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NIGHT ARMOR TRAINING IN SIMULATED DARKNESS

Robert W. Bauer
ARI Field Unit at Fort Knox

and

Paul R. Bleda
Engagement Simulation Technical Area

ARI FIELD UNIT AT FORT KNOX, KENTUCKY

U. S. Army
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JOSEPH ZEIDNER **Technical Director**	**WILLIAM L. HAUSER** **Colonel, US Army** **Commander**

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To reduce problems with safety, logistics, and evaluative feedback inherent in training at night, the Army Research Institute (ARI) has developed experimental light-attenuating devices (LADs), which simulate visual conditions of night during the day. Single-density or bidensity lenses can be fitted to various existing facemasks and used to conduct certain simulated night-training operations during the day, with little reduction in effectiveness.

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Two concurrent field experiments applied LADs to supplement or supplant night armor training (a) in nighttime M60A1 tank driving--cross-country and obstacle course--and (b) in classroom disassembly-assembly of the M219 machinegun under simulated night conditions before testing under actual night conditions. Three groups were trained in each experiment: one group used LADs, one practiced under actual night conditions, and one received no comparable night training. The LADs-trained group performed as well as or better than the night-trained groups and significantly better than the daylight-trained groups. The LAD concept appears effective as a supplement or substitute for regular night training in selected situations. However, the actual equipment--welder's goggle and filter lenses--should be more rugged to withstand regular troop use.

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Robert W. Bauer
ARI Field Unit at Fort Knox

and

Paul R. Bleda
Engagement Simulation Technical Area

Submitted by:
Donald F. Haggard, Chief
ARI FIELD UNIT AT FORT KNOX, KENTUCKY

Approved By:

A. H. Birnbaum, Acting Director
ORGANIZATIONS AND SYSTEMS
RESEARCH LABORATORY

Joseph Zeidner
TECHNICAL DIRECTOR

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333

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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 Army Research Institute (ARI) Field Unit at Fort Knox, Ky., provides research programs and technical advisory services to support the U.S. Army Armor Center and its training commands. In December 1977, the commander of the 1st Training Brigade (Advanced Individual Training Armor) requested ARI assistance in a research project to explore the possible applications of light-attenuating devices (LADs) to basic armor and basic reconnaissance training. At that time, the resources of the brigade were severely strained by the training load, day-night schedule, and equipment limitations.

With the full cooperation of the 1st Training Brigade staff and trainers, ARI personnel conducted the evaluation as an adjunct to a research work unit on crew performance analysis.

Commanders of the 1st Training Brigade, COL Thomas E. Williams and later COL Richard L. Coffman, provided the continued interest and command emphasis that made this research evaluation possible.

JOSEPH ZEIDNER
Technical Director

NIGHT ARMOR TRAINING IN SIMULATED DARKNESS

BRIEF

Requirement:

This research was done in direct response to a request from the 1st Training Brigade, Advanced Individual Training Armor (AITA), Fort Knox, Ky., for technical assistance in assessment of light-attenuating-device (LAD) applications in armor training.

Procedure:

Two concurrent field experiments in the application of LADs in supplement or substitute night armor training were conducted during the introduction of Tank Forces Management (TFM) training by the 1st Training Brigade in 1978. One application was in training for nighttime M60A1 tank driving--cross-country and obstacle course. A second application was in classroom training in disassembly-assembly of the M219 machinegun under simulated night conditions.

Each experiment involved the same general design: comparing three different groups in three trial exercises. Only one of the groups used the LADs in the second trial, as preparation for the nighttime (criterion) trial. The other two groups provided control conditions for comparing the LADs-trained group with (a) the group that received no comparable night training, and (b) the group that did have actual night practice prior to the criterion nighttime trial.

In all three groups the same measures were taken from the first daytime trial to the last nighttime trial. These measures included numbers of errors observed on critical steps, overall subtask or task ratings, and, in the case of M219 disassembly-assembly, time to completion, which represented an important standard for this task. A total of 462 driver trainees were included in all the tank driving comparisons, and 160 of those were in the LADs (experimental) group; 430 turret trainees were included in the M219 comparisons, with 129 of those in the LADs (experimental) group.

Findings:

The LADs-trained groups were relatively successful in both M60A1 night obstacle-course driving and in M219 machinegun disassembly-assembly. In each experiment the LADs-trained group performed as well as or better than the night-trained group and significantly better than the control group with no training.

The LADs were useful for simulated night driving even on overcast, hazy, and rainy days, though the visibility range was significantly reduced on such days. Use of LADs during daylight can provide similar benefits to actual night training by enhancing task proficiency in night cross-country driving and in certain selected weapons tasks.

In the opinion of observers, the welder's goggle chassis and filter package adaptation used in this experiment was not sufficiently rugged for regular troop training use.

Utilization of Findings:

The LAD concept can be recommended as an effective supplement or transition to regular night training and as an effective substitute for night training in certain tasks where problems in scheduling people and resources require reduction of the night-training load. The application of LADs also offers potential for greatly increased control and safety in selected night-training exercises. Further development of the chassis and filter package is recommended.

NIGHT ARMOR TRAINING IN SIMULATED DARKNESS

CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

NIGHT ARMOR TRAINING IN SIMULATED DARKNESS

INTRODUCTION

Recent revisions in military training have placed increased emphasis upon training for night operations under complete blackout so as to prepare soldiers to perform without providing light clues to enemy sensors. For example, tank driver trainees are required to perform tasks such as M60A1 tank cross-country obstacle course driving at night with no lights inside or outside and no night-vision systems aids. As another example, tank turret crew trainees are required to perform a complete disassembly, assembly, and function check of the M219 machinegun in 4 minutes or less, with no errors, in darkness.

Commanders and trainers have expressed serious reservations about the costs of night training in terms of both personnel and equipment. Prohibitive scheduling problems plus the high incidence of tank damage in night driving that occurred when this training was introduced at Fort Knox, Ky., in 1977 stimulated a request to the U.S. Army Research Institute (ARI) from the commander of the 1st Training Brigade, Advanced Individual Training Armor (AITA). The commander asked for support in a research project to explore the possible applications of light-attenuating devices (LADs) to basic armor and basic reconnaissance training programs.

It was noted that the night environment presented hazards that often went beyond safe limits before the limit was fully comprehensible. For example, in one task, driver trainees negotiated a tank obstacle course at night under complete blackout, i.e., without the aid of instruments, infrared, headlights, or flashlights. Of eight tanks performing that exercise, five were disabled temporarily by the end of the 20-minute session. Since maintenance costs associated with the repair and recovery of tanks are high, and since the night schedule of training was heavy, the commander at that time sought an alternative to actual training at night.

The LADs concept has been under development in ARI since 1974. Three prototypes have been fabricated and evaluated for use in various night combat training tasks, including night rifle marksmanship, distance estimation, target detection, terrain walking, and nap-of-the-earth helicopter piloting.

OBJECTIVE

The objective of this evaluation was to determine whether LADs training in the daytime could serve as an effective supplement or substitute for actual nighttime training in armor crew tasks.

PROCEDURE

Two parallel experiments were run concurrently, employing (a) 462 M60A1 tank driver trainees in night driving of a cross-country obstacle course, and (b) 430 tank turret trainees in night disassembly-assembly of the M219 machinegun.

The driving trainees were divided into three groups; each group received the same training on the first (daytime) trial for record and the last (nighttime) trial on the driving course. Only one of the groups, the experimental group, wore the LADs on the second (daytime) trial on the course. The other two groups served as controls. One of the control groups received no training between the first trial and the last (criterion) trial. The second control group had an actual night-practice run between the first trial and the criterion trial. Comparisons were expected to determine whether LADs training (given to the experimental group) was better than no training in its effect on the nighttime trial performance, and whether LADs training was as effective as actual night training in its effect on the nighttime criterion performance.

The same measures were used on each of the practice exercises described above. The measures included records of errors--recorded by the tank commander (TC)--on critical steps in driving subtasks such as starting, level driving, vertical obstacle crossing, ditch crossing, etc. The measures also included performance ratings by the TC/instructor on each subtask and records by the ARI observer on site of critical incidents and weather/terrain conditions.

The turret crew trainees were also divided into three groups that followed a similar pattern of instruction through the M219 disassembly-assembly exercises. The experimental group was given a daytime (lighted classroom) trial followed by a LADs trial and then a final nighttime (blackout) trial for criterion. The first control group was given no training between the daytime trial and the (blackout) criterion trial. The second control group was given an extra blackout trial prior to the criterion trial.

Records of subtask errors on critical steps in each trial were kept by trainee/observers, who also rated the overall performance on the task. In addition--since the performance standard called for M219 disassembly, assembly, and function check within 4 minutes--elapsed time was recorded on each trial.

RESULTS

The LADs-trained group performed as well as the night-practice control group in the M60A1 night obstacle course driving, and both were significantly better than the control group without training in measures of performance improvement (error changes) during the training.

Performance ratings did not show significant differences among the three groups. Critical incidents, largely minor incidents such as thrown tracks or tanks mired in mud, were scattered rather evenly among the three groups and were even more frequent in day driving than in night driving. Use of the LADs (after an appropriate period of adaptation to the dark) was feasible even during the worst visibility conditions experienced--combinations of overcast, light rain, and haze--though the range of visibility was reduced, as might be expected, on comparable overcast or hazy nights.

Of the turret crew trainees, the LADs-trained group performed as well as the night-practice control group on M219 machinegun disassembly-assembly error measures and somewhat better than the control group without training, but the differences among groups were not significant. In terms of performance ratings, the LADs-trained group performed well, but differences among the three groups were not significant. On the elapsed time measures, the LADs group performed significantly better than the group without training and also significantly better than the night-practice group.

CONCLUSIONS

1. The light-attenuating device (LAD) concept is applicable and training is effective in either supplementary or substitute simulated night training in armor weapons and M60A1 tank cross-country obstacle course driving.

2. Use of the LADs afforded certain advantages in class control, scoring, feedback, and correction by the instructors.

RECOMMENDATIONS

The following recommendations are made, based upon the experimental results, the review of previous LAD research, and accumulated experience with the LADs.

1. The LAD concept has very wide application to simulated night training in tasks that are to be accomplished in moonlight to low-starlight levels of darkness and that do not require fine, detailed vision.

2. The density 5 LADs are not recommended for training tasks that require detailed vision, such as acquiring main gun targets or tracking distant targets on the tank optical sight system.

3. A more rugged chassis and filter package for the goggles will be needed for most Army training applications.

BACKGROUND

The introduction of the Tank Forces Management (TFM) Program of Instruction for armor trainees placed increased emphasis on training for night operations without the aid of artificial lighting. Trainees were required to perform a number of tasks under night conditions, giving no light signal to a potential enemy. The tasks included disassembly and assembly of the M219 machinegun in a darkened room (for gunner-loader trainees) and nighttime cross-country tank driving, using neither exterior nor interior light (for driver trainees).

When the 1st Training Brigade, Advanced Individual Training Armor (AITA), inaugurated this program of instruction in 1977, the scheduling of personnel and equipment for night training strained the brigade's resources. The commander noted that the night driving environment presented hazards that were very difficult to control and associated with these was a high incidence of tank damage.

One suitable alternative was to use light-attenuating devices (LADs) that simulated night illumination levels in daylight. Such devices have been in development and evaluation by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) since 1974.

Simulation of night illumination levels using LADs could offer a number of advantages over actual nighttime training in terms of safety, training effectiveness, and scheduling flexibility. Safety and control could be increased because individual and group performances could be monitored more closely in the daylight by trainers with unrestricted vision. For example, tank commanders/instructors (TCs) could observe terrain contour and warn drivers of potentially hazardous situations. Training effectiveness would improve since the TC would be better able to observe, evaluate, and correct trainee performance. Finally, increased flexibility in scheduling would be especially beneficial to training centers with limited facilities.

To date (mid-1979), three prototype LADs have been fabricated. They represent different filter sandwich designs and means of attachment: (a) a sandwich on the standard Army sun/wind/dust goggle; (b) outsert lenses on the M17 protective mask, and (c) insert lenses in a conventional welder's goggle. Figure 1 shows the sandwich version, field-tested for infantry tasks including distance estimation, target detection, and terrain walking. Aviation tasks consisted of such nap-of-the earth helicopter maneuvers as 360° and 45° bank turns, hovering, obstacle avoidance, and obstacle detection. The results of these preliminary field tests were encouraging, since performances with the LADs appeared degraded to the same extent as those under actual night conditions. Unfortunately, the initial mockup of these LADs could not accommodate corrective lenses and was too fragile and expensive for more extensive field testing (Farrell, 1975).

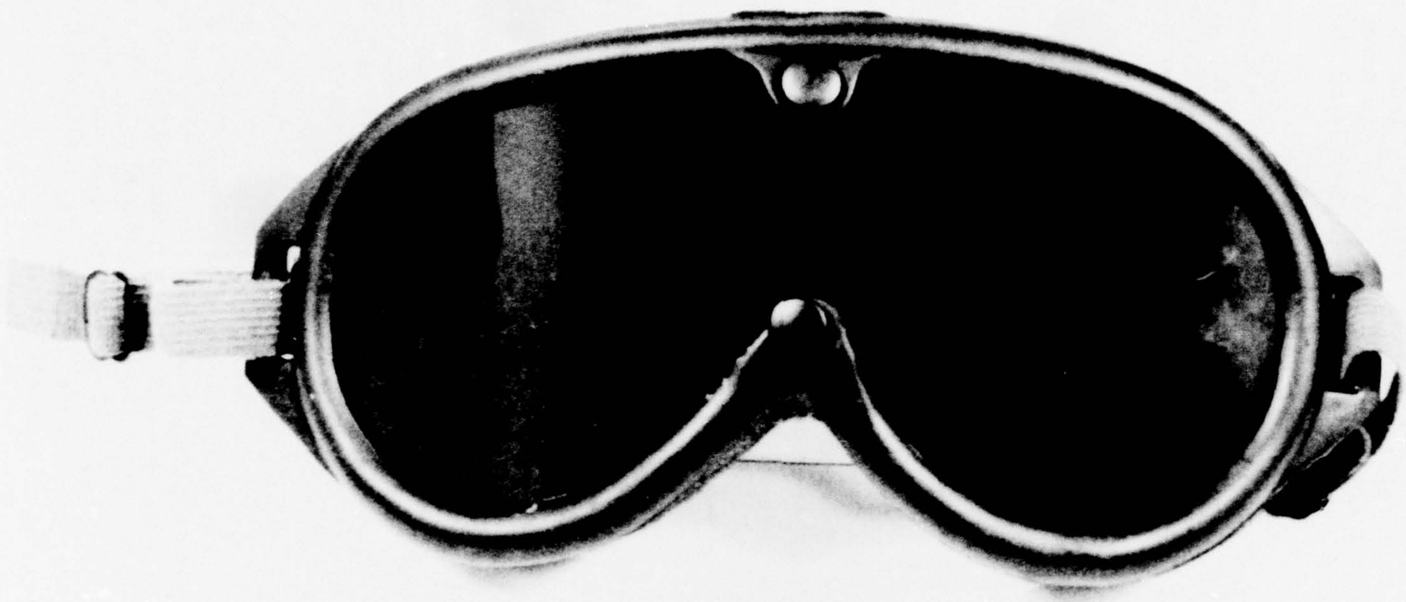

Figure 1. Light-attenuating device: sandwich of standard Army sun/wind/dust goggle.

The next stage of development produced light-attenuating filters that fit as outsert lenses on the standard Army protective mask (M17A1), as shown in Figure 2. These LADs were field-tested with elements of the 9th Infantry Division at Fort Lewis, Wash. A bidensity lens having an optical density of 5.5 in the upper portion and 4.0 in the lower portion was used for safety reasons--so that navigators could verify their footing easily.

The findings indicated that compared with daylight performances, actual nighttime performances degraded significantly in terms of navigation speed and accuracy. Performances obtained using the LADs were intermediate to those found in the daylight and at night. It appeared that the bidensity safety feature allowed navigators using LADs to travel faster than those who performed at night. However, the ARI scientists conducting the research concluded that a single-density LAD probably would have yielded results comparable to actual night findings (Peters, Bleda, & Fineberg, 1979).

Figure 3 shows the welder's goggle version which had undergone extensive field testing at Fort Jackson, S. Car., for use in the training and testing of night rifle marksmanship. The results of the first of these tests validated the behavioral correspondence of those using various optical densities of the LADs (4.5, 5.0, and 5.3) to the performances of men under different lunar phases (full, quarter, and new moon). The correspondence was in terms of the percentage of trainees qualifying for record, which involved achieving a specified number of hits on exposures to pop-up targets at various distances (Bleda, 1979; Bleda & Labrozzi, 1979).

One limitation of the welder's goggle version of the LADs is the restricted field of vision--about 50°--as compared with the normal daytime or nighttime field of vision--about 170°. The findings of the Fort Jackson field tests indicated that a wide field of view is not essential for LADs used in nighttime rifle marksmanship training and testing. However, an important question arises regarding the extent to which peripheral vision might be necessary to drive a tank or to disassemble-assemble weapons. In view of the limitations inherent in the welder's goggle version of the LADs, the armor training brigade commander requested that ARI scientists conduct a preliminary assessment of the feasibility of using LADs for various nighttime armor tasks.

Included among the selected armor tasks were driving with the M60A1 tank and M34 driving trainer vehicle, disassembly-assembly of the M219 machinegun, and the tank gunnery task. Preliminary assessments of the LADs in these applications indicated a fair probability of success with the driver tasks despite the reduced field of view permitted by the LADs, and a relatively high probability of success with the weapon disassembly-assembly task. The tank gunnery task was abandoned because neither the targets nor the reticle could be acquired through the LAD when used with tank sights.

Figure 2. Light-attenuating filters fitted as outsert lenses on standard Army protective mask (M17A1).

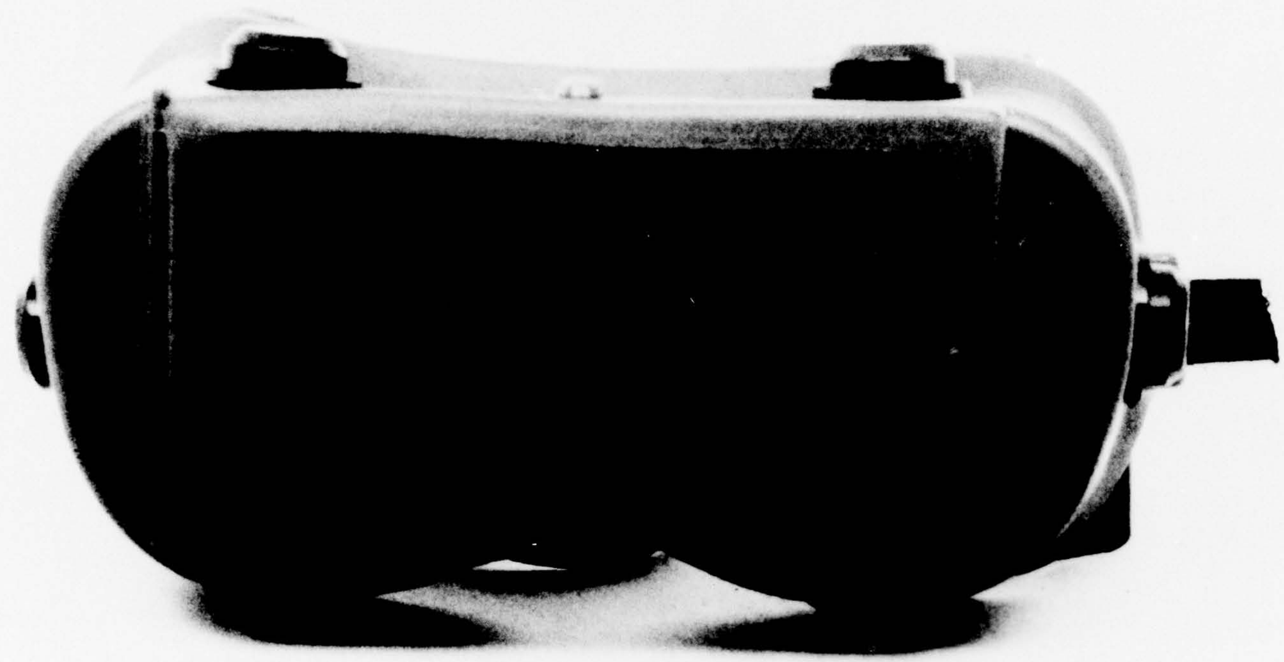

Figure 3. Light-attenuating device: welder's goggle version.

Therefore, the 1st Training Brigade and ARI decided to proceed with field evaluations of the LADs application to tank night driving training and night weapons disassembly-assembly training.

Formal field evaluation of the LADs was considered necessary for several reasons. Foremost was the fact that the LADs do not replicate night conditions precisely, but approximate some essential features of night illumination.

There was also some concern about the restricted peripheral vision of the welder's goggle LAD, specifically, that this would limit depth and cue perception and inhibit skill acquisition.

LIGHT-ATTENUATING DEVICE DESCRIPTION

The density 5.0 filter package was selected for this experiment because it appeared most likely to provide a level of illumination comparable to natural nighttime under a wide range of daylight conditions. Shown below are the density to light and transmissivity (T) to ultraviolet (UV) and infrared (IR), as well as safety and environmental limitations of the goggles used in this experiment.

Specifications

Filter package - Molded neutral density polycarbonate plastic plates

- Density = (transmits 1×10^{-5})

- Reflective to UV and IR

  $T \leq 1 \times 10^{-6}$ at 385mμ

  $T \leq 4 \times 10^{-3}$ from 750-2600mμ

- Deforms (but does not break) on impact

- Resists impact from $-40^{\circ}F$ to $+250^{\circ}F$

  Softens and distorts at $+350^{\circ}F$

Filter package maker: Omnitech Division of Gentex

Chassis (face mask): Welder's goggle design with added flaps, foam strips, and air vents

Chassis maker: American Optical Company

RESEARCH PLAN AND PROCEDURE

Improvement of performance effectiveness was the criterion used for evaluating the LADs in this research. The standard was defined operationally as the degree to which intervening practice changed the performance rating, the elapsed time, or the number of errors involved in performing a given task. The research plan in both experiments included three different groups of trainees, only one of which received the LADs training during the practice exercises. The other two groups were used as control conditions, in order to compare the LADs-trained group with (a) the group that received no comparable intervening night training, and (b) the group that did have actual night practice prior to the nighttime criterion trial. The first control condition was included to provide a baseline level of performance for determining whether any type of night training makes a difference. An actual night condition was needed to determine whether the LADs provided nearly the same training transfer as practice during normal nighttime darkness.

The 1st Training Brigade, in cooperation with ARI, conducted two concurrent field experiments involving driver training with the M60A1 tank and turret crew training in the disassembly-assembly of the M219 machinegun. A total of 24 companies participated in the tank driver training, while only 12 of these same companies were represented in the disassembly-assembly training. Each company was made up of twice as many platoons of turret crew (gunner/loader) trainees as tank driver trainees. The performance data were collected during practice exercises prior to the examination. The performance measures for both the tank driver and disassembly-assembly tasks included error counts and subjective ratings by observers. In addition, time required to complete the latter task was recorded, because a time requirement is included in the performance standard for disassembly-assembly of the M219 machinegun.

Forty-eight platoons of driver trainees were assigned to the three types of driver training conditions. The field experiment progressed in a series of three phases which included (a) day training for all soldiers, (b) exposure to one of three practice conditions, and (c) a criterion nighttime trial for assessing the effects of training. Each practice trial for driver trainees involved their completion of seven subtasks, including starting, stopping, vertical wall climb, ditch crossing, and other cross-country terrain maneuvers on the tank obstacle course. The tank commander/instructor used an inventory that included a checklist on trainee performance for each critical step involved in the subtasks and a rating scale on each subtask. In addition, the TC was required to report in detail on near-misses, personal injuries, or incidents of damage to the tanks (critical incidents). See Appendix A for data form samples.

In the disassembly-assembly field test, 48 platoons of turret crew trainees participated. This test was conducted with two platoons at a time in a half-day classroom exercise. Platoons were assigned systematically to the three comparison groups. The LADs practice and night-training/testing trials were preceded by 25 minutes of dark adaptation. In accordance with the usual procedure followed at Fort Knox, the night trials did not occur during actual nighttime, but rather in a blacked-out room in the training facility. Since the performance standard called for disassembly-assembly and a function check within 4 minutes, the time required to complete the task was recorded for each trainee. If all trainees had not finished after 10 minutes, the exercise was terminated to allow the remainder of the class to continue the session.

DRIVER TRAINING RESULTS

Table 1 shows the mean number of errors in each of the experimental conditions across the three training phases. Inspection of the results indicates that both the LADs (simulated night) and actual night-trained groups started with relatively high error rates that were reduced by the final phase. On the other hand, the group not receiving night practice started at the lowest mean error level and showed no change. It could be argued that this group was so low to begin with that any improvement would be difficult to demonstrate. However, the actual night-practice group also started low, but did continue to improve across training phases. One-way analysis of variance of error deltas (difference scores) was significant at $p < .01$. Newman-Keuls multiple range test of the differences among the ordered groups indicated that the LADs-trained group showed significantly better reduction in errors than the no-practice group ($p < .05$). The night-trained group also showed significantly better improvement than the no-practice group. The difference between the night-training group and the LADs-trained group was not significant.

Since three dependent measures were used in each of these experiments, thus increasing the probability of a Type I error, a relatively rigorous α level was adopted, $\alpha = .01$, for each analysis of variance (Table 2). A less stringent $\alpha = .05$ was used in the Newman-Keuls multiple range test applications because it incorporates the number of comparisons being made with any one measure into the size of the critical difference required, and was used only after a significant level ($\alpha = .01$) was reached on analysis of variance (Bruning & Kintz, 1977).

Estimated omega squared (ω^2) value was .02, whether calculated between the experimental group and the no-practice group or between the no-practice group and the night-trained group. This level of ω^2 indicates a small experimental effect (difference) either way--i.e., LADs-trained or night practice (Plutchik, 1974).

Table 1

Mean Number of Errors Made in Driving M60A1 Tank

Group	n	Training phase			
		Step 1 (day)	Step 2	Step 3 (night)	$\bar{\Delta}_{13}$[a] change
LADs	160	3.0	2.4	2.0	+1.0
Control I (no practice)	169	1.1	--	1.1	0.0
Control II (night practice)	133	1.5	1.1	0.8	+0.7

[a]Obtained by subtracting step 3 errors from those made in step 1.

Table 2

Error Count Differences (Δ_{13}) One-Way ANOVA

Source	SS	df	MS	F	p
Between groups	107.6	2	53.2	5.83	<.01
Within groups	4294.6	459	9.1		
Total	4187.0	461			

Performance ratings showed no significant differences among the groups (on analysis of variance), although the night-trained group performed best.

Critical incidents during either day or night training were relatively rare and scattered so that no group incurred more than its share of tank disabilities. The most common incidents were thrown tracks, getting bogged down in mud, and, occasionally, locked brakes. No near-misses or personal injuries were reported during the field test. In view of routine training experience, this zero report probably reflected the general aversion of organizational personnel to report such incidents.

An ARI observer/data coordinator made hourly checks on sky and visibility conditions during the practice and test sessions. This was to determine whether driving with the LADs was practical under all types of weather conditions. During the period of data collection, 10 April through 11 July 1978, trainees experienced days that were overcast, hazy, and rainy in varying degrees. Even in the worst of these visibility conditions, the LADs were used effectively, though the daytime visibility range was reduced with LADs as might be expected on a comparable overcast or hazy night.

M219 DISASSEMBLY-ASSEMBLY TRAINING RESULTS

On the disassembly-assembly task the trainees generally performed more slowly and committed more errors on the last (criterion) nighttime trial versus the first daytime trial. Therefore, difference scores were generally negative, presumably because of the more difficult exercise with blackout conditions. The error score differences favored the experimental (LADs-trained) group, but differences among the groups were not significant (on analysis of variance, $p > .01$). See Table 3.

Table 3

Mean Number of Errors Made in M219 Disassembly-Assembly

Group	n	Training phase			
		Step 1 (day)	Step 2	Step 3 (night)	$\bar{\Delta}_{13}$[a] change
LADs	129	.29	.50	.31	-.02
Control I (no practice)	181	.37	--	.54	-.17
Control II (night practice)	120	.15	.25	.23	-.08

Note. One-way ANOVA F not significant.

[a]Negative $\bar{\Delta}$ values indicate more errors, generally, on step 3 (night) as compared with step 1 (day).

Ratings of each trainee's performance were obtained, in addition to error and time measures. Since there were not enough instructors to attend to each individual, trainees were instructed to score one another on the correct performance of the five critical steps involved in the task and also provide an overall performance evaluation of a 9-point scale that ranged in value from 1 (extremely poor) to 9 (outstanding). To prevent collusion, half the trainees were rotated to a different classroom position after each trial so that no two trainees were permitted to score one another. Performance ratings differences also favored the LADs group over the no-practice group, but differences among groups were not statistically significant. See Table 4.

Table 4

Mean Performance Ratings on M219 Disassembly-Assembly

Group	n	Training phase			
		Step 1 (day)	Step 2	Step 3 (night)	$\bar{\Delta}_{13}$[a] change
LADs	129	6.4	5.1	5.6	+0.8
Control I (no practice)	181	6.6	--	5.0	+1.6
Control II (night practice)	120	6.7	5.7	6.1	+0.6

Note. One-way ANOVA F not significant.

[a]Positive $\bar{\Delta}$ values indicate lower ratings, generally, on step 3 (night) as compared with step 1 (day).

Table 5 gives the mean times required to perform the disassembly-assembly task in each training condition across the various phases of the field test. Inspection of the results indicates that, on the average, from 143 to 199 seconds were required to perform the task in daylight, and more than twice that amount of time was needed during the night trials.

Table 5

Mean Time (Seconds) for Disassembly-Assembly of M219 Machinegun

Group	n	Training phase			
		Step 1 (day)	Step 2	Step 3 (night)	$\bar{\Delta}_{13}$[a] change
LADs	129	167	310	284	-117
Control I (no practice)	181	199	--	420	-221
Control II (night practice)	120	143	379	367	-223

[a]Negative $\bar{\Delta}$ values indicate mean times were generally longer on step 3 (night) as compared with step 1 (day).

Since the acceptable standard for both day and night performance is the same--240 seconds--a large portion of the trainees apparently did not reach this level by the end of the practice sessions. The results indicate that the LADs-trained group performed the best overall. In fact, trainees in this group outperformed their counterparts in the night- and no-night-practice conditions by 83 and 136 seconds, respectively. The time differences between groups were significant as indicated by analysis of variance. See Table 6.

Table 6

Time (Seconds) Used in Disassembly-Assembly of M219 Machinegun One-Way ANOVA

Source	SS	df	MS	F	p
Between groups	1.01×10^6	2	5.05×10^5	19.2	<.01
Within groups	1.12×10^6	427	2.63×10^4		
Total	1.23×10^6	429			

Newman-Keuls multiple range test of the differences among ordered groups indicated that the LADs-trained group had significantly better time performances than the no-practice group. The LADs-trained group also performed significantly better than the night-trained group ($p < .05$). *The night-trained group was not significantly better* than the no-practice control group on time score changes.

Estimated omega squared (ω^2) for the difference between the LADs group and the no-practice control group was .23, indicating only about 41% overlap between the experimental and control groups. The ω^2 for the difference between the experimental and the night-trained control group was .18, indicating about 47% overlap. These differences are relatively large (Plutchik, 1974).

The differential performances also were apparent in the relative number of trainees who failed to complete the task within the 10-minute limit. Table 7 shows, in each training condition, the number of trainees who exceeded the 10-minute limit. These results further support the finding that the LADs-trained group performed as well as the night-practice group, and the no-practice group did worst.

Table 7

Number of Trainees Failing To Complete Disassembly-Assembly Task

Group	Training phase			
	Step 1 (day)	Step 2	Step 3 (night)	$\overline{\Delta}_{13}$[a] change
LADs	0	1	2	-2
Control I (no practice)	2	--	41	-39
Control II (night practice)	0	11	9	-9

[a]Obtained by subtracting the step 3 number from that of step 1.

Discussion

The density 5 LADs used in armor training can be expected to reduce luminances to mesopic vision levels on most days, as illustrated by the arrows in Figure 4. On relatively clear days, driver trainees were able to discriminate some instrument figures as well as to observe terrain, personnel, and other tanks in the surroundings, using a combination of cone and rod vision. However, cone vision acuity through the LADs was not adequate for target acquisition, sighting, or tracking on main gun optical sights. Since the LADs do permit rod vision, a 20- to 30-minute dark adaptation period is essential prior to any practical use of the LADs. In the armor training experiments reported here, all trainees in the experimental group adapted to the dark for a minimum of 25 minutes prior to each exercise with the device.

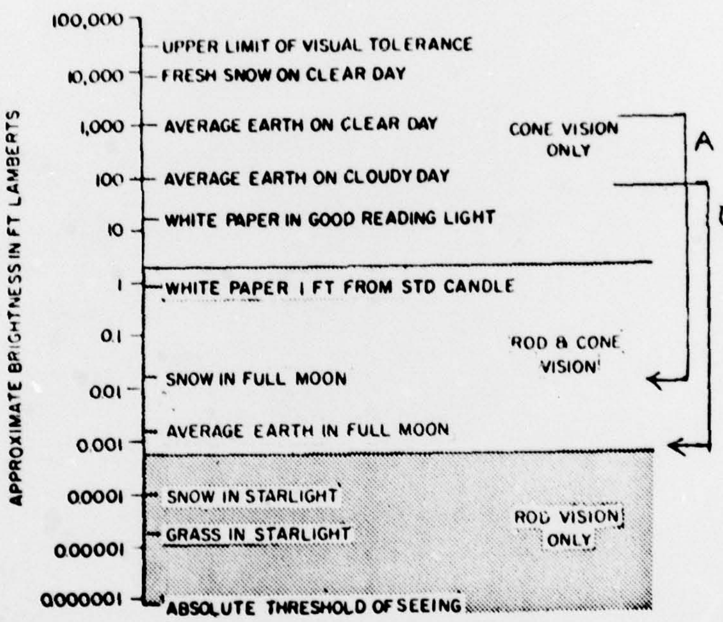

Figure 4. 10^{-5} reductions in brightnesses resulting from use of the LADs, (a) on a clear day, and (b) on a cloudy day. (Adaptation of Figure 3-8 from Van Cott & Kinkade, 1972.)

Results from this pair of experiments and review of previous research on the LAD concept indicate a broad range of potential military training applications for the LADs. Different filter densities may be more appropriate for different training requirements. Field experience, while consistently favorable to the training effectiveness of the LAD, has also consistently questioned the chassis and filter design. A small human factors design effort is warranted to develop a more rugged and compatible military training design.

REFERENCES

Bleda, P. R. Simulating Various Moon Illumination Levels with Light Attenuating Devices (LADs). ARI Technical Paper 374, July 1979.

Bleda, P. R., & Labrozzi, A. In the Dark of the Day, Infantry, March-April 1979, 69 (2), 32-34.

Bruning, J. L., & Kintz, B. L. Computational Handbook of Statistics, (2nd ed.). Glenview, Ill.: Scott, Foresman and Co., 1977.

Farrell, J. P. Simulating Night Visual Conditions During the Day with Light Attenuating Filters. Behavior Research Methods and Instrumentation, 1975, 7(6), 539-541.

Peters, J. I., Bleda, P. R., & Fineberg, M. Effects of Illumination Level and Sense of Direction on Land Navigation Performance. ARI Technical Paper 362, May 1979.

Plutchik, R. Foundations of Experimental Research, (2nd ed.). New York: Harper & Row, 1974.

Van Cott, H. P., & Kinkade, R. G. (eds). Human Engineering Guide to Equipment Design (Rev. ed.). Department of Defense, 1972.

APPENDIX A

ADVANCED DRIVING COURSE "A" INSTRUCTOR DATA FORM

____Gp ____Day

____LAD(day)

Advanced Driving Course "A"
Instructor Data Form

____Night

Driver SSN____________________________

1. Subtask: Before Operations Date________ Time________

Does the driver . . . Yes No

a. check the engine oil? ☐ ☐
b. check the transmission oil? ☐ ☐
c. depress the brake pedal before attempting to start the engine? ☐ ☐
d. check the gauges? ☐ ☐

Performance Rating

1	2	3	4	5	6	7	8	9
Extremely Poor		Poor		Average		Above Average		Outstanding

2. Subtask: Starting the Vehicle Date________ Time________

Does the driver . . . Yes No

a. fasten the seat belt? ☐ ☐
b. move the shift lever to "S"? (P) ☐ ☐
c. switch down the main engine fuel switch? ☐ ☐
d. fast idle the engine at approximately 1000 rpms for 5 minutes to warm-up the engine before moving out? ☐ ☐

Performance Rating

1	2	3	4	5	6	7	8	9
Extremely Poor		Poor		Average		Above Average		Outstanding

3. Subtask: Climb Vertical Wall Date________ Time________

Does the driver . . . Yes No

a. approach the wall at 90°? ☐ ☐
b. slow down sufficiently on approach to the wall? ☐ ☐
c. place the shift lever in "L"? ☐ ☐
d. release the accelerator as the tank pitches forward? ☐ ☐

Performance Rating

1	2	3	4	5	6	7	8	9
Extremely Poor		Poor		Average		Above Average		Outstanding

ATZK-TC-TBA FORM 2323
1 Mar 78

4. Subtask: Descend Vertical Wall

Date________ Time________

Does the driver . . .

	Yes	No
a. approach the drop at 90°?	☐	☐
b. alert the crew of the drop?	☐	☐
c. place the shift lever in "L"?	☐	☐
d. decelerate sufficiently as the vehicle approaches the drop?	☐	☐

Performance Rating

1	2	3	4	5	6	7	8	9
Extremely Poor		Poor		Average		Above Average		Outstanding

5. Subtask: Ditch Crossing

Date________ Time________

Does the driver . . .

	Yes	No
a. alert the crew to the ditch crossing?	☐	☐
b. approach the ditch at 90°?	☐	☐
c. decelerate before entering the ditch?	☐	☐
d. accelerate properly to climb out?	☐	☐

Performance Rating

1	2	3	4	5	6	7	8	9
Extremely Poor		Poor		Average		Above Average		Outstanding

6. Subtask: Uphill Climb

Date________ Time________

Does the driver . . .

	Yes	No
a. put the shift lever in "L"?	☐	☐
b. pursue a straight course?	☐	☐
c. keep climbing speed constant?	☐	☐
d. make any turns in the climb?	☐	☐

Performance Rating

1	2	3	4	5	6	7	8	9
Extremely Poor		Poor		Average		Above Average		Outstanding

7. Subtask: Stopping the Vehicle Date________ Time________

Does the driver . . .

	Yes	No
a. apply the brakes evenly when coming to a halt?	☐	☐
b. place the shift lever in "P", after stopping?	☐	☐
c. lock the brakes?	☐	☐
d. idle the engine up to approximately 1000 rpms and hold for 2 to 5 minutes before pushing up the "Main Engine Fuel" switch?	☐	☐

Performance Rating

1	2	3	4	5	6	7	8	9
Extremely Poor		Poor		Average		Above Average		Outstanding

Please note below any occurrence not covered earlier including damage to: persons, property, near-misses, safety violations, serious errors, etc.

____

____

____

____

APPENDIX B

CRITICAL INCIDENT INTERVIEW

A. Was the tank you used the exercise disabled or inoperative for any time? NO______ YES______ If yes, complete Section A.

1. Tank number__.__ Design Gp______ Step______

2. In what way was the tank disabled or inoperative?

_____ threw track

_____ stuck

_____ other, please specify________________________________

____

3. Date/time of occurrence___________________

4. Recovery.

a. Was a VTR 88 required to recover the tank? NO_____ YES_____

b. How many people were involved in the recovery of the tank? _____Men

c. How many hours were spent in recovery of the tank? _____Hrs

5. Repair.

a. Was there any damage to equipment? NO_____ YES_____

b. What was damaged?____________________________________

c. How many people were involved in the repair?_____Men

d. How many hours were spent in the repair? _____Hrs

e. What do you estimate to be the cost to repair or replace the damaged equipment?____________

6. Availability.

What was the total amount of time that the tank was unavailable for training? _ _____Days (or) _____Hrs.

B. Was any person injured during the exercise? NO____ YES_______

If yes, complete section B.

1. Tank number________ Design GP_____ Step________

2. How did injury occur?_______________________________________

____

3. Date/time of occurrence__________________

4. Describe the kind (nature) of injury.__________________________

____

5. Estimate severity.

   a. Slight, minor, no medical assistance required _________

   b. Moderate, requiring medical help________

   c. Severe, possibly crippling__________

   d. Very severe, near fatal or fatal________

C. Did you experience a "near miss" during the exercise?

NO________ YES________ If yes, complete section C.

1. Tank number_________ Design Gp_______ Step______

2. Describe the incident____

____

3. Date/time of occurrence__________________________

4. What was the potential damage or injury?___________________________

____

____

APPENDIX C

WEATHER AND TERRAIN CONDITIONS

DATE ____

PLT ________________ COMPANY ________________

TIME	SKY	VISIBILITY	PRECIPITATION
0800			
1000			
1200			
1400			
1600			
1800			
2000			
2200			
2400			

SKY CODE

CB - Clear, very bright moonlight
C - Clear, less than 10% covered
S - Scattered, 10-50% covered
B - Broken, 60-90% covered
O - Overcast, over 90% covered

VISIBILITY CODE

EC - Exceptionally clear, not less than .9[illegible]
VC - Very clear, not less than .73
C - Clear , not less than .53
LH - Light haze, not less than .21
H - Haze, less than .21

D - Drizzle
R - Rain
H - Hail
S - Snow

Note any unusual weather or terrain conditions, e.g. very heavy rain, dense fog, mud or snow on surface.

____

____

ATZK-TC-TBA FORM 2340
1 Mar 78

AG 6671-M-Army-Knox-Apr 78-54

____ Gp ____Day

____LAD(day)

____Night

APPENDIX D

M219 7.62mm COAXIAL MACHINEGUN
Disassembly/Assembly
Instructor Data Form

Trainee Last Four SSN:________________ Date___________________

DISASSEMBLY

Does the trainee . . .

	Yes	No
1. Pull back on the charger handle while depress the buffer support lever to remove barrel extension from the receiver?	☐	☐
2. Slide the breech block 2/3 of way across barrel extension and lift out to remove the breech block from the barrel extension?	☐	☐

ASSEMBLY

	Yes	No
3. Place the retaining ring on the support block after mounting the charger handle?	☐	☐
4. Push the buffer support lever down to level with the bottom of the receiver in inserting the barrel extension into the receiver?	☐	☐
5. Quickly and correctly align and connect the barrel jacket and the receiver?	☐	☐

Disassembly and Assembly overall Performance Rating

Extremely Poor	Poor	Average	Above Average	Outstanding

Total elapsed time for clearing weapon, disassembly, assembly, and performance function check.

_________Min. _______sec.

ATZK-TC-TBA FORM 2324
1 Mar 78

AG 6676-O-Army-Knox-Apr 78-2560

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1 USA Chaplain Ctr & Sch, Ft Hamilton, ATTN: ATSC-TE-RD
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