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

Research Report 1504

Target Acquisition and Analysis Training System: Effects of Motion on Performance in the Combat Vehicle Identification (CVI) Training Program

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U.S. Army Research Institute

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U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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The purpose of this research was to determine (1) whether introducing motion into the Basic Combat Vehicle Identification (CVI) Training Program produces improved performance following initial and repeated training; (2) whether motion facilitates learning by soldiers who were not training responsive (NTR) in acquiring recognition and identification (R&I) skills, compared to soldiers who were training responsive (TR); and (3) whether motion helps soldiers retain recognition and identification materials over an 18-hour period.

Soldiers from the 1st and 3rd Brigades of the 85th Army Reserve Division (Tng) [One Station Unit Training], Arlington Heights, Illinois, received R&I training. Each soldier received three training sessions with three modules from the CVI program with one of four types of motion: (1) rotational, (2) circular, (3) straightline, and (4) static (no motion). Useable data were obtained from 71 soldiers.

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Major conclusions drawn from analyses of these data include the following:

- Motion (after repeated training) provides a small positive effect but does not appear to be an essential ingredient in learning ground-to-ground vehicle R&I using the Basic CVI Training Program. This is true for both training responsive and nontraining responsive soldiers.

- Short term retention of learned R&I skills is not improved when motion is included in the training.

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Education and Training

FOREWORD

The Fort Hood Field Unit of the U.S. Army Research Institute (ARI) has developed a series of target recognition and identification (R&I) training programs and conducted related research as part of the research titled Target Acquisition and Analysis Training System (TAATS). Both Training and Doctrine Command (TRADOC) and Forces Command (FORSCOM) recognized the need for standardized R&I training and requested that ARI develop such programs. This work was performed for the Combined Arms Center (CAC), Fort Leavenworth, Kansas.

This research report examines whether R&I performance is enhanced by using moving target vehicle images (video tape) during Combat Vehicle Identification (CVI) training rather than static target vehicle images. It evaluates both the amount of material learned and the retention over time of this material. Inasmuch as R&I training done in the Army with the Basic CVI Program uses static target vehicle images (35mm slides), and training with motion uses video, the results have cost and training implications. Specifically, CVI training with moving (videotaped) images is projected to be more costly than training with static 35mm slide images.

These results were briefed on 19 October 1984, to LTC Harold Fritz, proponent for vehicle identification, and copies were provided to CAC, Fort Leavenworth.

EDGAR M. JOHNSON
Technical Director

TARGET ACQUISITION AND ANALYSIS TRAINING SYSTEM: EFFECTS OF MOTION ON PERFORMANCE IN THE COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

EXECUTIVE SUMMARY

Requirement:

The Target Acquisition and Analysis Training System (TAATS) research program was established to provide a framework for development of logically related training programs. The impetus for such a system was provided by a series of Human Resources Needs (HRN) requests dating from 1975 from both Training and Doctrine Command (TRADOC) and Force Command (FORSCOM). In 1980 an integrated series of training programs was planned in conjunction with the Army's proponent for vehicle recognition at the Combined Arms Center (CAC), Fort Leavenworth, Kansas. The first of the training programs was the Basic Combat Vehicle Identification (CVI) Training Program, produced in 1981 and adopted the same year by the Army as its standardized recognition and identification (R&I) training program (GTA 17-2-9).

Some researchers thought that motion would be an important addition to CVI training programs. These advocates felt that motion would add realism, increase soldier motivation to learn, and provide cues about the vehicles that would facilitate learning. The purpose of this research is to first explore the validity of the belief that using vehicles in motion (video tape) in the Basic CVI Training Program would improve performance over that achieved with static vehicles; and second, to determine whether motion differentially affects training responsive and non-training responsive performers.

Procedure:

Data from the 85th Army Reserve Division (Tng), Arlington Heights, Illinois, were used to evaluate the effects of motion on performance immediately after repeated training and again, 18 hours after training. Soldiers (N=120) were assigned to one of four conditions: circular motion, rotational motion, straightline motion, or static (no motion). The training medium was videotape. Soldiers in each condition were pretested and then trained on three modules comprising a total of 15 vehicles from the Basic CVI Training Program. Three training iterations were given to each condition. The first and last iteration were followed by a videotape test appropriate to the type of motion used.

Findings:

Groups presented with vehicles in motion learned the vehicles no better after one training session than groups trained on static vehicles. After three training sessions, all groups showed further improvement. However, the rotational group improved most, while the static group improved least. Motion did not contribute to improved performance in retention over an 18-hour period

when compared with that achieved with static targets. When soldiers were divided into training responsive (TR) and non-training responsive (NTR) groups based on their performance on the first post-training test, motion did not differentially improve performance by the NTR group when compared with the TR group.

Conclusions:

- Motion (after repeated training) provides a small positive effect but does not appear to be an essential ingredient in learning ground-to-ground vehicle R&I using the Basic CVI Training Program. This is true for both training responsive and non-training responsive soldiers.

- Short term retention of learned R&I skills is not improved when motion is included in the training.

Utilization of Findings:

Motion is not a key requisite to improving performance in R&I. This information will be used in cost-benefit analyses of future training considerations.

TARGET ACQUISITION AND ANALYSIS TRAINING SYSTEM: EFFECTS OF MOTION ON PERFORMANCE IN THE COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

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INTRODUCTION

Background

In 1980, the Target Acquisition and Analysis Training System (TAATS), a part of the research program at the Army Research Institute's Field Unit, Fort Hood, Texas, was established. The major objective of TAATS was to provide a framework within which to do research and develop interrelated target acquisition training programs. Five have been developed, tested and turned over to the Army. They are the Basic Combat Vehicle Identification (CVI) Training Program, the Basic Thermal Combat Vehicle Identification (TCVI) Training Program, the Advanced Combat Vehicle Identification Training Program, the Flash Card Program, and the Combat Vehicle Identification Training Program for the Remotely Piloted Vehicle (RPV).[1] Three programs, the CVI, TCVI, and Flash Cards have been adopted and issued by the Army as standard training for vehicle identification designated as GTA 17-2-9, GTA 17-2-10, and GTA 17-2-11, respectively. The Advanced CVI program awaits issue by the Army. The RPV program was used to train RPV operators for Operational Test (OT) II in June 1984.

Military Problem

Some trainers believed that if motion were to be added to CVI training programs which use imagery, performance would be substantially improved. Certainly, motion does add realism to the extent that moving vehicles are frequently confronted and this may have a motivating effect on performance. There is no question that movement generally attracts attention. Research findings in the vehicle visual detection area (Smith, W.M., 1951; Gottsdanker, R.M., 1957; Miller, J.W., 1960; and Gutmann, J.C. et al., 1979) concluded that targets were usually more likely to be detected when in motion than when static and greatest detection occurred as the target shifted from a static to motion state when other factors such as target shape and size, contrast, clutter, etc., were held constant.

However, the objective of the CVI training programs is to teach recognition and identification (R&I)[2], not detection. Merrill and Bunderson (1981, pg. 4) point out that "motion is necessary only if movement is a critical attribute required for proper discrimination." The central research question here is whether vehicle targets in motion result in better discrimination and thus significantly better soldier performance on R&I than do static vehicle targets under similar environmental conditions. If motion is not required in training to achieve improved R&I performance, costs of training materials, production, and playback systems will probably be substantially less.

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[1] A citation for the technical or research report on each of the training programs is in the Reference Section.

[2] Detection is defined as being aware of the presence of a man-made object in the field of view; recognition is being able to call the object a friend or threat; identification is being able to give the name or number if the object is a vehicle or aircraft.

Purpose and Scope of This Report

The major objectives of this research were to determine (1) whether introduction of motion into the Basic CVI Training Program produced better performance following initial and repeated training; (2) whether motion might facilitate learning by those soldiers who demonstrate difficulty in acquiring R&I skills; and (3) whether motion might affect retention of R&I materials after 18 hours.

METHOD

General Description

Four groups comprised of 30 soldiers each were employed. All groups were trained on (videotaped) modules 3 thru 5 (for a total of 15 vehicles) of the Army's Basic CVI Training Program (GTA 17-2-9). Each group was trained on one of four conditions: a) video rotation, b) circular motion, c) straight line motion, and d) standard static CVI images. The conditions indicated by these group designations will be explained below.

In the video rotation group, vehicles were rotated about the center of their axes, completing a 180° rotation in 7.5 seconds. The view obtained was from one full side to the other full side view. Both clockwise (CW) and counterclockwise (CCW) rotation were employed. Training was conducted showing each vehicle for a 15 second period utilizing both the CCW and CW rotations.[3] Testing was accomplished using the CW and CCW rotations separately. In the posttraining test where the standard CVI slide sequence called for a front view, the vehicle was presented CW; where an oblique view was to be presented, the vehicle was shown CCW.

In the circular motion group, vehicles traveled through a 180° circular path in a 15 second period for the training imagery. The vehicle was seen from one full side to the other full side. Both CW and CCW movements were employed. Scaled ground speed was 8 mph. Test imagery was the same except that the vehicles traversed a 180° arc in 7.5 seconds. In order to keep the ground speed at constant 8 mph, the diameter of the arc traversed was one-half that employed in the training imagery and the speed was doubled.

For the straight line motion group, training imagery consisted of 15 second sequences with the vehicles following straight paths. Five paths were utilized. These paralleled the views seen in the standard CVI program, i.e., left side, left oblique, front, right oblique and right side. The test imagery consisted of 7.5 second views edited out of the 15 second views used for training.

In the fourth group the standard CVI reproduced on video tape was used, i.e., static images. No new imagery was required.

Personnel

To conduct the research, 160 soldiers were requested--40 for each of the four groups. For various reasons only 120 soldiers were ultimately made available, thus reducing each group size to 30. Data from 71 soldiers met the two criteria for inclusion; 1) they were present for all training sessions and tests, and 2) they responded on all test answer sheets. Final group sizes were: Rotational 16, Circular 19, Straightline 15, and Static 21.

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[3] It is important to not that exposure time to each vehicle was held constant across all motion conditions--during training and testing.

Personnel trained were from the 1st and 3rd Brigades of the 85th Army Reserve Division (Tng) [One Station Unit Training (OSUT) 19E/19D], Arlington Heights, Illinois. In view of the large number of soldiers who failed to qualify for inclusion in subsequent analyses, it seemed prudent to examine the remaining population for potential biases.

Previous research within TAATS (Shope, et al. 1984; Smith, et al. 1986) has pointed to the probable role of GT on R&I performance. It was, therefore, judged appropriate to verify that the useable data from the final four training groups were comparable on this factor. Results of an analysis of variance of GT score for the four motion groups indicated no significant differences [$F(3,66) = .30$, $p = .82$]. Means and standard deviations to support this analysis are found in Table 1.

Table 1

Mean GT Score for Each Motion Group[a]

Group	n	M	SD
Rotational	15	109.20	20.45
Circular	19	105.89	18.63
Straight line	15	110.87	13.34
Static	21	110.38	16.85

[a] GT information was unavailable for one person in Rotational group.

Procedure

Personnel were randomly assigned to seats but were asked to take the same seat for all subsequent training and testing in order to maintain image size constancy.

To insure that the three repeated training sessions could be completed in the time available following extensive orientation for the soldiers on the first day, tests after all but the first and last training sessions were omitted.

During training and testing soldiers were required to make a written response on prepared answer sheets each time a vehicle was projected. They had first to make a recognition response--F for friend, T for threat or DK (?) for "don't know." This was followed by an identification response in which the name or number of the vehicle was stated, or a DK (?) response if it could not

be identified. For example, if a Soviet T-62 were projected, the soldier should immediately write T for threat and follow it with T-62. Three modules dealing with five vehicles each were used.

In Sections A and B of each module each vehicle was presented five times for a total of 50 presentations; in section C, the Module Test, three presentations of each vehicle were shown. In the pretraining test (Test 1), static images consisting of five views of the 15 vehicles for a total of 75 responses were used. The posttraining tests (Tests 2, 3, and 4) consisted of the same number of views and vehicles as the pretraining test but using the motion on which training took place. A listing of the vehicles can be found in Appendix A.

On the morning of the second day time was allotted to test retention of the previous days knowledge after a lapsed time of 18 hours.

The data collection schedule is presented in Table 2.

Table 2

Data Collection Schedule

Motion Group	Testing/Training Schedule							
Circular	Test 1 Pre-Tng Test	Tng	Test 2	Tng	Tng	Test 3	18 hours Lapsed Time	Test 4
Rotational	"	"	"	"	"	"		"
Static	"	"	"	"	"	"		"
Straight line	"	"	"	"	"	"		"

A detailed description of The Basic CVI Training Program procedure and instructions are found in GTA 17-2-9.

Collection and Presentation Materials

A training response form was required for each module. These forms provided for responses for three presentations of five vehicles for each of the three module sections (A, B and C). In addition, the pretraining and posttraining tests required a form providing for responses to five presentations of each of the 15 vehicles. (See Appendix B)

A Soldier Reaction Questionnaire composed of 10 items was administered at the end of the research. (See Appendix C)

Five 3/4" videotape players and five 19" monitors were supplied by the 85th Division. Classrooms that would provide each of 30 soldiers with desk armchairs were used.

Data Analysis

In order to address study objectives several analyses of variance were performed and, where appropriate, Duncan Multiple Range Tests. These statistical analyses were interpreted by use of tables and figures showing mean number of images identified.

Previous research (see references) with two dependent variables--vehicle images (slides) recognized and vehicle images (slides) identified--has reliably shown that the former is a relatively unstable measure of performance and a less sensitive measure for assessing treatment design differences. This is due primarily to the 50/50 probability of being correct if one guesses, and the consistent disregard by soldiers of the instructions which attempt to discourage guessing. For those reasons, only the number of images correctly identified was used as the dependent variable in this research.

Development of Training Responsiveness Concept

Research conducted within the TAATS program has focused primarily on test evaluation of prototype training. In these evaluations repeated training was not given and evaluations were based on pretraining test-postraining test comparisons which, though statistically significant, left unanswered questions of suitable performance criteria, retention, and retraining. Clearly the impression that R&I is one of the more difficult skills to develop is created. More recently attention has shifted to exploring learning curves for individual soldiers when repeated training and testing are conducted. This approach has demonstrated that although some soldiers are extremely responsive to the program, other soldiers, even with repeated training, are not responsive to R&I training as currently provided in the CVI program. In order to operationalize the concept of training responsiveness as a preliminary research tool, soldiers who identified less than 50% of the vehicle images correctly on the first posttraining test were defined as non-training responsive (NTR) and those who identified 50% or more of the images were defined as training responsive (TR)[4]. Using this definition in the present research, 27 (38%) soldiers were considered as NTR and 44 (62%) as TR.

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[4]Previous exploratory research (Smith, et al. 1986) involving repeated training and testing indicated that this criterion resulted in significant absolute performance curve differences for training responsiveness groups at each training and test point. The consistency of these differences between comparable points on the performance curve for these groups was used as a basis for inferring that these groups do differ in one or more important dimensions related to R&I training.

RESULTS[5]

Effects of Motion During Training

Pretesting Before Training

Before training began a videotaped pretest (Test 1) using 75 static vehicle images (5 views for each of 15 vehicles) was given to determine whether the knowledge of vehicles differed among soldiers assigned to groups. An analysis of variance (ANOVA) using the number of vehicle images identified as the dependent variable found that no significant differences existed [F (3,882) < 1, p >.05]. Performance in this initial test was near zero, the means for the groups were as follows: circular, .55; rotational, .46; static, .70; and straightline, 1.03.

Initial Training. An ANOVA was completed on the identification performance data (number of vehicle images correctly identified) on the first posttraining test (Test 2) to determine whether or not any of the motion conditions used led to training performance differences early in learning. Results of that analysis indicated that while absolute performance of the static group was lower than for each of the other motion conditions, no significant differences among the groups were found [$F(3,63) = 1.79$, $p = .16$]. Means and standard deviations for each group on this test are found in Table 3.

Repeated Training. While performance differences among the four groups could not be detected following an initial training session, it is nevertheless relevant to ask whether motion conditions used show the same pattern of training effectiveness with repeated training. The plan was to give as many training periods as time allowed (rest periods intervening between each) during a single work day of 8 hours. Bad weather delayed the start and foreshortened the duration so that a total of only three training periods was possible. An ANOVA was performed with identification performance data following the first and last training session to address this question. Results of that analysis indicated that while all groups showed improvement from Test 2 to Test 3 after repeated training, the rotational group was responsible for the greatest improvement. This accounts for the significant group by test interaction [$F(3,63) = 5.05$, p <.01]. Means and standard deviations to support this analysis are also presented in Table 3 and graphically depicted in Figure 1. Inspection of these data suggests that with repeated training, rotational motion of vehicles results in substantially greater improvement in performance compared to other motion conditions (including the static no-motion group).

Finally, a separate ANOVA of only Test 3 identification performance data was performed. It indicated significant differences among the groups [$F(3,63) = 5.77$, p <.01]. A Duncan Multiple Range Test for these means indicated that while differences existed among non-static motion conditions, performance in the Static condition was significantly lower than for all other motion conditions (p <.05). Complete results of this test are summarized in Table 3.

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[5]A summary of the sources of variance for all ANOVAs is found at Appendix D.

Table 3

Means and Standard Deviations of Number of Images Identified for Each Motion Group on Test 2 and Test 3

Motion Group	n	Tests: Test 2 M	Test 2 SD	Test 3[a] M	Test 3[a] SD
Circular	19	46.21	17.42	58.11[a]	19.88
Rotational	16	42.81	19.02	65.31[b]	9.22
Static	21	36.81	21.26	50.71[c]	21.11
Straightline	15	51.00	21.04	63.60[ab]	12.84
Total possible score = 75					

[a]Means with the same superscript on Test 3 are not significantly different ($p > .05$) according to the results of a Duncan Multiple Range Test; because results reported in the first paragraph of this section (for Test 2) indicate no significant differences among motion conditions, no further testing on mean differences was statistically appropriate.

Motion and Training Responsiveness

Effects of Motion on Training Responsiveness. As discussed in a previous section, exploratory analyses of performance data collected in previous research determined that the large variance in performance could be accounted for by particular soldiers who manifest an inability or unwillingness to learn this material. These findings were further explored in this research. The division of the sample population was made empirically after examination of the data--all soldiers who scored 50% or more correctly on the first posttraining test were labeled training receptive (TR) and those below 50% as non-training receptive (NTR).

To first determine whether there was an overall performance difference between the TR and NTR groups for each of the four motion conditions, an ANOVA of their identification performance scores (number of vehicle images identified) after three training periods was done. Results of that analysis indicated no overall differences existed [$F(3,63) = 2.01$, $p > .05$].

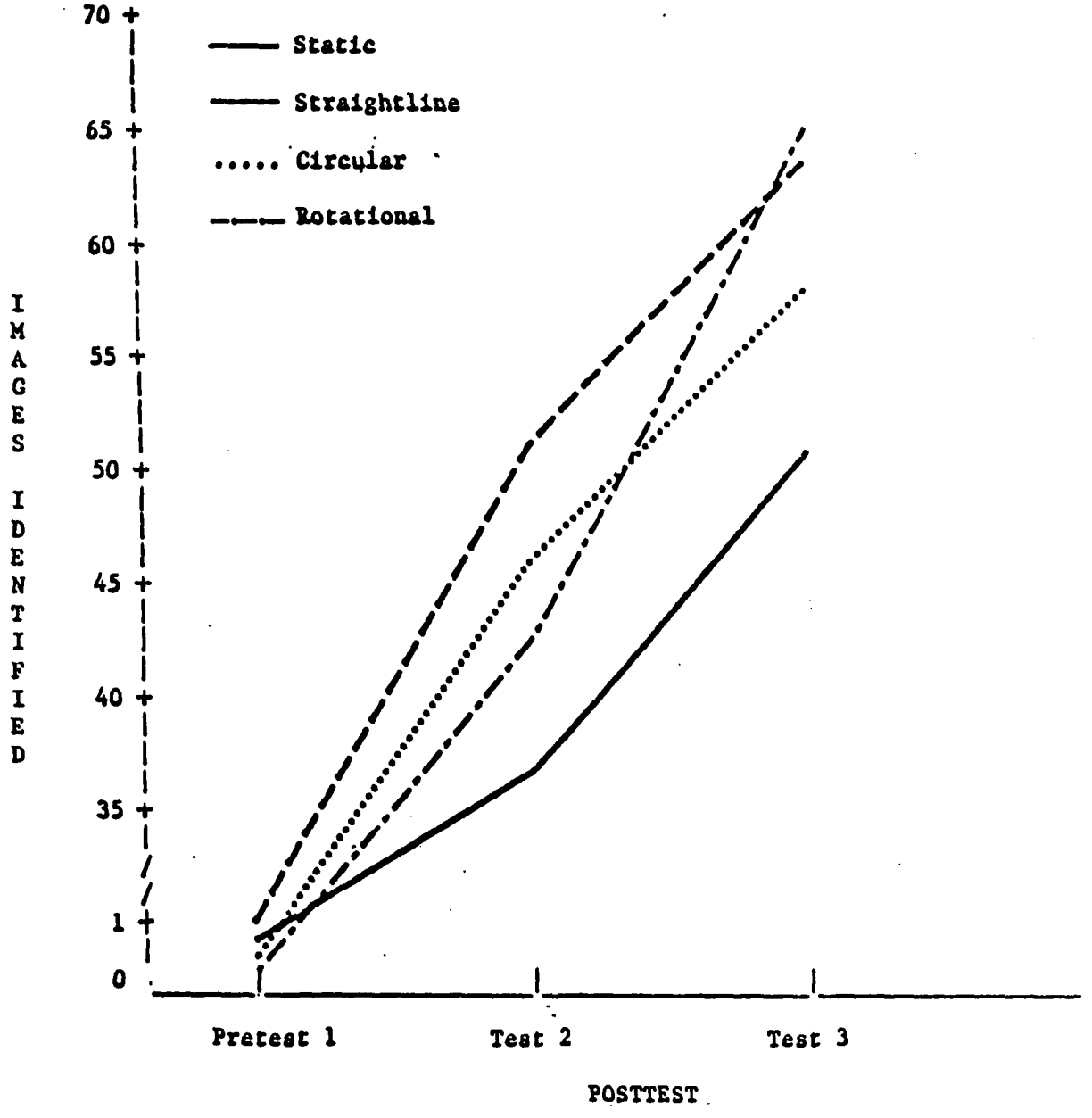


Figure 1. Mean Number of Vehicle Images Identified on Pretraining Test and Posttraining Tests (T_2, T_3) by Motion Group After Two Additional Training Trials

Effects of Motion and Repeated Training on Training Responsiveness. As just noted, there were no overall significant differences among training responsiveness groups to different motion training conditions. It did seem relevant however, to ask whether both training responsiveness groups showed the same pattern of differences to different training conditions after one and three training sessions. Results of an analysis of variance involving these three variables (motion type, training responsiveness group and test period) indicated that indeed significant differences did exist [$F(3,63) = 6.18$, $p < .01$]. Table 4 presents supporting means and standard deviations; Figure 2 portrays this relationship pictorially. These data show that this significant difference probably can be attributed to the fact that the NTR soldiers in the rotational and straightline motion conditions show large increases in performance after receiving two additional training sessions. The inference can be drawn that if additional training time is available, training with motion might be useful for soldiers who experience difficulty in acquiring R&I skills (NTR soldiers).

To investigate further the inference noted above, four additional simple analyses of variance were performed. These analyses involved comparison of performance to each motion condition for only: 1) TR soldiers after the first training session; 2) TR soldiers after the third training session; 3) NTR soldiers after the first training session; and 4) NTR soldiers after the third training session. Analyses for TR soldiers indicated no significant performance differences among motion conditions [$F(3,90) < 1$] following either one or three training sessions. For NTR soldiers performance following the first training sessions showed no significant performance differences among motion conditions [$F(3,23) < 1$]. For the NTR soldiers there were significant performance differences among motion conditions following the third training session [$F(3,23) = 6.50$, $p < .005$]. A Duncan Multiple Range Test for NTR soldier performance following the third training session revealed that performance to the Rotational motion condition was superior to all other training conditions ($p < .05$); no significant differences existed among any remaining training conditions for these soldiers.

Effects of Motion on R&I Performance With Individual Vehicles

While different motion conditions did not produce overall significant performance differences during initial training (as noted above), it was nevertheless relevant to expect that for some vehicles, motion might facilitate learning. An ANOVA of number of vehicle images correctly identified on the first posttraining test (Test 2), however, indicated no significant difference [$F(42,882) = 1.37$, $p = .06$]. A comparable analysis on the test performance after the last training session was, however, significant [$F(42,882) = 1.70$, $p < .01$]. See Appendix E for means, standard deviations and the Duncan Multiple Range Test analysis.

Table 4

Means and Standard Deviations of Number of Vehicle Images Identified for Each Motion and Training Responsiveness Group After One and Three Training Sessions

Motion Group	Training Responsiveness	n	Test 2 M	Test 2 SD	Test 3 M	Test 3 SD
Circular	TR	11	58.27	12.00	71.27	6.18
	NTR	8	29.62	5.58	40.00	17.74
Rotational	TR	10	55.30	9.99	68.90	9.75
	NTR	6	22.00	8.60	59.33	3.93
Static	TR	11	53.64	12.72	68.27	6.23
	NTR	10	18.30	9.90	31.40	12.47
Straightline	TR	12	59.33	11.92	68.08	4.06
	NTR	3	17.67	15.31	45.67	20.60

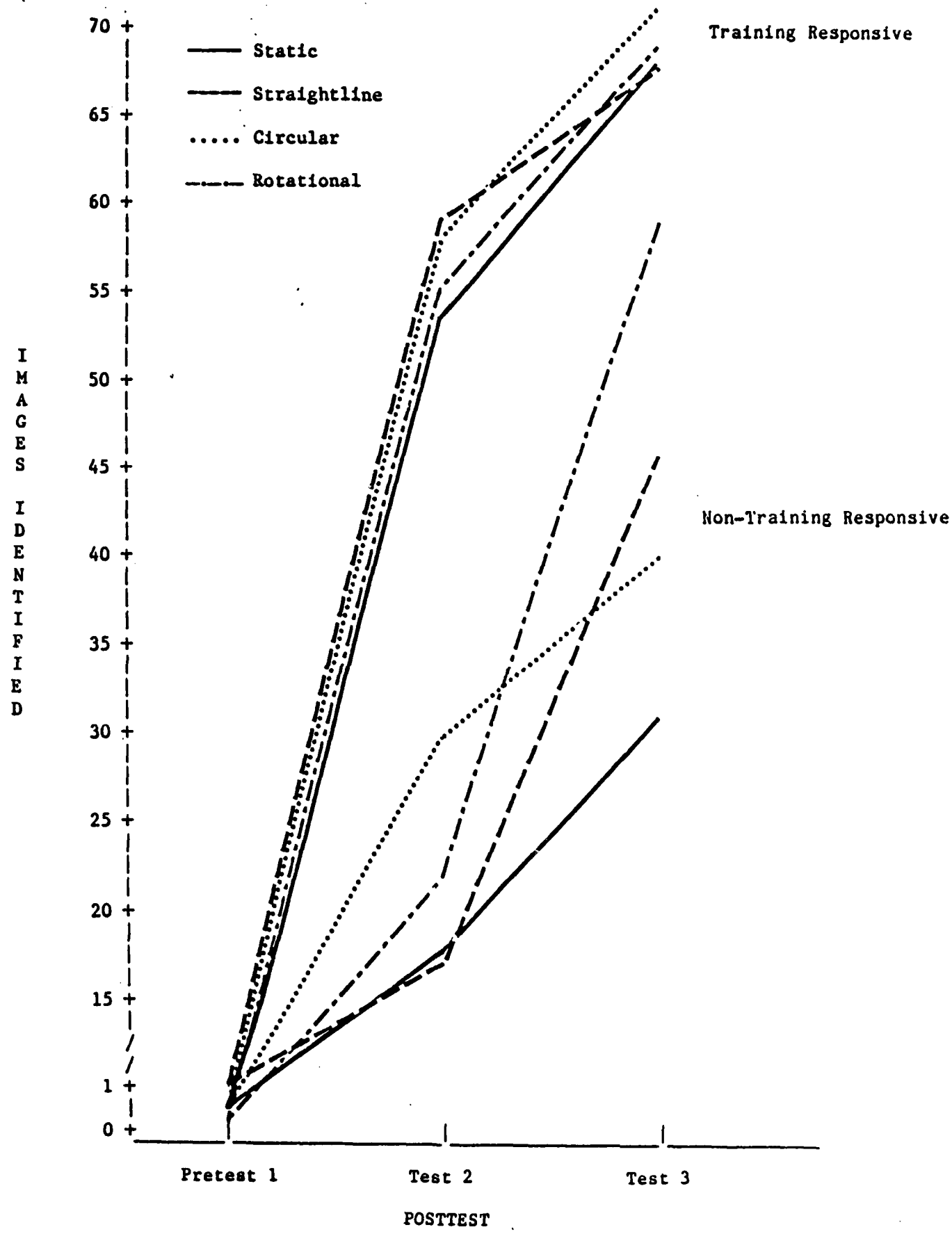


Figure 2. Mean Number of Vehicle Images Identified on Pretraining Test and Posttraining Tests (T_2, T_3) by Motion and Training Responsiveness Group (TR and NTR)

Effect of Motion on Retention

The amount of learning which was retained after an eighteen hour lapse of time was examined by comparing scores received on the test given after the last training session (the last test administered after completion of training on one day) with scores from a test administered eighteen hours later. An ANOVA of number of images identified over these two tests was performed with four motion groups, two training responsiveness groups and 15 vehicles included as design variables. Results of that analysis indicated no significant differences in retention among motion conditions [$F(3,63) = 1.23$, $p > .05$] and no significant retention differences as a function of both motion and training responsiveness conditions [$F(3,63) = 2.40$, $p > .05$].

Soldier Reaction Questionnaire

The responses to the questions on the Soldier Reaction Questionnaire were generally positive. In response to how effective or ineffective the soldiers had found the training, 95% thought circular motion to be either "very effective" or "effective," 89% gave Rotational Motion a similar rating, approximately 73% found Straightline Motion training to be either "very effective" or "effective," and 68% found static image training to be "very effective" or "effective." When asked how this training compared with previous combat vehicle identification training they had received, approximately 91% indicated it was "much" or "somewhat" better. Frequencies supporting these conclusions are presented in Table 5.

Characteristics of TR and NTR Soldiers

In order to better understand the dimensions characterizing TR and NTR soldiers, and in order to assure that the effects of motion conditions and training responsiveness were not confounded, a Chi-square analysis of the distribution of TR/NTR soldiers across motion groups was performed. Results of that analysis were non-significant. See Appendix D2. This finding is consistent with the inference that TR and NTR soldiers were generally distributed in about the same proportion in each motion treatment. Review of data in Appendix D2, Table 1 indicates NTR soldiers were between 21% and 47% of the sample in each motion group. To further examine the dimensions characterizing TR and NTR soldiers, additional Chi-square analyses were performed using the three GT groupings (<90, 90-109, 110 and up) which produced a significant $X^2 = 13.66$, $p < .001$ on 2 degrees of freedom (See Appendix F3). Inspection of the table in Appendix F3 suggests that this significant relationship is due to the disproportionately large number of TR soldiers with GT > 109. Using ranks comprising Skill Level 1 (pay grades E1-E4) vs higher skill levels (pay grades E5-E8) and time in service arbitrarily grouped by years, soldiers were found to be proportionately distributed in TR and NTR groups, $X^2 = 2.20$, $p = .65$ on 1 degree of freedom, $X^2 = 1.34$, $p = .93$ on 5 degrees of freedom, respectively (See pages F4 and F5).

Table 5

Soldier Reaction Questionnaire Responses

	Responses									
	n	%	n	%	n	%	n	%	n	%
	Very Effective		Effective		In Between		Ineffective		Very Ineffective	
How effective/ineffective was the training using straight line motion for you?	14	35.00	15	37.50	9	22.50	2	5.00	0	0.00
How effective/ineffective was the training using circular motion for you?	21	53.85	16	41.03	2	11.43	0	0.00	0	0.00
How effective/ineffective was the training using rotational motion for you?	16	45.71	15	42.86	4	11.43	0	0.00	0	0.00
How effective/ineffective was the training using stationary motion for you?	7	18.42	19	50.00	10	26.32	2	5.26	0	0.00

cont'd

Table 5 (continued)

Soldier Reaction Questionnaire Responses

	Responses									
	n	%	n	%	n	%	n	%	n	%
	Much Better		Somewhat Better		The Same		Somewhat Worse		Much Worse	
Compared with other training in vehicle recognition how would you evaluate the training you have just received?	35	55.56	22	34.93	3	4.76	3	4.76	0	0.00
					Yes		No			
Are you familiar with the Basic CVI Training Program?					38	55.88	30	44.12		
Are you familiar with the Thermal Training Program?					4	7.27	51	92.73		
Did you participate in the CVI training given in January?					26	38.24	42	61.77		

DISCUSSION

Discussion

During the development of the CVI program an hypothesis evolved which held that if motion were added to training programs using static imagery, performance would be substantially improved. Realism (training fidelity) and motivational effects caused by increased interest may be part of the reason for this presumed improvement in performance; however, it seems appropriate to use movement (motion) only when it is a critical attribute which facilitates improved training performance.

Results of this research have indicated that during initial training, motion does not generally appear to contribute significantly to identification performance compared to presentation of static images. While repeated training with motion did result in statistically significant overall performance differences compared to the static (no motion) condition, the improvement seems to be of little practical significance. Table 6 shows that the proportion of variability in the data accounted for by motion is only about 3%. Further, while motion did appear to significantly increase identification performance with the AMX30 and PT76 after repeated training, the proportion of variability in the data accounted for by motion and vehicles is only slightly over 1% (See Table 6). Finally, while use of motion did tend to significantly reduce performance differences between TR and NTR soldiers with repeated training, the proportion of variability accounted for by this relationship was only a little over 3% (See Table 6).

Table 6

Use of the ω^2 Statistic to Estimate the Proportion of Variance Accounted for by Each ANOVA Effect Using Posttest Data Obtained Following the Third Training Session[a]

Effect	ω^2
Motion Group (G)	.032
Training Responsiveness (T)	.208
Vehicle (V)	.068
G x T	.033
G x V	.012
T x V	.025
G x T x V	.008

[a] The proportion of variance accounted for by each effect is estimated by a generalization of formulas presented by Hays, Statistics, p.407 by

$$\omega^2 \text{ y/effect} = \frac{\text{SS effect} - (\text{df effect}) \times \text{MS error}}{SS_{total} + MS_{error}}$$

In addition to the weakness of the training responsiveness and motion relationship after repeated training, it is relevant to consider absolute performance levels attained by NTR soldiers compared to TR soldiers. In most cases average performance of NTR soldiers after three training sessions does not reach the level attained by TR soldiers after a single training session. This raises two questions of some interest to the training community: (1) Should all soldiers be required to be proficient in R&I? (2) If so, since motion does not add significantly to their performance, what medium would be required and would it be cost-effective to use it?

Finally, it appears that motion contributes nothing to either group's (NTR, TR) short term memory.

CONCLUSIONS

- Motion (after repeated training) provides a small positive effect but does not appear to be an essential ingredient in training ground-to-ground vehicle R&I using the Basic CVI Training Program. This is true for both training responsive and non-training responsive soldiers.

- Short term R&I retention is not improved when motion is included in the training.

REFERENCES

Foster, D. (1976). Target Detection in the Real World and From Photographic Projection in the Laboratory - A Correlational Study of the Validity of Photo Simulation. Virginia Military Institute. (AD A041 233)

Gottsdanker, R. M. (1957). The Role of Form Discrimination in the Perception of Motion. In J. W. Wulfeck and J. H. Taylor (eds.), Form Discrimination as Related to Military Problems. Armed Forces, NRC Committee in Vision, Nat. Acad. Sci., Nat. Res. Council Publ. 561, 127-129.

Gutman, J. C., Snyder, H. L., Farley, W. W., & Evan, J. E. III. (1979). An Experimental Determination of the Effect of Image Quality on Eye Movements and Search for Static and Dynamic Targets. Dept. of Industrial Engineering & Opers. Research, Virginia Polytechnic Institute & State University, Blacksburg, VA. (AD A077 728)

Heuckeroth, O. H., Smith, N. D., & Shope, G. L. (1988). Target Acquisition and Analysis Training System: Retention and the Effects of Retraining. U.S. Army Research Institute for the Behavioral and Social Sciences. In Preparation.

Kinkade, R. G., Krumm, R. L., & Muckler, F. A. (1980). Comparative Cost Indexes for Selection of Instructional Media. San Diego: Essex Corporation.

Merrill, P. F., & Bunderson, C. V. (1981). Preliminary Guidelines for Employing Graphics in Instruction. Journal of Instructional Development, Summer, 4 (4).

Miller, J. W., & Ludvigh, Elek. (1960). Time Required for Detection of Stationary and Moving Objects as a Function of Size in Homogeneous and Partially Structured Visual Fields. Visual Search Techniques. Nat. Acad. Sci., Nat. Res. Council Publ. 712.

Shope, G. L., Smith, N. D., & Heuckeroth, O. H. (1984). Evaluation of an Advanced Combat Vehicle Identification (CVI) Training Program (Masking): A New Approach to Target Acquisition & Analysis Training. U.S. Army Research Institute for the Behavioral and Social Sciences. Research Report 1368. (AD A148 911)

Smith, N. D., Heuckeroth, O. H., Shope, G. L., Warnick, W. L., & Essig, S. S. (1989). Target Acquisition and Analysis Training System: Effects on Combat Vehicle Identification (CVI) Performance on Number of Vehicle Trained and Training Frequency. U.S. Army Research Institute for the Behavioral and Social Sciences. In Preparation.

Smith, N. D., Heuckeroth, O. H., Warnick, W. L., & Essig, S. S. (1980). Evaluation of a New Approach to Target Acquisition Training: The CVI Training Program. U.S. Army Research Institute for the Behavioral and Social Sciences. Research Report 1304. (AD A111 732)

Smith, N. D., Shope, G. L., Heuckeroth, O. H., Warnick, W. L., & Essig, S. S. (1985). Target Acquisition & Analysis Training System: Development and Evaluation of the Basic Thermal Combat Vehicle Identification (TCVI) Training Program. U.S. Army Research Institute for the Behavioral and Social Sciences. Research Report 1378. (AD A192 488)

Smith, N. D., Shope, G. L., Heuckeroth, O. H., Warnick, W. L., & Essig, S. S. (1984). Target Acquisition & Analysis Training System: Comparison of Image Quality of Three Presentation Media. U.S. Army Research Institute for the Behavioral and Social Sciences. Technical Report 622. (AD A169 194)

Smith, W. M. (1951). The Sensitivity to Apparent Movement in Depth as a Function of "Property of Movement." J. Exp. Psychol, 42, 143-152.

APPENDIX A

List of Vehicles Used in Training

Table 1

Vehicles Used for All Groups

M48	MARDER
SALADIN	T72
ZSU23-4	CHIEFTAN
BTR 5C	ZSU57-2
AMX 30	JAGD
PT76	T54/55
Scimitar	ROLAND
M1	

APPENDIX B

Data Collection Instruments

1. Pre/Post-Test

2. Example of Training Response Sheets for one type of motion, Straightline. All others are the same.

DATA REQUIRED BY THE PRIVACY ACT OF 1974
(5 U.S.C. 552a)

TITLE OF FORM	PRESCRIBING DIRECTIVE
Basic Combat Vehicle Identification (CVI) Training Program - Soldier Information	AR 70-1

1. AUTHORITY

10 USC Sec 4503

2. PRINCIPAL PURPOSE(S)

The data collected with the attached form are to be used for research purposes only.

3. ROUTINE USES

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 70-1. When identifier (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.

4. MANDATORY OR VOLUNTARY DISCLOSURE AND EFFECT ON INDIVIDUAL NOT PROVIDING INFORMATION

Your participation in this research is strictly voluntary. Individuals are encouraged to provide complete and accurate information in the interests 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 form and retained by the individual if so desired.

FORM	Privacy Act Statement - 26 Sep 75

DA Form 4368-R, 1 May 75

DATE _____
MODULE NO. _____
SEAT # _____
RANGE _____

BASIC COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

MODULE 7

SOLDIER INFORMATION

1. Name: _____
(Last) (First) (MI)
2. Rank: _____ 3. SSN: _____
4. Age: _____ 5. Military Unit: _____
6. Time in Service: _____
(Years) (Months)
7. MOS: _____
8. Length of time in MOS: _____
(Years) (Months)
9. What is the MOS of the job to which you are currently assigned?

_____

10. Do you wear glasses (or contact lenses) on the job?

Yes _____ No _____

10a. Do you wear glasses (or contact lenses) only for reading?

Yes _____ No _____

MOTION STUDY

PRE/POSTTEST

Date: _____

Row No. ____
Seat No. ____
Range ____

Name & Rank _____

Unit _____

Treatment: _____

No.	Friend/ Threat	Name/ Model	No.	Friend/ Threat	Name/ Model
1			27		
2			28		
3			29		
4			30		
5			31		
6			32		
7			33		
8			34		
9			35		
10			36		
11			37		
12			38		
13			39		
14			40		
15			41		
16			42		
17			43		
18			44		
19			45		
20			46		
21			47		
22			48		
23			49		
24			50		
25			51		
26			52		

No.	Friend/ Threat	Name/ Model	No.	Friend/ Threat	Name/ Model
53			64		
54			65		
55			66		
56			67		
57			68		
58			69		
59			70		
60			71		
61			72		
62			73		
63			74		
			75		

MOTION STUDY

MODULE 3

Straightline Motion Training Worksheet

Date: _____
Row No. _____
Seat No. _____
Range _____

Name & Rank _____

Unit _____

Section A: Video Presentation Sequence

No.	Friend/ Threat	Name/ Model	No.	Friend/ Threat	Name/ Model
D-1			D-14		
D-2			15		
D-3			D-16		
4			D-17		
D-5			18		
6			D-19		
D-7			D-20		
D-8			D-21		
D-9			22		
D-10			D-23		
D-11			D-24		
D-12			D-25		
D-13					

Section B: Video Presentation Sequence

D-26			39		
D-27			D-40		
28			41		
D-29			D-42		
D-30			D-43		
D-31			D-44		
32			D-45		
D-33			D-46		
D-34			D-47		
D-35			D-48		
D-36			D-49		
D-37			50		
D-38					

MODULE 3

Row No. _____
Seat No. _____
Range _____

STRAIGHTLINE MOTION TEST ANSWER SHEET

Name & Rank _____

MOS _____ Unit _____

Section C: Module Test
(7.5 second exposure)

No.	Friend/Threat	Name/Model
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____
11	_____	_____
12	_____	_____
13	_____	_____
14	_____	_____
15	_____	_____

APPENDIX C

Soldier Reaction Questionnaire

SOLDIER REACTIONS

Motion Test
85th Div
22-23 Oct 1983

Name _____ Rank/GS _____

Organization _____

Position or Job Description _____

_____

1. How realistic - unrealistic was the straight line motion you observed?

Very Realistic	Realistic	Neither Realistic nor Unrealistic	Unrealistic	Very Unrealistic

2. How realistic - unrealistic was the circular motion you observed?

Very Realistic	Realistic	Neither Realistic nor Unrealistic	Unrealistic	Very Unrealistic

3. How realistic - unrealistic was the rotational motion you observed?

Very Realistic	Realistic	Neither Realistic nor Unrealistic	Unrealistic	Very Unrealistic

4. If your response to 2, 3, or 4 was other than "Very Realistic" or "Realistic" please state your reasons. _____

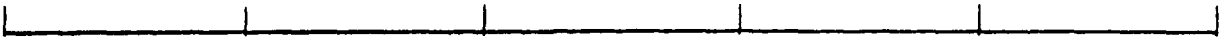
_____

5. Did you participate in the CVI training given in January of this year.
Yes _____ No _____

6. Compared with other training in vehicle recognition how would you evaluate the training you have just received?

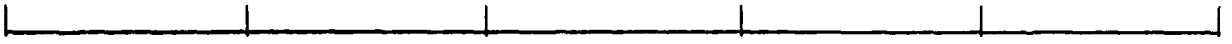
Much Better Than Previous Training	Better Than	About The Same	Poor Than	Much Poorer Than Previous Training

7. How effective/ineffective was the training using straight line motion for you?



Very Effective	Effective	In Between	Ineffective	Very Ineffective

8. How effective/ineffective was the training using circular motion for you?

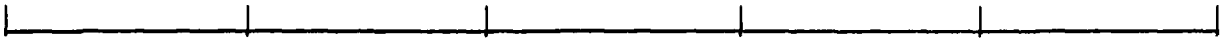


Very Effective	Effective	In Between	Ineffective	Very Ineffective

9. How effective/ineffective was the training using rotational motion for you?

Very Effective	Effective	In Between	Ineffective	Very Ineffective

10. How effective/ineffective was the training using stationary vehicles for you?



Very Effective	Effective	In Between	Ineffective	Very Ineffective

11. Are you familiar with the current vehicle training programs in the Army?

GTA 17-2-9 Basic CVI ( ) Yes ( ) No
GTA 17-2-10 Thermal CVI ( ) Yes ( ) No

APPENDIX D

Sources of Variance for all ANOVAs

Table 1

Analysis of Variance of Number of Vehicle Images Identified Following the Initial and Third Training Session for Soldiers Participating in the Motion Study

SV	df	SS	MS	F	P
Between Soldiers (S)	70	2582.32			
Motion (M)	3	102.16	34.06	3.21	<.05
Training Responsiveness (R)	1	1747.74	1747.74	164.73	<.001
MR	3	63.88	21.29	2.01	>.05
S/MR	63	668.54	10.61		
Within Ss	2059	5272.57			
Test (T)	1	589.03	589.03	147.63	<.001
Vehicle (V)	14	705.49	50.39	24.88	<.001
TV	14	134.51	9.61	8.08	<.001
MT	3	60.43	20.14	5.05	<.005
MV	42	151.78	3.61	1.78	<.01
MTV	42	50.69	1.21	1.02	>.05
RT	1	46.08	46.08	11.55	<.01
RV	14	137.72	9.84	4.85	<.01
RTV	14	41.10	2.94	2.47	<.01
MRT	3	74.01	24.67	6.18	<.01
MRV	42	140.82	3.35	1.65	<.01
MRTV	42	52.73	1.26	1.06	>.05
ST/MR	63	251.11	3.99		
SV/MR	882	1786.44	2.03		
STV/MR	882	1050.63	1.19		

Table 2

Analysis of Variance of Number of Vehicle Images Identified During the Initial Posttest for Soldiers Participating in the Motion Study

SV	df	SS	MS	F	P
Between Soldiers (S)	70	1755.78			
Motion (M)	3	42.41	14.14	1.79	>.05
Training Responsiveness (R)	1	1197.18	1197.18	151.69	<.001
MR	3	18.98	6.33	<1	>.05
S/MR	63	497.21	7.89		
Within Ss	994	2686.18			
Vehicle (V)	14	616.48	44.03	22.15	<.001
MV	42	114.49	2.73	1.37	>.05
RV	14	85.09	6.08	3.06	<.001
MRV	42	116.95	2.78	1.40	<.05
SV/MR	882	1753.17	1.99		

Table 3

Analysis of Variance of Number of Vehicle Images Identified Following the Third Training Session for Soldiers Participating in the Motion Study

SV	df	SS	MS	F	P
Between Soldiers (S)	70	1292.33			
Motion (M)	3	116.15	38.72	5.77	<.01
Training Responsiveness (R)	1	634.82	634.82	94.67	<.001
MR	3	118.92	39.64	5.91	<.01
S/MR	63	422.44	6.71		
Within Ss	994	1565.75			
Vehicle (V)	14	223.53	15.97	12.99	<.001
MV	42	87.99	2.10	1.70	<.005
RV	14	93.73	6.70	5.45	<.001
MRV	42	76.60	1.82	1.48	<.05
SV/MR	882	1083.90	1.23		

Table 4

Analysis of Variance of Number of Vehicle Images Identified Following the Third Training Session and a Retention Test the Following Day for Soldiers Participating in the Motion Study

SV	df	SS	MS	F	P
Between Soldiers (S)	70	2655.07			
Motion (M)	3	229.98	76.66	5.65	<.005
Training Responsiveness (R)	1	1301.33	1301.33	95.94	<.001
MR	3	269.25	89.75	6.62	<.001
S/MR	63	854.51	13.56		
Within Ss	2059	3422.39			
Test (T)	1	3.82	3.82	2.21	>.05
Vehicle (V)	14	400.94	28.64	14.39	<.001
TV	14	15.00	1.07	1.73	>.05
MT	3	6.41	2.14	1.23	>.05
MV	42	176.82	4.21	2.12	<.001
MTV	42	36.52	.87	1.40	>.05
RT	1	1.12	1.12	<1	>.05
RV	14	163.70	11.69	5.87	<.001
RTV	14	7.35	.52	<1	>.05
MRT	3	12.49	4.16	2.40	>.05
MRV	42	157.15	3.74	1.88	<.01
MRTV	42	34.43	.82	1.32	>.05
ST/MR	63	109.10	1.73		
SV/MR	882	1752.85	1.99		
STV/MR	882	544.69	.62		

Table 5

Analysis of Variance of the Number of Vehicle Images Identified During the Pretest for Soldiers Participating in the Motion Study

SV	df	SS	MS	F	P
Between Soldiers (Ss)	70	1006.18			
Motion (M)	3	18.05	6.02	<1	>.05
Training Responsiveness (R)	1	200.85	200.85	16.21	<.0002
MR	3	6.88	2.29	<1	>.05
S/MR	63	780.40	12.39		
Within Ss	994	1169.24			
Vehicle (V)	14	162.34	11.60	11.83	<.0001
MV	42	38.85	.93	<1	>.05
RV	14	66.95	4.78	4.88	<.0001
MRV	42	36.35	.87	<1	>.05
SV/MR	882	864.75	.98		

APPENDIX E

Means, Standard Deviations, and Duncan Multiple Range Test Analysis for Vehicles

Table 1

Means and Standard Deviation of Number of Vehicle Images Identified for Each Vehicle in Each Motion Condition After the Third Training Session[a]

Vehicle		Motion Condition			
		Static	Rotational	Circular	Straightline
M48	M	3.48_{a}	4.50_{b}	4.53_{b}	4.20_{ab}
	SD	1.75	.73	1.02	1.57
SALADIN	M	3.38_{a}	4.75_{b}	4.11_{ab}	4.33_{b}
	SD	2.01	.77	1.88	.62
ZSU23-4	M	2.14_{a}	3.94_{c}	2.89_{b}	3.40_{bc}
	SD	2.37	1.73	2.26	1.76
BTR 50	M	2.90_{a}	3.63_{ab}	3.00_{a}	4.00_{b}
	SD	2.21	1.67	2.29	2.07
AMX 30	M	2.33_{a}	3.81_{b}	3.21_{b}	3.20_{b}
	SD	2.20	1.56	2.23	1.61
PT76	M	3.05_{a}	4.31_{b}	4.11_{b}	4.40_{b}
	SD	2.13	1.35	1.37	.51
Scimitar	M	3.43_{a}	4.34_{bc}	3.68_{ab}	4.67_{c}
	SD	1.83	1.09	2.06	.49
MARDER	M	3.67_{a}	4.94_{b}	4.11_{ab}	4.40_{b}
	SD	2.06	.25	1.76	.63
T72	M	3.05_{a}	4.13_{b}	3.89_{ab}	4.33_{b}
	SD	2.09	1.09	1.66	1.11
CHIEFTAN	M	3.62_{a}	4.81_{b}	4.47_{ab}	4.53_{c}
	SD	1.60	.40	.96	.92

Table 1 (cont'd)

Means and Standard Deviation of Number of Vehicle Images Identified for Vehicle in Each Motion Condition After the Third Training Session[a]

Vehicle		Motion Condition Static	Rotational	Circular	Straightline
ZSU57-2	M	3.24_a	4.50_{bc}	3.63_{ab}	4.53_c
	SD	2.14	1.10	1.80	1.13
JAGD	M	4.43_a	4.81_a	3.89_a	4.13_a
	SD	1.21	.54	2.00	1.77
T54/55	M	3.38_a	3.69_a	3.79_a	4.20_a
	SD	1.77	1.70	1.81	1.15
ROLAND	M	4.81_a	4.50_a	4.42_a	4.87_a
	SD	.68	.89	1.35	.52
M1	M	3.81_a	4.63_a	4.37_a	4.40_a
	SD	1.69	1.09	1.30	1.59

[a]Means followed by the same letter for a given vehicle are not significantly different according to the Duncan Multiple Range Test ($p > .05$). Statistical differences between vehicles are not reported.

APPENDIX F

Chi-Square Analyses of TR and NTR Groups by Background Variables

Table 1.

CHI-SQUARE ANALYSIS OF TRAINING AND NON-TRAINING RESPONSIVENESS AND MOTION

Train	Group				
Frequency Percent Row PCT COL Pct	Circular	Rotational	Static	Straight	Total
Non-	8	6	10	3	27
	11.27	8.45	14.08	4.23	38.03
	29.63	22.22	37.04	11.11	
	42.11	37.50	47.62	20.00	
Resp	11	10	11	12	44
	15.49	14.08	15.49	16.90	61.97
	25.00	22.73	25.00	27.27	
	57.89	62.50	52.38	80.00	
TOTAL	19	16	21	14	71
	26.76	22.54	29.58	21.13	100.00

CHI-SQUARE 3.024 DF = 3 Prob = 0.3879

Table 2.

CHI-SQUARE ANALYSIS OF TRAINING AND NON-TRAINING RESPONSIVENESS BY GT

Train	GT				
Frequency Percent Row PCT Col PCT	-	Under 90	90 - 109	Over 109	TOTAL
Non-	0	9	9	9	27
	-	12.86	12.86	12.86	38.57
	-	33.33	33.33	33.33	
	-	81.82	47.37	22.50	
Resp	1	2	10	31	43
	-	2.86	14.29	44.29	61.43
	-	4.65	23.26	72.09	
	-	18.18	52.63	77.50	
TOTAL	-	11	19	40	70
	-	15.71	27.14	57.14	100.00

Chi-Square 13.664 DF = 2 Prob = 0.0011

Table 3.

CHI-SQUARE ANALYSIS OF TRAINING AND NON-TRAINING RESPONSIVENESS BY RANK

Train	Rank		
Frequency Percent Row PCT Col Pct	E1-E4	E5-E8	Total
Non-	10	17	27
	14.08	23.94	38.03
	37.04	62.96	
	41.67	36.17	
Resp	14	30	44
	19.72	42.25	61.97
	31.82	68.18	
	58.33	63.83	
Total	24	47	71
	33.80	66.20	100.00

Chi-Square 0.204 DF = 1 Prob = 0.6518

Table 4.

CHI-SQUARE ANALYSIS OF TRAINING AND NON-TRAINING RESPONSIVENESS BY SERVICE TIME

Train	Servtime						
Frequency Percent Row Pct Col Pct	-	Up to 1 yr	1+ to 2 yrs	2+ to 3 yrs	3+ to 4 yrs	4+ to 5 yrs	Over 5 yrs	Total
Non-	1	0	2	2	3	3	16	26
	-	0.00	2.90	2.90	4.35	4.35	23.19	37.69
	-	0.00	7.69	7.69	11.54	11.54	61.54	
	-	0.00	25.00	40.00	42.86	37.50	40.00	
Resp	1	1	6	3	4	5	24	43
	-	1.45	8.70	4.35	5.80	7.25	34.78	62.31
	-	2.33	13.95	6.98	9.30	11.63	55.81	
	-	100.00	75.00	60.00	57.14	62.50	60.00	
TOTAL	-	1	8	5	7	8	40	69
	-	1.45	11.59	7.25	10.14	11.59	57.97	100.00

Chi-Square 1.336 DF = 5 Prob = 0.9312