rd Plt A/1/14th AR
2nd Plt A/1/13th INF

1. Situation

a. Enemy Forces. Threat forces are believed to be withdrawing in an attempt to stabilize their front. Enemy situation to the front is uncertain. Some activity has been observed in the vicinity of 767970 and 764974,

b. Friendly Forces. TF 1-14 is conducting a movement to contact.

(1) TF 1-14 is conducting a movement to contact.

(2) TM B is to our left flank conducting a movement to contact.

(3) TM C is to our right flank conducting a movement to contact.

(4) TM D will follow TM A as a TF reserve.

(5) 1-5 FA is DS to our TF.

2. Mission.

TM A will conduct a movement to contact along axis Iron to seize OBJ Bravo, be prepared to continue the attack on order.

3. Execution.

a. Concept of the Operation. (Operation Overlay - drawn on commander's map sheet).

(1) Maneuver. TM A will conduct a passage of lines (forward) with TM A 1-5. TM A will cross LD/LC at ________ hours. First platoon will use passage point 2. Third platoon 1-14 AR will use passage point 1. Second platoon 1-13 Inf will use passage point 3. TM A will conduct a movement to contact using traveling overwatch to seize OBJ ________. TM A will use a company/team wedge with 1st Plt in the center, third platoon the right and second platoon on the left.

(2) Fires. There will be a 5 minute mortar and artillery prep for OBJ Bravo on call. Priority of fires to 1st Plt initially.

b. First Platoon.

(1) Conduct passage of lines at Passage Point 2. I will coordinate with TM A 1-15 AR and provide information to platoon leader.

(2) Move using wedge; you will be overwatched by third and second platoons.

c. Third Platoon

(1) Conduct passage of lines at Passage Point 1. XO will coordinate with TM A/1-15 AR and provide information to the platoon leader.

(2) Move as the right portion of a company/team wedge. Overwatch first platoon who will be the point of the wedge.

d. Second Platoon

(1) Conduct passage of lines at Passage Point 3. 1SG will coordinate with TM A/1-15 AR for Second platoon and Company/Team Cbt Trains passage. 1SG will provide necessary information to Second platoon leader.

(2) Move as the left portion of a company/team wedge. Overwatch first platoon who will be the point of the wedge.

e. Coordinating Instructions

(1) ADA status is weapons tight.

(2) Report crossing and clearing all check points, passage points and phase lines.

(3) MOPP O level in effect.

(4) Report any enemy obstacles.

(5) Report reaching the objective.

4. Service Support

a. BN/TF combat trains located at 828987. Co Cbt trains will follow one phase line behind company combat elements.

b. Evacuate vehicles to equipment rally point vicinity 802961.

5. Command and Signal

a. CEOI Set 1 Period 1 in effect. Listening silence in effect until start road march.

b. Cdr will move with third platoon initially. XO will move with second platoon.

c. Security of Communications Activity Level (SCALE) 1 will be used.

EXERCISE CONTROLLER/OPFOR CONTROLLER EVENT SCRIPT FOR
SCENARIO B

Scenario 2
Page 1

TEAM	EVENT	CO/FIST ACTION	OPFOR ACTION	PLT LEADER REQUIREMENTS
T-40	- Company warning order issued	- Company Commander issues warning order	- None	- Receives company warning order - Alerts platoon for issue of warning order - Prepares warning order
T-38	- Platoon warning order issued	- None	- None	- Issues platoon warning order
T-35	- Company Commander operations order	- None	- None	- Receives company operations order
T-15	- Platoon operations order issued	- None	- None	- Issues platoon operations order
T-9	- Platoon starts moving	- None	- None	- Signals platoon to move out
	* - Platoon leader's wingman fails to move out *	- None	- None	- Notices and takes remedial action - Reports crossing SP
T-7	- Platoon crosses SP	- Company commander acknowledges report - Other voices simulate other platoons crossing SP	- None	- Reports crossing SP
T-5	- Platoon crosses CP 1	- Company commander acknowledges report	- None	- Reports crossing CP 1

Scenario 2
Page 2

TIME	EVENT	CO/FIST ACTION	OPFOR ACTION	PLT LEADER REQUIREMENTS
T-3	- Platoon crosses CP 2	- Company commander acknowledges platoon report - Other voices simulate other platoons crossing CP 2	- None	- Reports crossing CP 2
T-2	- Platoon crosses RP	- Company commander acknowledges platoon report - Other voices simulate other platoons crossing RP	- None	- Reports crossing RP
T-1	- Platoon conducts passage of lines	- None	- None	- Gives proper recognition signal
T-Ø	- Platoon crosses LD/LC	- Company commander acknowledges platoon report - Other voices simulate other platoon crossing LD/LC	- None	- Reports crossing LD/LC - Directs proper formation
T+5	- Platoon engaged by sagger	- Company commander acknowledges, directs to seek defilade and engage - FIST calls in artillery mission	- Fires sagger at platoon - if no response from platoon leader, fires a second sagger and other platoon member respond	- Alerts platoon - Directs reaction - Reports - Takes action on commander instructions
T+7	- Platoon is directed to continue mission	- Commander directs continue mission	- None	- Directs platoon to continue mission
T+1Ø	- Objective BRAVO taken, FRAGO #1 given	- Commander gives FRAGO to continue to OBJ E	- None	- Gives FRAGO to continue to OBJ E

TIME	EVENT	CO/FIST ACTION	OPFOR ACTION	PLT LEADER REQUIREMENTS
T+11	- Cross PL BLUE	- Acknowledges reports - Other platoons report crossing PL BLUE	- None	- Reports crossing PL BLUE
T+12	- Platoon is engaged by direct fire	- Acknowledges report	- Engages right flank tanks	- Directs reaction - Reports
T+13	- FRAGO #2	- Commander issues company FRAGO directing 2nd Plt to assault while overwatched by other two platoons	- Continues to engage	- Issues FRAGO to Platoon - Directs assault
T+15	- FRAGO #3	- Commander issues company FRAGO directing company to take up overwatch positions with 1st Plt oriented toward 8, 2nd toward 9, and 3rd toward 1Ø.	- None	- Issues FRAGO to Platoon - Responds with "SET" when in position