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EVALUATION OF FOUR TARGET-IDENTIFICATION TRAINING TECHNIQUES.(U)

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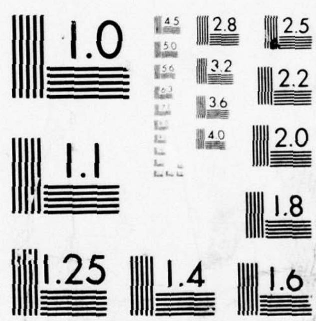

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Technical Paper 301

LEVEL II

EVALUATION OF FOUR TARGET-IDENTIFICATION TRAINING TECHNIQUES

John T. Cockrell
System Development Corporation

BATTLEFIELD INFORMATION SYSTEMS TECHNICAL AREA

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

August 1978

U. S. ARMY RESEARCH INSTITUTE

FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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

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As part of a research program seeking more efficient methods of training image interpreters in target identification, four alternative experimental instructional techniques were evaluated. Eight recently trained image interpreters used each method (N = 32). Two of the four methods used pictures instead of text, one in a random presentation and the other in a structured sequence of increasing difficulty. The third method used programed text to

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teach verbal identification cues, and the fourth combined programed text in the first half and the structured pictorial method in the last half of training. In each method, half the students received feedback of both the correct answer and the reason a wrong answer was wrong, and half received only the correct answer.

Students were evenly divided across all conditions by their general technical (GT) aptitude score: high (at or above 124) and low (below 124).

Posttests on visual target identification and verbal target cues evaluated the effectiveness of the methods and feedback conditions for each GT level.

Target identification performance was significantly poorer with the structured text method but about the same among the three methods using pictures. Recognition of target cues was significantly better when verbal instructions on target cues were given than when training was entirely pictorial. Type of feedback had no significant effect. Learning performance did not differ as a function of GT aptitude, but interpreters with lower aptitude forgot their training more rapidly.

Technical Paper 301

EVALUATION OF FOUR TARGET-IDENTIFICATION TRAINING TECHNIQUES

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BATTLEFIELD INFORMATION SYSTEMS TECHNICAL AREA

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Interpreter Techniques

ARI Research Reports and Technical Papers are intended for sponsors of R&D tasks and other research and military agencies. Any findings ready for implementation at the time of publication are presented in the latter part of the Brief. Upon completion of a major phase of the task, formal recommendations for official action normally are conveyed to appropriate military agencies by briefing or Disposition Form.

FOREWORD

The Battlefield Information Systems Technical Area is concerned with the demands of the future battlefield for increased man-machine complexity to acquire, transmit, process, disseminate, and utilize information. The research focuses on the interface problems and interactions within command and control centers and deals with such areas as topographic products and procedures, tactical symbology, information management, user-oriented systems, staff operations and procedures, and sensor systems integration and utilization.

One area of special interest is the extraction of information from surveillance displays and the efficient processing of this information within advanced automated image interpretation facilities. Research results are used in systems requirements determinations and in the development, evaluation, and application of doctrine, operating procedures, and system design concepts. The present publication is the second study in a series exploring instructional techniques for more efficient training of image interpreters in target identification. The first study, ARI Technical Paper 209, indicated the feasibility of computer-assisted instruction to maintain and improve interpreter skills, using existing computers within an automated image interpretation facility. The present study indicates that effective training in target identification can be provided with minimum instructor participation and relatively simple support, using operational imagery as the instructional material.

Research in the area of sensor systems integration and utilization is conducted as an in-house effort augmented by contracts with organizations selected as having unique capabilities and facilities for research on sensor systems. The present study was conducted by personnel from System Development Corporation under contract DAHC 19-67-C-0040 under the program direction of Abraham H. Birnbaum. The effort was responsive to requirements of Army Project 2Q662704A721 and to special requirements of the U.S. Army Intelligence Center and School, Fort Huachuca, Ariz., and the Assistant Chief of Staff for Intelligence.

JOSEPH ZEIDNER
Technical Director (Designate)

EVALUATION OF FOUR TARGET-IDENTIFICATION TRAINING TECHNIQUES

BRIEF

Requirement:

To develop a flexible instruction technique, using the equipment to be found within an advanced computer-based image interpretation facility, to train interpreters in visual discrimination of fine detail.

Procedure:

Alternative experimental training techniques for maintaining or improving image interpreter performance in an operational facility were evaluated across two types of target (tank and truck). For each type of target, one of four instructional methods was administered to 8 of 32 recent graduates of the U.S. Army Intelligence School. Two of the four methods used pictures instead of text, one in a random presentation and the other in a structured sequence of increasing difficulty. The third method used programed text to teach verbal identification cues, and the fourth combined programed text in the first half and the structured pictorial method in the last half of the training.

In each method, half the students received response-sensitive feedback, which gives both the correct answer and the reason a wrong answer is wrong, and half received response-insensitive feedback, which supplies only the correct answer.

Students were evenly divided across all conditions by their general technical (GT) aptitude score: high (at or above 124) and low (below 124).

Posttests on visual target identification and verbal target cues evaluated the effectiveness of the methods and feedback conditions for each GT level.

Findings:

Target identification performance was significantly poorer with the structured text method but about the same among the three methods using pictures. Recognition of target cues was significantly better when verbal instructions on target cues were given than when training was entirely pictorial. Type of feedback had no significant effect. Learning performance did not differ as a function of GT aptitude, but interpreters with lower aptitude forgot their training more rapidly.

Utilization of Findings:

Effective school or on-the-job training in target identification can be provided with a minimum of instructor participation and relatively simple support, using operational imagery as the basic instructional material. Immediate feedback on right or wrong answers is vital, but it need not be complex.

EVALUATION OF FOUR TARGET-IDENTIFICATION TRAINING TECHNIQUES

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EVALUATION OF FOUR TARGET-IDENTIFICATION TRAINING TECHNIQUES

BACKGROUND

Theoretical and Practical Aspects of Course Design

This is the second study in a series exploring instructional techniques for training image interpreters in target identification. A previous study (Root, Gallagher, & Sadacca, 1969), using computer-assisted instruction to teach interpreters to identify U.S. Army cargo trucks and tanks, employed two main variables: the method of presenting the instructional material (linear or branching format) and two types of interpreter feedback (response-sensitive and response-insensitive). The linear program presented the instructional material in a fixed order, whereas the branching program permitted the more able students to skip over material that was too easy. Response-sensitive feedback provided the students with information appropriate to the specific answer they had given; e.g., if they gave wrong answers, the feedback explained why the answers were wrong. Response-insensitive feedback provided only the correct answer.

The first study indicated that the branching program was superior to the linear program in that less time was required to train interpreters to a given level of proficiency; no significant differences between response-sensitive and response-insensitive feedback were shown. Overall results were promising and indicated that some form of programed instruction can be a very effective tool for upgrading the skill level of image interpreters. Nevertheless, many questions remain as to which instructional techniques are most effective. A very important consideration is determining the type of program that most effectively upgrades each type of skill.

In the first study, the identification, or discrimination, skill was taught by a fairly conventional method that relied on breaking each target type down into significant recognition features, which the students learn. Research evidence as to the effectiveness of this approach is not clear cut; however, some evidence suggests it is not necessary to verbalize the difference between two objects to make a discrimination (Gibson, 1969). Verbalization may be an artificial and unnecessary burden. For example, an interpreter may be able to identify an M60 tank or an M48 tank without being able to describe its characteristics fully.

Thus there is a basic theoretical, yet practical, question related to course design. In training for target identification, is verbalization of discriminating characteristics necessary, or does it inhibit learning? From a practical viewpoint, if it is not necessary to teach verbalization of discriminating cues or features of a target, instructional material can be developed with less cost and less careful preparation and structuring.

Program format and feedback type also influence the cost and time of developing instructional materials. Branching programs cost more than linear programs, and response-sensitive programs are harder to prepare than response-insensitive ones. Cost is also affected by the recurring need to revise a program each time new elements are added to or subtracted from the program. A readily modified program would provide substantial savings.

Perceptual Training

The research background for the experiment cuts across several major areas studied over the past 30 years. Leibowitz (1967) discusses much of the perceptual research relevant to image interpretation, relates it to interpreter training, and provides many suggestions for further research by his thorough analysis of the human visual system and image interpretation. His proposed perceptual teaching method is the most interesting suggestion for the present experiment. His analysis of perceptual learning, relying mostly on the work of Gibson (1969), suggests several possible ways in which an expert image interpreter learns to separate relevant from irrelevant cues when viewing a complex photograph. Two of the most appropriate of these are (a) increase in specificity and (b) discovery of distinctive features.

Gibson and Gibson (1953) illustrated "increase in specificity" by a nonsense figure or "scribble." Subjects were shown a standard figure and then asked to identify that figure when presented with a group of figures that included several similar scribbles. Increases in the number of trials produced an increase in specificity of recognition of the standard figure, as shown by a decrease in the number of drawings which elicited the response of "same."

These subjects (Gibson & Gibson, 1953) faced a task similar to that of the interpreter in attempting to differentiate various types of targets. One may detect an object as a shapeless spot, recognize it as a ship, classify it as a passenger liner, or identify it as the Queen Mary. The role of verbalization is particularly relevant to the present experiment. As they went through the runs, the Gibson subjects made more and more <u>spontaneous</u> verbalizations describing the differences among the scribbles. The subjects were never taught the verbalizations, and some subjects could make the desired discriminations without being able to put verbal "tags" on the stimuli to describe the differences among them. The investigators concluded that verbalizations were not the cause of the increase in specificity, but merely correlated with it--that verbalization becomes possible as one discovers new dimensions of difference among stimuli.

Thus, verbalizations may not be necessary concomitants of skilled perceptual acts. This is not to imply that the image interpreter's verbalizations are not meaningful, but rather that they should be considered of limited importance because they do not necessarily reveal the complete or the correct basis for discriminations. In considering perceptual learning, it is helpful to consider verbal statements regarding perceptual acts as only crude representations of the breadth and variety of cues and factors involved in perception.

A second point regarding perceptual learning is that critical identifications are based on the distinctive features of targets. Gibson (1969) points out that a single variable or property rarely determines the uniqueness of an object. Rather, it is a set of physical characteristics that permits the final and critical identification. Perceptual learning in such instances may involve the interaction of more cues than the individual can consciously identify.

Drawing from E. J. Gibson's research, Leibowitz (1967) contended that the present military methods of perceptual training may suffer from a number of deficiencies: heavy emphasis on verbal concomitants, failure to exploit the critical role of frequency of exposure, and no attempt to gradually teach recognition of distinctive features. Leibowitz proposed, instead, a perceptual training method that would take advantage of programed instruction technology. In this method, a large series of images would be presented; the student would then discriminate among them and be immediately informed of the correctness of his choice. Each image would emphasize different distinctive features, and cues to the correct answer would be gradually faded as the student demonstrated progress.

This procedure incorporates a number of principles. The material is not taught at a verbal level; instead, students discover for themselves the features that provide consistency of response. Feedback is informative; it helps the students determine from the complex of stimuli those that are more consistent with the task of identifying a certain type of target. Student attention is drawn to finer and finer features corresponding to the critical details used by the skilled interpreter. Perceptual learning is accomplished by perceiving, not by talking.

In image interpretation, it is important that interpreters learn to identify targets based on a wide range of distinctive cues, because targets frequently are blurred or partially hidden by trees or shadows. Interpreters must also view targets at various scales, orientations, and attitudes, and in different configurations. Therefore, it is necessary to determine the best method for learning the wide range of distinctive cues associated with each target.

Leibowitz argues that verbal learning of visual discriminations is undesirable, indeed unnatural. Verbalization comes after discrimination, not before, and generally only partially covers the basis for the discrimination. Perhaps the greatest problem in learning verbal cues is the difficulty of finding descriptive words. A cursory inspection of dichotomous keys often used as interpreter aids in image interpretation reveals that target features are imperfectly described; trying to relate such features as actually seen on the imagery to the verbal descriptions can be very frustrating. Whole paragraphs would be needed to completely describe features such as the shape of a turret. It is hardly reasonable to expect interpreters to memorize paragraphs.

Leibowitz suggests that a better method for perceptual learning might be to require the interpreter to make visual discriminations and to present the targets in a way that uses all possible combinations of distinctive features. Starting with the easiest discriminations and gradually working down to fewer and fewer cues should permit teaching the interpreter to identify any target from the minimum number of distinctive cues.

OBJECTIVE

The primary purpose of the present study was to develop and evaluate an instructional technique for training image interpreters in target identification that would

1. Be easy to develop,

2. Require only materials that an operational unit would have readily available,

3. Require little effort for updating or revision,

4. Be flexible in terms of amount of training that could be provided, ranging from a few minutes to a few hours, and

5. Allow free choice by the student as to material to be covered.

Such a flexible and simple program might of necessity omit certain conventional features generally deemed desirable. Hence material designed to teach certain points would not be included, material would not be ordered according to difficulty, and special material for feedback purposes and the teaching of verbal cues would be omitted.

To demonstrate the potentialities of the simplified technique described above, three other instructional programs were constructed. These programs included certain tenets of programed instruction and were basically designed to evaluate the need for verbalization in the discrimination of objects.

Secondary objectives included evaluation of the relative effectiveness of two competing feedback formats--response-sensitive and response-insensitive--and of the importance of the trainee's general technical (GT) aptitude score as an indicator of his ability to learn to identify targets.

METHOD

Instructional Method

Research on programed instruction has been extensive but has produced conflicting findings. However, certain concepts, when appropriately applied, have proved beneficial to learning. Feedback, or knowledge of results, has been shown to enhance learning (e.g., Stolurow, 1968) and has been incorporated into all four training methods. Other research has indicated that such conditions as low error rate during learning, structured increase in the difficulty of course material, overt response, and prompting may benefit learning, depending on the specific application. These factors were considered potentially valuable for visual discrimination training and were used in various combinations in the three comparison training methods.

The four methods studied in this experiment are the unstructured pictorial method, the structured textual method, the structured pictorial method, and the structured method (mixed).

Unstructured Pictorial Method. In the general case, this method entails a data bank of instructional materials and a means for presenting these materials to the student. The presentation means could be a computer-controlled display, a teaching machine, a manually operated slide projector controlled by the student or an instructor or, simply, the scanning of hard-copy photographs. The essential features are that the instructional materials do not require elaborate preparation and can be presented in any order from random to fixed, while new materials can be added or deleted without affecting operation of the program. In the field, operational imagery could serve as the instructional material. Targets, positively identified by experienced interpreters, could be annotated on selected frames of imagery, indexed, and stored in an imagery data bank. For each target, feedback information would need to be developed and stored, with additional feedback in the form of keys available in all units to be used as part of training. This is the instructional technique described by the objective of the study.

For this experiment, target slides with no identifications and with approximately nine targets to a slide were prepared, together with key slides showing each vehicle at four different scales. All vehicles on key slides were identified on the slide.

After instructions were read to the student, the key slides were presented one by one to familiarize the student with the target types. Target slides were then presented one at a time in a random order, and the student was directed to identify a specified target on each slide. After each response, feedback was presented as follows:

1. For the response-sensitive condition, feedback for wrong answers consisted of showing the student the correct key slide, followed

in a few seconds by the key slide for his incorrect target. For correct answers, feedback involved only the correct-answer key slide. (Later in the course, feedback for a correct answer was omitted when the correct answer was given without hesitation.)

2. For the response-insensitive condition, the correct-answer key slide was shown for both correct and incorrect answers; the incorrect-choice slide was never shown. (Later in the course, feedback for a correct answer was omitted when the correct answer was given without hesitation.)

3. Under all conditions, appropriate verbal comments were made after each response; e.g., for the response-sensitive condition, the comment might have been "Wrong, the truck is the M37. Slide 23 shows your incorrect choice, the M38 truck. Notice the difference between these two trucks."

The second half of the course followed the same procedure as the first half but employed a different set of slides to reduce student tendency to memorize backgrounds rather than targets.

<u>Structured Textual Method</u>. This method, consisting of verbal questions and multiple-choice answers, was similar to the usual programed instruction courses. The objective was to teach interpreters to memorize and to verbalize the cues associated with each tank and truck by choosing the correct multiple-choice answer. Cues can be divided into three categories:

1. Cues considered essential to identification. These cues received the most stress (see Figures 1 and 2).

2. Unique cues that can partially or completely identify a target. These cues received intermediate stress.

3. Cues not unique to a single target or small category of targets but which can distinguish among larger categories of targets. Such cues received only minor stress.

This version of the course was designed to teach only the cues to identification; at no time were subjects required to identify the targets directly. Response-sensitive and response-insensitive feedback for a correct answer was given by presenting the correct answer (sometimes verbally and sometimes both verbally and on a slide). However, for an incorrect answer, response-sensitive feedback presented the correct answer as well as an explanatory comment and a specially constructed feedback slide specific to the particular incorrect answer.

The course began with a slide showing all trucks or tanks to be learned, followed by a slide of a schematic drawing of a tank or truck

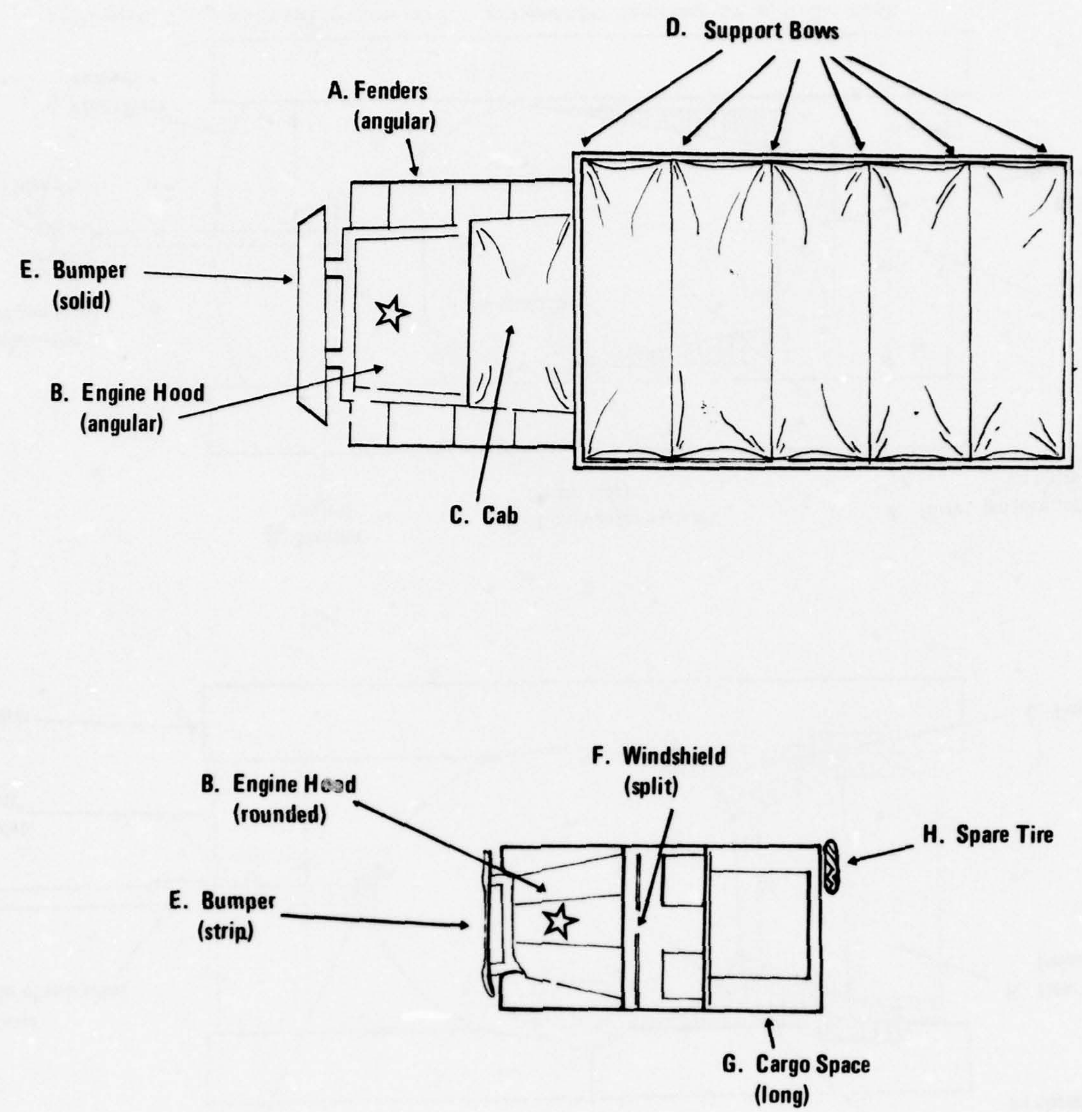

Figure 1. Discrimination aid: schematic drawing of a U.S. cargo truck.

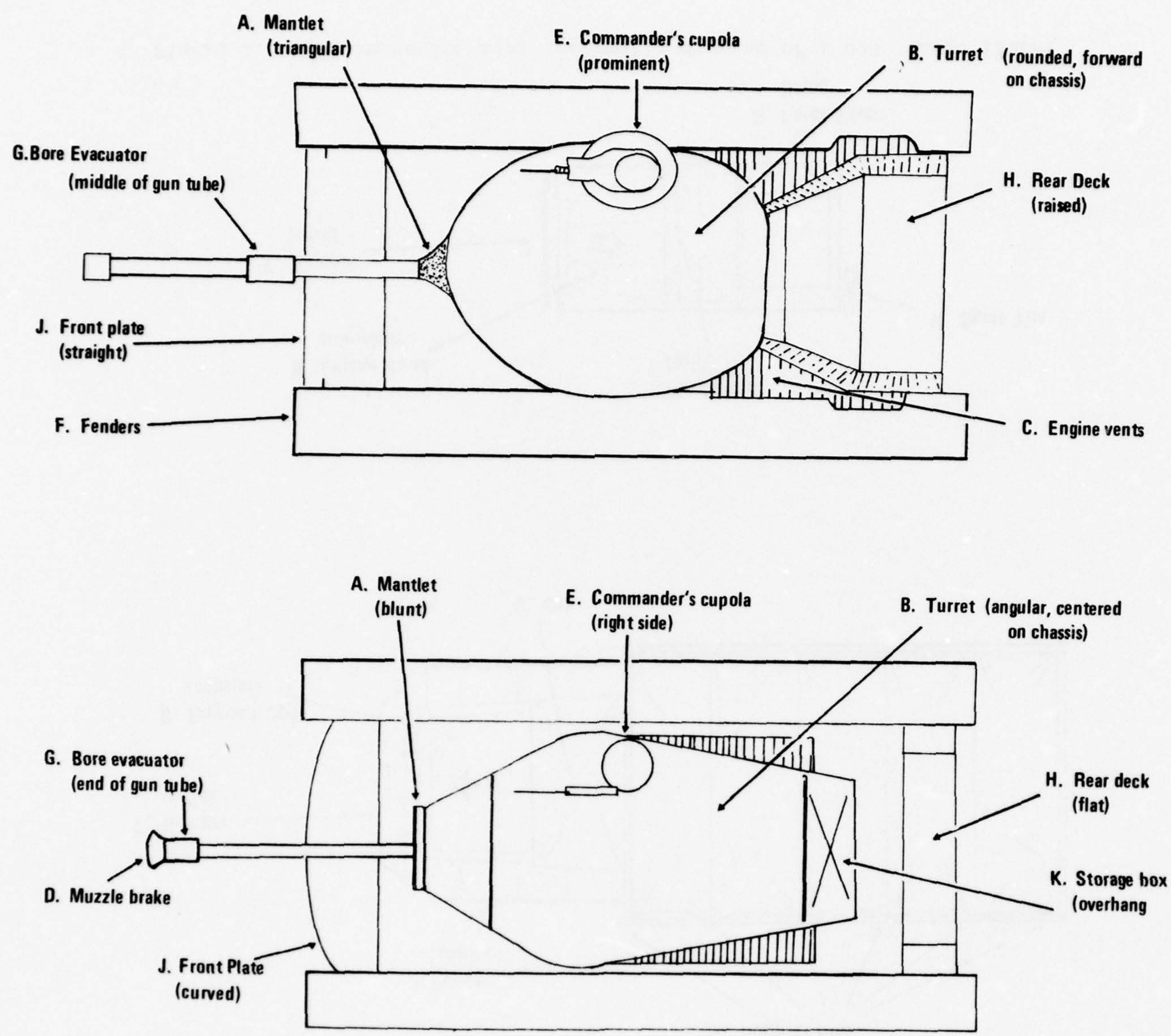

Figure 2. Discrimination aid: schematic drawing of a U.S. tank.

(Figures 1 and 2) and a series of questions on labeled recognition features. Next came a short series of questions on the dichotomous breakdowns shown in Figures 3 and 4, followed by a long series of questions on specific cues (i.e., recognition features). At first, the student could easily determine the correct answer merely by looking at the target image which was projected on the screen. For example, "What is the shape of the fenders on the M35 truck shown on the screen?" Later the target image was omitted for similar questions, and the student had to answer from memory. All questions were repeated until the student gave the correct answer readily.

During the latter part of the course, target objects on prompting slides became progressively more difficult to see because of degree of concealment, lighting angle, etc., and therefore were less and less helpful in answering questions. This procedure insured that the students trained by this method and by the other methods used slides of the same difficulty. For this method, both training and key slides had the identification printed just beneath the picture of each vehicle.

Structured Pictorial Method. This method was essentially the same as the unstructured pictorial method except that it included the specially constructed training and feedback slides (described under structured textual method) and an enforced low error rate. To maintain a low error rate, the data bank was structured into difficulty levels, and slides were presented in sets of slowly increasing difficulty, from the easiest to the hardest. All slides in each set had to be learned and readily identified before the next set started.

Feedback was essentially the same as that for the unstructured pictorial method except that response-sensitive feedback for each incorrect answer used special key slides that showed a photograph of the correct target and the incorrect one side-by-side for quick comparison. For the unstructured pictorial method, this comparison was shown with two slides in succession.

Structured Method (Mixed). This method was identical to the structured textual method for the first half of the instructional period. During the second half of each course, students identified target examples as they did in the structured pictorial method. In the second half, identification difficulty started at an intermediate level and progressed by greater increments than under the structured pictorial method, to insure that students were exposed to targets just as difficult as in the other methods.

Experimental Design

A factorial design was used to provide an empirical evaluation of (a) the four training methods, (b) feedback type (response-sensitive

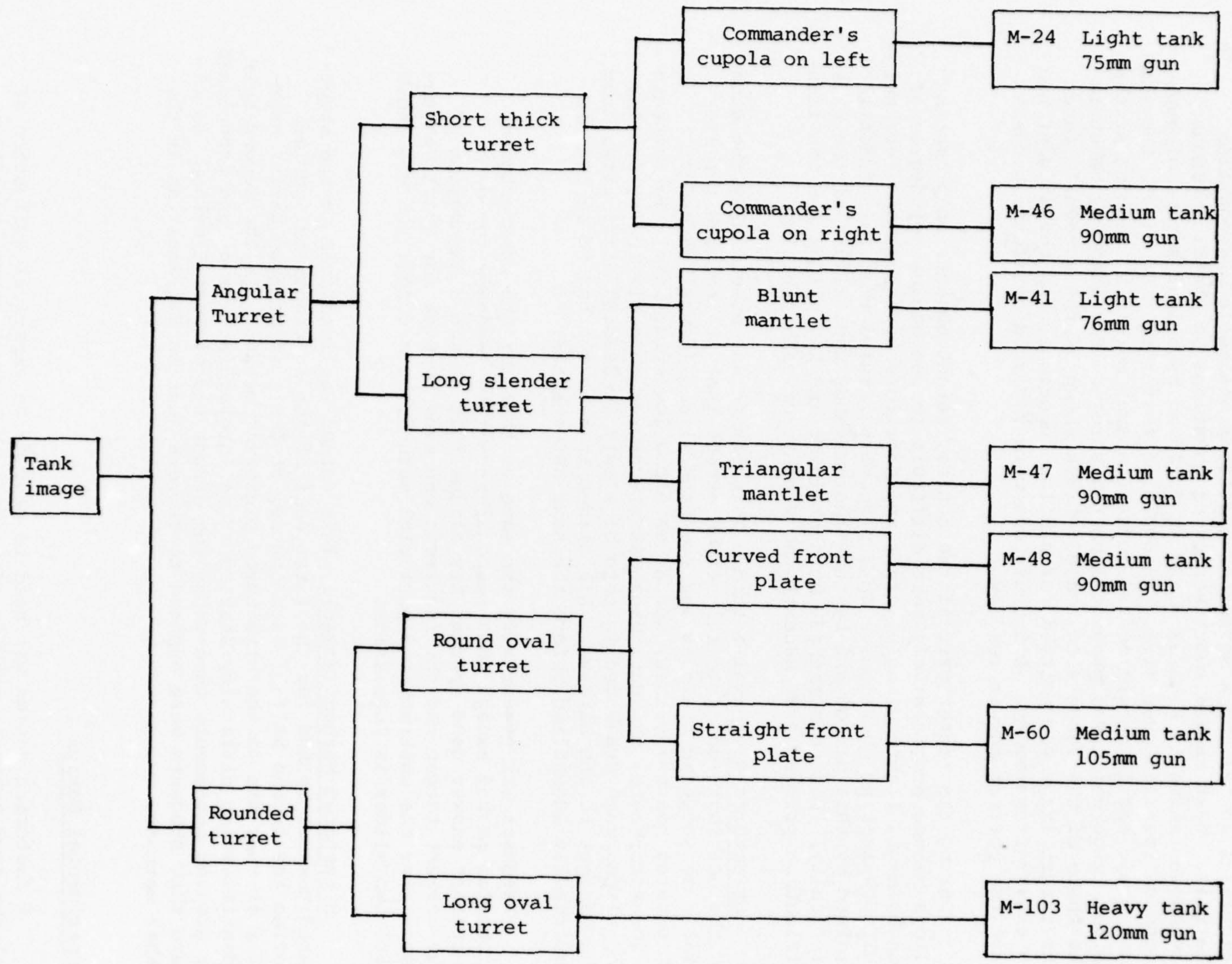

Figure 3. Discrimination aid: recognition features for a set of U.S. tanks.

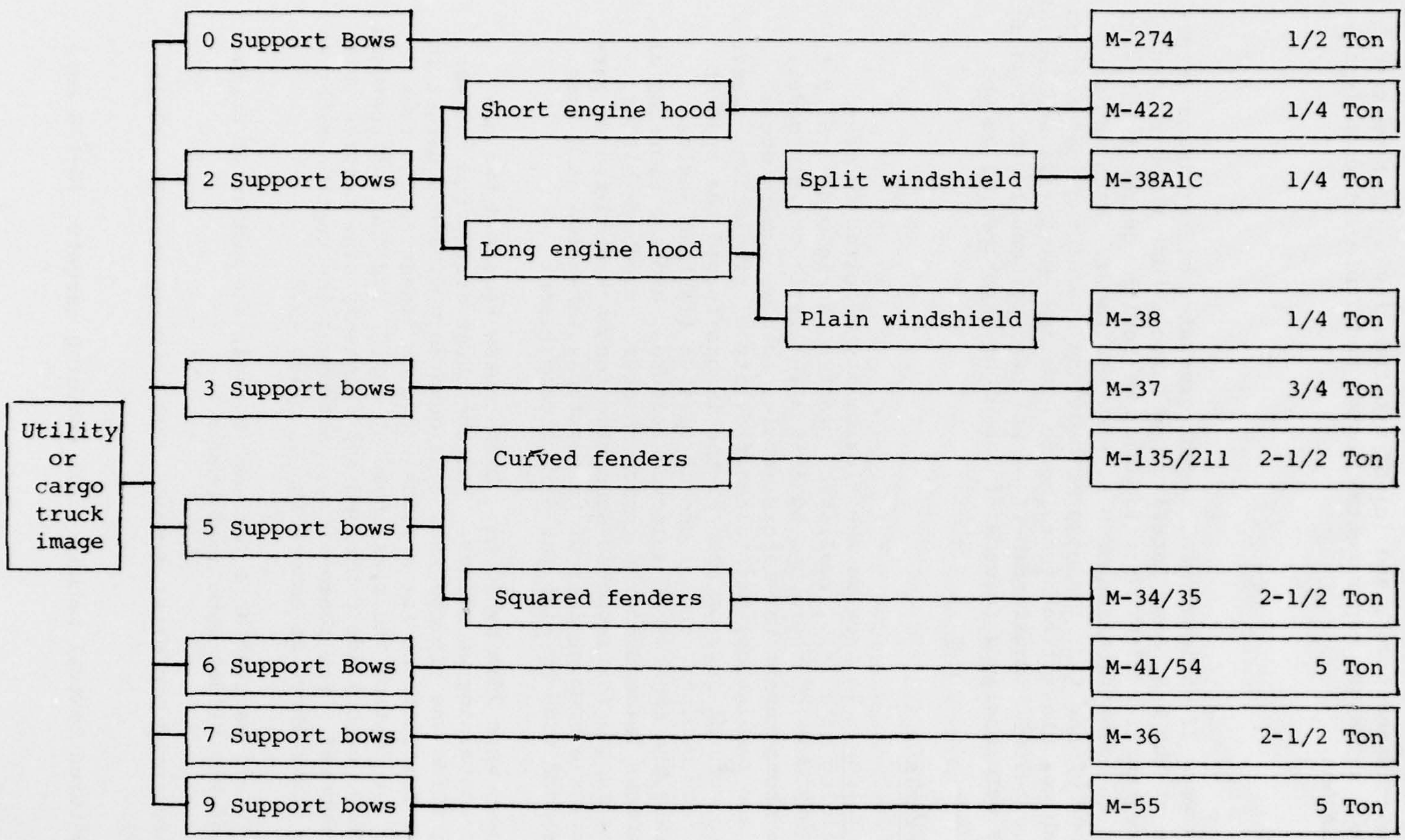

Figure 4. Discrimination aid: recognition features for a set of U.S. trucks.

versus response-insensitive), and (c) GT aptitude level (high versus low). Figure 5 shows the experimental design and Table 1 the analysis-of-variance layout.

Subjects

Subjects were 32 enlisted men, recent graduates of the image interpreter course at the U.S. Army Intelligence School, Fort Holabird, Md. These men were familiar with identification of Soviet equipment but were inexperienced in identification of U.S. Army equipment. Each man was assigned to one of the four training methods and one of the feedback conditions. Each was classified according to GT score--high (124 and above) or low (123 or below). Equal numbers of enlisted personnel with high and low GT scores were assigned to each of the eight experimental groups.

Stimulus Materials

Imagery Slides. To provide the flexibility required in constructing training materials, realistic, plastic, scale models of U.S. trucks and tanks were photographed against a realistic terrain model. Variations in photographic parameters (scale, shadow, camera angle, concealment, and resolution) maintained fidelity of simulation. Trees and shadows to conceal cues on some of the images forced the student to attend to less dominant cues. Use of various lighting angles changed contrast and emphasized selected features, and the blurring of some of the images introduced resolution changes. Feedback slides, specially constructed for response-sensitive feedback conditions, permitted all possible combinations of target types taken two at a time to be photographed side-by-side for direct comparison.

Slides used were 70mm by 100mm. Each course required two carousels, each containing 60 slides. For the three structured courses, each training slide was divided into four quadrants with one target in each. Typical instructions for a slide would be "Identify the tank shown at 45B," or "Notice the tank shown at 46C." For the unstructured pictorial method, each slide contained approximately nine targets, with each target numbered. For these slides, a typical instruction might be "Identify the truck shown at annotation 6, slide 45."

In the 120 slides available for each method, the number of training targets and key slides were as follows:

1. Unstructured pictorial method: 900 training targets, 20-24 keys,

2. Structured textual method: 200 training targets, 70-100 keys,

Training method	Feedback type	GT aptitude	Subject number	Sequence	Order of sessions	
					First	Second
Unstructured pictorial method	Response-sensitive	High	1	1	Tanks	Trucks
			2	2	Trucks	Tanks
		Low	3	1	Tanks	Trucks
			4	2	Trucks	Tanks
	Response-insensitive	High	5	1	Tanks	Trucks
			6	2	Trucks	Tanks
		Low	7	1	Tanks	Trucks
			8	2	Trucks	Tanks
Structured textual method	Response-sensitive	High	9	1	Tanks	Trucks
			10	2	Trucks	Tanks
		Low	11	1	Tanks	Trucks
			12	2	Trucks	Tanks
	Response-insensitive	High	13	1	Tanks	Trucks
			14	2	Trucks	Tanks
		Low	15	1	Tanks	Trucks
			16	2	Trucks	Tanks
Structured pictorial method	Response-sensitive	High	17	1	Tanks	Trucks
			18	2	Trucks	Tanks
		Low	19	1	Tanks	Trucks
			20	2	Trucks	Tanks
	Response-insensitive	High	21	1	Tanks	Trucks
			22	2	Trucks	Tanks
		Low	23	1	Tanks	Trucks
			24	2	Trucks	Tanks
Structured method (mixed)	Response-sensitive	High	25	1	Tanks	Trucks
			26	2	Trucks	Tanks
		Low	27	1	Tanks	Trucks
			28	2	Trucks	Tanks
	Response-insensitive	High	29	1	Tanks	Trucks
			30	2	Trucks	Tanks
		Low	31	1	Tanks	Trucks
			32	2	Trucks	Tanks

Figure 5. Experimental design.

Table 1

Source of Variance and Degrees of Freedom for Analysis of Variance

Source		df
Between subjects		
Training methods	(T)	3
Feedback type	(F)	1
GT aptitude	(A)	1
TF		3
TA		3
FA		1
TFA		3
Residual = e_1		16
Total		31
Within subjects		
Order	(O)	1
Content	(C)	1
OT		3
OF		1
OA		1
CT		3
CF		1
CA		1
Residual = e_2		20
Total		32

3. Structured pictorial method: 300 training targets, 50-60 keys, and

4. Structured method (mixed): 250 training targets, 60-80 keys.

Feedback. Response-sensitive and response-insensitive feedback provided a basic experimental comparison. For response-sensitive experimental conditions, feedback for wrong answers consisted of examples of both the correct and incorrect targets, along with a verbal explanation of the error; for a correct answer, only an example of the correct target was presented. For response-insensitive conditions, an example of the correct target was shown for both correct and incorrect answers, accompanied by an appropriate verbal statement from the experimenter. (Under both conditions, the feedback example for a correct answer was omitted later in the course when a correct answer was given without hesitation.)

Proficiency Tests

Pretests and posttests were developed for measuring change in identification performance as a function of training. Each test simultaneously assessed target identification performance for both tanks and trucks. Slides for the pretest were presented in random order; those for the posttest were shown in an ascending order of difficulty (difficulty ratings based on expert image interpreter judgments). Difficulty varied as a function of degree of concealment, lighting angle, image scale, and so forth. The tank images were divided about equally between firing position and travel position; truck images showed canvas covers in place and removed in about equal numbers. The tests contained 200 targets--98 tanks and 102 trucks.

In addition to the target identification pretest and posttest, a verbal paper-and-pencil posttest was constructed, consisting of 100 multiple-choice questions (50 for tanks and 50 for trucks) about the cues associated with each tank and truck.

Experimental Equipment Configuration

Slides were rear-projected by a random access slide projector (TELEPRO RA60) controlled through an IBM 1092 programed keyboard.[1]

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[1] Commercial or trade names are given only in the interest of precision in reporting experimental procedures. Use of the names does not constitute official endorsement by the Army or by the U.S. Army Research Institute for the Behavioral and Social Sciences.

The experimenter could call up any slide by pressing the appropriate keyboard buttons. During each session, four projectors trained four subjects, with each experimental booth screened from the others. The size of the projected image was large enough to permit subjects to sit back from the screen and identify the targets, although subjects were allowed to move as close to the screen as they desired.

Each station was controlled by one experimental assistant, who was equipped with a schedule showing slide presentation order, 4-in. x 6-in. question cards, 4-in. x 6-in. answer cards, forms for recording responses, and computational aids to determine the verbal feedback and the feedback slides to be presented. The original plan called for computer control of laboratory equipment, with training and feedback slides presented automatically. However, because the computer program was not available at the time of this study, the computer's role was simulated by experimental assistants at each student station.

Administration

Each group of four subjects required 1-1/2 days to complete the experiment. After receiving general instructions from the experimenter, each subject was assigned to an experimental station, and the pretest started. Pretest scores confirmed that the subjects had no familiarity with U.S. Army vehicles. As soon as the experimental assistant determined that the subjects were performing at a chance level, the pretest was stopped. Normally, this occurred after about 30 targets had been presented (about 10 minutes).

Each of the two courses (tank or truck) was designed to take 3 hours, broken into four sessions of 45 minutes each. At the start of the first 45-minute session, each assistant read to the students the instructions for the course to be used and began asking them questions or showing them slides with targets to be identified.

After the first course was completed, the first 45-minute session of the second course was begun. The first experimental day ended with completion of the second 45-minute session of the second course.

During the morning of the second experimental day, the two remaining 45-minute sessions were completed and the posttest was started. After students completed the target identification posttest, they were given the verbal posttest.

Dependent Variables

The primary dependent variable was the percentage of targets identified correctly on the posttest. Subscores included these values:

1. Percentage of tanks identified correctly,

2. Percentage of trucks identified correctly, and

3. Percentage of all vehicles identified correctly.

The score for the verbal posttest was the percentage of questions answered correctly for tanks, for trucks, and for tanks and trucks combined.

RESULTS

The results for the main effects for both posttests appear in Table 2; they show that the structured textual method gave poorer identification performance than any of the other three methods. Table 3 summarizes the analysis of variance for these scores. The training-methods variable yielded mean differences significant at the .01 level of confidence. The results indicate that methods permitting students to develop their own discrimination cues were more effective than those requiring the student to learn specified cues. However, the results show no sizable performance differences among the three remaining methods, which indicates that an unstructured presentation of available operational imagery with minimal (i.e., response-insensitive) feedback can serve as a valuable tool in target identification training at least as well as more structured presentations.

The structured method (mixed) resulted in target identification performance equivalent to that of the unstructured pictorial method and the structured pictorial method, and equivalent to the structured textual method on the verbal test designed to determine the subject's knowledge of target recognition features (cues). These results indicate that, for interpreters to be able to verbalize recognition features (e.g., for the development of operational keys or for on-the-job training), a minimum of structured training on such cues is probably required. The structured method (mixed) used only half the verbal materials of the structured textual method, yet it resulted in equivalent performance. However, the structuring of such training materials will require much time and effort.

A method modeled after the unstructured pictorial method can provide effective school or on-the-job training for target identification with minimal instructor participation and relatively simple support materials. If opaque imagery is used, response-insensitive feedback may be provided by indicating the correct identification on the back of the print. The only obligatory structure is in the instructional setting: a situation that will insure interpreters will concentrate on the learning situation. Failure to monitor student behavior may reduce the potential value of this very unstructured training method. If a computer is available to monitor the instruction, personnel can be released for other duties.

Table 2

Mean Percentage of Correct Scores on Identification and Verbal Posttests

Main variable	Target Identification Test			
	Total tanks	Total trucks	Total vehicles	Verbal test
Training method:				
Unstructured pictorial	69.3	79.9	74.6	59.1
Structured textual	57.1	64.0	60.5	84.9
Structured pictorial	71.8	75.7	73.8	65.9
Structured (mixed)	70.1	79.5	74.8	84.4
Feedback type:				
Response-sensitive	70.7	75.6	73.2	76.1
Response-insensitive	63.5	73.9	68.7	71.0
General technical aptitude:				
Above median (GT ≥ 124)	67.8	76.6	72.2	74.4
Below median (GT ≤ 123)	66.8	72.9	69.6	72.8
Order:				
Studied first			70.0	72.2
Studied second			71.8	74.9
Content:				
Tanks	67.1		67.1	71.5
Trucks		74.8	74.8	75.6

Table 3

Analysis of Variance for Identification Scores Made on Posttests

Source		df	MS	F
Between subjects				
Training method	(T)	3	773.43	6.05**
Feedback type	(F)	1	317.73	2.49
GT aptitude	(A)	1	106.60	.83
TF		3	85.96	.67
TA		3	186.70	1.46
FA		1	4.85	.04
TFA		3	65.00	.51
Residual = e_1		16	127.74	
Subtotal		31		
Within subjects				
Order	(O)	1	53.65	1.06
Content	(C)	1	947.10	18.72**
CT		3	47.45	.94
OF		1	59.30	1.17
OA		1	259.22	5.12*
CT		3	34.65	.68
CF		1	123.21	2.44
CA		1	20.26	.40
Residual = e_2		20	50.58	
Subtotal		32		
Total		63		

*$p \leq .05$.
**$p \leq .01$.

Table 4 shows the results of each training method by feedback type and GT aptitude. There is a slight but nonsignificant tendency for response-sensitive feedback to yield better learning and a general but not totally consistent tendency for higher aptitude subjects to perform better.

Table 4

Mean Percentage of Correct Target Identifications: Training Method by Feedback Type and GT Aptitude

Variables	Training method			
	Unstructured pictorial	Structured textual	Structured pictorial	Structured (mixed)
Feedback type:				
Response-sensitive	80.3	61.6	75.0	75.7
Response-insensitive	68.9	59.4	72.5	74.0
GT aptitude:				
Above median (GT ≥ 124)	71.2	65.3	76.2	76.3
Below median (GT ≤ 123)	78.0	55.8	71.4	73.4

Table 5 presents the scores made on the paper-and-pencil posttest, and Table 6 shows the analysis of variance for these scores. Differences in performance due to training method were statistically significant ($p \leq .01$). Subjects trained with target cue materials--structured textual method and structured method (mixed)--scored highest.

CONCLUSIONS AND IMPLICATIONS

Results generally seem to support Leibowitz's contention that training image interpreters to rely on the learning of specific verbal cues for target identification may not be a particularly effective method. A more effective method seems to be the teaching of target identification by showing the interpreter a large number of images and requiring an identification, followed by feedback on whether the identification was correct.

Table 5

Mean Percentage Scores on Verbal Posttests by Target Type

Variables	Target class: Tanks	Target class: Trucks	Mean
Training methods:			
Unstructured pictorial	57.5	60.8	59.1
Structured textual	82.0	87.8	84.9
Structured pictorial	64.5	67.2	65.9
Structured (mixed)	82.0	86.8	84.4
Feedback type:			
Response-sensitive	73.5	78.8	76.1
Response-insensitive	69.5	72.5	71.0
GT aptitude:			
Above median (GT ≥ 124)	72.5	76.2	74.4
Below median (GT ≤ 123)	70.5	75.0	72.8

Table 6

Analysis of Variance for Verbal Scores Made on Posttests

Source		df	ms	F
Between subjects				
Training methods	(T)	3	2732.92	10.45**
Feedback type	(F)	1	420.25	1.61
GT aptitude	(A)	1	42.25	.16
TF		3	412.25	1.58
TA		3	66.92	.26
FA		1	30.25	.12
TFA		3	90.75	.12
Residual = e_1		16	261.50	
Subtotal		31		
Within subjects				
Order	(O)	1	109.75	1.60
Content	(C)	1	272.25	3.98
OT		3	220.91	3.23*
OF		1	6.25	.09
OA		1	110.25	1.61
CT		3	7.58	.11
CF		1	20.25	.29
CA		1	2.25	.03
Residual = e_2		20	68.45	
Subtotal		32		
Total		63		

*$p \leq .05$.
**$p \leq .01$.

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