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Research Report 1368

Evaluation of an Advanced Combat Vehicle Identification (CVI) Training Program (Masking): A New Approach to Target Acquisition Training

Gary L. Shope, Norman D. Smith, and Otto H. Heuckeroth
Army Research Institute

William L. Warnick and Stephen S. Essig
Human Resources Research Organization

ARI Field Unit at Fort Hood, Texas
Systems Research Laboratory

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EDGAR M. JOHNSON
Technical Director

L. NEALE COSBY
Colonel, IN
Commander

Research accomplished under contract for
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Human Resources Research Organization (HumRRO)

Technical review by

Richard M. Johnson
Brian L. Kottas

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This advanced CVI training program (Masking) presents vehicles in hull and turret defilade. Forty-three personnel were trained with either this advanced CVI training program (Masking) or the Basic CVI Training Program (Masking) at (GTA 17-2-9) either 1250 meters or 2000 meters. Performance on an initial test of all the vehicles administered before training was compared with performance on the same test after training to evaluate the effectiveness of the training program. Data indicated this advanced CVI training program (Masking) is an effective training system for what is perceptually a very difficult task.

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Charles O. Nystrom, Contracting Officer's Representative

Submitted by
George M. Gividen, Chief
ARI Field Unit at Fort Hood, Texas

Approved as technically adequate
and submitted for publication by
Jerrold M. Levine, Director
Systems Research Laboratory

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
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Training for Combat Effectiveness

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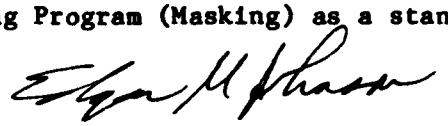
EVALUATION OF AN ADVANCED COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM (MASKING): A NEW APPROACH TO TARGET ACQUISITION TRAINING

FOREWORD

The US Army Research Institute for the Behavioral and Social Sciences (ARI), Fort Hood Field Unit, is developing a series of broad based target recognition and identification (R&I) training programs. Both TRADOC and FORSCOM have recognized the need for standardized R&I training and have requested that ARI develop appropriate programs.

This report evaluates the first of a series of advanced R&I training programs developed by the ARI Fort Hood Field Unit and its contractor, Human Resource Research Organization (HumRRO). These Advanced CVI Training Programs follow the earlier development of the Basic CVI Training Program which has already been adopted for Army-wide use by TRADOC. This current evaluation examines the technical and training effectiveness of an advanced Combat Vehicle Identification (CVI) Training Program utilizing masking (vehicles presented in hull or turret defilade).

Results of this assessment will be used by TRADOC in determining the usefulness of this Advanced CVI Training Program (Masking) as a standard program for implementation Army wide.



EDGAR M. JOHNSON
Technical Director

EVALUATION OF AN ADVANCED COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM (MASKING): A NEW APPROACH TO TARGET ACQUISITION TRAINING

EXECUTIVE SUMMARY

Requirement:

A series of Human Research Needs (HRN) from both TRADOC and FORSCOM led to the development of the Basic CVI Training Program which has now been adopted Army wide. The Fort Hood Field Unit of ARI and its contractor, HumRRO, are now in the process of developing a series of Advanced CVI Training Programs to meet more specialized R&I training needs. This report describes ARI's testing of the first training program in this advanced series, a training program involving masking.

Procedure:

Two groups of Armor and Infantry soldiers were trained with the new Advanced CVI Training Program (masking), while a third group of soldiers were trained with the Prototype CVI Training Program for comparison purposes. Pre-test and post-test measures of combat vehicle recognition and identification knowledge were taken to evaluate the effectiveness of the training. Background information was collected to assess previous training the soldiers had received, as well as their assessment of this CVI training in comparison with previous recognition and identification (R&I) training they had received.

Findings:

Results indicate that this Advanced CVI Training Program (Masking) is an effective training program which meets the expressed need for higher fidelity training consistent with that found in tactical situations. Changes in both recognition and identification scores comparable to those produced by the Prototype CVI Training Program were demonstrated. Personnel evaluations of the effectiveness of the Advanced CVI Training Progam (Masking) were uniformly positive, finding it clearly more effective than any previous training they had received.

Utilization of Findings:

The Basic CVI Training Program has been adopted as the standardized vehicle identification training program for the Army (GTA 17-2-9), the Thermal CVI Training Program has been officially adopted (GTA 17-2-10), and this Advanced CVI Training Program has been approved by TRADOC pending available funding.

EVALUATION OF AN ADVANCED COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM (MASKING): A NEW APPROACH TO TARGET ACQUISITION TRAINING

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CHAPTER I

INTRODUCTION

Background

Since World War II, considerable interest has been shown in the problems of target acquisition, i.e., the detection, recognition and identification of a target sufficiently well to permit the effective employment of weapons. New weapons development has resulted in weapons and fire-control systems that can engage targets at ranges far in excess of the ranges at which the unaided human observer can acquire them. Although great technological advances continue to be made, the human eye augmented with optics still provides the best way to recognize and identify targets.

Our allies use many vehicles which look different from ours and which, in some cases, closely resemble those of nations we consider to be potential threats. Many of these friendly and threat vehicles have common design characteristics, making distinction of friend from foe difficult.

Military Problem

The demands on human performance in this area of recognition and identification have been increasing in the past several years. It has been generally accepted that the threat armored forces likely to be engaged by US and other NATO units in a mid-to-high intensity conflict in Europe will be equipped with antitank missile systems that are both accurate and lethal at ranges extending beyond 3000 meters. This concern is made even more acute by the expectation that the threat-to-friend force ratio will be quite large (6:1). This general analysis led to increased awareness by the 6th Cavalry Brigade (Air Combat) as well as the Armor School, Fort Knox and the US Army Intelligence Center and School, Fort Huachuca, that as weapon systems change, target acquisition performance (recognition and identification) must be improved. It was in this context that FORSCOM's Opposing Force Training Detachment, Red Thrust, in 1979 and 1980 found that in both the active Army and Reserve Components no standard recognition and identification training program existed. In response to these concerns, the US Army Research Institute for Behavioral and Social Sciences, Fort Hood Field Unit, with the support of the Human Resources Research Organization, Fort Hood (ARI/HumRRO), undertook a research program to investigate systematically the problem of recognition and identification, particularly at extended ranges.

The focus of the data collection in previous related studies (e.g., Maxey, Ton, Warnick & Kubala, 1976; Haverland & Maxey, 1978; Warnick, Chastain, & Ton, 1979; and Warnick & Kubala, 1979) was upon the Attack Helicopter (AH) crew training of the 6th US Cavalry Brigade (Air Combat) which was being equipped at that time with the TOW weapons system. Using the tactics of flying Nap-of-the-Earth (NOE) and firing at standoff ranges (3,000-4,000 meters) increased the importance of accurate recognition and identification of both threat and NATO vehicles.

In using such tactics it was not known whether helicopter crew members could identify targets at these ranges. At standoff ranges both friendly and threat armored vehicles present very small visual angles, about 3 to 4 minutes, when viewed by the unaided eye. Even with optical aids (such as 7x50 binoculars or the 13X COBRA TOW gunsight) these images are still so small that only gross target features are clearly recognizable.

Findings from these earlier research efforts resulted in serious concerns over the adequacy of current training for long range R&I.

Status of Development of the CVI Training Program Series

Because of this general interest throughout the Army in better recognition and identification training, the products of the research for the 6th US Cavalry Brigade (Air Combat) were redesigned and repackaged as the Prototype CVI Training Program for testing throughout the Army. The potential of the CVI Training Program to meet an immediate need in the recognition and identification area was acknowledged by numerous commanders and trainers even before final testing could begin. Twenty-two CVI training packages were provided to a wide range of military units who were asked to use the experimental package and provide ARI with the training results (Smith, Heuckeroth, Warnick & Essig, 1980). Based on the outcome of the testing, minor changes were made in the Prototype CVI program and the Army standardized its R&I training by adopting the CVI training as its Basic Training Program.

Advanced CVI training programs are now in various stages of development. The Advanced CVI Training Program (Masking), which this report addresses, will be turned over to the sponsor, CAC, by February, 1982. The Advanced CVI Training Program (Masking) incorporates another level of realism with the vehicles portrayed in defilade as unit commanders thought they would most likely be viewed in a tactical situation. The two levels of masking used in photographing the models on the terrain board were hull defilade and turret defilade. Dependent on the difficulty of identifying a particular vehicle, some vehicles are presented in only hull defilade while others are presented in both hull and turret defilade. Range and optic power differences were simulated by varying the soldiers' seating position in the classroom, similar to the procedure used in the CVI Prototype Training Program.

Another Advanced CVI Program involving obscuration will be completed by March, 1982. A third, designed to provide R&I training on the thermal night sight will be fielded for operational testing in April, 1982.

Purpose and Scope of This Technical Report

This report presents the results from the field testing of the Advanced CVI Training Program (Masking) conducted in June 1981, at Fort Hood, Texas. The evaluation provides the basis for recommendations to the proponent, CAC, concerning the use of the Advanced CVI Training Program for recognition and identification training in the Army.

CHAPTER II

THE ADVANCED COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM (MASKING)

Objectives

The major objective of the CVI Training Program series is to train soldiers on what cues to use to identify vehicles at realistic combat (engagement and pre-engagement) ranges. The first program called the Basic CVI Training Program presents vehicles in open terrain that does not obscure or mask the vehicle. The Advanced CVI Programs place the vehicles in conditions of diminished visibility, i.e., tactical settings where masking and obscuration are present or images are viewed through the thermal night sight. The design of the materials and procedures for all training packages in the CVI series tries to incorporate the following subobjectives:

- Provide a controlled, standardized training package.
- Provide a basis (measure) for evaluating the level of success reached by soldiers in identifying vehicles.
- Allow scheduling flexibility through its design in 5-vehicle modules.
- Employ a minimum of support materials to keep training simple operationally feasible at most Army facilities.
- Permit training of varying users' optics/distance requirements in a classroom through simulation procedures.

Description of the Advanced CVI Program (Masking)

The Advanced CVI Training Program is predicated on the same principles as the Basic CVI. For a detailed description of the Prototype CVI used in initial testing as well as the Basic CVI Training Program, see Appendix B.

The Advanced CVI Training Program presented here includes vehicles partially obscured from view by natural terrain features. The vehicles are shown in hull and turret defilade using the same 30 which are found in the Basic CVI Training Program.

There are six training modules and one final test module. (See Table 2-1.) Each training module deals with a combination of 5 of the 30 different vehicles listed. Each module is an independent training unit and can be used alone. The Final Test Module can be administered as a pre-test and then as a post-test after the soldier has completed all six training modules.

Each of the six modules uses 5 of the 30 vehicles photographed in three different positions (front, oblique left, and oblique right) and two levels of masking (partial obscuration) in each of the three different views. Mask Level 1 obscures that portion of the vehicle from the top of the tracks or wheels to the ground. Mask Level 2 obscures that portion of the vehicle from just beneath the main weapon to the ground. On vehicles which were flat on top and had no turreted weapon (e.g., the M113 or the BTR-60P) obscuration started from below the top deck to the ground. Exposed portions of the vehicles were held relatively constant across all vehicles, taking into consideration the type and design of each particular vehicle.

As in the Basic CVI Training Program, each module is divided into: (1) a manual presentation phase during which slides (vehicles) are projected one at a time onto a screen; (2) an automated presentation phase during which the slides are shown every 15 seconds; and (3) a test phase in which each vehicle is presented in six diferent view/masking conditions at 8-second intervals for soldier-written responses. During the manual presentation phase the soldier makes a written recognition and identification response[1], the instructor then describes key cues relevant to recognition and identification of the vehicle in that view/masking condition and the soldier has a chance to ask questions. During the automated presentation phase the soldier again gives a written R&I response, the instructor reiterates the key cues for R&I response but permits no questions. The test phase provides a measure of the effectiveness of the training and the computed score provides the soldier with feedback on his performance.

[1]Recognition is being able to state whether a vehicle is "friendly" or "threat," and identification is being able to label a vehicle by its common or accepted name or its model number.

TABLE 2-1

Advanced CVI Target Array

Training Module 1

M48 Tank (USA)
M1 Abrams Tank (USA)
Roland ADA (FRG)
BMP-1 MICV (USSR)
ASU-85 Assault Gun (USSR)

Training Module 2

AMX-30 Tank (FR)
Centurion Tank (UK)
BTR-60P (USSR)
Saladin Scout Car (UK)
SP-74 SP Howitzer (USSR)

Training Module 3

T-62 Tank (USSR)
BTR-50P APC (USSR)
AMX-13 Light Tank (FR)
Gepard (Flakpanzer) ADA (FRG)
Marder MIVC (FRG)

Training Module 4

BMD IFV (USSR)
Scorpion Light Tank (UK)
ZSU 57-2 ADA (USSR)
Leopard Tank (FRG)
T54/55 Tank (USSR)

Training Module 5

T-72 (USSR)
M113 APC (USA)
Jagdpanzer (JPZ 4-5) Aslt Gn (FRG)
Scimitar Recon Vehicle (USSR)
PT-76 Amphib Light Tank (USSR)

Training Module 6

M109A2 SP Howitzer (USA)
BRDM-2 Amphib Armored Car (USSR)
Chieftain Tank (UK)
ZSU 23-4 ADA (USSR)
M60A1 Tank (USA)

FINAL TEST - MODULE 7

All 30 of above vehicles

CHAPTER III

METHOD

The Advanced CVI Training Program (Masking) was tested by training two groups of personnel with the Advanced CVI Training Program (Masking) while a third similar group was trained separately with the Prototype CVI Training Program. (A copy of the Basic CVI Training Program was not yet available.) For comparison purposes, all groups were tested on Day 1 before the training and on Day 5 after the three days of training with the final tests (Mod 7) from both programs. All groups were trained on two modules a day from their assigned programs, completing the six modules in either program in the three-day training period. Personnel were assigned to groups on the basis of their pre-test scores to create three groups with equivalent performance on the pre-test. An effort was made to collect pre- and post-test data on a fourth matched group that was to serve as a control group and which was not to be trained. However, post-test data on only three untrained personnel was collected. Due to the small number of cases completing the control group testing, the design was modified to include only the three trained groups.

Subjects

Data from 33 male personnel were included in the analysis; the data from 10 personnel were discarded[1]. As only 43 of 64 soldiers planned for participation in the research were present for pre-testing, this additional loss makes some caution necessary in interpretation of the remaining data.

The personnel trained were drawn from the 1/66, 2/41, 3/67, 1/67 and 3/66 Infantry Battalions of the 2nd Armored Division, Fort Hood, Texas, and were relatively homogeneous. The median age was 20 (range from 18 to 27), median time in the service was 2 years (range from 8 months to 5 years), median rank was E-4 (range from E-1 to E-5), and all from one of 6 MOS's as tabled below.

TABLE 3-1

MOS's of Sample Group

MOS	n	Percent
11B - Infantryman	3	9.1
11C - Mortarman	3	9.1
11H - Heavy Antiarmor Weapons Crewman	2	6.1
19D - Cavalry Scout	1	3.0
19E - M48-M60 A1/A3 Armor Crewman	20	60.6
19F - Tank Driver	4	12.1
	33	

[1]Five personnel failed to return for the post-test, three missed one or more of the training modules and two failed to follow the training instructions.

Procedure

The personnel reported in the morning on Day 1 (43 out of 64 requested) and were randomly assigned to one of four sessions scheduled that day for the pre-test. This was done to permit testing in a classroom which was arranged to train 16 people at one time. Half the personnel were trained at a simulated range of 1250 meters, while the other half were trained at a simulated range of 2000 meters. Simulated seven power optics (7X) were used for all training/testing. Personnel were assigned to the same seat (and consequent range) for pre-testing, training and post-testing. The seating arrangements are illustrated in Figure 3-1.

Personnel in each group were administered the final test (Mod 7) from the Advanced CVI Training Program studied here and the final test (Mod 7) from the Prototype CVI Training Program to permit transfer of training comparisons. Pre- and post-test administration was counterbalanced--two groups received the Prototype Mod 7 before the Advanced Mod 7, while two other groups were tested on the Advanced Mod 7 before the Prototype Mod 7. Demographic and various other background data were collected, as well as estimates of the quantity and quality of previous vehicle identification training.

Scores from the pre-test were used to create four groups with roughly equivalent scores. The original experimental design planned for two groups to be trained with the Advanced CVI Training Program, one to be trained with the Prototype CVI Training Program, and a fourth group to serve as a control group. The control group was to receive no training but simply be pre-tested and post-tested along with the other three groups. As indicated above only three of the original members of this control group were available for post-testing, even after an additional testing period was arranged for the Monday following Day 5. Therefore, results discussed are for only the three trained groups. The only difference between the two groups trained with the Advanced CVI Program (Masking) was the order of slides used during the pre- and post-testing on the Advanced Final Test.

Since circumstances precluded use of a control group, all units' commander or first sergeant as well as the S3 were contacted and asked if there had been any combat vehicle identification training of any type during the study period. Since none did occur, it is reasonable to assume that post-test improvements reflect the CVI training provided.

A comparison between those personnel trained with the Advanced CVI Training Program (Masking) and the group trained with the Prototype CVI Training Program revealed a close match on their pre-scores (total correct), $\underline{M}_A = 72.92$, $\underline{M}_P = 76.00$, $\underline{t}\ (30) = 0.43$, $\underline{p} > .05$, hours of previous vehicle identification training, $\underline{M}_A = 29.99$, $\underline{M}_P = 30.12$, $\underline{t}\ (30) = 0.01$, $\underline{p} > .05$, and time in service, $\underline{M}_A = 2.20$, $\underline{M}_P = 1.92$, $\underline{t}\ (30) = 0.59$, $\underline{p} > .05$.

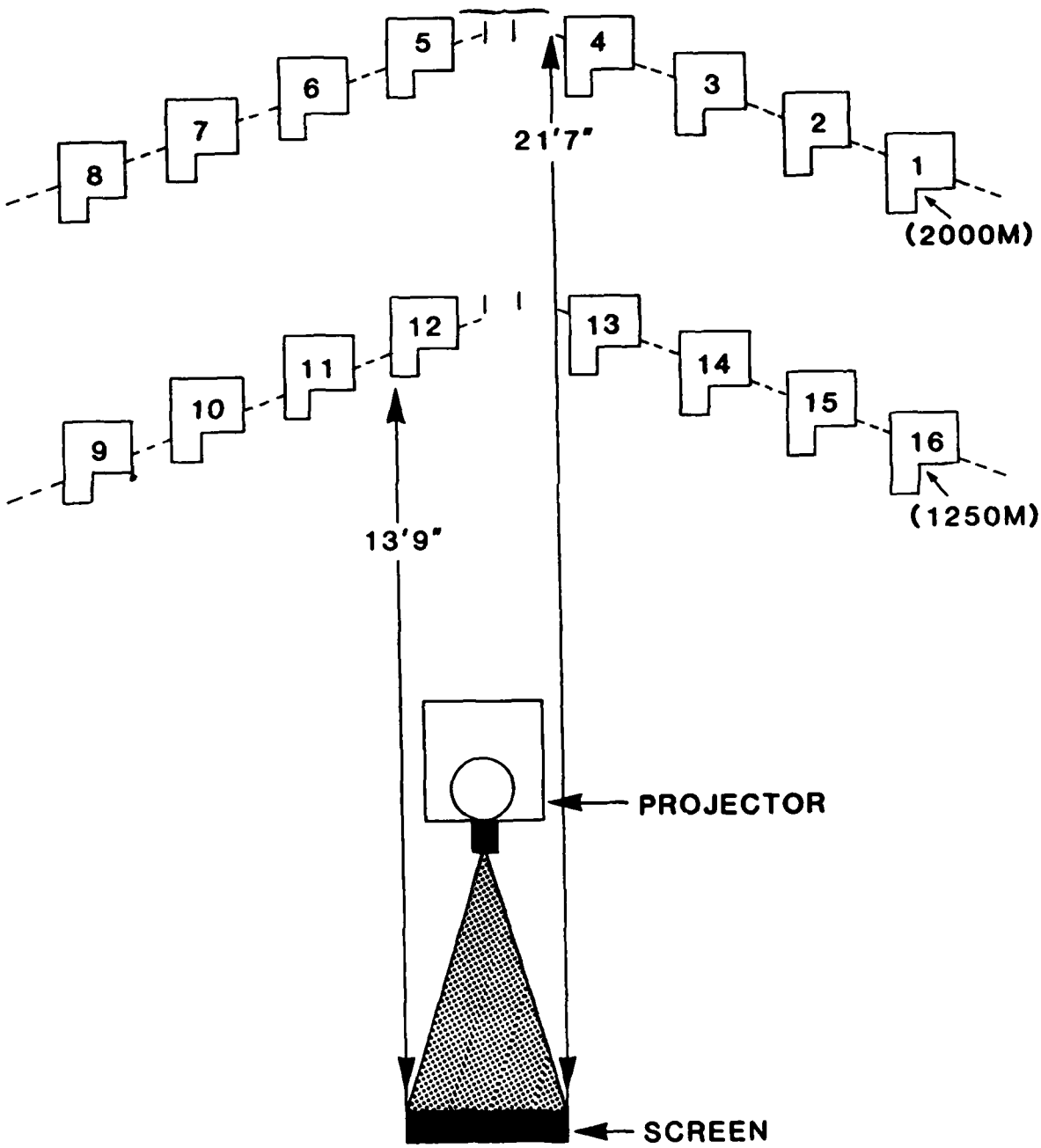

Figure 3-1. Classroom seating arrangement for 7X Optics (large room).

During the three days of training, Day 2 to Day 4, the three trained groups were trained on the six modules in their assigned training program. Two groups were trained on two modules a day from the Advanced CVI Training Program (Masking), while one group was trained on two modules a day from the Prototype CVI Training Program. Three civilian trainers were used, counterbalanced so that each of the three groups was exposed to all of the trainers and each trainer trained each group on two of the six modules. With either training program, a module takes under an hour to train, consequently personnel were trained for only about two hours a day.

On Day 5, all personnel were post-tested in the same manner as they had been pre-tested on Day 1. Regardless of the training they had received, all groups were tested (given Mod 7) with both the Advanced CVI Training Program (Masking) and the Prototype CVI Training Program. The presentation of the two test modules was again counterbalanced as it had been during the pre-test. Following post-testing, soldiers were asked to evaluate the training they had received and to estimate how many vehicles they thought they could identify.

CHAPTER IV

RESULTS

Analysis

Analysis of variance designs were used to assess the effectiveness of the Advanced CVI Training Program (Masking), the impact of various military, demographic and other background variables on target acquisition[1] performance and to compare the effects of training on one CVI program (Prototype or Advanced) on post-test performance in each program. Except for analyses involving military, demographic and other background factors, the designs used involved test period (pre- vs. post-testing) and target acquisition measure (recognition and identification) as within group factors. Differences in difficulty among the vehicles were examined in an extended four-way ANOVA design which included vehicle type, angle of presentation, time of testing and target acquisition measure as factors. The dependent measures used in all analyses were the total number of correct recognitions and total correct identifications. When background variables were examined they were treated as a between-group factor and analyzed in a split-plot design.

Two circumstances produced heterogeneity of variance with this data: (1) the inclusion of scores from both testing periods, pre-test and post-test; and (2) the combining of both dependent measures, recognition and identification, for analysis. Probably the chief source of this hetergeneity of variance was from the pre-test scores. Personnel prior to being trained were able to identify few if any of the vehicles and there is consequently little variation within these scores. After training, post-test scores show significant overall increases but with wide differential learning across personnel. Further compounding the issue is the fact that recognition scores are higher than identification scores given the 50% probability of a guess being correct while identification scores at the time of the pre-test are not significantly different from zero.

Two sources of evidence tend to support the validity of the analyses and their interpretations, despite the lack of homogeneity of variance in the ANOVA designs used. Since heterogeneity of variance tends to lead to definite but small increases in the F values (Lindquist, 1953), it is prudent to look for lower probabilities of Type I error than the usually acceptable .05. The majority of the F values produced by the analyses in this report have associated probability values considerably less than the .05 level. Combined with the congruence of these results with both previous and current research with the CVI series, these observations lend credence to the validity of these findings.

[1]In this report we use "target acquisition" to indicate only recognition and identification. In the systems context, Target Acquisition is composed of detection, recognition and identification and analysis. An extensive research effort at the Fort Hood Field Unit entitled "Target Acquisition and Analysis Training System" (TAATS) is working toward an integrated training approach involving these several elements.

Effectiveness of Training

The overall effectiveness of the Advanced CVI Training Program was assessed in a within-subjects analyses of variance with target acquisition measures (recognition and identification) and test period (pre- vs post-) as within-subjects factors. Number of correct responses was the dependent measure. Results produced a main effect for time of testing, $F(1,23) = 72.07$, $p < .001$, indicating that post-test scores were improved over pre-test scores after the training; a main effect for target acquisition measure, $F(1,23) = 2622.29$, $p < .001$, implying the identification response is the more difficult; and an interaction between these two effects, $F(1,23) = 6.19$, $p < .02$, suggesting that there is more improvement in the identification scores as a result of the training than in the recognition scores. Note, of course, that there is a much larger chance factor operating in the recognition scores--a score of 50% is possible by chance alone. Means and standard deviations supporting these analyses are found in Table 4-1.

TABLE 4-1

Advanced CVI Training (Masking) Pre-test and Post-test Scores
(Number correct of 120 possible)
for Advanced CVI Trained Personnel (n = 24)

	Pre-test		Post-Test	
	M	SD	M	SD
Recognition	64.00	7.93	77.58	13.95
Identification	1.29	3.98	22.12	11.33

Note: All means are significantly different from one another by a Duncan's New Multiple Range Test procedure, all $p < .01$.

Performance results pointing to the effectiveness of the Advanced CVI Training Program (Masking) were further supported by the rating data collected on the post-test questionnaire in which personnel assessed the effectiveness of the training. In particular, 52% of the personnel trained with the Advanced CVI Training Program (Masking) found the training "very effective," 39% found it "effective," 9% found it "neither effective nor ineffective," none found it "ineffective," and none found it "very ineffective." Similarly, when asked to compare the Advanced CVI Training (Masking) they had just received with previous vehicle identification training they had received, 59% evaluated it as "much better," 27% found it"better," 14% found it "about the same," none found it "worse," and none found it "much worse." While before training, personnel reported being able to identify an average of only 7.96 of the 30 vehicles, after the training this figure was 18.96.

Further support for the perceived effectiveness of the Advanced CVI Training Program (Masking) came from comparison of rated effectiveness of vehicle identification training hours soldiers had received from Basic Training, $\underline{M}$BT=9.38 hours, Advanced Individual Training, $\underline{M}$AIT=9.08 hours, in their present unit, M PU = 7.00 hours, and the Advanced CVI Training Program (Masking), $\underline{M}$ CVI = 6.00 hours. The perceived effectiveness of the combat vehicle identification training received in the three previous training arenas was rated by the personnel on a five-point scale and then compared with the effectiveness rating given the Advanced CVI Training Program (Masking) using a one-way within-subjects analysis of variance. Only the 16 personnel who had had all four types of training could be used in such an analysis, although the incomplete data are included in Table 4-2. Results indicated significant differences among the rated effectiveness of the four vehicle identification training arenas, $F(1,15)=154.97$, $p < .001$. Duncan New Multiple Range Tests applied to these means indicated that the Advanced CVI Training Program (Masking) was ratedsignificantly more effective than previous combat vehicle training (SeeTable 4-2).

TABLE 4-2

Effectiveness of Training: Response Frequencies and Duncan New Multiple Range Test Results

	Training							
	BT		AIT		Present Unit		CVI (m)	
Response (score)	n	%	n	%	n	%	n	%
Very Effective (1)	1	5	4	17	2	11	12	52
Effective (2)	10	50	12	52	7	39	9	39
Neither (3)	6	30	3	13	5	28	2	9
Ineffective (4)	3	15	4	17	4	22	0	0
Very Ineffective (5)	0	0	0	0	0	0	0	0
	20		23		18		23	
$\underline{M}$ ($\underline{n}$ = 16)	2.69a		2.38b		2.75a		1.62	

Note: Means with common subscripts are not significantly different from one another, $\underline{p} > .05$, by a Duncan New Multiple Range Test procedure.

Further assessment of the effectiveness of vehicle identification training received in the three previous arenas was investigated by examining the relationship between the hours of training received in each of those arenas and Advanced CVI (Masking) pre-test performance. Hours of training reported in each of these arenas (as well as total hours) were used to define four between-group variables. In each case, the hours of training were divided into three or four categories of range of hours to produce groups of personnel approximately equal in size. Each of these between group variables was used in separate one-way analyses of variance. Consistent with the rating effectiveness results cited above, results of these one-way analyses indicated no significant differences in pre-test performance on the Advanced CVI (Masking) and hours of training received in Basic Training, F (3,20) < 1, hours of AIT, F (2,21) < 1, hours of training in their present unit, F (3,20) < 1, or total hours of previous vehicle identification training reported in all arenas, F (3,20) < 1.

Evaluation of the Prototype CVI Training Program

The current research effort also afforded an opportunity to examine the effectiveness of the Prototype CVI Training Program with a within-subjects design utilizing pre- vs post-test data from the same soldiers. Earlier research (Smith, Heuckeroth, Warnick & Essig, 1980) evaluated this program with a between subjects design utilizing different groups of soldiers. In the current report, the within-subjects variables were target acquisition measure (recognition and identification) and test period (pre- and post-test). Analysis of variance of these data indicated a significant effect for test period, F (1,8) = 26.15, p < .001, and a significant difference due to target acquisition measure, F (1,8) = 87.69, p < .001. While absolute improvement in identification performance from pre- to post-test was greater than changes in recognition performance, the interaction failed to attain significance, F (1,8) = 2.73, p > .18. Means and standard deviations to support these analyses (see Table 4-3) indicate that for both target acquisition measures, post-test performance is superior to pre-test and recognition performance is superior to identification performance.

TABLE 4-3

Prototype CVI Training Pre-test and Post-test Scores
(Number correct of 50 possible)
for Prototype CVI Trained Personnel (n = 9)

	Pre-test		Post-test	
	M	SD	M	SD
Recognition	31.11	9.03	36.00	11.96
Identification	2.67	3.35	13.33	6.58

Results similar to those for the Advanced CVI Training Program which support the effectiveness of the Prototype CVI Training Program were also obtained by the data collected on the post-test questionnaire. In particular, 33.3% of the personnel trained with the Prototype CVI Training Program found the training "very effective," 44.4% found it "effective," and 22.2% found it "neither effective nor ineffective," none found it "ineffective," and none found it "very ineffective." When personnel were asked to compare the effectiveness of the Prototype CVI Training they had just received with previous training they had received, 44.4% found it "much better," 44.4% found it "better," 11.1% found it "about the same," none found it "worse," and none found it "much worse." Personnel also reported they could now identify 18.25 of the 25 vehicles, whereas before CVI training they could only identify 10.67 of the 25 vehicles.

The effectiveness evaluations of the personnel trained with the Advanced CVI Training Program were compared with the same evaluations of the Prototype CVI Training Program to assess the perceived relative effectiveness of the two training programs. Effectiveness was evaluated on a five-point scale with the most effective end of the scale scored as one for analysis purposes. Results indicated no difference between personnel trained with the Advanced CVI Training Program and those trained with the Prototype CVI Training Program in either how effective they believed the CVI program they were exposed to be, $\underline{M}_A = 1.50$, $\underline{M}_P = 1.88$, $\underline{t}\ (30) = 1.22$, $\underline{p} > .30$ or how much more effective they regarded the CVI program they were trained with to be than any previous type of combat vehicle identification training they had received, $\underline{M}_A = 1.71$, $\underline{M}_P = 1.62$, $\underline{t}\ (30) = 1.80$, $\underline{p} > .05$. Generally these findings indicate that both the Advanced (Masking) and Prototype CVI Programs were perceived equally effective and about equally superior to previous combat vehicle identification training received.

Relative Effectiveness of the Two CVI Training Programs

The degree to which training with one training program aided performance on the Final Test (Mod 7) of the alternative training program was assessed in two analyses of variance, one applied to the scores of personnel on the Final Test from the Prototype CVI Program and one applied to the scores of these personnel on the Final Test from the Advanced CVI Training Program. Vehicles not common to both programs were eliminated from the scoring for comparison purposes. As previously, time of testing (pre-test or post-test) and target acquisition measure (recognition or identification) were treated as within-group factors of the design and the type of training personnel had received (Advanced or Prototype) as a between-group factor in a split-plot design.

The results of the ANOVA for scores on the Final Mod 7 Test from the Advanced CVI Training Program produced no effect for the type of training that personnel had received, nor did the analysis of the scores on the Final Mod 7 Test from the Prototype CVI Training produce any effect for the type of training the personnel had received. (See Table 4-4.) Apparently, training in either training program is helpful in improving performance on the Final Test (Mod 7) from the alternative training program.

TABLE 4-4

Means and Standard Deviations from 2 ANOVA's Evaluating the Advanced and Prototype CVI Programs

	Pre-test				Post-test				
	Recognition		Identification		Recognition		Identification		Improvement In Total Score
	M	SD	M	SD	M	SD	M	SD	
Prototype CVI Scores (50 possible)									
Prototype Trained (n = 9)	23.00	7.94	1.44	2.35	38.89	16.89	27.67	14.45	172%
Advanced Trained (n = 24)	23.00	6.95	2.21	4.97	32.00	12.67	26.12	13.57	130%
Advanced CVI Scores (120 possible)									
Prototype Trained (n = 9)	60.44	11.64	0.0	0.0	69.89	16.45	14.56	7.57	40%
Advanced Trained (n = 24)	57.21	15.43	2.00	4.79	67.79	21.07	18.67	11.80	46%

Note that given the magnitude of the experimental effects, it is not considered that the small changes produced in the error term by doing two separate analyses would effect the practical significance of the results.

Training Variables

In administration of the Advanced CVI Training Program, the two Mod 7 Final Tests was administered in two different orders. In addition, simulated range and seat position in the classroom were varied. The effect of these three variables on the training were assessed by treating each of these variables as a between-groups factor in three independent ANOVAs. In those ANOVAs the time of testing (pre-test or post-test) and target acquisition measure (recognition or identification) were treated as within-group factors. The variable seat position was defined so as not to be confounded with ranges of training (which is simulated by varying seating positions). The sum of correct recognitions and identifications was the dependent variable.

Order of presentation. The analysis of variance examining the impact of order of presentation of the two Mod 7 Final Tests indicated no effect on performance, F (1,22) < 1, nor did order of presentation appear to interact with either time of testing or target acquisition measure, or these factors taken together, all $p > .06$.

Simulated range. The analysis of variance assessing the effect of simulated training range (1250 meters or 2000 meters) on performance produced no significant effect for training range, F (1,22) < 1, nor did the simulated training range interact with either time of testing or nature of response or these factors together, all $p > .28$.

Seat position. Given the lack of a significant difference between the two simulated ranges, seat position was analyzed by dividing the 16 positions into 8 groups of 2 positions, 1 from each range, corresponding to the 2 seat positions to the left of the aisle, the 2 to the right of the aisle, the next 2 in on either side, and so on, with finally the 2 outermost on the left and the 2 outermost on the right. (See Figure 3-1 in the Methods Section for a seating diagram.) The results of the ANOVA utilizing seat position as a between-subject variable produced no significant effect for this factor, F (7,16) = 2.10, $p > .12$; nor did any interaction effects involving seat position appear significant, all $p > .19$.

Vehicle Characteristics

The factors of vehicle and presentation angle were examined in a five-way ANOVA, with all factors treated as within-group variables. Factors included were time of testing (pre-test and post-test), vehicles (30 vehicles), angle (front view or oblique), presentation (first or second) and target acquisition measure (recognition or identification). The ANOVA table produced by this analysis is presented in Appendix D. As more thoroughly discussed in previous studies (See Heuckeroth, Shope & Smith, 1981) the type of vehicle, the angle of presentation, and the interaction between them were all significant. Some vehicles are simply more difficult to learn than others, the oblique view tends to be somewhat easier to learn, and the magnitude of the discrepancy in performance between these two angles varies from vehicle to vehicle.

Military Career Variables

Career variables such as rank, MOS, duty MOS, time in service, and time in MOS were analyzed as between-groups factors to assess their effect on performance in the Advanced CVI Training Program (Masking). The effect of these five factors were assessed using time of testing (pre-test or post-test) and target acquisition measure (recognition or identification) as within-group factors.

Rank. The rank of the personnel trained appeared to have no significant effect on personnel's performance with the training program, F (3,20) < 1, nor were any of the interactive effects involving rank significant, all $p > .08$.

MOS. The impact of MOS on training performance was assessed by comparing the scores of the Armor and Infantry personnel. This analysis revealed no significant main effect for MOS, F (1,22) < 1, but did reveal a significant interaction between time of testing and MOS, F (1,22) = 4.32, $p < .05$. Means and standard deviations supporting this finding indicated that Infantry soldiers appeared to benefit significantly more from training than did Armor soldiers (See Table 4-5). Further, a significant interaction between target acquisition measure and MOS, F (1,22) = 11.59, $p < .003$, was detected. Means and standard deviations indicated a nonsignificant reversal such that Infantry soldiers are superior on recognition performance, but the Armor soldier is superior on identification performance (See Table 4-6).

TABLE 4-5

MOS X Time of Testing Interaction:
Advanced CVI Scores

	Pre-Test		Post-test	
	M	SD	M	SD
Armor (n = 7)	70.14_a	14.71	92.29	29.49
Infantry (n = 17)	63.29_a	7.76	102.76	20.01

Note: Means with common subscripts are not significantly different, $p > .05$, by a Duncan's New Multiple Range Test procedure.

TABLE 4-6

MOS X Response Interaction:
Advanced CVI (Masking) Scores

	Recognition		Identification	
	M	SD	M	SD
Armor (n = 7)	136.43_a	23.49	26.00_b	19.99
Infantry (n = 17)	143.71_a	15.18	22.35_b	10.83

Note: Means with common subscripts are not significantly different, $p > .05$, by a Duncan's New Multiple Range Test procedure.

Duty MOS. A similar analysis was not attempted for the variable of duty MOS as only 13 people responded to this question and of those, only 4 had duty MOS's which were different from their actual MOS's.

Years in service. The effect of years in service on training performance was assessed by dividing the range of years of service into four categories of approximately equal n's and treating these categories as levels of a between-group factor. The results of this analysis produced no significant effects for years of service, F (3,20) < 1, nor did any of the interactive effects involving years of service appear significant, all p > .50.

Years in MOS. A similar analysis for years in MOS also failed to produce a significant effect, F (3,20) = 1.22, p > .33, nor did any of the interactions in which years in MOS was involved appear significant, all p > .05.

Demographic Variables

Two additional background variables included use of eye glasses and age. Two independent ANOVAs were planned with these background variables as between-group factors and time of testing (pre-test and post-test) and target acquisition measure (recognition and identification) as within-group factors.

Glasses on the job. An analysis comparing personnel who wore glasses on the job with those who did not was impractical due to the wide disproportionality among conditions; only 2 personnel out of the 24 answered "yes" to this question.

Age. Overall, target acquisition performance did not differ for soldiers differing in age , F (3,20) = 2.57, p > .08, however a significant interaction between age and test period (pre- vs post-test) was detected, F (3,20) = 3.96, p < .03. Means and standard deviations supporting these analyses are found in Table 4-7. The relatively low frequency in each of these age groups and the irregular pattern of mean changes make it prudent to defer any attempt at interpretation.

TABLE 4-7

Age X Time of Testing Interaction:
Advanced CVI Scores

Age	Pre-test		Post-test	
	M	*SD*	*M*	*SD*
18 - 19 (*n* = 5)	64.40_{a}	6.02	97.00_{c}	29.66
20 (*n* = 9)	61.55_{a}	8.88	99.88_{c}	19.04
21 (*n* = 4)	66.00_{ab}	7.79	76.50_{b}	18.27
22 - 28 (*n* = 6)	71.16_{ab}	15.48	117.16	12.11

Note: Means with common subscripts are not significantly different from one another, $p > .05$, by a Duncan's New Multiple Range Test procedure.

CHAPTER V

DISCUSSION AND CONCLUSIONS

DISCUSSION

This study provided a generally successful laboratory type test of the effectiveness of the Advanced CVI Training Program (Masking). The new training program was demonstrated to be one which meets the expressed need for higher fidelity training consistent with that found in tactical situations.

Impact of the Advanced CVI Program Training

The results generally indicated that the personnel trained benefited significantly from their six hours of instruction. While the changes in recognition scores are not as dramatic, identification performance increased by a factor of some 17 times. Results for recognition are never as clearcut because of the large chance component which operates here; a guess at recognition has a .50 probability of being correct, while a guess at an identification has only a .03 probability of being correct given the set of 30 vehicles.

Note that while these soldiers reported already having had considerable combat vehicle identification training prior to this Advanced CVI Training Program (Masking), their pre-test scores were at about the chance level. They scored about 50 percent correct for recognition and about 1 percent correct on their identification performance. This finding is particularly noteworthy given the MOS's of these soldiers; they were all either Armor or Infantry with a clear need to have extensive knowledge of combat vehicle identification.

The soldiers' evaluation of the effectiveness of the Advanced CVI Training Program (Masking) was uniformly positive, finding it highly effective and clearly more effective than any previous training they had received. Since the amount of previous combat vehicle identification training received had no significant impact on pre-test scores, it appears soldiers were correct in assessing their previous training as significantly less effective.

Prototype CVI Training Program

Extensive evaluation of data collected on the Prototype CVI Training Program has been done (Smith, Heuckeroth, Warnick & Essig, 1980; Heuckeroth, Shope & Smith, 1981). Results from the small group in this study trained with the Prototype CVI Program again supported the effectiveness of the program. Soldiers learned to identify some five times more vehicles than they could prior to the training, they assessed the program as very effective, and significantly more effective than any training they had previously received.

Relationship Between Training Programs

There is apparently a close relationship between the two training programs. Personnel trained with the Advanced CVI Training Program were subsequently capable of scoring more highly on the Final Test of the Prototype CVI Training Program, and similarly, personnel trained with the Prototype CVI Training Program were later able to score much more highly on the Advanced CVI Training Program's Final Test.

Training Variables

Since post-test performance on the Advanced CVI Program (Masking)did not differ significantly for groups tested with different orders of presentation, results from either form are considered equally valid.

It would appear that a simulated range of 2000 meters was not far enough to produce the decrement in performance which must necessarily occur at greater ranges; similarly, 1250 meters was evidently not close enough to make the extremely difficult task of identifing these partially obscured vehicles any easier. Further research will be required to discover the extremes of range for successful training with the Advanced CVI Training Program.

The failure to find an effect for seat position independent of range again supports the effectiveness of the basic approach of the CVI Training Programs. If the classroom is correctly set up, other than the deliberate effect of simulated range created by the row in which personnel sit, actual seat position in the curved row will have no significant impact on training effectiveness.

Vehicle Characteristics

Since the impact on performance of such variables as the particular vehicle and the angle of presentation have been much more thoroughly discussed elsewhere (e.g., Heuckeroth, Shope & Smith, 1981), little effort was made here in either analyzing or interpreting these effects. In general: 1) some vehicles are more difficult to learn than others; 2) performance on front angle presentations tend to be poorer; and 3) the relative importance of any particular angle on performance shows significant variation among vehicles. A subsequent report will address these findings for the Advanced CVI Training Program in more detail specifically focusing on the consistency of findings for the Advanced CVI Program to results reported for the Prototype CVI Program.

Military Career Variables

Since the sample was composed of a relatively homogeneous group of soldiers, it is perhaps understandable that the small differences among levels of their military career variable did not have differential impact on performance. However, the differences in performance of Armor and Infantry personnel bears examination.

Tables 4-6 and 4-7 in the Results chapter reveal conflicting differences between these two groups of personnel. On the one hand, the Armor personnel demonstrate greater overall improvement in performance from the pre-test to the post-test. On the other hand, the Infantry personnel reveal themselves to be much better than the Armor personnel with the identification response while there is no difference between the two groups with the recognition response. No clear explanation for this pattern of results can be offered. Given the small sample size and the somewhat conflicting nature of the results, meaningful interpretation of these findings should await replication.

Demographic Variables

As noted in the Results chapter, little can be said of potential differences in performance between those personnel who reported wearing eye glasses on the job with those that did not, given the limited number who did. Nor can little be said of the significant age differences which are most likely an artifact of the age distribution.

CONCLUSIONS

The Advanced CVI Training Program (Masking) is effective and makes a valuable addition to the set of CVI Training Programs. One distinguishing characteristic of this Advanced Program (Masking) is the extent to which tactical realism is provided. The research problems generated in conducting this study pointed up the magnitude of problems associated with training research in the Army.

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APPENDIX A

Table A-1

Vehicles and Defilade Presentation in the Advanced Combat Vehicle Identification Training Program (Masking)

Vehicle	View	Mask (Defilade)
BRDM-2	F	Turret
T-62	OL	Turret
Roland	F	Hull
ZSU 57-2	F	Turret
Saladin	F	Hull
BTR-50P	OR	Hull
Marder	F	Turret
Saladin	OL	Turret
T-72	F	Hull
Scimitar	F	Hull
ASU-85	OL	Hull
AMX-30	F	Turret
Chieftain	F	Hull
T54/55	F	Hull
BTR-60P	F	Turret
M1 Abrams	OR	Hull
M113	F	Hull
T-62	F	Turret
Jagdpanzer	F	Hull
ZSU 23-4	OR	Turret
ASU-85	F	Hull
Gepard	F	Turret
BMP-1	F	Hull
T-72	OL	Hull
ZSU 23-4	F	Hull
M1 Abrams	F	Turret
M113	OR	Hull
Jagdpanzer	OR	Turret
M48	F	Turret
SP-74	OR	Turret

APPENDIX B

Prototype CVI Training Program

The Prototype CVI training program consists of slides and printed materials divided into five training modules and an overall test module. In addition an experimental module (Mod 6) of intermediate level difficulty was included. This experimental module was developed so that data collected might serve as a basis for deciding whether an intermediate level CVI training program (such as modules for specialized MOSs) would be necessary to bridge the gap between the Basic CVI and an advanced program (which uses masking). The Prototype training modules cover the array of 25 vehicles. Each of the first 5 modules uses 5 of the 25 vehicles photographed in 5 different positions (front, oblique right, oblique left, side right, and side left)during the training period; during the module test period a front, an oblique and a side view are presented for R&I response. Each module is divided into: (1) a manual presentation phase during which slides (vehicles) are projected one at a time onto a screen[1]; (2) an automated presentation phase during which the slides are shown every 15 seconds; and (3) a test phase in which three views for each of the five vehicles covered in the module are presented at 8-second intervals for soldier-written responses. During the manual presentation phase, the soldier makes a written recognition and identification response[2], the instructor then describes key cues relevant to recognition and identification of the vehicle, and the soldier has a chance to ask questions. During the automated presentation phase, the soldier again gives a written R&I response, the instructor reiterates the key cues for R&I response but permits no questions. The test phase allows a measure of the effectiveness of the training.

The sixth (experimental) module is composed of five vehicles which appeared in different Prototype training modules; previous research has indicated that the selected vehicles are very difficult for soldiers to learn.

The final test module is composed of two views (frontal and an oblique) of all 25 vehicles and uses an 8-second exposure for presentation and soldier-written responses.

In scoring the test, the soldier starts with a score of 100. One point is deducted for each "don't know" response, and two for each wrong answer. Thus, a greater penalty is assessed for a mistake than admitting lack of knowledge. The rationale for this scoring is that it is far worse in combat to mistakenly kill a friendly vehicle, or to allow an enemy vehicle to gain an unnecessary advantage because the gunner in error believes it to be friendly, than to honestly not know whether the sighted vehicle is friend or foe. In the latter case the gunner will presumably get help as soon as possible or take cover while waiting for the vehicle to move to a position where he can identify it positively.

[1]Slides projected present vehicle image sizes representative of what the soldier would actually see at realistic combat ranges.

[2]Recognition is being able to state whether a vehicle is "friendly" or "threat", and identification is being able to label a vehicle by its common or accepted name, or its correct model number.

The instructional materials consist of: (1) an overall guide for the use of CVI giving detailed instructions for all phases of the training; and (2) a complete instructor's script for the experimental and each of the five training modules, plus general reminders for presentation. This reduces instructor preparation time to nearly zero.

What the soldier sees in the CVI program that differs from a usual slide presentation is the heart of the CVI program. He sees an image of a vehicle on the screen that resembles in both size and identifiable characteristics what he would actually see if he were in the field looking at it. Furthermore, simulation of any power and/or optics is a regular part of the training. Hence, for example, a TOW gunner using 13-power optics at a range of 3,000 meters or an infantryman without optics at 500 meters can both be trained, simultaneously if desired.

The seating arrangement in the classroom is important in order to minimize image distortion. Of necessity, class sizes are usually held to not more than 35 for best results. Figure B-1 provides an example of how a class should be seated.

To achieve the correct simulated distance and optics combination, tables are provided in the instructor's manual as part of the CVI training program. See Table B-1 for an example of the distances used in a large classroom.

Throughout the CVI program, the soldier is a participant. He must attempt both to recognize and to identify the vehicle by responding on work sheets provided. Hence recognition and identification are combined into one training program such that a soldier's progress on both can be measured and tracked.

To assure that the program teaches the soldier to differentiate between vehicles as a function of vehicle characteristics rather than terrain features associated in the photograph (slide) with a particular vehicle, the same background is used for all vehicles. All of the 25 HO scale (1:87) models were photographed in an identical location on a realistic terrain board. The fact that only 25 vehicles (See Table B-2) were used in the initial program evaluation was due to the lack of availability at that time of scale models of other vehicles. However, as additional vehicles are developed and models become available, they are being added to the CVI training program.

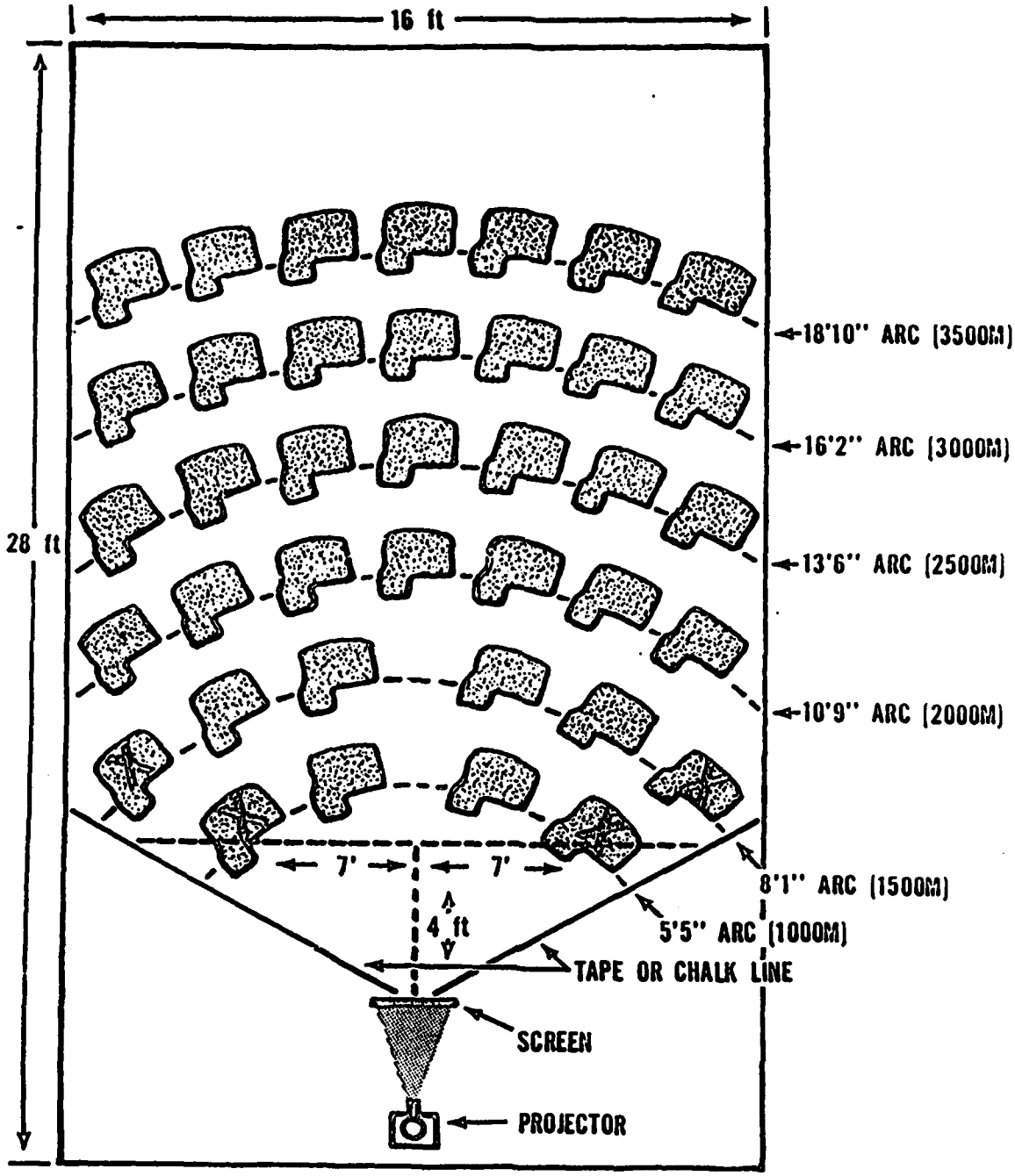

Figure B-1. Classroom arrangement for simulating a 7X optic at ranges of 1000M, 1500M, 2000M, 2500M, 3000M, and 3500M in a small classroom.

TABLE B-1. Eye-to-Screen Viewing Distances* for Large Rooms

Simulated Range (meters)	Distance From Screen to Trainees's Eyes				
	no optic	6X optics	7X optics	8X optics	10X optics	13X optics
250	18'10"	---	---	---	---	---
500	37'9"	6'3"	5'5"	---	---	---
750	---	9'5"	8'1"	7'1"	5'8"	---
1000	---	12'7"	10'9"	9'5"	7'7"	5'10"
1250	---	15'9"	13'6"	11'9"	9'5"	7'4"
1500	---	18'10"	16'2"	14'2"	11'4"	8'8"
1750	---	22'9"	18'10"	16'6"	13'2"	10'2"
2000	---	25'2"	21'7"	18'10"	15'1"	11'7"
2250	---	28'3"	24'3"	21'3"	17'0"	13'1"
2500	---	31'5"	26'11"	23'7"	18'10"	14'6"
2750	---	34'7"	29'8"	25'11"	20'9"	15'11"
3000	---	37'9"	32'4"	28'3"	22'8"	17'5"
3250	---	---	35'0"	30'8"	24'5"	18'10"
3500	---	---	37'9"	33'9"	26'5"	20'4"
3750	---	---	---	35'4"	28'3"	21'9"
4000	---	---	---	37'9"	30'2"	23'2"

*Practical viewing distances are from 5 to 40 feet. Few people can be expected to consistently identify vehicles beyond 40 feet under these conditions.

TABLE B-2

Prototype Target Array

Training Module 1

T-62 Tank (USSR)
BTR-60P APC (USSR)
Leopard Tank (FRG)
M113 APC (USA)
Scorpion Tank (UK)

Training Module 2

Centurion Tank (UK)
M60A1 Tank (USA)
Gepard [Flakpanzer]
ADA (FRG)
AMX-13 Tank (Fr)
M109 SP Howitzer (USA)

Training Module 3

M48 Tank (USA)
M551 Sheridan AR/AAV (USA)
Saladin Scout Car (UK)
ZSU 23-4 ADA (USSR)
BTR-50 APC (USSR)

Training Module 4

AMX-30 Tank (Fr)
PT-76 Amphib Tank (USSR)
Scimitar Recon Vh (UK)
Marder APC (FRG)
T-72 Tank (USSR)

Training Module 5

Chieftain Tank (UK)
ZSU 57-2 ADA (USSR)
Jagdpanzer [JPZ 4-5]
Aslt Gun (Frg)
T54/55 Tank (USSR)
Roland ADA (FRG)

Training Module 6

T-62 Tank (USSR)
M60A1 Tank (USA)
T-72 Tank (USSR)
Leopard Tank (FRG)
AMX-30 Tank (Fr)

Final Test - Module 7

All 25 of above vehicles

The Basic CVI Training Program

This is the final production title adopted by the Army. Its content differs from the Prototype version in only one training dimension. One vehicle, the M551 Sheridan, was replaced by the Abrams M1 Tank. Five additional vehicles, all Threat, were added, thus increasing the total number of vehicles from 25 to 30.

Module six in the Prototype, it will be recalled, simply repeated five of the vehicles appearing in one of the first five training modules. In Basic CVI, the sixth module is composed of five different vehicles.

Table B-3 presents the composition of the Basic CVI Training Program.

TABLE B-3

Basic CVI Target Array

Training Module 1	Training Module 4
T-62 Tank (USSR)	AMX-30 Tank (Fr)
BTR-60P APC (USSR)	PT-76 Amphib Tank (USSR)
Leopard Tank (FRG)	Scimitar Recon Vh (UK)
M113 APC (USA)	Marder APC (FRG)
Scorpion Tank (UK)	T-72 Tank (USSR)
Training Module 2	**Training Module 5**
BMD (USSR)	Chieftain Tank (UK)
M60A1 Tank (USA)	ZSU 57-2 ADA (USSR)
AMX-13 Tank (Fr)	Jagdpanzer [JPZ 4-5] Aslt Gun (FRG)
M109 SP Howitzer (USA)	T54/55 Tank (USSR)
ASU-85 (USSR)	Roland (FRG)
Training Module 3	**Training Module 6**
M48 Tank (USA)	Gepard [Flakpanzere] ADA (FRG)
M1 [Abrams] (USA)	Centurion (UK)
Saladin Scout Car (UK)	SP 74 (USSR)
ZSU 23-4 ADA (USSR)	BRDM-2 (USSR)
BTR-50 APC (USSR)	BMP-1 (USSR)

Final Test - Module 7

All 30 of above vehicles

APPENDIX C

TABLE C-1

ANOVA: Time of Testing x Vehicle Angle x Presentation x Target Acquisition Measure

Source	MS	df	SS	F
Time of Testing	59.22	1	59.22	72.07 ***
Error	18.89	23	0.82	
Vehicle	40.64	29	1.40	5.67 ***
Error	164.77	667	0.24	
Time x Vehicle	24.62	29	0.84	3.71 ***
Error	152.62	667	0.22	
Angle	3.68	1	3.68	16.24 ***
Error	5.21	23	0.22	
Time x Angle	0.20	1	0.20	2.46
Error	1.86	23	0.08	
Vehicle x Angle	10.06	29	0.34	1.67 *
Error	138.16	667	0.20	
Time x Vehicle x Angle	17.02	29	0.58	3.26 ***
Error	120.03	667	0.17	
Presentation	1.20	1	1.20	3.49
Error	7.96	23	0.34	
Time x Presentation	0.45	1	0.45	1.57
Error	6.59	23	0.28	
Vehicle x Presentation	10.55	29	0.36	2.74 ***
Error	88.64	667	0.13	
Time x Vehicle x Presentation	10.75	29	0.37	3.15 ***
Error	78.58	667	0.11	
Angle x Presentation	0.27	1	0.27	2.63
Error	2.37	23	0.10	

Source	MS	df	SS	F
Time x Angle x Presentation	0.10	1	0.10	1.85
Error	1.24	23	0.05	
Vehicle x Angle x Presentation	8.13	29	0.28	2.42 ***
Error	77.33	667	0.11	
Time x Vehicle x Angle x Presentation	3.22	29	0.11	0.93
Error	80.04	667	0.12	
Target Acquisition Measure	698.16	1	698.16	2622.29 ***
Error	6.12	23	0.26	
Time x Target Acquisition Measure	2.62	1	2.62	6.19 *
Error	9.76	23	0.42	
Vehicle x Target Acquisition Measure	26.28	29	0.90	5.47 ***
Error	110.54	667	0.16	
Time x Vehicle x Target Acquisition Measure	10.09	29	0.34	2.33 ***
Error	99.63	667	0.14	
Angle x Target Acquisition Measure	0.18	1	0.18	2.67
Error	1.58	23	0.06	
Time x Angle x Target Acquisition Measure	0.40	1	0.40	4.33 *
Error	2.13	23	0.09	
Vehicle x Angle x Target Acquisition Measure	6.91	29	0.23	1.90 **
Error	83.69	667	0.12	
Time x Vehicle x Angle x Target Acquisition Measure	7.57	29	0.26	2.08 ***
Error	83.76	667	0.12	

Source	MS	df	SS	F
Time x Vehicle x Presentation x Response	3.37	29	0.11	1.24
Error	62.88	667	0.09	
Angle x Presentation x Response	0.01	1	0.01	0.17
Error	1.72	23	0.07	
Time x Angle x Presentation x Response	0.07	1	0.07	1.33
Error	1.35	23	0.05	
Vehicle x Angle x Presentation x Response	5.02	29	0.17	1.85 **
Error	62.61	667	0.09	
Time x Vehicle x Angle x Presentation x Response	3.47	29	0.11	1.28
Error	62.46	667	0.09	

* $p < .05$
** $p < .01$
*** $p < .001$