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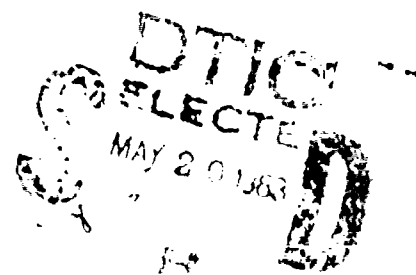
Technical Report 510

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COMPARISON OF POTENTIAL CRITICAL FEATURE SETS FOR SIMULATOR-BASED TARGET IDENTIFICATION TRAINING

Brian L. Kottas and David W. Bessemer

ARI FIELD UNIT AT FORT KNOX, KENTUCKY



U. S. Army

Research Institute for the Behavioral and Social Sciences

September 1980

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Effective representation of armored vehicles in simulation displays demands a careful evaluation of human perceptual capabilities. This is especially true for computer-generated target displays, which must provide sufficient detail to allow vehicle identification within limitations of computer processing time and display resolution. Even in image generation and display systems not incurring such limitations, the image detail should not exceed human perceptual and cognitive information processing capabilities. Care must be given to vehicle		

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representation to assure that the features represented and emphasized are those most valuable for identifying targets. The current research compared the effectiveness of two different sets of vehicle features for target identification training. Results showed that the two sets of features, in the context of the training in which they were embedded, produced equivalent levels of target identification accuracy, and both produced large gains in performance. Results also revealed that any effects due to range-specific learning of features were very small relative to the improvement produced by training, and were insignificant when data for one of the programs were analyzed separately. For both feature sets, training generalized over a wide difference in target ranges. One can also conclude from the results that highly detailed vehicle representations are unnecessary for target identification training.



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COMPARISON OF POTENTIAL CRITICAL FEATURE SETS FOR SIMULATOR-BASED TARGET IDENTIFICATION TRAINING

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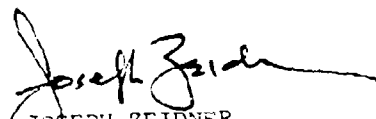
Training Simulation

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FOREWORD

The Fort Knox Field Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has conducted this research as part of an in-house investigation of target representation and target identification training in simulation displays. This research is responsive to the requirements of the Deputy for Educational Technology and the Director of Training Developments, USAARMC, Fort Knox, Kentucky, under Human Research Needs 80-34, "Training for Target Acquisition and Recognition (Friend/Foe)" and 81-225, "Training for Target Acquisition and Recognition," and the objectives of RDTE Project 2Q263744A795, FY 80.



JOSEPH ZEIDNER
Technical Director

COMPARISON OF POTENTIAL CRITICAL FEATURE SETS FOR SIMULATOR-BASED TARGET IDENTIFICATION TRAINING

BRIEF

Requirement:

Modern simulation systems possess a tremendous potential for providing effective training in both target acquisition and engagement skills. The full potential for target acquisition training depends on vehicle representations that provide effective target identification training. The Fort Knox Field Unit of ARI investigated the utility of two different sets of vehicle characteristics (features) that could potentially be used to represent several main battle tanks in simulation system visual displays. The goal of the research was to empirically determine which set of vehicle features afforded more effective training in long-range identification of both NATO and threat tanks. An important question in the current research was whether or not either set of features produced a strong training range by test range interaction. Such an interaction for either set of vehicle features would indicate that the feature set for which it occurs will not provide generalizable target identification skills.

Procedure:

The two sets of vehicle features were embedded in the context of two training programs with similar formats. Personnel at ARI Fort Knox analytically developed one set of vehicle features while the second set of features was taken from the ARI Combat Vehicle Identification (CVI) program. Armor soldiers first received a timed pretest, followed by one of the two training programs at a distance simulating a range of either 2,000 or 4,000 meters through the M60A1 primary sight under ideal viewing conditions. The observers responded by writing the name and nationality of each vehicle and indicating "friend" or "foe" for slides of model tanks that were shown in either flank, oblique, or frontal orientations.

Findings:

Results showed that the two training programs failed to differ significantly in final performance levels produced on flank and oblique vehicle views. Both programs improved performance dramatically over initial performance levels. Results revealed a very small training range by test range interaction, which did not remain when data for one of the programs (the Standard program) were analyzed separately. However, even in the other program, range-specific training effects were small relative to the effect of training. The practical significance of this is that training using both sets of features appears to generalize over a wide range of tactically feasible target identification ranges.

Results also revealed that flank target views were much more accurately identified than oblique views. This was consistent with past research, and probably reflects the larger number of cues available for identifying flank targets than for those in other orientations.

Utilization of Findings:

It appears from these results that either set of critical target features can be adequate for target representation in simulation systems.

COMPARISON OF POTENTIAL CRITICAL FEATURE SETS FOR
SIMULATOR-BASED TARGET IDENTIFICATION TRAINING

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COMPARISON OF POTENTIAL CRITICAL FEATURE SETS FOR SIMULATOR-BASED TARGET IDENTIFICATION TRAINING

INTRODUCTION

Picture yourself as a Tank Commander, moving in column along a road toward your forward battle position. Suddenly, you detect two tracked vehicles moving along a treeline about 2,000 meters away. Do you engage them or don't you? You have only seconds to decide. If they are friendly and either simply lost or moving to a position near yours, engaging them would result in the death either of U.S. or allied troops. If they are enemy, failing to engage them endangers your life, the lives of your men, and your tank. Are they friend or foe? This question will recur frequently given the fluid and "dirty" battlefield expected in most future European scenarios.

The situation described above clearly points out the need for effective target identification training. Simulation offers exciting opportunities for training in many aspects of combat performance, including target identification, since it affords the capability to present a wide variety of realistic targets in highly realistic tactical settings. Troops can be trained to identify targets within the normal context of maneuver and combat engagement. However, the capability to train target identification as a matter of course raises the question of how much detail computer-generated vehicle representations or other target displays require to allow realistic target identification. The detail must be sufficient to represent a vehicle's critical features (those that differentiate it from other, similar vehicles), but the display should not represent features that would be unavailable in a combat setting and at the ranges a target would normally be identified.

The attempt to answer the question of how much detailing is necessary began with an analysis of vehicle shapes and the distinctive features of several main battle tanks (both NATO and threat). The results of the analysis are reported in "Detectability of Armored Vehicle Features Under Visibility Variations," ARI Working Paper FKFU 81-1 by Kottas and Bessemer. This analysis yielded a set of potential critical features for target identification training and target representation of several main battle tanks.

At the same time that ARI at Fort Knox developed the feature set for vehicle representation in simulation systems, the ARI Field Unit at Fort Hood (in conjunction with their contractor) developed a prototype target identification training program called the Combat Vehicle Identification (CVI) program (see Warnick & Kubala, 1980, or the Instructor's guide of the CVI program, 1980). The features selected for emphasis in the CVI program may also be considered as viable candidates for critical vehicle representation features in producing simulation displays. Table I lists features specifically mentioned as identification cues for seven vehicles common to the ARI CVI program and the vehicle analysis conducted at Fort Knox. One can see that, while the two feature sets overlap somewhat, there are some differences. One could easily expect some differences since the two feature sets were specified for slightly different purposes.

TABLE I
POTENTIAL CRITICAL FEATURE SETS, BY VEHICLE

	Feature Set Developed at Fort Knox	Features Emphasized by ARI CVI
Vehicle		
T55	<ul style="list-style-type: none"> a. Domed turret b. Centered turret c. Gap between first and second road wheels d. No support rollers e. Low silhouette f. Turret narrower than hull g. Flat rear deck h. Small gun mantle i. Large road wheels 	<ul style="list-style-type: none"> a. Domed turret b. Centered turret c. Gap between first and second road wheels d. Christie suspension e. Low, compact look f. Long, slender gun tube
T62	<ul style="list-style-type: none"> a. Domed turret b. Centered turret c. Gaps between third and fourth, and fourth and fifth road wheels d. Turret narrower than hull e. Small gun mantle f. Flat rear deck g. Large road wheels h. No support rollers 	<ul style="list-style-type: none"> a. Domed turret b. Centered turret c. Gaps between third and fourth, and fourth and fifth road wheels d. Grab rails on turret e. Smooth taper of turret top f. Searchlight g. Machinegun h. Long main gun relative to hull i. Gradual front slope j. Edge of prow low to ground k. Low silhouette l. Five roadwheels
T72	<ul style="list-style-type: none"> a. Domed turret b. Support rollers c. Turret to rear of hull d. Flattened turret top e. Small gun mantle f. Flat rear deck g. Smaller road wheels than T55 or T62 	<ul style="list-style-type: none"> a. Domed turret b. Support rollers c. Turret centered on chassis d. Turret in from sides of tank e. Extremely long main gun f. High front fender line at front of prow g. Gradual downward slope to front h. Low silhouette
AMX30	<ul style="list-style-type: none"> a. Flat domed turret b. Sloping sides c. Large mufflers toward rear d. Long turret e. Large gun mantle f. Flat rear deck g. Turret forward of center h. Support rollers 	<ul style="list-style-type: none"> a. Flat turret b. Sloping armor c. Large mufflers toward rear d. Beetle shaped turret e. Thick gun tube f. No bore evacuator g. Sharp front slope h. Higher than Soviet tanks

TABLE I
(CONTINUED)

M60A1	a. Long turret	a. Long turret
	b. Large turret	b. Large turret
	c. Boxy turret	c. Squared turret.
	d. Cupola	d. Cupola
	e. Support rollers	e. Support rollers
	f. Overall size	f. Overall size
	g. Large gun mantle	g. Flat turret sides
	h. Turret forward of center	h. Turret centered
	i. High rear deck	i. Sharp prow line
		j. Suspension
		k. Turret and hull roughly same size
LEOPARD	a. Long turret	a. Long turret
	b. Boxy turret	b. Rectangular turret
	c. Scalloped skirts	c. Scalloped skirts
	d. Exhaust grills on rear	d. Exhaust grills on rear
	e. Large gun mantle	e. Heavy gun mantle
	f. Forward turret	f. Sharp angle at turret front
	g. High rear deck	g. Grenade launchers
	h. Sloping sides	h. Main gun length
		i. Searchlight
		j. Square vehicle rear
		k. Height from turret bottom to visible part of roadwheels
		l. Seven roadwheels
CHIEFTAIN	a. Long turret	a. Long turret
	b. Boxy turret	b. Flat turret
	c. Skirts	c. Skirts
	d. Large boxes on turret	d. Many angles on turret
	e. Large gun mantle	e. Large turret
	f. Turret with boxes nearly as wide as hull (from front)	f. Long main gun
	g. Turret slants down at rear to overhang	g. Thick main gun
	h. Turret to rear of center	h. Low silhouette
	i. Overall length	

Since a primary aim of representing specific vehicles in simulation systems is to train target identification concurrently with tank gunnery, the effectiveness of the two feature sets for representing vehicles was assessed by evaluating the target identification training provided by two training programs emphasizing the two sets of features.

Another specific question to be answered in this research deals with the generality of the critical features proposed. That is, does the set of features taught generalize to the entire gamut of target identification ranges encountered by armor crewmen in a modern tactical setting? One might expect that observers will attend to vehicle characteristics that are salient at the ranges at which they are trained, and primarily learn those that are most salient during the training period. Hence, regardless of the features emphasized during training, observers might learn to identify vehicles using different cues or features at each of several different ranges. The most readily appreciable danger in such a situation is that an observer might learn to discriminate among targets at one range on the basis of cues that are not salient at other ranges. This might occur because of a loss of feature visibility as range increases, or a breakup of global features by increased detail (a can't-see-the-forest-for-the-trees kind of phenomenon) as range decreases. If such a situation of range-specific learning of features does occur, it should produce a training range by test range interaction after training. This study was designed specifically to investigate such a possible training x training range x test range interaction. One might expect such an interaction on the basis of previous findings by Cockrell (1979), who showed an interaction between training and testing with respect to the amount of each armored vehicle that was obscured.

METHOD

The current research examined observers' ability to identify targets after receiving training on two different sets of target features embedded within two different target identification programs. Simulated training and test ranges of 4,000 and 2,000 meters through the 8x sight of the M60A1 were selected, because these two values encompass the ranges in which tank target identification would optimally take place. Four thousand meters was selected as a maximum range since it is reasonable to assume that few targets in a tactical setting will be detected beyond 4,000 m (with the exception of large armor formations, in which case target identification is a different task than for individual vehicles). The minimum range of 2,000 meters was selected because the enemy should be identified at a range of 2,000 m or more, given the engagement hit probabilities given in FM 71-1.

Subjects

Forty One Station Unit Training (OSUT) armor crewmen (20 gunner/loaders and 20 drivers) served as observers. All had completed the standard block of instruction on Soviet Soldiers and Equipment, which includes basic friend or foe target identification training, prior to the current research. Three observers, two gunner/loaders, and one driver were dropped from the research. One observer had broken his glasses, and two did not participate in the final test for reasons unrelated to the research.

Apparatus

Slides were rear-projected via a Kodak Ektagraphic carousel slide projector. An overhead projector showed transparencies of vehicles during the Prototype program training. The experimenter timed slide presentations during testing using a hand-held stopwatch. Narratives were presented by means of audio cassette tapes.

Stimuli

Seven main battle tanks were selected as stimuli, since tanks are the primary targets for tanks on the battlefield, and since they are highly confusable combat vehicles and therefore present some of the most difficult discriminations to be made in target identification. The seven tanks used were the Soviet T-55, T-62, and T-72, the French AMX30, the U.S. M60A1, the West German Leopard I, and the British Chieftain.

The Standard training program constructed for this research consisted of slides of the seven vehicles above that were extracted from the ARI CVI program, along with the vehicles' corresponding narrative.

The color slides used in this research showed each camouflage-painted model vehicle separately on a terrain board. Although the terrain board incorporated some vegetation, no vegetation blocked the view of any vehicle. All vehicles were fully exposed, and presented either a frontal, frontal-oblique, or flank view to the camera.

The Prototype training program consisted of transparencies of vehicle line drawings, photographs of actual vehicles, and slides of models from the CVI program. The narratives accompanying each view of each vehicle were developed at Fort Knox, and emphasized the features selected for the Prototype program. Slides in both programs yielded projections approximately 16.5 cm by 23 cm. This yielded projected sizes of model vehicles from 2.9 cm to 3.8 cm high, 3.2 cm to 4.1 cm wide on frontal views, and 9 cm to 12 cm long from flank views. Sizes of vehicles on the slides of actual vehicles used in the Prototype program varied much more and ranged from approximately 3 cm to 10 cm high, 6 cm to 19 cm wide on frontal views, and 10 cm to 16 cm long from flank views. These slides were obtained from the Gunnery Department of the Armor School at Fort Knox and were selected because of the ease of pointing out certain vehicle characteristics. The transparencies were displayed via an overhead projector and yielded fairly homogeneous sizes of vehicles. Projected line drawings showed flank lengths of approximately 125 cm, frontal widths of approximately 50 cm, and heights of approximately 30 cm. Vehicles were drawn to different scales to produce similar sizes on the transparencies to minimize size cues, with the rationale that at long ranges size and distance may become somewhat confusable and vehicles may be misidentified on the basis of size if range is misperceived.

Procedure

Table II provides an overview of the experimental design. The pretest and posttests included one slide each of the frontal, oblique, and flank

TABLE II

OVERVIEW OF EXPERIMENTAL DESIGN

DAY	OBSERVERS	PHASE I: PRETESTS		PHASE II: PREPARED INSTRUCTION		PHASE III: PRACTICE IDENTIFICATION With Knowledge of Results		PHASE IV: POSTTESTS	
		No Knowledge of Results						No Knowledge of Results	
		PRETEST I RANGE	PRETEST II RANGE	PROGRAM AND RANGE		BLOCK I RANGE	BLOCK II RANGE	TEST I RANGE	TEST II RANGE
1	1-5	2,000m	4,000m	STANDARD*	2,000m	2,000m†	2,000m†	2,000m	4,000m
1	6-10	4,000m	2,000m	STANDARD*	4,000m	4,000m†	4,000m†	4,000m	2,000m
2	11-15	2,000m	4,000m	PROTOTYPE**	2,000m	2,000m††	2,000m†	2,000m	4,000m
2	16-20	4,000m	2,000m	PROTOTYPE**	4,000m	4,000m††	4,000m††	4,000m	2,000m
3	21-25	2,000m	4,000m	STANDARD*	2,000m	2,000m†	2,000m†	2,000m	4,000m
3	26-30	4,000m	2,000m	STANDARD*	4,000m	4,000m†	4,000m†	4,000m	2,000m
4	31-35	2,000m	4,000m	PROTOTYPE**	2,000m	2,000m††	2,000m††	2,000m	4,000m
4	36-40	4,000m	2,000m	PROTOTYPE**	4,000m	4,000m††	4,000m††	4,000m	2,000m

*APPENDIX D (Model Slides)

**APPENDIX A (Model & Vehicle Slides, and Transparencies)

†APPENDIX F

††APPENDIX E

view of each of the seven vehicles. Both training programs included frontal, right and left flank, and right and left oblique views of vehicles.

Observers were escorted into the experimental room and seated behind tables arranged in two arcs, so that all seating positions within each arc were approximately equidistant from the screen. The distance of the nearer arc of seats from the screen was approximately 287 cm and simulated a viewing range of 2,000 meters through an 8x sight; the distance of the farther arc of seats was approximately 574 cm and simulated a viewing range of 4,000 meters through an 8x sight. Each arc contained five seating positions, which allowed 10 observers to be run at a time. Seating was arranged so the view of observers in the second row was not obstructed by the observers in the first row.

The research consisted of four phases. The first phase included an introduction and two pretests, the second phase consisted of prepared instruction, the third phase consisted of practice target identification with knowledge of results and verbal explanations of the correct answer using critical features, and the fourth phase consisted of two posttests.

Phase I. After initial instruction on the purpose of the research, all observers received a questionnaire about their target identification knowledge (included in Appendix C) and two pretests. Before the first pretest, observers were told the names and nationalities of the vehicles that would be shown and whether each was friend or foe,¹ although they were not shown slides of the vehicles at that time. The pretests consisted of slides showing one frontal, one flank, and one oblique view of each of the seven vehicle models. The 21 vehicle slides were presented in a random order. Observers viewed each slide for 10 seconds. Slides were separated by 10 seconds of blank screen to allow observers time to write down the name of the vehicle, its nationality, and to mark "friend" or "foe" on the answer sheet. Observers received the first pretest and then moved to the other simulated range position. The second pretest was then administered with a different random ordering of the stimuli, so that all observers received a pretest at both the 2,000 m and 4,000 m simulated ranges. Observers were instructed to guess if they were unsure of the correct answer. (This assured that differences in performance did not simply reflect differences in willingness to respond.) No knowledge of results was provided after either pretest.

Phase II. After the first and second pretests, observers returned to their original seating positions to receive target identification training.

¹This information yields a fairer comparison of pretest-posttest performance when a limited set of alternatives is presented than if no information is provided prior to the pretest. Observers do not know the number of alternatives among which they are to choose on the pretest, but are aware of the number of alternatives on the posttest; the difference in prior knowledge between the two situations provides a posttest advantage simply due to observers' awareness of a restricted number of response alternatives. Performance differences with different numbers of response alternatives are well documented in psychological literature (see, for example, Garner, 1962; Lappin & Uttal, 1976).

7.

The major difference between the two training programs occurred during this phase. Groups selected for the Prototype program received the slides and transparencies listed in Appendix A, along with the corresponding narrative; groups selected for the Standard program received the slides and narrative in Appendix D. Appendixes A and D show that observers saw each vehicle five times during the Standard program, while observers during the Prototype program saw the T54/55 24 times, the T62 24 times, the T12 15 times, the AMX 30 16 times, the LEOPARD 21 times, the M60 20 times, and the CHIEFTAIN 17 times. Presentation time were much faster for slides and transparencies in the Prototype program, in an attempt to equate training time for the two programs. However, the Prototype program did take approximately 9 minutes longer than the Standard program. After this phase of the program, there was approximately a 1-hour delay while the observers broke for lunch.

Phase III. Observers were instructed to sit in the same seats they had occupied during Phase II. All observers then received two blocks of slides, with 35 slides in each block. Stimuli included frontal, right and left flank, and right and left oblique views of all seven model vehicles, and were taken from the ARI CVI program.

Appendix E contains the narrative used for each view of each vehicle for observers receiving the Prototype program, though not in either of the random orders in which they were presented to the observers. Observers remained in the same seats throughout both blocks so that each observer received all training at only one range. Appendix F contains the narratives for each vehicle presentation for the observers receiving the Standard program.

Presentations were not timed for either group, but each slide of each vehicle was displayed on the screen and remained on while the experimenter asked the observers to write down the vehicle's name, its nationality, and to check whether it was friend or foe. When all observers had completed writing their answers, the experimenter told them the correct answer, read the narrative corresponding to that view of that vehicle for that group, and answered any questions the observers had. Because of the number of questions and discussions involved, observers receiving the Standard program took slightly longer to complete Phase III than observers receiving the Prototype program.

Phase IV. Next, two posttests with no feedback were administered. These final tests followed the same format as the pretests. They employed the same model vehicle slides used in previous phases, with three slides of each vehicle (frontal, one flank, and one oblique) in a different random order for each final test. Observers viewed each vehicle for 10 seconds, followed by 10 seconds of blank screen to allow them to write their answers. Observers in the front and rear seating arc changed places between the first and second posttest, so that all observers were tested at both 2,000 meter and 4,000 meter simulated ranges. As in the pretests, observers were told the names and nationalities of the vehicles and were told again whether each was friend or foe. Observers again were instructed to guess if they were unsure of the correct answer. Finally, the questionnaire in Appendix C was readministered and observers were dismissed.

RESULTS AND DISCUSSION

Questionnaire Results

A major result from the questionnaire was that after training, observers reported a reduction in their reliance on small or removable vehicle features (such as bore evacuators, hatches, searchlights, etc.) and increased reliance on larger and more reliable features (such as turret and hull shape, road wheels, etc.). While the boundary between large features and small features is somewhat arbitrary, an informal categorization by the first author revealed that over both training programs and over all vehicles, large and reliable vehicle features reported in the first seven questions accounted for an average of 49.4% of all responses before training. After training, large and reliable features accounted for an average of 80.6% of all responses. The shift from reliance on small features to reliance on large features is also demonstrated by the results of analyses of variance done on these data for each of the seven vehicles. Appendix G presents the results of the seven analyses, which show that the Feature Size by Training interaction is significant beyond the .001 level for all seven vehicles.

Appendix H includes attitude data from the Tank Identification Questionnaire. Observers' attitudes in general were favorable toward the training received in both programs.

Identification Results

Table III provides an overview of percentages of correct vehicle identifications. As one can see, pretest scores for soldiers receiving the Standard program differ somewhat from those of soldiers receiving the Prototype program. Analysis revealed that the data fail to meet the assumption of homogeneity of within-group regression coefficients (see Kirk, 1969, p. 469) that must be met to perform an analysis of covariance. Because of this, an unweighted means analysis of variance (Kirk, 1968) was performed on the pretest scores to determine whether pretest scores were homogeneous enough to permit conclusions to be drawn from an analysis of variance on the posttest scores. As the ANOVA table in Appendix I shows, there were several significant differences among pretest scores. In addition, the pretest analysis revealed several high-order interactions with vehicle view. These interactions are largely due to the results on frontal views of vehicles, as one can see from Table III. Table III shows that the average pretest score for observers receiving the Standard program who were to be trained at the 2,000 m training range was much higher on frontal views than for observers receiving the Prototype program at the 2,000 m training range, but only when their performance at the 4,000 m test range was considered. Conversely, observers selected to receive the Prototype program at the 4,000 m training range performed much better on frontal views in the pretest than observers who were to receive the Standard program, but this marked superiority only occurred at the 4,000 m test range. Such large and complex differences preclude drawing meaningful conclusions about comparisons of the two programs on frontal views of vehicles, as evidenced by the significant test of heterogeneity of within-group regression coefficients mentioned above.

TABLE III

PERCENTAGE OF CORRECT RESPONSES IN EACH
CATEGORY (CORRECTED FOR FAILURE TO GUESS)*

		VEHICLE VIEW		
		FRONT	SIDE	OBLIQUE
PRETEST	2,000m TRAIN - 2,000m TEST	18.1	23.0	22.7
	2,000m TRAIN - 4,000m TEST	21.4	28.6	20.6
	4,000m TRAIN - 2,000m TEST	19.4	24.1	31.6
	4,000m TRAIN - 4,000m TEST	11.4	21.6	14.7
STANDARD PROGRAM				
FINAL TEST	2,000m TRAIN - 2,000m TEST	41.6	71.6	60.0
	2,000m TRAIN - 4,000m TEST	47.3	71.4	52.9
	4,000m TRAIN - 2,000m TEST	21.4	68.6	48.6
	4,000m TRAIN - 4,000m TEST	30.0	64.3	51.4
PRETEST	2,000m TRAIN - 2,000m TEST	18.4	34.3	35.6
	2,000m TRAIN - 4,000m TEST	12.7	37.3	27.1
	4,000m TRAIN - 2,000m TEST	19.0	33.6	39.7
	4,000m TRAIN - 4,000m TEST	26.0	30.3	23.0
PROTOTYPE PROGRAM				
FINAL TEST	2,000m TRAIN - 2,000m TEST	55.7	81.4	67.1
	2,000m TRAIN - 4,000m TEST	45.9	71.6	50.0
	4,000m TRAIN - 2,000m TEST	38.7	71.4	59.1
	4,000m TRAIN - 4,000m TEST	28.6	71.4	57.1

* Despite instructions, some observers left items blank on the pretests or posttests. Data obtained on identification of specific vehicles were therefore corrected by adding $1/7$ of the number of blanks left (which yields the number of correct guesses expected in a seven-alternative forced-choice task by chance alone) to the number of correct identifications.

As a result of the differences between the two programs on frontal views, the data from frontal views were dropped from the overall analysis. A subsequent analysis of covariance run only on data from flank and oblique vehicle views yielded the results shown in Table IV. A test of the assumption of homogeneity of within-group regression coefficients for these data proved to be insignificant ($F < 1$). This result supports (statistically, at least) the decision to drop frontal views from the analysis.

Table IV shows that the effect of vehicle view was significant. The training range by test range interaction which the experiment was designed to address yielded only a marginal result ($p < .10$), but does provide some evidence that there is a weak range-specific learning effect. Clearly, the two programs failed to differ significantly for flank and oblique target identification training when pretest performance was covaried with final performance.

A further question concerns the magnitude of the effect of training, and the magnitude of the experimental effects relative to overall improvements due to training. To this end, an analysis of variance was performed on the pretest and posttest data, again excluding data from frontal views.

Table V shows the results of an analysis of variance of both pretest and posttest scores for oblique and flank vehicle views. As one can see, the effect of whether observers received the Standard or the Prototype program was statistically insignificant, though training had a large effect for both programs as reflected in the significant difference between tests. Figure 1 shows the effect of training on target identification performance for each training program. Both training programs increased target identification performance by approximately 100% over that afforded by OSUT training. One must consider, however, that the final test was administered immediately after training. Determining the amount of learning retained over long periods of time affords an important area for future research.

Analysis further revealed a significant interaction of test and training range with test range. The reader will recall that the analysis of covariance above indicated that this effect was only marginally significant. Figure 2 shows this interaction graphically. A multiple comparison test (Newman-Keuls) showed that no significant differences occurred among any of the means on the pretest, but that on the posttest, performance on the 2,000 m test after training at 2,000 m was significantly better than performance on the 4,000 m test after training at 2,000 m ($p < .05$). No other pairwise comparisons of the posttest means were significant. Pairwise comparisons of each pretest score with each posttest score showed that all posttest scores were significantly higher ($p < .01$ in all cases) than all pretest scores.

The test by training range by test range interaction again indicates some learning of cues specific to a given training range, but the above analysis shows that the differences were fairly small relative to the overall performance gains shown between pretest and posttest under all conditions. A previous analysis of the data for only the Standard program, including data for frontal views, failed to yield even a marginally significant interaction. (For more information see Kottas & Bessemer, 1980.) One

TABLE IV

ANALYSIS OF COVARIANCE OF FLANK AND OBLIQUE VEHICLE VIEWS

SOURCE	ss	df	ms	f	beta estimate
Training Program (P)	.0654	1	.0654	<1	
Training Range (R)	2.0878	1	2.0878	<1	
PR	.6281	1	.6281	<1	
1st Covariate	51.5506	1	51.5506	18.88	.6190
Error 1	87.3815	32	2.7307		
Test Distance (D)	1.3745	1	1.3745	1.0	
DP	.7952	1	.7952	<1	
DR	4.9015	1	4.9015	3.55	
DPR	.7122	1	.7122	<1	
1st Covariate	5.4983	1	5.4983	3.98	.3489
Error 2	44.1878	32	1.3809		
View (V)	38.3331	1	38.3331	30.56**	
VP	.0058	1	.0058	<1	
VR	.0022	1	.0022	<1	
VPR	.4282	1	.4282	<1	
1st Covariate	4.0660	1	4.0660	3.24	.3484
Error 3	40.1401	32	1.2544		
DV	.0325	1	.0325	<1	
DVP	.2371	1	.2371	<1	
DVR	1.1394	1	1.1394	1.22	
DVPR	.2407	1	.2407	<1	
1st Covariate	.2761	1	.2761	<1	.1131
Error 4	29.9721	32	.9366		
Pooled Regression Coefficient - .4086					

**p<.01

TABLE V

UNWEIGHTED MEANS ANOVA TABLE FOR VEHICLE IDENTIFICATION SCORES ON SIDE AND
OBLIQUE VEHICLE VIEWS

SOURCE	ss	df	ms	f
Training Program (P)	18.1512	1	18.1512	2.6932
Training Range (Trn Rng)	2.7469	1	2.7469	<1
P x Trn Rng	.0704	1	.0704	<1
Error b	222.4100	33	6.7397	
Pre/Posttest (Test)	449.6958	1	449.6958	290.5239**
P x Test	1.5432	1	1.5432	<1
Trn Rng x Test	.7594	1	.7594	<1
P x Test x Trn Rng	.3928	1	.3928	<1
Error W ₁	51.08	33	1.5479	
Test Range (Tst Rng)	8.6616	1	8.6616	4.7012*
P x Tst Rng	1.2200	1	1.2200	<1
Trn Rng x Tst Rng	.0596	1	.0596	<1
P x Trn Rng x Tst Rng	1.0403	1	1.0403	<1
Error W ₂	60.8000	33	1.8424	
Vehicle View (V)	28.3325	1	28.3325	19.4219**
P x V	.0027	1	.0027	<1
Trn Rng x V	.7404	1	.7404	<1
P x Trn Rng x V	.1634	1	.1634	<1
Error W ₃	48.14	33	1.4588	
Test x Tst Rng	.0189	1	.0189	<1
P x Test x Tst Rng	.1634	1	.1634	<1
Test x Trn Rng x Tst Rng	6.4474	1	6.4474	6.2486*
P x Test x Trn Rng x Tst Rng	.1625	1	.1625	<1
Error W ₄	34.05	33	1.0318	
Test x V	16.04	1	16.0426	13.9061**
P x Test x V	.0117	1	.0117	<1
Test x Trn Rng x V	.1381	1	.1381	<1
P x Test x Trn Rng x V	.2383	1	.2383	<1
Error W ₅	38.07	33	1.1536	
Tst Rng x V	4.3353	1	4.3353	4.6555*
P x Tst Rng x V	.2094	1	.2094	<1
Trn Rng x Tst Rng x V	.1634	1	.1634	<1
P x Trn Rng x Tst Rng x V	.0252	1	.0252	<1
Error 6	30.73	33	.9312	

* p < .05

** p < .01

TABLE V (CONTINUED)

SOURCE	ss	df	ms	f
Test x Tst Rng x V	1.9667	1	1.9667	5.1591*
P x Test x Tst Rng x V	.0595	1	.0595	<1
Test x Trn Rng x Tst Rng x V	1.0836	1	1.0836	2.8425
P x Test x Trn Rng x Test Rng x V	.2501	1	.2501	<1
Error W ₇	12.58	33	.3812	

*
p < .05

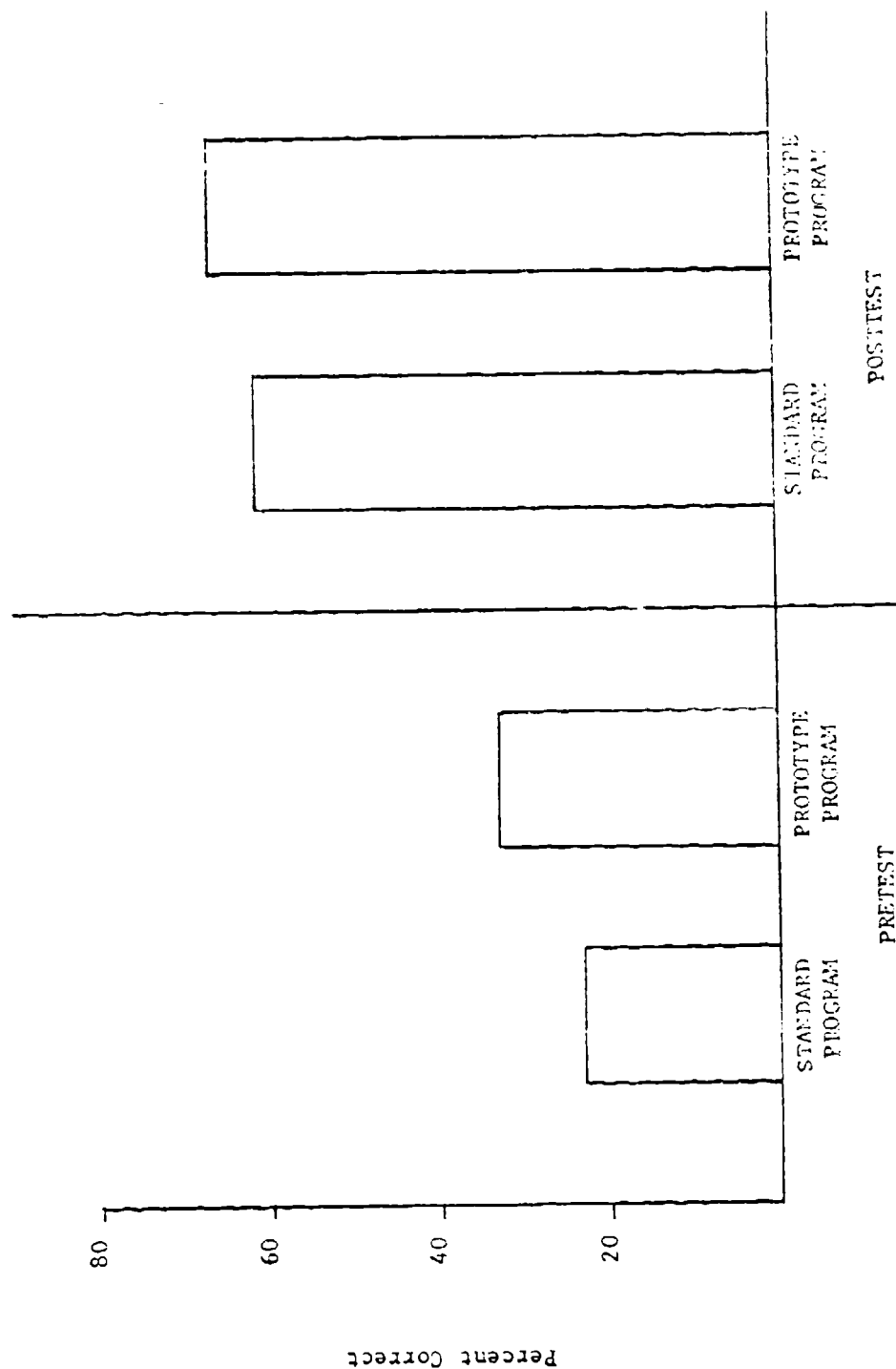


Figure 1. Target identification performance both before and after training for both training programs.

PRETEST

POSTTEST

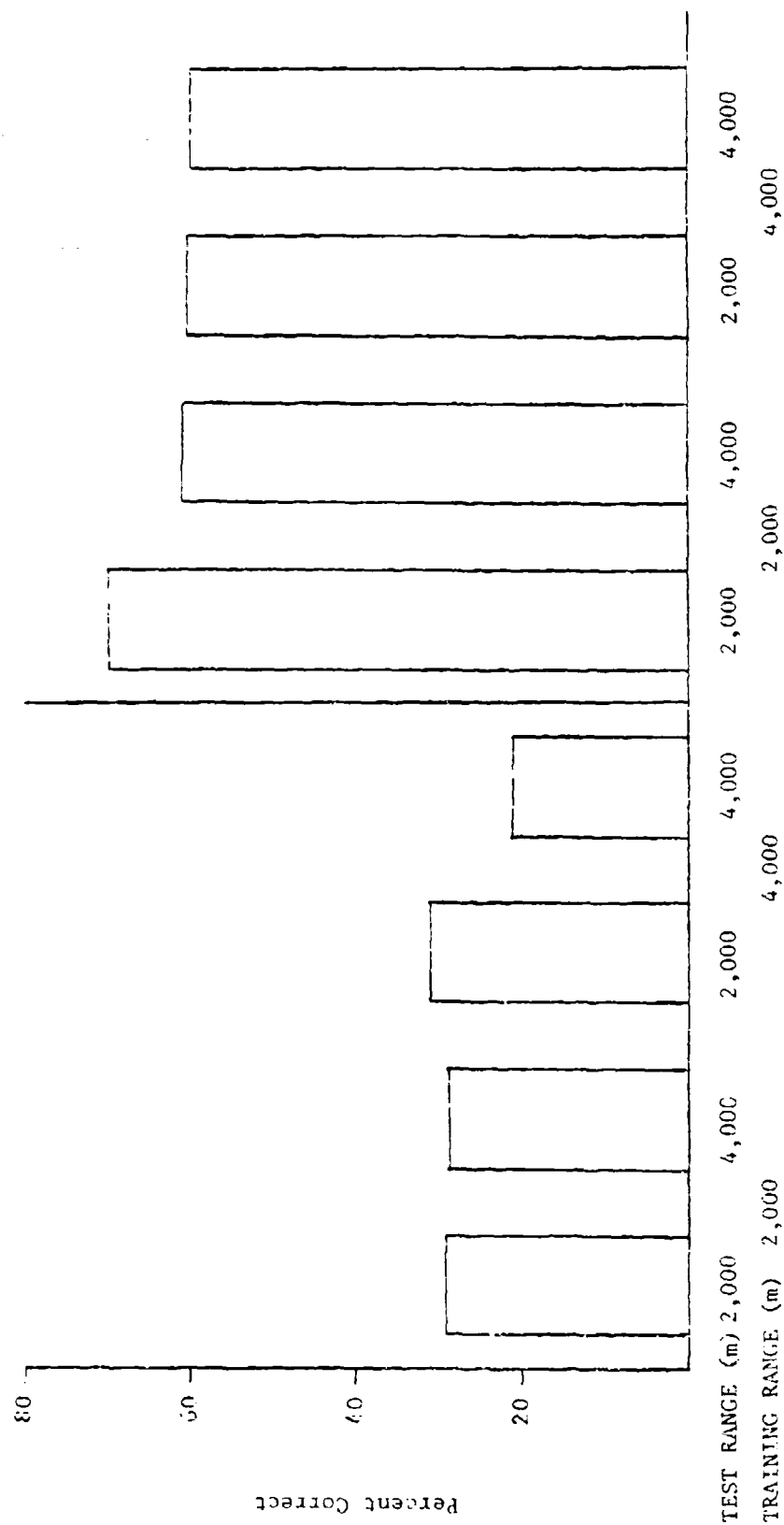


Figure 2. Graph of the TEST X TRAINING RANGE X TEST RANGE interaction.

can readily see in Table VI that gains specific to training range were generally much larger than other gains for the Prototype program, and this difference was more marked for the Prototype than for the Standard program. Further, range-specific performance gains are not as clear on frontal views of vehicles as on other views, for both programs. The implication of this result for target identification training is that while there may be some very small interaction of training range with test range, it is minimized by the set of cues used in the Standard program. Hence, one need not be concerned greatly about simulated training range using the features of the Standard program, if training is held between the boundaries of 2,000 meters and 4,000 meters. Despite any ~~test~~ by training range by test range interaction, it is clear that effects due to range-specific learning of cues are small relative to gains from training for both programs.

The effect of vehicle view proved to be significant in the analysis, as in the earlier analysis of covariance. As could be expected, the effect of view was much larger after training, as indicated by the significant training x vehicle view interaction. However, the significant test range x vehicle view interaction shown by the analysis of variance failed to reach significance in the earlier analysis of covariance.

As mentioned earlier, frontal identification scores were not included in the overall analysis because of complex interactions of vehicle view with training program on pretest scores. Perhaps the best one can do with the frontal scores in the current data is to examine gains in percent correct, as shown earlier in Table VI. From Table VI, one can see that gains on the frontal view are larger under the Prototype program. The average gain on frontal views under the Standard program was 17.5%, while the average gain with the Prototype program was 25.3% (or 23.2% if one calculates an unweighted mean across the four training range-test range combinations). Most of the gains for both programs were realized at the 2,000 meter training range; but even at this training range, there was no significant difference between the two programs on frontal views ($t = .62$, $df = 38$).

CONCLUSIONS

Both target identification training programs in this research increased target identification performance. The programs yielded target identification performance that did not differ significantly after training. However, since the Standard program produced the same level of final performance as the Prototype program and yielded larger gains than the Prototype program, one might argue that the Standard feature set is preferable for target identification training. However, the data reported here do not allow such a conclusion, as the analysis of covariance demonstrated. Another possible reason for arguing that the Standard program was more effective lies in the different number of vehicle exposures of the two programs, since the Standard group did just as well as the Prototype group even though observers in the Standard group received fewer exposures of vehicles during training. However, the training time over all phases of training was approximately equal for the two programs. From a practical standpoint (that of the trainer), total training time is the important variable, regardless of other variables as long as they do not significantly affect training costs. The significance of differing numbers of vehicle exposures for the two programs is that

TABLE VI
GAINS IN PERCENTAGE OF CORRECT RESPONSES
OVER TRAINING FOR BOTH PROGRAMS

		FRONT	VEHICLE VIEW SIDE	OBLIQUE
STANDARD PROGRAM	2,000m TRAIN - 2,000m TEST	23.5	48.6	37.3
	2,000m TRAIN - 4,000m TEST	25.9	42.8	32.3
	4,000m TRAIN - 2,000m TEST	2.0	44.5	17.0
	4,000m TRAIN - 4,000m TEST	18.6	42.7	36.7
PROTOTYPE PROGRAM	2,000m TRAIN - 2,000m TEST	37.3	47.1	31.5
	2,000m TRAIN - 4,000m TEST	33.2	34.3	22.9
	4,000m TRAIN - 2,000m TEST	19.7	37.8	19.4
	4,000m TRAIN - 4,000m TEST	2.6	41.1	34.1

statements made about the effectiveness of the two feature sets in question must be qualified by considering the context of the training program in which the features were embedded.

Target identification for flank targets proved to be superior to identification of oblique targets after training. This effect is understandable, given that several cues (such as road wheel size and spacing) are much more easily seen from the vehicle's flank. This finding is consistent with past results of Warnick et al. (1979) and Haverland and Maxey (1978).

Perhaps the major purpose of the research was to investigate the generality of target identification performance when observers are trained on the two sets of features. The results of this research indicate some marginal effects of range-specific learning of features. However, from a practical standpoint the effect of such specific learning was extremely small relative to the improvement due to training for both programs, and training can be expected to be relatively effective in either case.

From the standpoint of target representation, it appears that including the features emphasized by either program in a simulation display can be effective in providing target identification training concurrent with tank gunnery training. The most important result of this research, however, is the finding that the use of either set of critical features in training at extremely long ranges does not adversely affect target identification at much nearer ranges (at least up to the nearer range of 2,000 meters investigated in the research). If there is any such adverse effect, it is very small relative to the effect of training. This result indicates that highly detailed vehicle representations are unnecessary for target identification training.

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APPENDIX A

This program includes narrative along with (a) slides of line drawings and slides of groups of vehicle models, taken from a prototype target identification program, entitled the "Armored Vehicle Recognition Training Slide Kit," (b) transparencies of rough line drawings of armored vehicles (shown in Appendix B), (c) slides of individual model vehicles in frontal oblique and flank orientations on a terrain board, (d) slides of hull-down models produced by blacking out the vehicle hull on the slides mentioned in c above, and (e) slides of armored vehicles obtained from the Gunnery Department of the US Army Armor School at Fort Knox.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
1	1	T54/55	Slide of Line Drawing	Flank	Before going on to learn about NATO and threat tanks, there are several parts of tanks that you should be familiar with. This is the turret, this is the hull, and these are road wheels. This is a Soviet T55 tank and has no support rollers to hold up the track.
2	2	M60A1	Slide of Line Drawing	Flank	On this slide of a US M60A1, you can see the support rollers, cupola, and a turret that is shaped very differently from that of a Soviet T55.
-	3	T54/55	Trans. Line Drawing	Flank	Here is a rough line drawing of a Soviet T54 or T55, showing those things that will help you to identify it at long range. A T54 and T55 are so much alike that you can lump them all together and call them T55, but don't miss calling them a threat. The two main things that let you know this is a Soviet T55 are the rounded, dome-shaped turret that is centered on the hull, and the space between the first and second road wheels.
3	4	T54/55	Slide of Model	Flank	This is a model of a Soviet T55. Notice the rounded turret and the space between

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>
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NARRATIVE

the first and second roadwheels. Also notice that it has no support rollers, a droopy track, and very large road wheels. Sometimes T55s will have an external fuel tank that looks like a 50-gallon drum on the rear of the tank (point out). At close range, a T55 has other things you can see that tell you what it is. It has a bore evacuator on the end of the gun tube, and a funny, squarish gun mantle, but you can't see those things at long range. There are more T54s and T55s in operation than any other tank in the world, the Soviets and Warsaw Pact countries have almost 33,000 of them according to our best guess.

-	5	T54/55	Trans. Line Drawing	Front
4	6	T54/55	Slide of Model	Front
5	7	T54/55	Slide of Actual Vehicle	Front

Here is a front view of a Soviet T55. Notice the rounded turret and notice that the turret is not as wide as the hull. Here is a slide of a T55 from the front. Note the rounded turret. Here is an actual photograph of a T54 from the front. A T55 will look almost identical.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
6	8	T54/55	Slide	Oblique	Here is another T55 model. Note the rounded turret, the gap between the first and second roadwheels, the large roadwheels, and the droopy track.
			of Model		
7	9	T54/55	Slide	Oblique	Here is a slide of a T55. These tanks are very small, and stand 3' shorter than our M60A1s.
			of Model		
8	10	T54/55	Slide	Oblique	Here is another photo of a T54. Note the space between the first and second roadwheels.
			of Actual Vehicle		
9	11	T54/55	Slide	Flank	Here is what a T54 or T55 would look like from the side in a hull-down position. About all you have to go by to identify it is the turret shape.
			of Model		
			Hull-down		
10	12	T54/55	Slide	Front	When this tank is in a hull-down position, a front view is even harder to identify. About all you have to go by is the turret shape.
			of Model		
			Hull-down		
11	13	T54/55	Slide	Oblique	Again, from an angle, if a T54 or T55 is hull-down about all you can go by to identify it is the turret shape.
			of Model		
			Hull-down		
12	14	4 vehicles	Slide	Flank	Which of these tanks is a Soviet T54 or T55? (A = AMX30, B = T62, C = M551, D = T54/55). Do you know what any of the others are?
		of			
		Several			
		Models			

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
-	15	T62	Trans. Line Drawing	Flank	<p>This is a newer Soviet tank called the T62.</p> <p>This is the main Soviet battle tank and is their equivalent of our M60A1. Note the dome-shaped turret, centered on the hull and very similar to that of a T54 or T55. The T62, like the T54/55 has no support rollers and a droopy track. The road wheels are large, but instead of the single space between the first and second wheels as the T54/55 have, the T62 has two spaces between the last three roadwheels. It's easy to confuse the T62 with a T54 or T55, but remember that it's a threat tank.</p>
-	16	T54/55	Trans. Line Drawing	Flank	<p>See how similar the T62 and T54/55 look?</p>
-	17	T62	Trans. Line Drawing	Front	<p>From the front, the main way to tell a T62 is by the rounded turret. Notice that as with the T54/55, the turret is not nearly as wide as the hull.</p>
-	18	T54/55	Trans. Line Drawing	Front	<p>Compare the T62 to this T54/55. They are very similar.</p>
-	19	T62	Trans. Line Drawing	Flank	<p>Compare this line drawing to:</p>

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
13	20	T62	Slide of Model	Flank	a slide of a T62 model. Sometimes T62s will also have large fuel barrels on the rear. Up close, other things tell you this tank is a T62. It has a bore evacuator halfway up the gun tube and may or may not have a round searchlight.
-	21	T62	Trans. Line Drawing	Front	Compare this front drawing of a T62 with:
14	22	T62	Slide of Model	Front	A model of a T62 from the front. Pay close attention to the shape of the turret.
15	23	T62	Slide of Actual Vehicle	Front	Here is a front view of a T62. Note the rounded turret. The Soviets have over 16,000 of these, and they're good tanks.
16	24	T62	Slide of Model	Oblique	From this angle, the rounded turret shows up well, but it's hard to see the spaces between the roadwheels. You can see that the roadwheels are large, though.
17	25	T62	Slide of Actual Vehicle	Oblique	Here is a T62 running down the road with its smoke generator on. Note the rounded turret and droopy tracks.
18	26	T62	Slide of Actual Vehicle	Oblique	This tan color is about the way T62s are painted for desert combat.
19	27	T62	Slide of Model Hull-down	Flank	This is a T62 in a hull-down position. About all you can go by is the turret shape.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
20	28	T62	Slide of Model Hull-down	Front	Again, in a hull-down position it is important to know the shape of a T62 turret.
21	29	T62	Slide of Model Hull-down	Oblique	Here is an oblique view of a hull-down T62.
22	30	4 vehicles	Slide of Several Models	Flank	Here are several tanks. Which one is the T62? (A = M551, B = T54/55, C = T62, D = AMX30). Can you name the others?
-	31	T72	Trans. Line Drawing	Flank	This is the Soviet T72. It is almost identical to a somewhat older Soviet tank, the T64. The two look so much alike that we will just call them T72s. From all reports the T72 is nearly a match for the XM1, but the Soviets have almost 11,000 of them in the field. The T72 has a rounded turret like earlier Soviet tanks, but the turret is far back on the hull. It <u>has</u> support rollers so the tracks don't droop, and has smaller roadwheels than earlier threat tanks. It has approximately a 125mm gun that fires fin-stabilized ammo, and packs quite a wallop. The Soviets have been sending T72s to Syria.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
-	32	T62	Trans. Line Drawing	Flank	Compare the T72 to the T62,
-	33	T54/55	Trans. Line Drawing	Flank	and a T54/55. There are differences, but they all have rounded turrets.
-	34	T72	Trans. Line Drawing	Front	From the front you can see the rounded turret, set in from the sides of the hull. Sometimes you may be able to see the V-shaped piece of metal on the front slope. This keeps mud from splashing on the driver, since the front is really slanted. Compare the front view to that of a:
-	35	T62	Trans. Line Drawing	Front	T62 and a:
-	36	T54/55	Trans. Line Drawing	Front	T54/55.
-	37	T72	Trans. Line Drawing	Flank	Compare the line drawing to this model:
23	38	T72	Slide of Model	Flank	of a T72. Note how far back the rounded turret sits on the hull. If you get close, you can see the bore evacuator midway down the gun tube, but then you're too close.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
24	39	T72	Slide of Actual Vehicle	Flank	Here is a photograph of a T72. This tank has even a lower profile than the T62 or T54/55.
-	40	T72	Trans. Line Drawing	Front	Compare a frontal line drawing to:
25	41	T72	Slide of Model	Front	this model of a T72 from the front.
26	42	T72	Slide of Model	Oblique	Here is another view of the T72. Sometimes the T72 has a series of spring-loaded plates that can serve as fender skirts.
27	43	T72	Slide of Actual Vehicle	Oblique	Here is a close-up photograph of a Soviet T72. Note the sponson boxes put on the side of the turret. Also note the external fuel tank on the rear.
28	44	T72	Slide of Model	Flank Hull-down	Here is a hull-down T72. Note the turret shape.
29	45	T72	Slide of Model	Front Hull-down	A frontal view of a T72 in a hull-down position.
30	46	T72	Slide of Model	Oblique Hull-down	Because of the advantage afforded by being in a hull-down position, it is necessary to be able to identify tanks by seeing just their turrets.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
31	47	3 vehicles	Slide of	Oblique	These, then, are the three main threat tanks.
			Several		
			Models		
-	48	AMX30	Trans.	Flank	There is one other main battle tank that has a rounded turret, but it is a friendly tank. This is the French AMX30. It looks very much like a T72, but has several things that are clearly different from threat tanks. First, the gun mantle of the AMX30 is extremely large (point out). The turret, although rounded, has a rear overhang and is well forward on the hull. The AMX 30 has support rollers, like the T72, so you cannot use that to try to tell the two apart. One easily recognizable thing about the AMX 30 are the large mufflers on the upper rear part of the hull.
			Line		
			Drawing		
-	49	T72	Trans.	Flank	Contrast the AMX 30 turret with that of the T72. What is the difference? (AMX 30 turret is long, flatter, and farther forward on the hull.)
			Line		
			Drawing		
-	50	T62	Trans.	Flank	Also contrast the AMX 30 to the T62;
			Line		
			Drawing		

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
-	51	T54/55	Trans.	Flank	and the T54/55.
			Line		
			Drawing		
-	52	AMX30	Trans.	Front	Here is a front view of the AMX 30. Note
			Line		the rounded, wide, low, turret. Also note
			Drawing		the extremely wide gun mantle (point out).
					The sides of the AMX 30 hull slant in
					toward the turret. This is not like any
					threat tank, whose sides are all straight
					to the top of the hull.
-	53	T72	Trans.	Front	Contrast the turret shape of the AMX 30
			Line		with that of the T72,
			Drawing		
-	54	T62	Trans.	Front	the T62,
			Line		
			Drawing		
-	55	T54/55	Trans.	Front	and the T54/55.
			Line		
			Drawing		
-	56	AMX30	Trans.	Flank	Compare the line drawing of an AMX 30 to:
			Line		
			Drawing		
32	57	AMX30	Slide	Flank	this model of an AMX 30. Again, note the
			of		large gun mantle, the flat, dish-shaped
			Model		turret, and the large muffler on the rear
					part of the hull.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
33	58	AMX30	Slide of Model	Front	Note the turret shape and large gun mantle on this front view of an AMX 30. Can you tell that the sides of the hull slope up to the turret?
34	59	AMX30	Slide of Actual Vehicle	Oblique	Note the turret shape on this close photograph of an AMX 30. The knobs on the sides of the turret for the rangefinder almost look like eyes. Note the muffler at the rear of the hull.
35	60	AMX30	Slide of Model	Oblique	How many distinctive features can you find on this model of an AMX 30?
36	61	AMX30	Slide of Actual Vehicle	Oblique	Here is an AMX 30 equipped for fording. Note the turret shape.
37	62	AMX30	Slide of Model Hull-down	Flank	Here is all you would see of an AMX 30 if it was hull-down. Look carefully at how long and low the turret is.
38	63	AMX30	Slide of Model Hull-down	Front	Note the low, rounded turret and wide gun mantle that you would see of an AMX 30 hull-down from the front.
39	64	AMX30	Slide of Model Hull-down	Oblique	Again, note the turret shape from this angle. What else tells you this is an AMX 30?
40	65	6 vehicles	Slide of Several Models	Oblique	Which of these vehicles is the AMX 30? Can you name the other vehicles? (A = T62, B = Leopard, C = Chieftain, D = T54/55, E = AMX 30, F = M60A1).

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
-	66	M60A1	Trans. Line Drawing	Flank	All the previous tanks have had rounded turrets. Now you're going to see tanks with squarer turrets. This is our M60A1. The M60A3 looks the same. Note the large turret, the commander's cupola, the high rear deck, and note that the M60A1 has support rollers. Perhaps the most identifiable thing about the M60A1 at long range is its height and its very large turret.
-	67	M60A1	Trans. Line Drawing	Front	The commander's cupola, the large squared turret, and large gun mantle indicate that this is an M60A1 from the front.
-	68	M60A1	Trans. Line Drawing	Flank	Compare this line drawing to:
41	69	M60A1	Slide of Model	Flank	the slide of this model.
42	70	M60A1	Slide of Model	Front	Note the cupola and wide turret on this front view.
43	71	M60A1	Slide of Model	Oblique	Again, note the large turret and its shape. Note the high profile of the M60A1. We have the tallest main battle tank in the world.
44	72	M60A1	Slide of Actual Vehicle	Oblique	Here is a picture of the M60A1. You should know what it looks like very well by now.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
45	73	M60A1	Slide of Model Hull-down	Flank	Here is what an M60A1 looks like in defilade from the side, and:
46	74	M60A1	Slide of Model Hull-down	Front	this is what it looks like from the front, and:
47	75	M60A1	Slide of Model Hull-down	Oblique	from an angle.
48	76	6 vehicles	Slide of Several Models	Flank	Which of these vehicles is the M60A1? (A = AMX 30, B = M551, C = Leopard, D = M60A1, E = Chieftain, F = T62). How many of the others can you name?
-	77	Leopard	Trans. Line Drawing	Flank	This is a West German Leopard, a friendly tank. Note the large gun mantle, the large gun mantle, the large squared turret, the wavy fender skirts, and the exhaust grill at the rear of the hull. Several tanks have fender skirts, such as the British Chieftain and the American XM1. Even the Soviet T72 sometimes may have fender skirts in combat, and it is a threat tank.
	78	M60A1	Trans. Line Drawing	Flank	Compare the Leopard to the M60A1. Getting these two tanks confused is no problem, since they are both friendly.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
-	79	Leopard	Trans. Line Drawing	Front	The frontal view of a Leopard shows the squared turret, the large gun mantle, and sides that slope into the turret.
-	80	M60A1	Trans. Line Drawing	Front	Contrast that with the taller M60A1's shape.
-	81	Leopard	Trans. Line Drawing	Flank	Compare the line drawing:
49	82	Leopard	Slide of Model	Flank	to a model of a Leopard. You can clearly see the turret shape and exhaust louvres on this model.
50	83	Leopard	Slide of Actual Vehicle	Flank	Here is a view of a Leopard in the field. The turret seems to be shaped differently than that of the model in the previous slide, but the difference is that the model:
49	84	Leopard	Slide of Model	Flank	has the new bolt-on armor used on many Leopards:
50	85	Leopard	Slide of Actual Vehicle	Flank	while the Leopard in this slide doesn't. Without the bolt-on armor, the Leopard has a turret that is rounded in the back.
51	86	Leopard	Slide of Actual Vehicle	Flank	Here is a clearer view of a Leopard turret without the bolt on armor.

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
-	87	Leopard	Trans. Line Drawing	Front	Compare this line drawing of the front of a Leopard to:
52	88	Leopard	Slide of Model	Front	this model. What features tell you from the front that this is a Leopard?
53	89	Leopard	Slide of Actual Vehicle	Front	Here is a close-up of a Leopard from the front. This Leopard does not have the new bolt-on armor.
54	90	Leopard	Slide of Model	Oblique	Here is another view of a Leopard with the bolt-on armor. Note the large gun mantle, squared turret, and exhaust louvres.
55	91	Leopard II	Slide of Actual Vehicle	Oblique	This is West Germany's tank of the future, the Leopard II. It looks a lot like an XM1, and will not have the exhaust louvres on the rear of the hull that the present Leopards have. The Leopard II will not be West Germany's main battle tank until a few years from now.
56	92	Leopard	Slide of Model Hull-down	Flank	Here is a Leopard I from the side as if it were hull-down. Could you tell this is a Leopard by just seeing the turret?
57	93	Leopard	Slide of Model Hull-down	Front	This is a hull-down Leopard from the front,

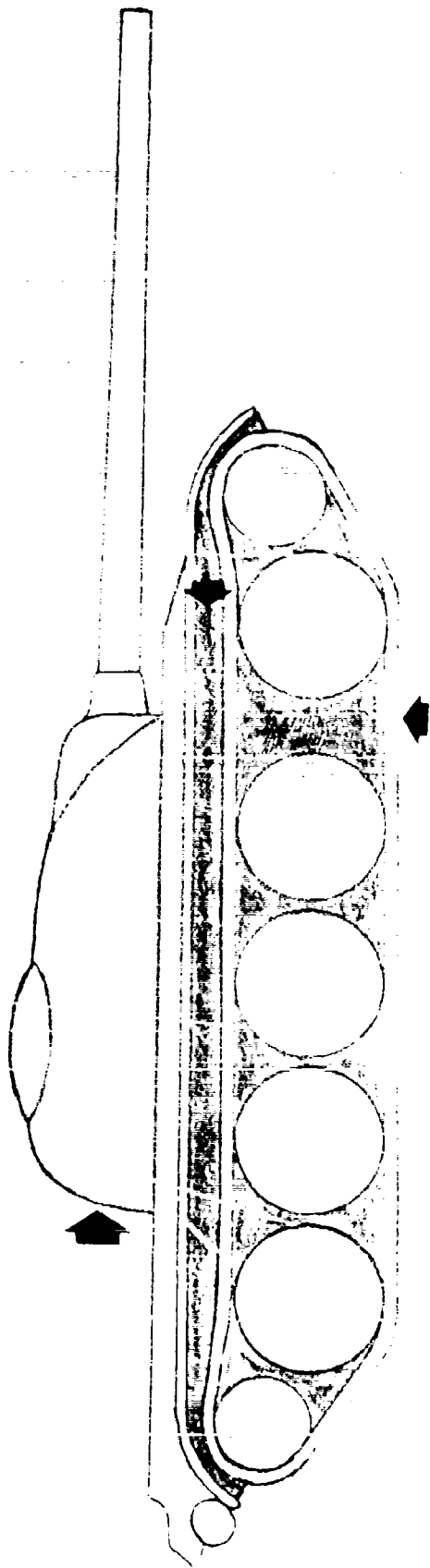
<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
58	94	Leopard	Slide of Model Hull-down	Oblique	and here is a Leopard seen from an angle. What clues can you find to let you know this is a friendly, German Leopard.
59	95	6 vehicles	Slide of Several Models	Oblique	Which of these tanks is the Leopard? Can you name the others? (A = T62, B = Leopard, C = Chieftain, D = T54, E = AMX30, F = M60A1).
-	96	Chieftain	Trans. Line Drawing	Flank	This is a friendly British Chieftain. Note the long, low turret, with the funny- shaped rear overhang. The turret has large sponson boxes on both sides, that can be seen for a long distance. The Chieftain also has fender skirts. The Chieftain has a powerful 120mm gun, but a lousy engine.
-	97	Leopard	Trans. Line Drawing	Flank	Contrast the Chieftain with the Leopard,
-	98	Leopard	Trans. Line Drawing	Flank	and the M60A1.
-	99	Chieftain	Trans. Line Drawing	Front	Here is a front view of a Chieftain. Note the squared turret and the large sponson boxes that look almost like ears. They nearly go out to the sides of the hull.
-	100	Leopard	Trans. Line Drawing	Front	Compare that to a front view of a Leopard,

<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
-	101	M60A1	Trans. Line Drawing	Front	and an M60A1.
-	102	Chieftain	Trans. Line Drawing	Flank	Compare this line drawing of a Chieftain to:
60	103	Chieftain	Slide of Model	Flank	this model of a Chieftain. Can you see the shape of the rear overhand and the large sponson box on the side of the turret?
61	104	Chieftain	Slide of Actual Vehicle	Flank	Here is a slide of a Chieftain. The picture quality is poor, but you can see the large sponson box and the shadow it makes on the turret pretty clearly.
-	105	Chieftain	Trans. Line Drawing	Front	Compare this frontal line drawing of a Chieftain to this:
62	106	Chieftain	Slide of Model	Front	model. Note the large sponson boxes on the sides of the turret, so that the turret appears nearly as wide as the hull.
63	107	Chieftain	Slide of Actual Vehicle	Front	Here is a close-up of a Chieftain from the front. Those sponson boxes are really big.
64	108	Chieftain	Slide of Actual Vehicle	Front	Here is another Chieftain. A friendly, British tank.

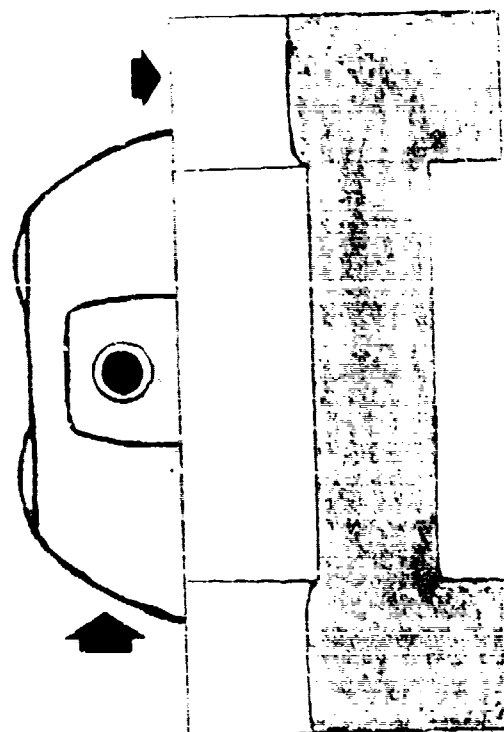
<u>SLIDE</u>	<u>STEP</u>	<u>VEHICLE</u>	<u>MEDIUM</u>	<u>VIEW</u>	<u>NARRATIVE</u>
65	109	Chieftain	Slide of Model	Oblique	And here is another view of a Chieftain. What things let you know that it is a friendly, British Chieftain?
66	110	Chieftain	Slide of Model Hull-down	Flank	This is what you would see of a hull-down Chieftain from the side,
67	111	Chieftain	Slide of Model Hull-down	Front	from the front,
68	112	Chieftain	Slide of Model Hull-down	Oblique	and at an angle.
69	113	6 vehicles	Slide of Several Models	Front	Can you tell which of these tanks is the Chieftain? What are the others? (A = Leopard, B = AMX 30, C = T62, D = M60A1, E = Chieftain, F = T54/55).

APPENDIX B

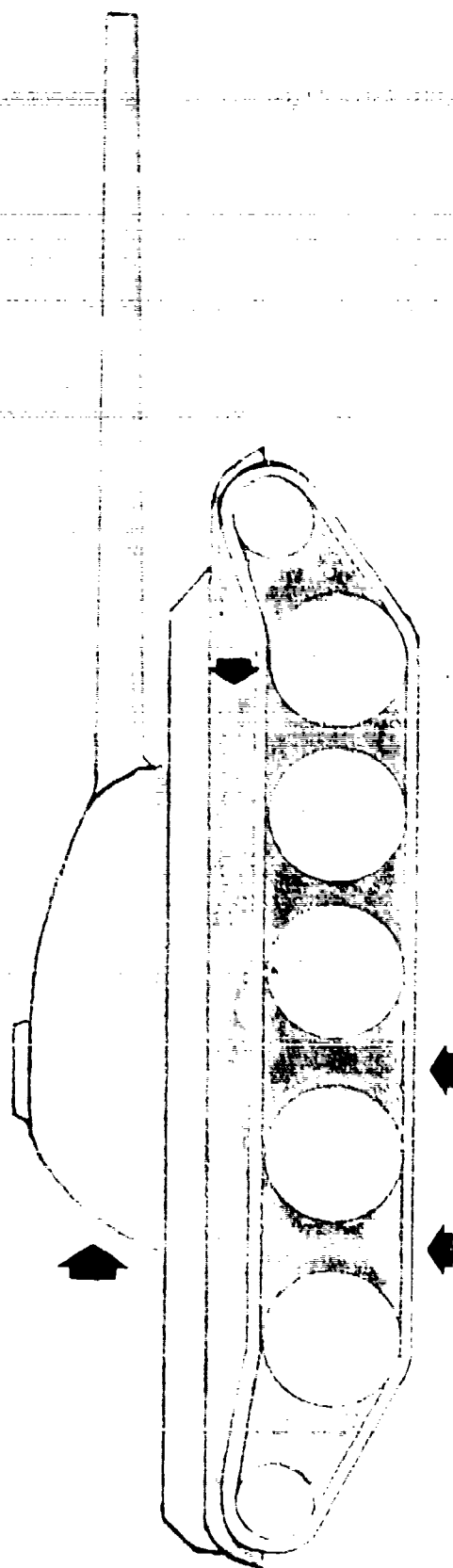
Line drawings of vehicles used in
Prototype target identification
training program



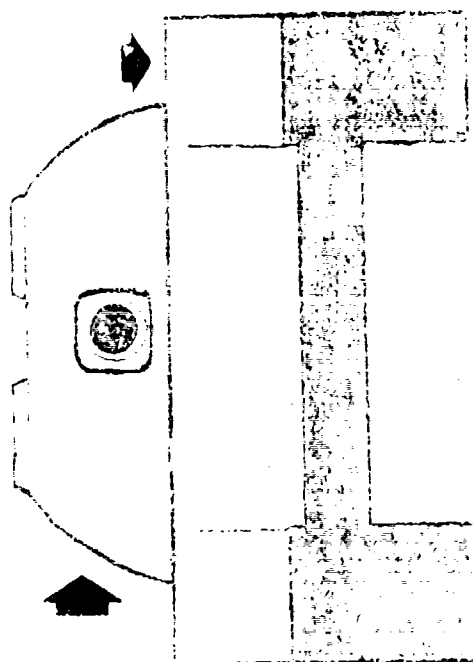
T55



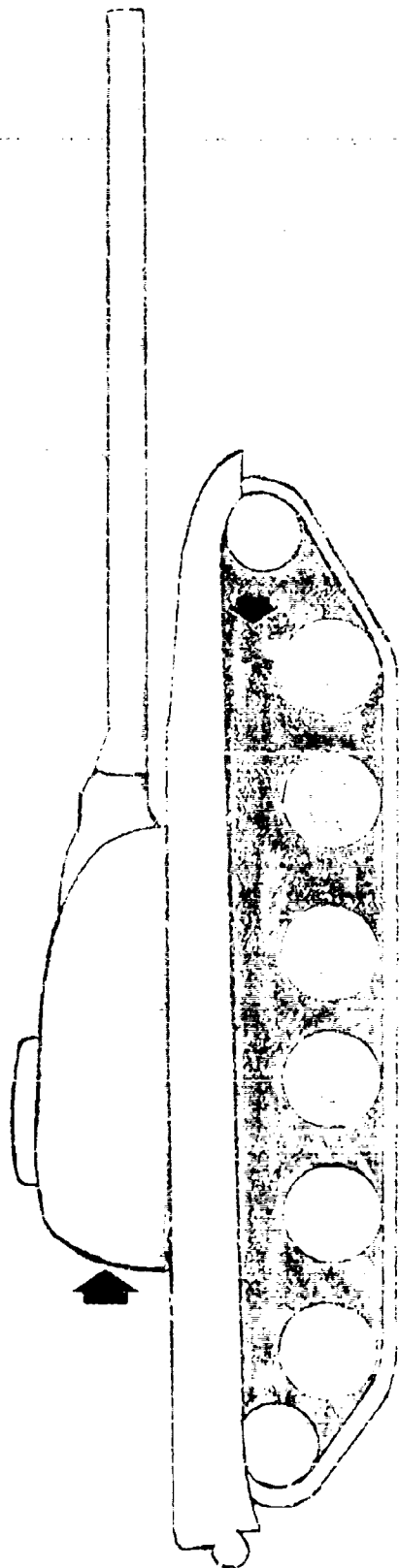
T55



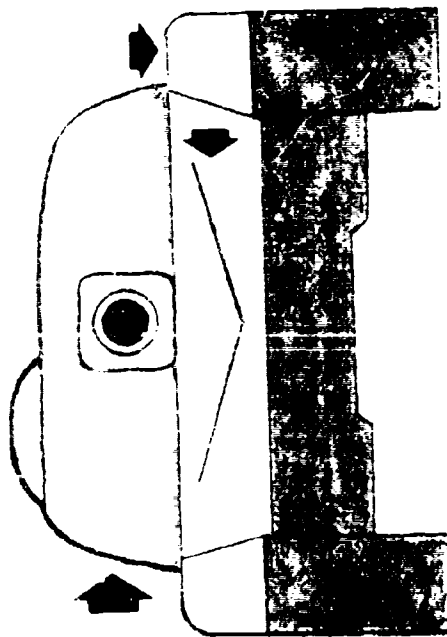
762



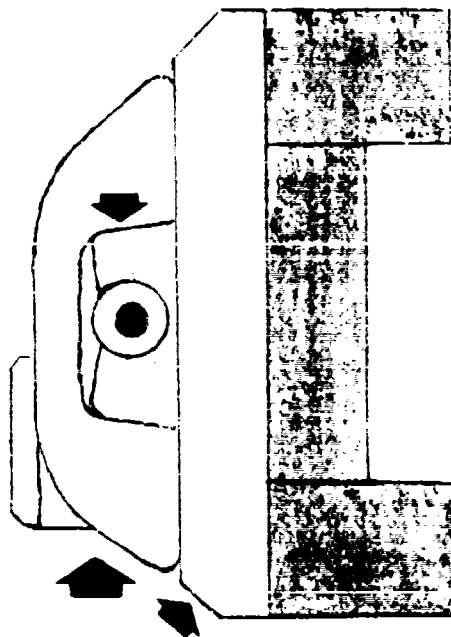
T62



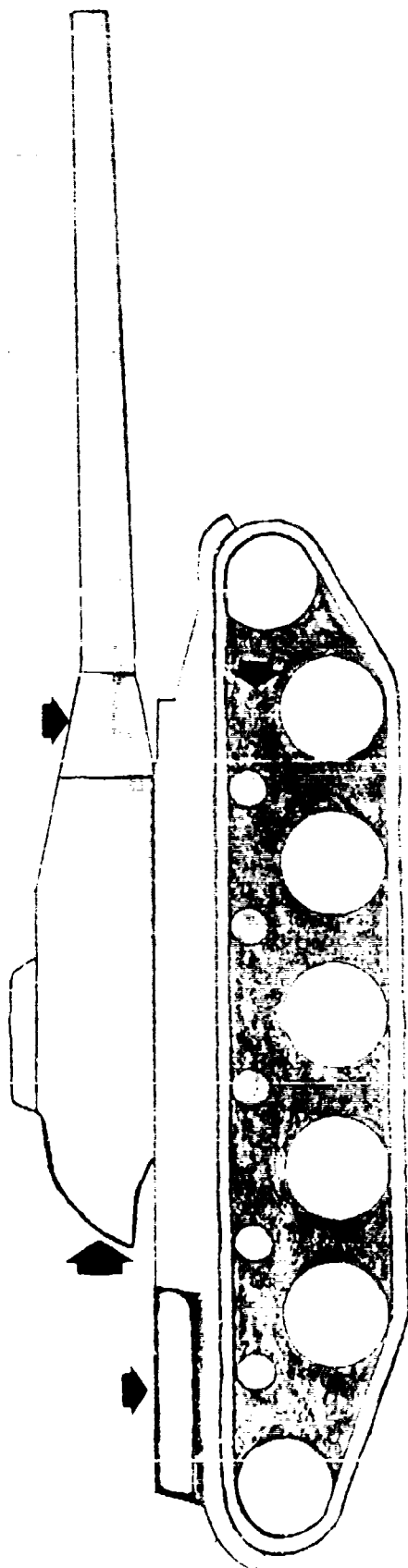
T72



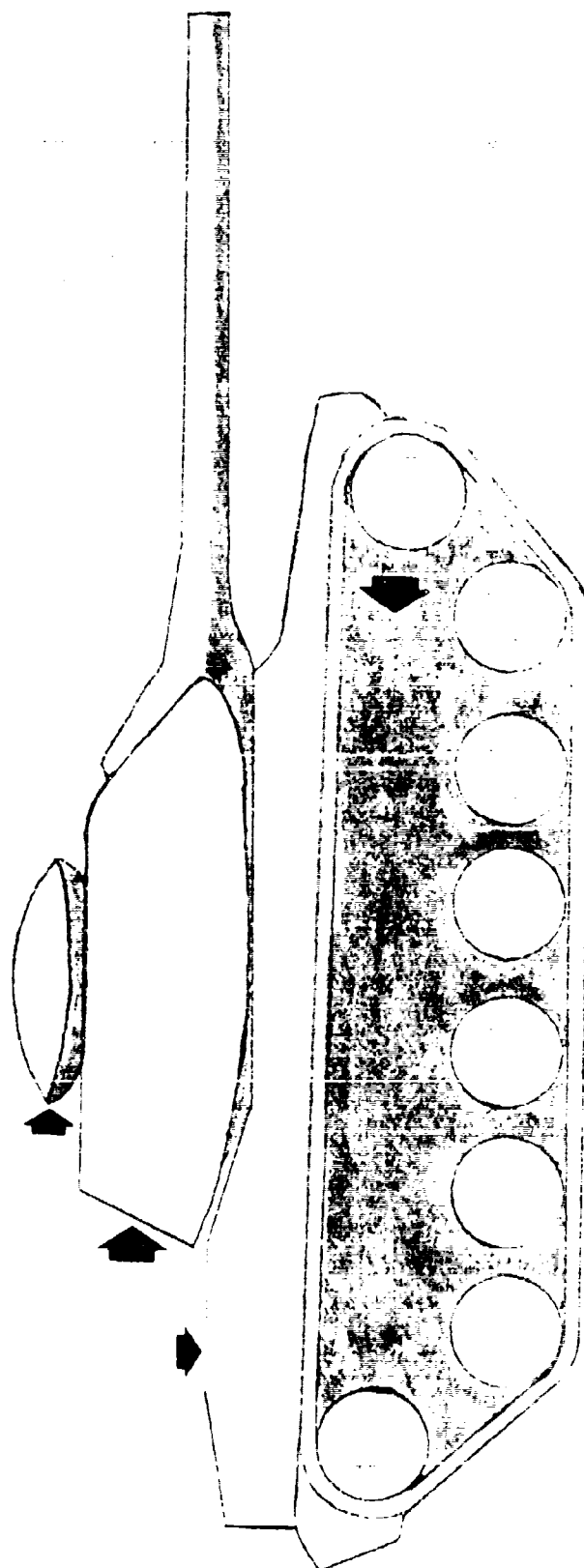
T72



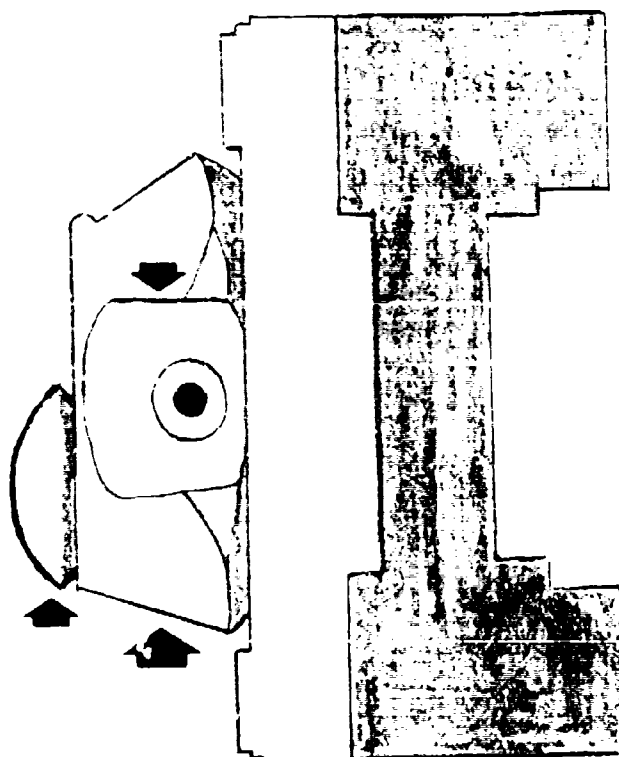
AMX 30



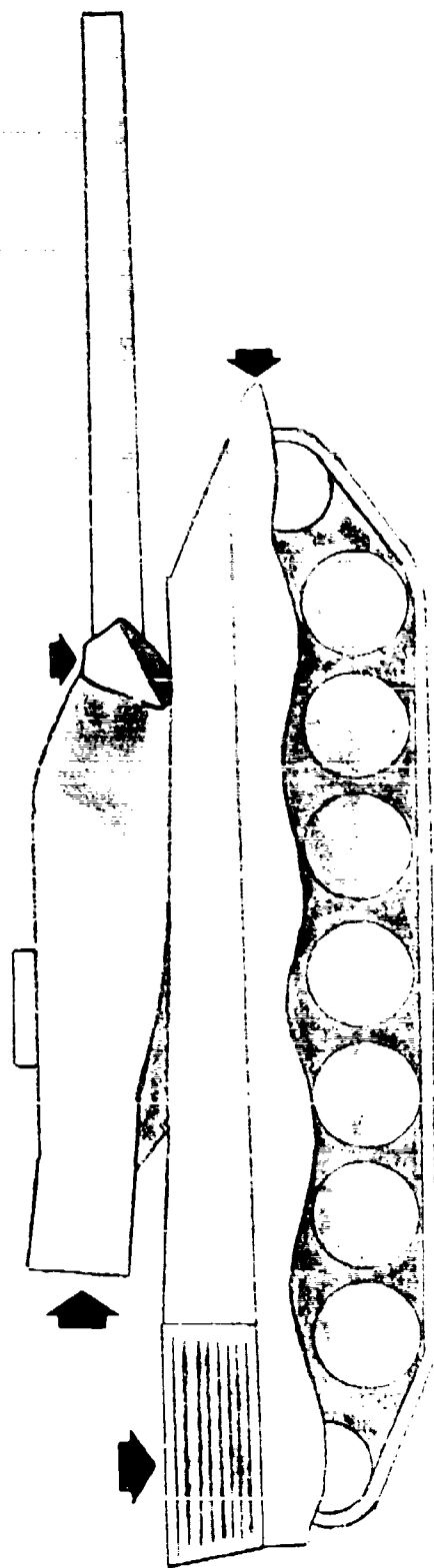
AMX 30



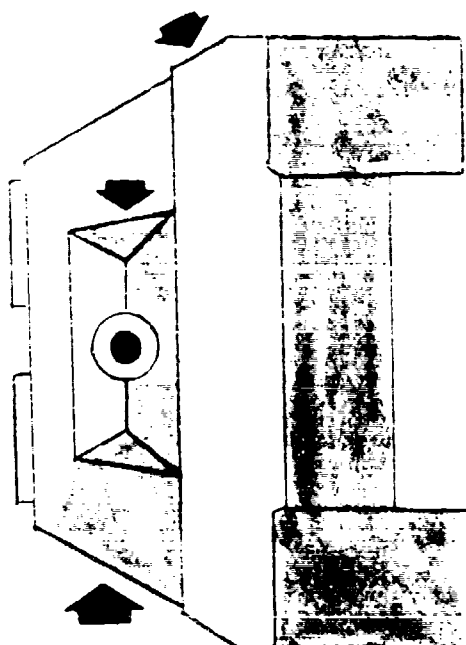
M60



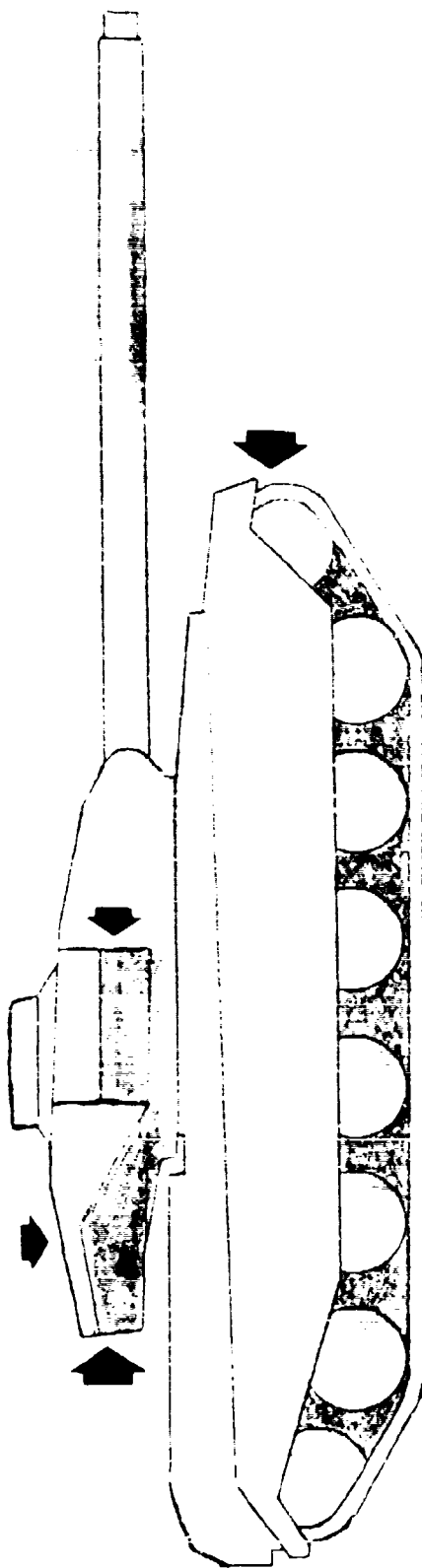
M 60



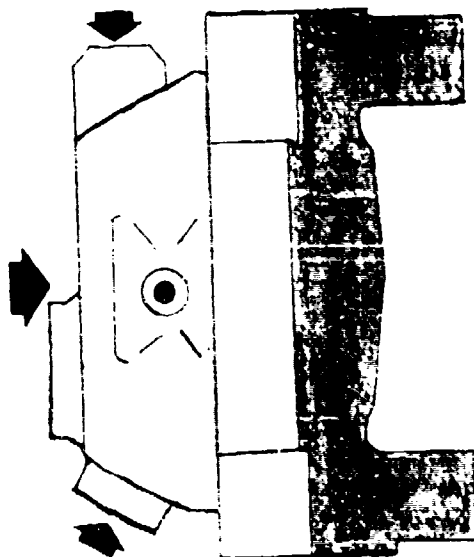
LEOPARD



LEOPARD



CHIEFTAIN



CHIEFTAIN

7.

APPENDIX C

Target identification questionnaire administered to observers before the research, as well as after the research. When the questionnaire was administered prior to the training program, observers were instructed not to respond to items 8, 10, and 11.

DEPARTMENT OF THE ARMY NATO AND THREAT TANK IDENTIFICATION QUESTIONNAIRE

We want your ideas on this training.

1. In your own words, what are some of the things you look for to tell that a tank is an M60A1?

2. What do you look for to tell that a tank is a Leopard?

3. What do you look for to tell that a tank is a Chieftain?

4. What do you look for to tell that a tank is an AMX-30?

5. What do you look for to tell that a tank is a T-54/55?

6. What do you look for to tell that a tank is a T-62?

7. What do you look for to tell that a tank is a T-72?

8. We would like to know if you have any ideas about how to make this target identification training better. What would you do differently to make it better?

9. When you see a tank, what is the very first thing you look at to try to tell what it is? Do you look at the turret shape, hull shape, main gun, or what?

10. Would you like to see more different pictures of tanks during training, or are there enough?

11. Are there any ways the pictures could be made better?

12. Circle one of the answers below. This kind of training is:

Very important	Sort of important	Not very important	Not important at all
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APPENDIX D

Instruction received by groups selected for the Standard program

Trial 1: T54/55, SR

- ° Threat, Soviet, T54/55 Tank.
- ° Soviet tanks are characterized by their:
 1. low compact look,
 2. dome- or cup-shaped turret,
 3. long slender gun tube.

° Pay particular attention to the turret shape; it's one way of telling the difference between this tank and other Soviet tanks. The modern Soviet tanks, since 1945, all tend to look much alike.

° Another cue which you can use to identify this tank is the wide gap between the roadwheels in the front.

° Note the suspension, often called "Christie." This type of suspension is characteristic of Soviet vehicles.

Trial 2: T54/55, OR

- ° Threat, Soviet, T54/55 Tank.

° I want you to look carefully at this vehicle, as all other Soviet vehicles are modeled after it. It's the T54/55. The T54 and T55 are two different models that look so much alike that it's almost impossible to tell them apart. Either designation is acceptable. Don't fail to recognize it as a "threat."

Trial 3: T54/55, SL

- ° Threat, Soviet, T54/55 Tank.

° Centered, rounded turret and low silhouette, plus suspension, lets us know it's Soviet.

° If you could see the bore evacuator, it may help you in identifying this model tank. The evacuator is on the end of the gun tube, not set back as in most current tanks.

Trial 4: T54/55, OL

- ° Threat, Soviet, T54/55 Tank.
- ° The sleek, low, compact silhouette identifies this as the T54/55.
- ° We can see clearly the front gap in the roadwheels.
- ° Note that the turret is centered in relationship to the hull.

Trial 5: T54/55, F

- ° Threat, Soviet, T54/55 Tank.
- ° The low silhouette and round-shaped turret identify it as a possible Soviet tank.
- ° From this view it's often confused with a French tank, the AMX-30.
- ° This is the most difficult view. Take a good look.

Trial 6: T-62, SR

- ° Threat, Soviet, T-62 Tank.
- ° Note the dome-shaped, centrally located turret.
- ° The bore evacuator on this tank is mounted a little way back from the front of the gun tube. At far ranges the evacuator can't be seen.
- ° The T-62 has grab rails located midway across the turret. In some pictures you can see them, in others you cannot.
- ° Note the gap in the roadwheels. The space between these two roadwheels is wider than the others. I want you to remember that on the T-62, the gap is located toward the rear of the track. Remember, in the T-62 the gap is to the rear. You will see why this is significant when we compare the T-62 to other Soviet tanks.

Trial 7: T-62, OR

- ° Threat, Soviet, T-62.
- ° By this time you should know the main features of the T-62.
- ° You can see the handrails and searchlight; note that the shadow hides the roadwheels.
- ° I would like to point out some very minor features. First, the smooth gradual front slope; and second, the smooth taper of the top of the turret.

Trial 8: T-62, SL

- ° Threat, Soviet, T-62 Tank.
- ° It's most distinctive feature is the overturned, cup-shaped turret.
- ° Note that the turret is centered on the hull. This type of turret is characteristic of all modern Soviet battle tanks.
- ° The main gun is relatively long in relationship to the length of the hull.

Trial 9: T-62, OL

- ° Threat, Soviet, T-62 Tank (115mm gun).
- ° In this view we get a better look at how the front armor is sloped.
- ° Note that the edge of the prow is very low to the ground.
- ° Keep in mind the turret slope and centered turret.
- ° It has 5 roadwheels with the gap toward the rear.
- ° You can see the searchlight and what looks like a machinegun.

Trial 10: T-62, F

- ° Threat, Soviet, T-62 Tank.
- ° This is the most difficult view, so take a good look at it.
- ° Note the sharp prow line, the extremely low silhouette, and the dome- or cup-shaped turret.
- ° In this slide you can see one of the IR searchlights with which this tank is equipped. Do not depend on this cue, but simply use it as a reinforcer along with the other vehicle characteristics.

Trial 11: T-72, SR

- ° Threat, Soviet, T-72 Tank.
- ° This is the latest Soviet main battle tank.
- ° Distinctive features are:
 1. Low silhouette. The suspension uses support rollers; which is a departure for Soviet tanks.
 2. Teacup-shaped turret with an extremely long main gun.
 3. Turret is centered on the chassis.
 4. Also, note the gradual downward sloping to the front which gives the track a tapered appearance towards the front of the vehicle.

Trial 12: T-72, OR

- ° Threat, Soviet, T-72 Tank.
- ° In this slide you should see all the features which are characteristic of Soviet tanks.

° The length of the gun tube appears to be extremely long; looks about as long as the chassis.

° The turret is what I call high-domed rather than slope-domed.

° Fuel cells cover almost the whole length of the right-hand fender and rear half of the left fender.

° Note the deck line. At the rear it looks like an amphibious design and then tapers toward the front. Keep in mind how the front of the track and suspension appear to be tapered.

Trial 13: T-72, SL

° Threat, Soviet, T-72 Tank.

° The fording snorkel can be seen on the side of the turret. Don't rely on this cue, as almost all fording equipment is portable and not built into the vehicle. In some pictures it has been seen carried on the back deck.

° The deck and track line makes this vehicle stand out from other Soviet tanks. The track uses support rollers like our tanks.

° Note that the turret is slightly tapered toward the front.

° Large spare fuel drums can be carried across the back of the tank. This is also characteristic of Soviet vehicles. The US experimented with them many years ago.

Trial 14: T-72, OL

° Threat, Soviet, T-72 Tank.

° In this slide you can see the high, thick sponsons tapering toward the front of the tank. Also, notice the high front fender line at the front of the prow.

° The low silhouette and rounded turret of the vehicle definitely stamps this vehicle as Soviet.

° Note how the turret is well back toward the center of the tank.

Trial 15: T-72, F

° Threat, Soviet, T-72 Tank.

° The turret is not quite as low as the AMX-30.

° Note how the fenders stand out in relief.

° The turret is evenly rounded and sets in a little on both sides from the edge of the tank.

- ° The main gun is a 125mm gun, the biggest of all main battle tanks.

Trial 16: AMX-30, SR

- ° Friendly, French, AMX-30, Light Tank.
- ° This tank's beetle shape makes it look like Soviet vehicles, but it appears much bigger than the Soviet tanks.
- ° The AMX-30 was designed primarily to fight other tanks.

Trial 17: AMX-30, OR

- ° Friendly, French, AMX-30, Light Tank.
- ° The AMX-30 in this slide shows very clearly the external muffler located conspicuously at the rear of the vehicle. There's another one on the other side in the same location. Use these to help you, but don't rely on using them at longer ranges. They wash out.
- ° We have the low, beetle-like turret.
- ° Notice how the armor slopes all around the turret.
- ° It is the lightest (36 tons) main battle tank mounting a 105mm gun.

Trial 18: AMX-30, SL

- ° Friendly, French, AMX-30, Light Tank.
- ° This slide shows the difference between what I call "high-domed" and "low-domed" turret sides.
- ° The muffler on the rear of the vehicle can aid in identification.
- ° Note how the turret armor slopes and meets the deck lines, giving it a very sloped look.
- ° The gun tube has no bore evacuator or muzzle brake, and the gun tube is very thick.

Trial 19: AMX-30, OL

- ° Friendly, French, AMX-30, Light Tank.
- ° Note the very flat, low turret.
- ° This particular slide does show the searchlight, but don't rely on it as your only cue.

° The front slope has a fairly sharp angle; note the absence of definitive fender lines. The fenders seem to blend in with the front armor rather than stand out in relief, as in the T-72 tank.

° One thing which does differentiate this vehicle from the Soviet is its much higher silhouette and the non-Soviet type suspension systems.

Trial 20: AMX-30, F

° Friendly, French, AMX-30, Light Tank.

° This tank is misidentified as a threat vehicle more than any other friendly vehicle. Take a careful look, as this is the most difficult of all vehicles to recognize or identify.

° It has 2 major features that may help you:

1. The very low, oval-shaped turret; the turret lines are smooth and unbroken.

2. The fairly large, flat frontal area leading up to the turret.

° There is a commander's cupola, but it's difficult to see.

Trial 21: M60A1, SR

° Friendly, American, M60A1 Tank.

° The slide shows clearly the long turret and high side-walls.

° Note the cupola and the very squared look of the back of the turret.

Trial 22: M60A1, OR

° Friendly, American, M60A1 Tank.

° The suspension design and large turret area should help you in identifying this vehicle.

° Pay particular attention to the very high turret lines; the cupola adds to that height.

° The relative size of the turret and hull are proportional (same size roughly).

Trial 23: M60A1, SL

° Friendly, American, M60A1 Tank.

° Recent experimental tests with air cavalry personnel disclosed that our own forces misidentify the M60A1 as a Soviet or French tank fairly often. Take a good look at it.

Trial 24: M60A1, OL

- ° Friendly, American, M60A1 Tank (105mm gun).
- ° The first thing that strikes you in this view is the rather large turret. The turret armor is not rounded but retains a flat surface look.
- ° The suspension uses roadwheels with support rollers over which the top of the track rolls.
- ° You can barely see the cupola.
- ° The turret is fairly well centered and takes up a large volume of space when compared to the hull size.

Trial 25: M60A1, F

- ° Friendly, American, M60A1 Tank.
- ° In this particular slide, at first glance, it looks much like a Soviet tank.
- ° You're probably used to seeing the very prominent commander's cupola on the left of the vehicle. Do not depend on it as your only cue. Shown here, the cupola is very difficult to see.
- ° Note the sharp prow line and the characteristic sharp, flat, angled surfaces at the front of the turret. When this turret first came out it was called "needlenosed." You'll see more of it.
- ° The relative overall large size of the M60A1 makes it stand out when compared to other vehicles. It stands fairly high in comparison to Soviet tanks. All modern Soviet tanks are built extremely low.

Trial 26: Leopard, SR

- ° Friendly, West German, Leopard Tank.
- ° The feature that stands out from a side view is the boxy (squared) shape.
- ° Its most distinctive feature is the scalloped skirts.
- ° The rather rectangular and elongated turret.
- ° The squared, or bobbed, rear of the vehicle.
- ° Note the large number of roadwheels (7).
- ° Note the searchlight. If it is mounted, this cue may help in identifying the vehicle, but do not rely on it, as it can be stowed or may not even be carried on the tank.

Trial 27: Leopard, OR

- ° Friendly, West German, Leopard Tank.
- ° In this picture we can see clearly the length of the main gun.
- ° Also, note the heavy gun mantle.
- ° The dark bar on the side of the turret is the smoke grenades.

Trial 28: Leopard, SL

- ° Friendly, West German, Leopard Tank.
- ° The main distinguishing feature is the square lines which characterize the whole tank (square grills, square end, and square turret lines).

Trial 29: Leopard, OL

- ° Friendly, West German, Leopard Tank.
- ° In this slide we can see the grill doors on the rear of the vehicle. There is also a grill on the other side of the vehicle.
- ° Note the scalloped skirting, rather compact body shape, with a lot of roadwheels showing.
- ° Also, note what appears to be a very sharp angle at the front of the turret.
- ° Note the very thick section between the bottom of the turret and the visible portion of the roadwheels.

Trial 30: Leopard, F

- ° Friendly, West German, Leopard Tank.
- ° High, narrow box shape.
- ° Distinctive sharp side slopes on the turret.
- ° Note how well the searchlight blends in with the turret in this view.

Trial 31: Chieftain, SR

- ° Friendly, British, Chieftain Tank.
- ° Four major characteristics stand out in this view:
 1. The extreme long, low length of the tank.
 2. The large, low, flat turret.

3. The very long thick gun tube; it's a 120mm gun.

4. The standardized shape of British armored skirts covering the suspension system. The skirts cover a large area and come down close to the ground and have the gradual upward slope in the rear.

Trial 32: Chieftain, OR

- ° Friendly, British, Chieftain Tank.
- ° The many angled low, flat turret is different than any other tank.
- ° The thickness of the gun tube is due to a thermal wrapping which helps to avoid gun tube droop during firing or hot weather.
- ° The latest model of this tank, built for the Iranians, is considered one of the best tanks in the world.

Trial 33: Chieftain, SL

- ° Friendly, British, Chieftain Tank.
- ° Four major characteristics stand out in this view:
 1. The extreme long, low length of the tank.
 2. The large, low, flat turret.
 3. The very long, thick gun tube.
 4. The standardized shape of British armored skirts covering the suspension system. The skirts cover a large area and come down close to the ground and have the gradual upward slope in the rear.

Trial 34: Chieftain, OL

- ° Friendly, British, Chieftain Tank.
- ° The thing that stands out in my mind is the large size of the vehicle as compared with other vehicles.
- ° This tank appeared in the early 1960s.
- ° Iran has ordered approximately 1,950 of these tanks.

Trial 35: Chieftain, F

- ° Friendly, British, Chieftain Tank.
- ° A very difficult view.
- ° The low, oval turret and low hull appearance from the front are features to look for.

° The low and overall large appearance as compared to other vehicles from the front view may also aid you.

APPENDIX E

Narrative used for each view of each vehicle for the Prototype program on blocks of trials when knowledge of results was provided

1. T55, Soviet, Foe, Flank

The three main things that let you know this is a Soviet T55 are the rounded, dome-shaped turret that is centered on the hull, the space between the first and second roadwheels, and the droopy track due to not having support rollers.

2. T55, Soviet, Foe, Front

Here is a front view of a Soviet T55. Notice the rounded turret and notice that the turret is not as wide as the hull.

3. T55, Soviet, Foe, Oblique

Here is another T55 model. Note the rounded turret, the gap between the first and second roadwheels, the large roadwheels, and the droopy track. Notice that the turret sets in from the sides of the hull. These tanks are very small, and stand 3' shorter than our M60A1s.

4. T62, Soviet, Foe, Flank

Note the dome-shaped turret, centered on the hull. The T62, like the T54/T55 has no support rollers and a droopy track. The roadwheels are large, but instead of the single space between the first and second wheels as the T54/T55 have, the T62 has two spaces between the last three roadwheels.

5. T62, Soviet, Foe, Front

From the front, the main way to tell a T62 is by the rounded turret. Notice that the turret is not nearly as wide as the hull.

6. T62, Soviet, Foe, Oblique

From this angle, the rounded turret shows up well, but it's hard to see the spaces between the roadwheels. You can see that the roadwheels are large, though.

7. T72, Soviet, Foe, Flank

The T72 has a rounded turret like earlier Soviet tanks, but the turret is far back on the hull. It has support rollers so the tracks don't droop, unlike earlier Soviet tanks, and has smaller road wheels than earlier threat tanks.

8. T72, Soviet, Foe, Front

From the front you can see the rounded turret, set in from the sides of the hull. Sometimes you may be able to see the V-shaped piece of metal on the front slope.

9. T72, Soviet, Foe, Oblique

Note how far back the rounded turret sits on the hull. If you get close, you can see the bore evacuator midway down the gun tube, but then you're too close.

10. AMX 30, French, Friendly, Flank

This is the French AMX30. It looks very much like a T72, but has several things that are clearly different from threat tanks. First, the gun mantle of the AMX30 is extremely large (point out). The turret, although rounded, has a rear overhang and is well forward on the hull, rather than centered like those of threat tanks. One easily recognizable thing about the AMX30 are the large mufflers on the upper rear part of the hull.

11. AMX 30, French, Friendly, Front

Here is a front view of the AMX30. Note the rounded, wide, low, turret. Also note the extremely wide gun mantle (point out). The sides of the AMX30 hull slant in toward the turret. This is not like any threat tank, whose sides are all straight to the top of the hull.

12. AMX 30, French, Friendly, Oblique

Note the large gun mantle, the flat, dish-shaped turret, and the large muffler on the rear part of the hull.

13. M60A1, US, Friendly, Flank

Note the large turret, the commander's cupola, the high rear deck, and note that the M60A1 has support rollers. Perhaps the most identifiable thing about the M60A1 at long range is its height and its very large turret.

14. M60A1, US, Friendly, Front

The commander's cupola, the large squared turret, and large gun mantle indicate that this is an M60A1 from the front.

15. M60A1, US, Friendly, Oblique

Again, note the large turret and its shape. Note the high profile of the M60A1. We have the tallest main battle tank in the world. Especially note the height from the top of the road wheels to the top of the track.

16. Leopard, German, Friendly, Flank

Note the large gun mantle, the large squared turret, the wavy fender skirts, and the exhaust grill at the rear of the hull.

17. Leopard, German, Friendly, Front

The frontal view of a Leopard shows the squared turret, the large gun mantle, and sides that slope into the turret.

18. Leopard, German, Friendly, Oblique

You can clearly see the turret shape and exhaust louvres or grills on this model.

19. Chieftain, British, Friendly, Flank

Note the long, low turret, with the funny-shaped rear overhang. The turret has large sponson boxes on both sides, that can be seen for a long distance. The Chieftain also has fender skirts. These skirts go nearly to the ground at the front of the tank and raise up slightly in the back.

20. Chieftain, British, Friendly, Front

Here is a front view of a Chieftain. Note the squared turret and the large sponson boxes that look almost like ears. They nearly go out to the sides of the hull.

21. Chieftain, British, Friendly, Oblique

Can you see the shape of the rear overhang and the large sponson box on the side of the turret? Also note the low, straight fender skirts.

APPENDIX F

Ordering of slide presentation and narrative for blocks with knowledge of results for the Standard program

Trial 1: M60A1, F

- ° Friendly, American, M60A1 Tank.
- ° Reminiscent of a Soviet vehicle from the front.
- ° The newer model will feature a low profile commander's cupola.

Trial 2: T54/55, OL

- ° Threat, Soviet, T54/55 Tank.
- ° Small, well-rounded turret.
- ° Note large front gap between first two roadwheels.

Trial 3: Leopard, OR

- ° Friendly, West German, Leopard Tank.
- ° Mounts a 105mm gun.
- ° It has a 7.62mm that can be mounted either on the commander or loader hatches.

Trial 4: T-72, SL

- ° Threat, Soviet, T-72 Tank.
- ° Note that the turret is slightly tapered toward the front.
- ° It is believed that this vehicle employs the first Soviet stereoscopic rangefinder.

Trial 5: M60A1, SR

- ° Friendly, American, M60A1 Tank.
- ° Note especially the large gap from the top of the roadwheels to the top of the track.

Trial 6: T-62, OL

- ° Threat, Soviet, T-62 Tank.
- ° It has four crewmembers.
- ° Note the line running across the front slope.

Trial 7: T-54/55, OR

- ° Threat, Soviet, T54/55 Tank.

° This vehicle weighs only 35.9 tons, as compared to 50 tons for the M60A1 and Chieftain.

Trial 8: Chieftain, F

- ° Friendly, British, Chieftain Tank.
- ° Considered to be one of the best tanks in the world.
- ° Look carefully at the turret lines.

Trial 9: T-72, F

- ° Threat, Soviet, T-72 Tank.
- ° The turret is equally rounded and sets in a little on both sides from the edge of the tank.
- ° Two large spare fuel drums can be carried across the back of the tank. This is also characteristic of Soviet vehicles.

Trial 10: M60A1, OL

- ° Friendly, American, M60A1 Tank.
- ° This vehicle is currently being improved. Will be called the M60A3.
- ° Note the large turret.

Trial 11: AMX-30, OR

- ° Friendly, French, AMX-30, Light Tank.
- ° This slide shows very clearly the external muffler located conspicuously at the rear of the AMX-30. There's another one on the other side in the same location. Use these to help you, but don't rely on using them at longer ranges. They wash out.
- ° We have the low, beetle-like turret. Notice how the armor slopes all around the turret.
- ° It is the lightest (36 tons) main battle tank mounting a 105mm gun.

Trial 12: Leopard, SR

- ° Friendly, West German, Leopard Tank.
- ° It has 7 roadwheels.

Trial 13: Chieftain, OL

- ° Friendly, British, Chieftain Tank.

- ° Can fire high-explosive ammunition out to 8000 meters. That's a lot of meters.

Trial 14: AMX-30, SR

- ° Friendly, French, AMX-30, Light Tank.
- ° Later production models will mount a 20mm coaxial weapon.
- ° I think of a beetle when I see this tank.

Trial 15: M60A1, OR

- ° Friendly, American, M60A1 Tank.
- ° Newer model will have flexible side skirts and a loader's machinegun on the hatch.
- ° The turret is its distinctive feature.

Trial 16: T-62, SL

- ° Threat, Soviet, T-62 Tank.
- ° Note that the turret is slightly tapered toward the front.
- ° It is believed that this vehicle employs the first Soviet stereoscopic rangefinder.
- ° The larger spacing is between the 3rd and 4th and 4th and 5th roadwheels. The first three roadwheels are much closer together.

Trial 17: Chieftain, OR

- ° Friendly, British, Chieftain Tank.
- ° The gun is stabilized in azimuth and elevation to permit firing on the move.
- ° Note the many angled turret design.

Trial 18: Leopard, OL

- ° Friendly, West German, Leopard Tank.
- ° The turret sets slightly forward on the tank and has sharply angled armor.

Trial 19: T-72, OL

- ° Threat, Soviet, T-72 Tank.

° The T-72 mounts a toothed-shovel/dozer blade in front. This enables it to dig itself in, in a few minutes.

° It also mounts two large, square bustle boxes on each side at the rear of the turret. This slide does not show them. They make the vehicle much easier to identify.

Trial 20: AMX-30, OL

° Friendly, French, AMX-30, Light Tank.

° One thing which does differentiate this vehicle from Soviet vehicles is its much higher silhouette and the non-Soviet type suspension system.

Trial 21: M60A1, SL

° Friendly, American, M60A1 Tank.

° Newer model will incorporate a commander's low profile hatch.

Trial 22: Chieftain, SL

° Friendly, British, Chieftain Tank.

° Its gun is exceptionally accurate and hard hitting.

° Note how long it looks from the side.

Trial 23: T-62, OR

° Threat, Soviet, T-62 Tank.

° Came out in 1961.

° Diesel powered.

Trial 24: Leopard, F

° Friendly, West German, Leopard Tank.

° The sharp cut sides of the turret front and high prow lines may help you in identifying this vehicle.

Trial 25: T-72, OR

° Threat, Soviet, T-72 Tank.

° The diesel engine is smooth running and free of the smoke signature you usually get with a diesel.

° The commander and gunner hatches are forward hinged, so they offer ballistic protection in the open position.

Trial 26: T54/55, F

- ° Threat, Soviet, T54/55 Tank.
- ° This is its most difficult view.
- ° It's used by 25 other countries besides the Warsaw Pact armies.

Trial 27: Chieftain, SR

- ° Friendly, British, Chieftain Tank.
- ° The skirts and unusual turret configuration make this vehicle stand out; particularly in the side view.
- ° Note its long length and low skirting.
- ° The thing that should stand out in your mind is the apparent large size of the vehicle as compared to other vehicles.
- ° The gun can hit armored targets out to 3000 meters with great accuracy.

Trial 28: T-62, F

- ° Threat, Soviet, T-62 Tank.
- ° Presents a very low profile in the front view.

Trial 29: T54/55, SL

- ° Threat, Soviet, T54/55 Tank.
- ° It's very cramped inside.
- ° The T54 has a 12.7 AA weapon; the T55 doesn't.

Trial 30: T-62, SR

- ° Threat, Soviet, T-62 Tank.
- ° Cup-shaped, centered turret is characteristic of Soviet tanks.
- ° Has 5 roadwheels in a Christie-type suspension.

Trial 31: AMX-30, F

- ° Friendly, French, AMX-30, Light Tank.
- ° It has 2 major features that may help you:

1. The very low, oval-shaped turret; the turret lines are smooth and unbroken.

2. The fairly large, flat frontal area leading up to the turret.

Trial 32: T-72, SR

° Threat, Soviet, T-72 Tank.

° It has a 3-man crew and an auto-loader.

° It employs light armor plate skirts on the front half of each side. They stick out at a 60° angle when not tied back.

° Remember where the turret is placed and the long gun tube.

Trial 33: T54/55, SR

° Threat, Soviet, T54/55 Tank.

° Centered, rounded turret and low silhouette, plus suspension, lets you know it's Soviet.

Trial 34: AMX-30, SL

° Friendly, French, AMX-30, Light Tank.

° Look at the distinctive low, oval turret.

° The muffler on the rear of the vehicle can aid in identification.

° Note how the turret armor slopes and meets the deck lines, giving it a very sloped look.

° The gun tube has no bore evacuator or muzzle brake, and the gun tube is very thick.

° Its oblique angles provide it good ballistic protection.

° Its gun is effective out to 3000 meters, using an antitank round.

Trial 35: Leopard, SL

° Friendly, West German, Leopard Tank.

° Scalloped skirts and square grills on the back.

Trial 1: M60A1, OL

- ° Friendly, American, M60A1 Tank.
- ° This vehicle is currently being improved. Will be called the M60A3.
- ° Note the large turret.

Trial 2: Leopard, SL

- ° Friendly, West German, Leopard Tank.
- ° Scalloped skirts and square grills on the back.

Trial 3: AMX-30, F

- ° Friendly, French, AMX-30, Light Tank.
- ° It has 2 major features that may help you:
 1. The very low, oval-shaped turret; the turret lines are smooth and unbroken.
 2. The fairly large, flat frontal area leading up to the turret.

Trial 4: M60A1, OR

- ° Friendly, American, M60A1 Tank.
- ° Newer model will have flexible side skirts and a loader's machinegun on the hatch.
- ° The turret and high hull are distinctive features.

Trial 5: Chieftain, SR

- ° Friendly, British, Chieftain Tank.
- ° The skirts and unusual turret configuration make this vehicle stand out, particularly in the side view.
- ° Note its long length and low skirting.
- ° The thing that should stand out in your mind is the large apparent size of the vehicle as compared to other vehicles.

Trial 6: Leopard, OR

- ° Friendly, West German, Leopard Tank.
- ° Mounts a 105mm gun.
- ° It has a 7.62mm that can be mounted either on the commander or loader's hatch.

Trial 7: T-72, SL

- ° Threat, Soviet, T-72 Tank.

- ° The fording snorkel can be seen on the side of the turret. Don't rely on this cue as almost all fording equipment is portable and not built into the vehicle. In some pictures it has been seen carried on the back deck.

- ° The deck and track line makes this vehicle stand out from other Soviet tanks. The track uses support rollers like our tanks.

- ° Note that the turret is slightly tapered toward the front.

Trial 8: T54/55, OR

- ° Threat, Soviet, T54/55 Tank.

- ° This vehicle weighs only 35.9 tons, as compared to 50 tons for the M60A1 and Chieftain.

Trial 9: M60A1, F

- ° Friendly, American, M60A1 Tank.

- ° Reminiscent of a Soviet vehicle from the front.

- ° The new model will feature a low profile commander's cupola.

Trial 10: T-62, OR

- ° Threat, Soviet, T-62 Tank.

- ° Came out in 1961.

- ° Diesel powered.

Trial 11: Leopard, OL

- ° Friendly, West German, Leopard Tank.

- ° The turret sets slightly forward on the tank and has sharply angled armor.

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- ° Threat, Soviet, T-62 Tank.

- ° Presents a very low profile in the front view.

Trial 13: T54/55, OL

- ° Threat, Soviet, T54/55 Tank.

- ° Small, well-rounded turret.
- ° Note large front gap between first 2 roadwheels.

Trial 14: Chieftain, F

- ° Friendly, British, Chieftain Tank.
- ° Considered to be one of the best tanks in the world.
- ° Look carefully at the turret lines.

Trial 15: T54/55, F

- ° Threat, Soviet, T54/55 Tank.
- ° This is its most difficult view.
- ° It's used by 25 countries besides the Warsaw Pact armies.

Trial 16: AMX-30, SL

- ° Friendly, French, AMX-30, Light Tank.
- ° Note how the turret armor slopes and meets the deck lines, giving it a very sloped look.
- ° Its oblique angles provide it good ballistic protection.
- ° Its gun is effective out to 3000 meters, using an antitank round.

Trial 17: T54/55, SL

- ° Threat, Soviet, T54/55 Tank.
- ° It's very cramped inside. The T54 has a 12.7 AA weapon, the T55 does not.

Trial 18: M60A1, SR

- ° Friendly, American, M60A1 Tank.
- ° Note especially the large gap from the top of the roadwheels to the top of the track.

Trial 19: Leopard, F

- ° Friendly, West German, Leopard Tank.
- ° The sharp cut side of the turret front and high prow line may help you in identifying this vehicle.

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- ° Threat, Soviet, T-62 Tank.

- ° There is larger spacing between the 3rd and 4th and 4th and 5th roadwheels. The first three roadwheels are much closer together.

Trial 21: T-72, OR

- ° Threat, Soviet, T-72 Tank.

- ° The diesel engine is smooth running and free of the smoke signature you'd usually get with a diesel.

Trial 22: T-72, F

- ° Threat, Soviet, T-72 Tank.

- ° The turret is equally rounded and sets in a little on both sides from the edge of the tank.

Trial 23: Chieftain, OR

- ° Friendly, British, Chieftain Tank.

- ° The gun is stabilized in azimuth and elevation to permit firing on the move.

- ° Note the many angled turret design and large, low hull.

Trial 24: T-62, OL

- ° Threat, Soviet, T-62 Tank.

- ° It has 4 crew members.

- ° Note the line running across the front slope.

Trial 25: AMX-30, SR

- ° Friendly, French, AMX-30, Light Tank.

- ° Later production model will mount a 20mm coaxial weapon.

- ° I think of a beetle when I see this tank.

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- ° Friendly, British, Chieftain Tank.

- ° Its gun is exceptionally accurate and hard hitting.

- ° Note how long it looks from the side.

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- ° Threat, Soviet, T-72 Tank.
- ° It has a 3-man crew and an auto-loader.
- ° It employs light armor plate skirts on the front half of each side. They stick out at a 60° angle when not tied back.
- ° Remember where the turret is placed and the long gun tube.

Trial 28: AMX-30, OL

- ° Friendly, French, AMX-30, Light Tank.
- ° One thing which does differentiate this vehicle from Soviet vehicles is its much higher silhouette and the non-Soviet type suspension system.

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- ° Friendly, West German, Leopard Tank.
- ° It has 7 roadwheels.

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- ° Threat, Soviet, T54/55 Tank.
- ° Centered, rounded turret and low silhouette, plus suspension, lets you know it's Soviet.

Trial 31: T-72, OL

- ° Threat, Soviet, T-72 Tank.
- ° The T-72 mounts a toothed-shovel/dozer blade in front. This enables it to dig itself in, in a few minutes.
- ° It also mounts two large, square bustle boxes on each side at the rear of the turret. This slide does not show them. They make the vehicle much easier to identify.

Trial 32: T-62, SR

- ° Threat, Soviet, T-62 Tank.
- ° Cup-shaped, centered turret is characteristic of Soviet tanks.
- ° Has 5 roadwheels in a Christie-type suspension.

Trial 33: Chieftain, OL

- ° Friendly, British, Chieftain Tank.
- ° Can fire high-explosive ammunition out to 8000 meters.

Trial 34: M60A1, SL

- Friendly, American, M60A1 Tank.
- The high suspension and large turret give this vehicle a very high profile.

Trial 35: AMX-30, OR

- Friendly, French, AMX-30, Light Tank.
- We have the low, beetle-like turret. Notice how the armor slopes all around the turret.
- Carries a crew of 4.

APPENDIX G

Analyses of variance on reported use of vehicle critical features

T54/55 FEATURES

Source	SS	DF	MS	F
Mean	117.540	1	117.540	-
Training Program (P)	.459	1	.459	<1
Error	43.771	35	1.251	-
Pretest-Posttest (Test)	5.881	1	5.881	9.49**
Test X P	.368	1	.368	<1
Error	21.700	35	.62	-
Feature Size(s)	18.930	1	18.930	29.11***
S X P	.011	1	.011	<1
Error	22.759	35	.650	-
Test X S	19.399	1	19.399	37.34***
Test X S X P	.588	1	.588	1.13
Error	18.182	35	.520	-

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

T62 FEATURES

Source	SS	DF	MS	F
Mean	127.003	1	127.003	-
Training Program (P)	2.138	1	2.138	1.94
Error	38.565	35	1.102	-
Pretest-Posttest (Test)	5.291	1	5.291	8.76**
Test X P	1.183	1	1.183	1.96
Error	21.141	35	.604	-
Feature Size (S)	20.032	1	20.032	32.35***
S X P	.140	1	.140	<1
Error	21.671	35	.619	-
Test X S	21.494	1	21.494	35.43***
Test X S X P	2.576	1	2.576	4.24*
Error	21.235	35	.607	-

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

T72 FEATURES

Source	SS	DF	MS	F
Mean	108.351	1	108.351	-
Training Program (P)	.919	1	.919	<1
Error	40.879	35	1.168	-
Pretest-Posttest (Test)	10.159	1	10.159	21.03***
Test X P	.835	1	.835	1.73
Error	16.908	35	.483	-
Feature Size (S)	13.265	1	13.265	17.71***
S X P	.211	1	.211	<1
Error	26.208	35	.749	-
Test X S	12.371	1	12.371	24.47***
Test X S X P	.885	1	.885	1.75
Error	17.696	35	.506	-

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

AM X 30 FEATURES

Source	SS	DF	MS	F
Mean	77.673	1	77.673	-
Training Program (P)	.187	1	.187	<1
Error	28.502	35	.814	-
Pretest-Posttest (Test)	9.821	1	9.821	39.61***
Test X P	.065	1	.065	<1
Error	8.679	35	.248	-
Feature Size (S)	42.071	1	42.071	70.13***
S X P	1.396	1	1.393	2.333
Error	20.996	35	.600	-
Test X S	10.794	1	10.794	17.43***
Test X S X P	.011	1	.011	<1
Error	21.679	35	.619	-

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

M60A1 FEATURES

Source	SS	DF	MS	F
Mean	485.557	1	485.557	-
Training Program (P)	4.260	1	4.260	2.23
Error	66.767	35	1.908	-
Pretest-Posttest (Test)	.835	1	.835	1.68
Test X P	.024	1	.024	<1
Error	17.408	35	.497	-
Feature Size (S)	2.365	1	2.365	1.47
S X P	5.068	1	5.068	3.16
Error	56.202	35	1.606	-
Test X S	48.300	1	48.300	49.14***
Test X S X P	.030	1	.030	<1
Error	34.402	35	.983	-

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

LEOPARD FEATURES

Source	SS	DF	MS	F
Mean	154.692	1	154.692	-
Training Program (P)	1.449	1	1.449	1.53
Error	33.132	35	.947	
Pretest-Posttest (Test)	1.837	1	1.837	3.28
Test X P	.215	1	.215	<1
Error	19.582	35	.560	-
Feature Size (S)	26.373	1	26.373	29.94***
S X P	.103	1	.103	<1
Error	30.829	35	.881	-
Test X S	23.611	1	23.611	22.26***
Test X S X P	.097	1	.097	<1
Error	37.132	35	1.061	-

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

CHIEFTAIN FEATURES

Source	SS	DF	MS	F
Mean	108.351	1	108.351	-
Training Program (P)	.919	1	.919	1.11
Error	28.879	35	.825	-
Pretest-Posttest (Test)	5.519	1	5.519	13.11***
Test X P	.465	1	.465	1.10
Error	14.738	35	.421	-
Feature Size (S)	65.321	1	65.321	73.33***
S X P	.429	1	.429	<1
Error	31.179	35	.891	-
Test X S	14.190	1	14.190	34.97***
Test X S X P	.001	1	.001	<1
Error	14.202	35	.406	-

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

APPENDIX H

OBSERVERS' ATTITUDES AND SUGGESTIONS

Observers' suggestions of how to improve training -- Question 8.

Standard Program

Suggestion	Frequency
Nothing needs to be done	9
Show it to more people	1
Spend more time on it	1
Compare tanks with one another	1
Make the tanks harder to spot	1
Provide more detail	1
Shorten training	1

Prototype Program

Suggestion	Frequency
Nothing Needs to be done	9
Need a bigger screen	1
Make the class longer	1
Go slower	1
Compare tanks with one another	1
Use 3-dimensional models	2

Number of individuals indicating that they would like to see more different pictures of tanks during training (Question 10).

	Standard	Prototype
Want to see more	11	13
Are enough already	1	2
Need to show more detail	0	2

Suggestions for making the pictures during training better (Question 11).

	Standard	Prototype
No way	6	6
Use clearer pictures	1	0
Use larger pictures	1	6
Use different backgrounds	1	0
Use real tanks	1	0
Use different ranges	1	0
Include more details	0	4

All observers always responded (both before and after training) that target identification training is very important (Question 12).

General Comments by Observers,
Which Do Not Fit In The Above Categories

	Standard	Prototype
Criticisms of models used	1	1
Class better than the one on Soviet Soldiers & Equipment		4
"A great class on target identification"		1
"Useful and thorough" training		1
Learned much from the class	1	
Outstanding training	1	
Thanks for the class	1	

APPENDIX I

UNWEIGHTED MEANS ANALYSIS OF VARIANCE-PRETEST SCORES

Source	SS	DF	MS	F
PROGRAM (P)	11.649	1	11.649	6.447 *
TRAINING RANGE (TRN RNG)	.090	1	.090	<1
P X TRN RNG	.632	1	.632	<1
ERROR _b	119.23	66	1.807	
TEST RANGE (TST RNG)	3.675	1	3.675	3.98
P X TST RNG	.090	1	.090	<1
TST RNG X TRN RNG	2.357	1	2.357	2.551
P X TST RNG X TRN RNG	1.824	1	1.824	1.974
ERROR W ₁	61.013	66	.924	
VIEW (V)	22.864	2	11.432	16.961 **
P X V	3.684	2	1.842	2.733
TRN RNG X V	1.122	2	.561	<1
P X TRN RNG X V	2.263	2	1.132	1.680
ERROR W ₂	88.905	132	.674	
TST RNG X V	7.206	2	3.603	28.824 **
P X TST RNG X V	.379	2	.190	1.52
TST RNG X TRN RNG X V	1.736	2	.868	6.944 **
P X TST RNG X TRN RNG X V	1.607	2	.804	6.43 **
ERROR W ₃	16.441	132	.125	

* p .05 ** p .01