Technical Paper 350

THE EFFECTS OF TANK CREW TURBULENCE ON TANK GUNNERY PERFORMANCE

Newell K. Eaton
Janet F. Neff

ARI FIELD UNIT at FORT KNOX, KENTUCKY

U. S. Army
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This research, by the Army Research Institute Field Unit at Fort Knox, Ky., sought specific data on the relationship of tank crew turbulence to performance.

In Phase I, a questionnaire developed to measure and evaluate existing crew turbulence was administered to crews of five armor battalions during tank gunnery training. Responses from 211 crews were correlated with gunnery qualification Table VIII scores to determine the relationship between various crew turbulence variables and gunnery performance.

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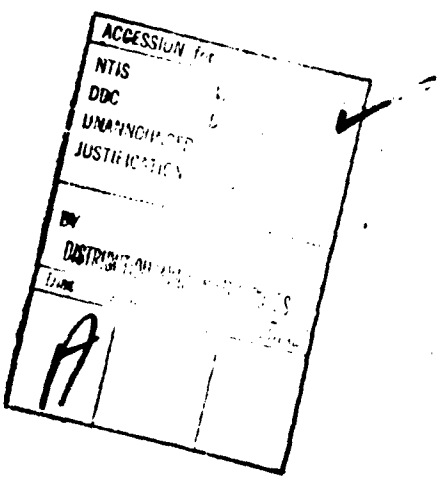
20. Phase II investigated, with four groups of 11 crews each, the effects of artificially created crew turbulence on Table VIII performance. Complete crews who had just completed Table VIII for record comprised the Control Group. In the second group (Unfamiliar Crews), crewmen were assigned to different crews and different M60A1 tanks. In the third group (Unfamiliar Crews and Positions), gunners acted as tank commanders and loaders acted as gunners, assigned to different crews and tanks as in Group 2. In the fourth group (Non-Armor Replacements), non-armor personnel who had received 3 days of special training acted as gunners and loaders.

Results showed considerable turbulence existed. Complete crews had been together typically 1-2 months, tank commander/gunner pairs 1-3 months. Typical tank commanders had held their positions 12-42 months, gunners 5-12 months, drivers 5-9 months, and loaders 2-6 months. Great variation in times existed.

In Phase I, experience of both tank commander and gunner in their positions was significantly related to gunnery performance. More experienced tank commanders had shorter opening times, and more experienced gunners had more main gun hits; the longer the two had trained together, the shorter their opening times. In Phase II, Groups 1 and 2 performed equally well, indicating that unfamiliar crews and tanks did not make a difference. Group 3 did much more poorly than Groups 1 and 2, indicating the importance of the tank commander and gunner being familiar with their duties. Groups 1 and 4 also performed about equally well, indicating that non-armor combat support personnel with brief intensive training can be integrated into crews with trained tank commanders and drivers and yield Table VIII performance comparable to that of armor crew.



Technical Paper 350

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Newell K. Eaton
Janet F. Neff

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

Approved By:

E. Ralph Dusek, Director
Personnel and Training
Research Laboratory

Joseph Zeidner, Technical Director
US Army Research Institute for the
Behavioral and Social Sciences

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

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Technology for Increasing
Soldier Productivity

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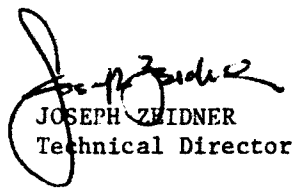
FOREWORD

An area of major importance in the Army Research Institue for the Behavioral and Social Sciences (ARI) is improvement of the individual soldier's training and performance. The ARI Field Unit at Fort Knox, Kentucky, in its work unit area "Technology for Increasing Soldier Productivity" (Army Project 2Q762717A767), is concerned with research and development of technology for improving individual performance among armor crewmen through more efficient individual training. One of the persistent problems in armor training is personnel turbulence. This Technical Paper describes research undertaken to determine the degree of tank crew turbulence in armor units and to evaluate the effects of turbulence on M60A1 gunnery performance. ARI Research Memorandum 78-15 presented Phase I of this research.



JOSEPH ZEIDNER
Technical Director

THE EFFECTS OF TANK CREW TURBULENCE ON TANK GUNNERY PERFORMANCE

BRIEF

REQUIREMENTS:

To determine the degree of tank crew turbulence in armor units and to evaluate the effects of turbulence on M60A1 gunnery performance on Tank Table VIII.

PROCEDURE:

In the first phase of this research a questionnaire was developed to evaluate existing crew turbulence. It was administered to crewmen in 5 battalions of the 1st Armor Division - USAREUR. Those crewmen were undergoing tank gunnery training, including the Table VIII qualification course, at the 7th Army Training Center, Grafenwoehr, FRG. Questionnaire responses were correlated with Table VIII scores to determine the relationship between various crew turbulence variables and gunnery performance.

In the second phase of the research personnel from the 4th Infantry Division (MECH) participated in a four-group experiment to determine the effects of artificially created crew turbulence on Table VIII gunnery performance. A control group was comprised of armor crewmen firing in their normal positions with their normal crews on their assigned tanks. A second group (Unfamiliar Crews) included armor crewmen working in their normal positions but assigned to different crews and different M60A1 tanks. A third group (Unfamiliar Crews and Positions) of armor crewmen included tank commanders who were normally gunners and gunners who were normally loaders. They were assigned to different crews and tanks as in Group 2. A fourth group (Non-Armor Replacements) included armor tank commanders and drivers, and non-armor gunners and loaders assigned from combat support units. Non-armor personnel underwent three days of training specifically designed to permit them to perform gunner and loader duties.

FINDINGS:

There was considerable turbulence in the battalions evaluated. Complete crews had normally been together 1-2 months, while typical tank commander/gunner pairs had been together 1-3 months. Typical tank commanders, gunners, drivers, and loaders had held their positions 12-42, 5-12, 5-9, and 2-6 months, respectively. Variation was great on both variables: length of time crewmen had worked together, and had been assigned to their positions.

In Phase I both the experience of the tank commander in his position and the experience of the gunner in his position were related to gunnery performance. More experienced tank commanders had shorter opening times, and more experienced gunners had more main gun hits. Neither the time the whole crew had been together nor the experience of the driver or loader was related to Table VIII performance. The longer the tank commander and his gunner had trained together, however, the shorter were their opening times.

In Phase II the Control Group and the Unfamiliar Crews Group performed equally well, indicating minimal effects of familiarity with specific crewmembers or specific tanks. The Unfamiliar Crews and Positions Group performed much more poorly than the Control or Unfamiliar Crews Group, indicating a need for the tank commander and gunner to be familiar with their duties to insure satisfactory gunnery performance. The performance of the Non-Armor Replacements Group was about equal to that of the Control Group. This indicated that non-armor combat support personnel with brief intensive training can be integrated into crews with trained armor tank commanders and drivers and yield Table VIII performance comparable to that of armor crewmen.

UTILIZATION OF FINDINGS:

These findings suggest that emphasis be placed on the training and retention of tank commanders and gunners in their respective positions.

The research also indicated the need for emphasis on cross-training gunner and loader personnel to permit them to assume tank commander and gunner positions as required. A brief intensive hands-on training program like that used with the non-armor personnel could be developed for that purpose.

Finally, the research suggested that with the 3 day training program, non-armor personnel could perform as well as gunners and loaders in tank crews with experienced tank commanders and drivers. Thus, such personnel could serve as a readily available source of replacement personnel in the event of combat.

THE EFFECTS OF TANK CREW TURBULENCE ON TANK GUNNERY PERFORMANCE

CONTENTS

CONTENTS (continued)

THE EFFECTS OF TANK CREW TURBULENCE ON TANK GUNNERY PERFORMANCE

INTRODUCTION

Tank crew turbulence, i.e. movement of crewmen to unfamiliar surroundings, occurs frequently in both training and combat situations. Loss of personnel resulting in crew turbulence has long been a concern of armor commanders in terms of the possible effects on training efficiency and gunnery performance. Crew turbulence is particularly important in combat units where personnel must be reassigned to replace combat losses. While it is generally accepted in the armor community that turbulence has a degrading effect on tank crew performance, the specific effects of different types of crew turbulence have not yet been determined empirically.

In assessing the potential effects of crew turbulence, three variables should be considered. These are position familiarity, personnel familiarity, and equipment familiarity. Position familiarity is related to the time an individual has to learn the duties associated with his duty position in the tank crew. Position turbulence can occur due to attrition of crewmen in combat situations, as well as to reassignment of personnel to new duty positions for periodic training during noncombat situations. Personnel familiarity is related to the time individuals trained in their specific duties are assigned to a particular crew. Personnel turbulence often results in crews who are together for only short periods of time prior to training exercises or combat missions. Finally, equipment familiarity is related to the time crewmen are assigned to their particular tanks. Of course, these variables are not independent. They can, and in the field usually do, occur in combination.

A review of the literature on tank crew turbulence revealed a study which investigated both the degree of crew turbulence in armor units and the effects of position familiarity on crew performance. Data on the degree of turbulence in 6 armor battalions (4 CONUS, 2 USAREUR) were presented by Larson, Earl, and Henson (1976). They found high levels of turbulence in terms of changes in duty position, and changes in personnel assigned to particular tank crews. Tank commanders typically changed duty position least (0-20% over 4-6 months), while drivers, gunners, and loaders changed duty positions quite often (33-88% over 4-6 months). Changes in personnel assigned to positions in specific tank crews was high for all positions (53-95% over 4-6 months). These findings are consistent with those from the Report of the Task Forces on Training Technology (1975) as given in Wagner, Hibbits, Rosenblatt, and Schulz (1977). The report indicated a 40% turnover in tank crews every 90 days. Larson et al. also reported a positive relation between Tank Crew Qualification Course (Table VIII) scores and time in position for tank commanders, gunners, and drivers.

The Tank Forces Management Group (1977) has identified turbulence as a consistent problem in armor training and suggested that tank crew turbulence "degrades armor unit combat readiness." The individual replacement system, centralized promotions, and position changes within the battalion were identified as the primary sources of turbulence.

Speculation about the effects of tank crew turbulence on gunnery performance to some extent depends on whether one conceptualizes a crew as consisting of a collection of individuals performing specific individual duties, or as a team of people whose performance depends more heavily on crew interaction. Wagner et al. (1977) indicated that structured team performance depended primarily on the skill levels of individual team members, and the effects of personnel turbulence were minimal. A series of studies by Egerman (Egerman, 1966, Egerman, Klaus, and Glaser, 1962; Egerman, Glaser, and Klaus, 1963; and Glaser, Klaus, and Egerman, 1962) supports this position. Wagner et al. suggest, however, that performance of tank crews in operational (low structure) settings may be affected by personnel turbulence.

The most widely utilized measure of tank gunnery is performance on a Tank Crew Qualification Course, Table VIII. Because a moderate degree of structure is involved on Table VIII, one would expect personnel turbulence to have a modest effect on gunnery performance. A Table VIII which requires movement of a firing tank from station to station to engage single and multiple targets would seem to be about midway in structure between a highly-structured, static range situation, such as Table VI, and a more freely structured unit training exercise, such as Table IX or an ARTEP.

The degree of formal job structure varies with duty position on a Table VIII. The loader and driver have highly structured duties; loading and maintaining the tank main gun and coax machine gun, and moving the tank from location to location. The gunner and tank commander have a greater variety of stimuli to which they must respond on Table VIII, and a greater degree of interaction is required. The tank commander, for example, must identify targets in a way the gunner can understand, and provide subsequent fire commands which lead to the desired gunner behavior.

Based on the premise that the effect of personnel turbulence is related to the degree of structure associated with the overall task requirements and with the degree of required crew member interaction, one might predict a moderate effect of crew turbulence on Table VIII performance. Also, tank commander/gunner turbulence would be expected to have a greater effect than driver/loader turbulence.

SPECIFIC OBJECTIVES

To determine current levels of tank crew turbulence, and to identify relationships between the various aspects of crew turbulence and gunnery performance, two research projects were executed. The first phase was conducted with a relatively large sample and utilized a correlational design. Its primary purpose was to determine current turbulence levels and explore a wide variety of potential turbulence-performance relationships. The second phase included a smaller sample under much more controlled conditions and utilized an experimental design. Its primary purpose was to explore the causal relationships between the three aspects of crew turbulence and tank gunnery performance.

PHASE I

The primary source of turbulence data presently available is that provided by Larson et al. In that report, a fairly comprehensive view of the degree of crew turbulence is presented, but the data was collected several years ago and may not represent today's armor forces. Also, the relationship of crew turbulence to gunnery performance was not fully explored.

Concern over the magnitude and effects of crew turbulence on tank gunnery training were expressed to ARI by numerous individuals in 1977, and research involving experimental manipulation of several degrees of turbulence (Phase II) was planned. In the interim this correlational research was designed and conducted in conjunction with tank crew assignment research ongoing with five armor battalions in USAREUR.

METHOD

RESEARCH PARTICIPANTS

Research participants were crewmen in the 255 tank crews from five armor battalions in a USAREUR armor division. Crewman in 211 crews completed a tank crew stability questionnaire and were included in the sample.

QUESTIONNAIRE

A Tank Crew Stability Questionnaire (PT 5188) was constructed to provide various measures of crew and crewman stability. The questionnaire included 22 questions. The tank commander was asked to answer the following questions about the crew:

1. How many months have you and your complete crew been assigned together, with you as TC, your current gunner assigned as your gunner, your current driver assigned as your driver, and your current loader assigned as your loader?

2. How many months have you and your complete crew been assigned together, with you as TC, your current gunner assigned as your gunner, your current driver assigned as your driver, and your current loader assigned as your loader, on the tank you used, or will use, to fire Table VIII?

3. How many months have you and your complete crew actually been able to train together, with you as TC, your current gunner as gunner, your current driver as driver, and your current loader as loader?

He was also asked to answer the following questions about himself and his gunner:

1. How many months have you and your current gunner been assigned together, with you as TC and your current gunner as gunner?

2. How many months have you and your current gunner been assigned together, with you as TC and your current gunner assigned as your gunner, on the tank you used, or will use, to fire Table VIII?

3. How many months have you and your current gunner actually been able to train together, with you as TC, and your current gunner as gunner?

Each tank commander was then asked to answer the following questions about himself:

1. How many months have you been assigned as the TC on the tank you used, or will use, to fire Table VIII?

2. How long have you been assigned the duties of TC, regardless of the tank, crew, or company you may have been in?

3. How long have you actually had to train in the duties of TC, regardless of the tank, crew, or company you may have been in?

4. How long have you served in M60 tanks, regardless of the duty position you held?

Then each gunner, driver, and loader were asked to answer the same four questions (which were rephrased to make them appropriate for the position). The Tank Crew Stability Questionnaire is included in Appendix A.

TANK GUNNERY MEASURES

Criterion data collected on Table VIII were opening time on each engagement and hit/miss data for each main gun round. Opening time was operationally defined as the time which elapsed from the beginning of the fire command by the tank commander until the first round was fired. To help insure completeness and accuracy of Table VIII hit and time data three sources were used. First was data taken from the records maintained by each battalion. These were collected at Grafenwoehr as each battalion fired the Table VIII. Second was data collected by a member of a data collection team during the tank crew's debriefing conducted after Table VIII. Data collection team members were enlisted men detailed by the battalion to assist ARI representatives in data collection. A data collection team member was present during each debriefing to acquire immediate hit/time data from the scorer (usually a platoon leader) and obtain answers to any questions about the conduct of the Table (misfires, targets which did not "pop-up", etc.). The third source was a tape-recording of each Table VIII run. The tape recordings included crew intercom communication, firing tank-to-control tank communication, and tower-to-tank communication. To make the recordings a data collection team member connected a cassette recorder to the firing tank's audio-frequency amplifier (AM 1780/VRC). Recordings were used to verify time measurements, answer questions about any unusual circumstances such as misfires, nonappearance of targets, etc., and to resolve any discrepancies between data collected in debriefings and data taken from battalion score sheets.

RESULTS

DATA HANDLING

Tank Crew Stability Questionnaire. Each questionnaire was checked for completeness upon receipt. Incomplete questionnaires were returned to the crew's company for completion. Using this procedure 211 questionnaires (83% of the questionnaires possible from the sample) were available for analysis. Of these 198 (78%) were complete. Crewmen's responses were converted to months for all items and tabulated for analysis. Because data was tabulated to two digits a maximum of 99 months (8 years 3 months) was permissible on any item. Any respondent answering with more than 8 years 3 months was assigned a score of 99 months.

Tank Gunnery Measures. Gunnery hit/miss and opening time raw scores were tabulated for each tank and cross-checked to insure accuracy by using battalion scoresheets, debriefing scoresheets, and the tape recordings. From these the following summary variables were computed for each tank:

Summary Variables

1. Mean main gun opening time - day.
2. Mean main gun opening time - night.

3. Mean main gun opening time - day and night.
4. Total first round main gun hits - day.
5. Total first round main gun hits - night.
6. Total first round main gun hits - day and night.
7. Total main gun targets hit - day.
8. Total main gun targets hit - night.
9. Total main gun targets hit - day and night.

Because Table VIII gunnery was conducted by each of the five battalions according to slightly different procedures the possibility existed that battalions would exhibit significant differences on the summary gunnery variables above, necessitating use of standardized rather than summary gunnery variables in ensuing analyses. Accordingly, nine ANOVAs were conducted to determine whether significant between-battalion differences existed. An alpha-level of .01 was chosen. Six of the nine analyses (variables 1-4, 6, and 7) yielded significant results. Because of the between-battalion differences, intercorrelation matrices for the nine summary variables were computed overall, and separately by battalion for use in choosing final gunnery criteria. These are provided in Appendix B.

Inspection of these matrices indicated a high correlation between main gun hit measures (variables 4-9), and between opening time measures (variables 1-3), and low correlation between the various hit and time measures. Because of these relationships, and because of their significance to tank gunnery, day and night mean opening time (variable 3) and total main gun targets hit (variable 9) were chosen as the bases for the gunnery criterion measures. To eliminate between-battalion differences indicated by the ANOVAs, standardized time and hit scores were computed for each tank in each battalion. These were used as criteria for all subsequent analyses.

DESCRIPTIVE STATISTICS

Descriptive statistics, including frequency distribution, mean, median, mode, standard deviation, standard error, and semi-interquartile range were computed for all items on the Tank Crew Stability Questionnaire. A summary of these descriptive statistics, including abbreviated item designation, mean, median, standard deviation and semi-interquartile range, is provided in Table 1. Note that due to the two-digit data tabulation, mean and standard deviation statistics are somewhat conservative for items 8, 9, and 10. There were 14-18% of the TCs who answered these items with more than 8 years 3 months and were arbitrarily assigned a maximum score of 99. The median and semi-interquartile range, of course, were unaffected by this procedure. Due to the fact that the distributions for all items were positively skewed, rather than normally distributed, the median and semi-interquartile range may be the more appropriate measures of central tendency and variability. Complete descriptive statistics and frequency distributions are provided in Appendix C.

Table 1

DESCRIPTIVE STATISTICS - PHASE I

Abbreviated Item Designation (N =)	Mean	Median	Standard Deviation	Semi Inter-Quartile Range
1. Months crew assigned together (211)	2.2	1.2	3.4	1.3
2. Months crew assigned on Table VIII tank (210)	1.9	1.1	2.7	1.2
3. Months crew trained together (211)	1.5	.8	2.5	.9
4. Months TC and GR assigned together (211)	3.5	2.6	3.9	2.1
5. Months TC and GR assigned on Table VIII tank (211)	3.4	2.5	3.8	2.0
6. Months TC and GR trained together (211)	2.9	1.9	2.4	1.8
7. Months TC on Table VIII tank (211)	6.8	4.1	6.9	3.9
8. Months TC assigned as TC (208)	(36.6)*	24.3	(34.3)*	26.6
9. Months TC trained as TC (209)	(38.1)*	24.4	(34.6)*	26.1
10. Months TC on M60 tanks (208)	(47.7)*	45.5	(33.2)*	26.1
11. Months GR on Table VIII tank (207)	5.3	3.4	6.1	2.9
12. Months GR assigned as GR (209)	12.6	8.9	12.1	7.9
13. Months GR trained as GR (209)	13.5	8.4	14.9	9.4
14. Months GR on M60 tanks (208)	27.4	24.3	16.8	8.6
15. Months DR on Table VIII tank (200)	5.4	3.2	6.0	3.7
16. Months DR assigned as DR (204)	11.1	7.7	11.5	7.9
17. Months DR trained as DR (204)	11.2	7.6	11.6	7.9
18. Months DR on M60 tanks (199)	16.3	12.5	14.6	9.4
19. Months LR on Table VIII tank (198)	4.0	2.1	5.1	2.6
20. Months LR assigned as LR (199)	7.3	4.1	8.1	4.7
21. Months LR trained as LR (200)	7.4	4.0	8.6	4.9
22. Months LR on M60 tanks (199)	13.4	9.3	12.2	8.6

* Due to tabulation procedure mean and standard deviation statistics are conservative for item 8, 9, and 10.

TURBULENCE - GUNNERY RELATIONSHIPS

In order to assess the relationship between crewmen's responses on the Tank Crew Stability Questionnaire and Table VIII performance, correlations were computed between crewmen's responses, in months, and the Table VIII opening time and targets hit criteria described above. The results of these correlations are shown in Table 2. Because of the large number of correlations computed, and the relatively large sample, an alpha level of .01 was chosen for significance.

Responses on many of the turbulence questionnaire items were positively skewed. In addition, a linear relation may not be expected between performance and crew/crewman experience. One might expect greater performance increments associated with experience increments for relatively inexperienced crews/crewmen than with equal experience increments for more experienced crews/crewmen. Therefore, a log transformation was computed for questionnaire responses wherein the transformed score equaled Log_{10} (raw score + c). The constant (c) was determined by examination of frequency distributions of transformed scores. Various constants from 0.2 to 3.0 were evaluated, and the c which best provided a median transformed score equidistant from the ends of the distribution was chosen. By this procedure more symmetrical distributions were obtained for all variables. Correlations were then computed between the transformed questionnaire responses and the opening time and targets hit criteria. Response-criterion correlations and constants chosen are shown in Table 2. Again an alpha level of .01 was chosen for significance.

Three kinds of relationships proved to be significant. First, the more time a TC and his gunner had trained together the more quickly the crew opened fire. Second, the more experience the TC had, in terms of his assignment as TC on his Table VIII tank, his assignment as TC, and his training as TC, the more quickly the crew opened fire. Third, the more training a gunner received the more targets his tank hit.

DISCUSSION

There were two objectives of this research. First was to determine the degree of tank crew stability in five armor battalions in USAREUR. The second was to determine the relation between tank crew stability and tank gunnery performance on the Tank Crew Qualification Course, Table VIII, at Grafenwoehr, FRG.

The data presented above under Descriptive Statistics indicated that there was considerable turbulence in the battalions observed. While complete crews normally had been together 1-2 months, as shown by mean and median statistics, there was considerable variation. Many had been together more than 2 months while others had been together less than 1 month. The same pattern existed for tank commander/gunner

Table 2

TURBULENCE - GUNNERY RELATIONSHIPS

Abbreviated Item Designation	Analysis of Raw Scores With:		Transformed Scores With:		
	Opening Time	Targets Hit	Opening Time	Targets Hit	c
1. Months crew assigned together	-.07	+.02	-.14	+.03	.2
2. Months crew assigned on Table VIII tank	-.09	-.01	-.12	+.03	.2
3. Months crew trained together	-.09	-.02	-.12	-.01	.2
4. Months TC and GR assigned together	-.11	+.04	-.15	+.02	.3
5. Months TC and GR assigned on Table VIII tank	-.10	+.04	-.14	+.04	.3
6. Months TC and GR trained together	-.12	+.02	-.19*	+.02	.2
7. Months TC on Table VIII tank	-.20*	+.03	-.21*	+.02	.5
8. Months TC assigned as TC	-.15	-.02	-.28**	+.03	.5
9. Months TC trained as TC	-.11	-.03	-.23**	-.01	.5
10. Months TC on M60 tanks	-.10	-.04	-.13	-.06	1.0
11. Months GR on Table VIII tank	-.05	.00	-.12	-.02	.5
12. Months GR assigned as GR	+.03	+.15	.00	+.10	.5
13. Months GR trained as GR	+.07	+.19*	+.05	+.10	1.0
14. Months GR on M60 tanks	+.01	+.14	-.03	+.11	3.0
15. Months DR on Table VIII tank	-.07	+.06	-.10	-.10	.5
16. Months DR assigned as DR	-.13	+.06	-.14	-.02	1.0
17. Months DR trained as DR	-.13	+.07	-.07	-.02	1.0
18. Months DR on M60 tanks	-.16	+.01	-.17	-.01	3.0
19. Months LR on Table VIII tank	-.08	-.04	-.11	-.01	.2
20. Months LR assigned as LR	+.03	-.09	+.03	-.05	.3
21. Months LR trained as LR	+.03	-.05	-.01	-.03	.2
22. Months LR on M60 tanks	-.01	-.04	-.01	-.00	1.0

$184 \leq N \leq 211$

*$p < .01$

** $p < .001$

turbulence. Typically, tank commanders and gunners had been together 1-3 months, but variation was great, with many together less than one month and many others together 4 months or more.

The data indicated that most tank commanders had a moderate level of experience as tank commanders, typically 12-42 months. Again, there was great variation in experience. Tank commanders typically had been assigned to their Table VIII tank 3-6 months, but wide variation was evident on this variable also.

Data for remaining crewmembers, gunners, drivers, and loaders, followed the same pattern, but with progressively less experience at each position. Results indicated gunners, drivers, and loaders typically had 5-11, 5-9, and 2-6 months experience, respectively. These crewmen had typically been assigned to their position on their Table VIII tank 1-5 months, depending on position. As with tank commanders, variation was great, with many gunners, drivers, and loaders assigned more than 6 months, and many others less than one month.

Observation of the relation between crew stability measures and gunnery performance was quite instructive. The results indicated no significant relation between gunnery performance and the time the entire crew had been together, but did indicate that the longer the tank commander and gunner had trained together the more rapidly they opened fire on their targets. Thus, while unit commanders may not need to stress whole-crew stability, some emphasis placed on tank commander-gunner stability may yield tank crews which can service targets more rapidly. Of course, these findings are limited by the degree of turbulence observed within the battalions, and would not necessarily generalize to situations where there might be considerably less turbulence. In these battalions, however, the range of crew and tank commander-gunner turbulence was in keeping with the findings of Larson et al. The battalions seemed to fairly represent current US armor battalions. While whole-crews having a significantly greater amount of experience together may indeed perform better than those in this research, such crews do not seem to exist in any sizable numbers.

Tank commanders experience, in that position, was related to gunnery performance. The longer a tank commander had been assigned to his tank, the longer he had been assigned as a tank commander, and the longer he had trained as tank commander, the faster his opening time on Table VIII. These relationships can best be explained in terms of the development of the tank commander's skills. It would seem logical that such relations arise. The tank commander has more control over time-to-fire, in terms of his target acquisition, gun-laying, ranging, and fire command, than any other crewmember.

While no relation was observed between tank commanders variables and number of targets hit, that can probably be explained by the fact that it is the gunner who normally engages targets. He must lay on targets and make adjusted lays based on the various fire adjustment methods. In addition, because the ranges to targets were fairly well known by the tank crews, any effects of differences in tank commanders ranging skills would have been attenuated.

From the discussion one might expect to observe a relation between gunner training and number of targets hit. Such a relation was revealed by the analysis. The longer a gunner had trained as gunner the more targets his tank hit on Table VIII. Although no relation was observed between gunner variables and opening time such a finding may be explained in terms of the tank commanders greater control on that variable.

No significant relationships were observed between driver or loader variables and either time or targets hit on Table VIII. These results may also be readily explained. In most cases the ammunition to be used was announced and loaded prior to the beginning of an engagement, thus limiting the effect a loader could have on opening times. And loaders appeared to be consistent in identifying and loading the ammunition correctly, thus limiting the effect of loader variables on the targets hit criterion. Because engagements did not begin until the tank was in position, the driver's contribution to hits and time was limited.

Overall, the findings for individual crewmembers indicate that position familiarity of tank commanders and gunners plays a small, but significant, part in reducing opening time on Table VIII, and increasing the number of targets hit. Such a finding is, of course, in concurrence with the beliefs of the majority of the armor community. It would seem to underscore the need for emphasizing the training, and retention, of tank commanders and gunners in their respective positions.

PHASE II

The results reported in the Phase I research indicated a relation between tank commander's position familiarity and gunnery performance; and a relation between tank commander/gunner personnel familiarity and gunnery performance. Because of the correlational nature of the research, however, causal relations between these variables were not clearly demonstrated. And the many uncontrolled variables in the correlational research, such as weather, equipment, unit training, unit policies, scoring standards, etc., may have overshadowed smaller effects due to more modest levels of crew turbulence.

The purpose of this research was to delineate causal relationships between gunnery performance and various types of crew turbulence which can occur in operational units. Maximum turbulence conditions were created, thus facilitating the evaluation of the effects of turbulence on gunnery performance.

It was hypothesized that reduced personnel and equipment familiarity would result in reduced gunnery performance. Personnel and equipment familiarity usually change concurrently in operational armor units. When an armor crewman is reassigned it is usually to a different crew and tank, which should lead to immediate reductions in personnel and equipment familiarity for the reassigned crewman. Reassignment of all crewmembers to crews and tanks with which they are unfamiliar should lead to maximal reductions in personnel and equipment familiarity, and show maximal effects of those variables on gunnery performance.

It was also hypothesized that reductions in position familiarity, resulting from changing an individual's position assignment, should lead to reduced gunnery performance. In typical units tank commander replacements are chosen from available gunners, while gunner replacements are chosen from available loaders or drivers. (With the implementation of CMF 19 gunners will be chosen from available loaders). Reduced position familiarity attendent to change in duty position from gunner to tank commander, and loader to gunner, should lead to reduced gunnery performance. The degree of such performance decrements should be a function of the level of cross training provided to gunners and loaders. Reductions in position familiarity, in combination with reduced position and equipment familiarity attendent to reassignment to new crews/tanks should lead to greater reductions in gunnery performance.

Position turbulence could also occur should there be an outbreak of hostilities requiring that replacements for tank crewmen be taken from combat support battalions and include non-armor personnel. Among the personnel selected for these positions may be cooks, clerks, military policemen, etc. Individuals in these occupations exist in most combat divisions world-wide, and could provide a source of personnel to serve in tanks should replacements for tank crews be required before time permits armor crewmen to be provided through normal channels. Preparation for combat would probably consist of a brief training program for crewmen and not more than a day to train with the crews to which they would be assigned. Such replacement personnel would initially experience reduced levels of position, equipment, and personnel familiarity, and probably reduced gunnery performance. The degree to which such reductions in familiarity lead to reduced gunnery performance would depend upon the efficacy of the training given and the time crewmen have to work together.

To evaluate these hypotheses a four-group experiment was designed. One group was a control group while three were experimental groups representing the different turbulence variables. All personnel in Groups 1, 2, and 3 were armor crewmen while non-armor crewmen were included in the 4th Group. Group 2 was comparable to the Control Group in position familiarity, but represented a low degree of personnel and equipment familiarity. Group 3 represented a low degree of position, personnel, and equipment familiarity. Group 4 was a group consisting of armor tank commanders and drivers, and non-armor gunners and loaders who had been given three days training. All were assigned unfamiliar equipment and personnel.

Comparisons of the Control Group and Group 2 permit an evaluation of personnel and equipment familiarity for armor personnel. Comparison of the Control Group with Group 3 was designed to illuminate the combined effects of position, personnel and equipment familiarity for armor personnel, while comparison of Group 3 with Group 2 would permit evaluation of the effects of position familiarity alone. Finally, comparison of the Control Group with Group 4 was designed to evaluate the combined effects of position, personnel, and equipment familiarity for non-armor personnel, while comparisons of Groups 2 and 4 could provide an evaluation of the effects of position familiarity alone.

The primary objectives were to determine the effects of crew turbulence on tank crew gunnery performance and to study the effects of replacing crewmembers with non-armor personnel including the development and evaluation of a training program for non-armor replacements. The secondary objective was to test the relationships between gunnery performance and selected turbulence variables using the Tank Crew Stability Questionnaire.

METHOD

RESEARCH PARTICIPANTS

The research participants were primarily tank crewmen from an operational armor battalion at Ft Carson. Tank crewmen from 44 crews completed the Tank Crew Stability Questionnaire for use in the correlational phase of the research. An additional 22 non-armor personnel were selected from the 4th Infantry Division (Mech) to participate in the experimental phase. These men were excused from their duties to participate in the research. This sample consisted of a Unit Organizational Supplyman, and Administrative Specialist, three Food Service Specialists, a Wheeled Vehicle Mechanic, two Infantrymen, a Telecommunications Center Specialist, six Military Policemen, one Correctional Specialist, one Race-Relations Equal-Opportunity Specialist, a Tracked Vehicle Mechanic, two Tactical Wire Operations Specialists, a Radio Operator, and a Voice Radio Operator.

PROCEDURE

The battalion participating in the research had just completed its annual gunnery season culminating in the Tank Table VIII for crew qualification. Following the Qualification Table VIII, tank crewmen were assigned to one of the four groups included in the research, and fired a second Table VIII. This second, or "turbulence", Table VIII provided scores with which to evaluate the effects of turbulence in the experimental groups.

Gunnery performance measures for both Qualification and Turbulence Table VIII were collected with the cooperation of the 4th Infantry Division (Mech) Tank Gunnery Assistance Team and included Table VIII point scores and time/hit data on individual engagements. A description of the Turbulence Table VIII engagements is provided in Table 3.

Tank Crew Stability Questionnaires (described in Phase I) were completed by tank crewmembers following the first Table VIII and returned to ARI personnel for use in the assignment of crewmen to experimental conditions for the Turbulence Table VIII. This data was also used in the correlational phase of the research.

Qualification Table VIII rosters and Tank Crew Stability Questionnaires were the bases for selecting research participants and assigning crews to experimental groups. Only crews that had remained stable through Tables VII and VIII were considered. The assignments were made for each company immediately following their completion of Table VIII. Fifteen crews from two companies and fourteen crews from a third company were selected. These crews were randomly assigned to experimental conditions to create four groups of 11 crews each, and fired the turbulence Table VIII under the conditions specified by the group to which they were assigned.

The experimental groups were created in the following manner: Group 1 (Control) crews were selected from the sample of complete crews which were available for the study. Each crewman assigned to this group was with his Table VIII crew and maintained his normal duty position. These crews were assigned to their Table VIII tanks. The first group was the control against which the remaining groups were compared.

The men assigned to Group 2 (Unfamiliar Crews) maintained the duty positions in which they had been trained and evaluated during the gunnery season. However, they were assigned to work with personnel with which they had not served during the Qualification Table VIII and were assigned to a tank to which they had not been previously assigned.

The Group 3 (Unfamiliar Crews and Positions) crews also consisted of crewmen who had not been together on Qualification Table VIII, and who were assigned to unfamiliar tanks. The Group 3 tank commanders were excused and replaced by their gunners, and the gunner positions

Table 3

TURBULENCE TABLE VIII

DAY

Target	Engagement	Range (Meters)
1. Anti-tank (steel)	Precision, HEP-T	1950
2. Moving tank (panel)	Precision, APDS-T	1750
3. Troops	Coax	300
4. Troops	Cal .50	1400
5. Troops	Coax	450
6. Tank (panel)	Battlesight, HEAT-T	1000
7. Moving truck (panel)	Coax	600
8. Truck (panel)	Cal .50	1600
9. Tank (steel)	Precision, HEAT-T	1750
10. Tank (steel)	Battlesight, APDS-T	900

NIGHT

Target	Engagement	Range (Meters)
1. Tank (panel)	Precision, APDS-T	2000
2. Truck (panel)	Cal .50	750
3. Troops	Cal .50	1400
4. Moving tank (panel)	Battlesight, APDS-T	1200
5. Anti-tank (steel)	Battlesight, HEAT-T	900
6. Anti-tank (panel)	Precision, HEAT-T	1500
7. Troops	Coax	200
8. Moving truck (panel)	Coax	500
9. Troops	Coax	450
10. Anti-tank (steel)	Battlesight, HEP-T	700

were filled by the loaders. The driver and loader positions were filled with men who had held those positions during the gunnery season. As with Group 2, the crewmen in Group 3 had not been trained together or worked on the tank to which they were assigned.

In Group 4 (Non-Armor Replacements) tank commanders and drivers were armor crewmen who had served in those positions, but not together, during the gunnery season. They were assigned to a tank they had not used during the Qualification Table VIII. The gunners and loaders were non-armor personnel who were randomly assigned to crews.

The assignment of personnel to experimental groups was random with the restrictions that Group 1 (Control) crews had to work with the same crewmembers and on the same tank they had used on the first Table VIII while crewmen in Experimental Groups 2, 3, and 4 were assigned to completely different crews and tanks. No crewman served in more than one duty position. Due to inoperative equipment it was impossible for a limited number of crews to fire on the tanks to which they had been assigned (familiar tanks for Group 1, and unfamiliar tanks for Groups 2-4). There were 4 such crews from Group 1; 3 from Group 2; 2 from Group 3; and 1 from Group 4. In order to retain these crews in the study, they were reassigned to other (and inappropriate) tanks. Due to movement of personnel within the battalion, drivers and loaders occasionally had to work with more than one crew, but maintained their normal duty positions.

The tank commanders in Groups 1, 2, and 3 were informed of their crews and group assignments one day prior to their firing the second Table VIII. No formal training program was permitted, but the tank commanders were encouraged to meet with their crews for several hours in order to familiarize themselves with each other, their tanks, and their specific crew duties.

The Group 4 tank commanders, drivers, and non-armor men reported to the Ft Carson Table VII where they remained until they fired the turbulence Table VIII. The non-armor personnel were arbitrarily designated as either gunners or loaders, and were assigned to a tank commander/driver pair. A three-day training program was conducted for the non-armor personnel under the supervision of ARI and battalion representatives with the tank commanders and drivers functioning as cadre. The three-day training program was designed to prepare gunners and loaders to fire Table VIII only and did not include training on normal maintenance, tactics, etc. The gunners' program involved safety, preparation for operations, fire commands, identification of targets, adjustment of fire, and tracking. The loaders' program included TEC lessons and hands-on practice. Loader's training emphasized safety, ammunition identification and loading procedures, preparation for operations, M219 disassembly and assembly, replenisher tape reading, preoperation checks and services, and combat loading. The gunners and loaders completed each exercise (day and night) using sub-caliber ammunition on Days 1 and 2, and 10 main gun rounds on Day 3.

On Day 3 the non-armor gunners and loaders were reassigned to a tank commander/driver pair other than the ones with which they trained. This was done to meet the requirements of the combat replacement scenario described above. This also made the familiarity of Group 4 crewmembers comparable to that of Group 2 and 3 crews. The crews fired Table VIII within a day or two following completion of their training.

An outline of the three-day training program is provided in Appendix D. A complete description of the training is given in O'Brien, Crum, and Healy, 1978.

RESULTS

Of the 44 crews identified for participation in the research 40 completed the turbulence Table VIII and were included in the data analysis. These included 11 crews in Group 1 (Control), 10 in Group 2 (Unfamiliar Crews), 9 in Group 3 (Unfamiliar Crews and Duty Positions), and 10 in Group 4 (Non-armor Replacements). The Group 2 tank was disqualified on Table VIII for disciplinary (not gunnery) reasons. One Group 3 tank was disqualified due to a gross (gunnery) safety violation and one failed to complete the night course due to a minor injury sustained during the day course. The Group 4 tank was disqualified due to equipment malfunctions.

DATA HANDLING

Table VIII data was tabulated for each crew for both the qualification Table VIII and the turbulence Table VIII. Variables considered are shown below:

Primary Variables

- Table VIII points
- Main gun targets hit
- Main gun opening time
- Machine gun points

Secondary Variables

- Main gun points
- Stationary battlesight targets hit
- Stationary precision targets hit
- Moving targets hit
- Number of main gun targets hit within time standard (5 sec battlesight or 10 sec precision)
- Stationary battlesight opening time
- Stationary precision opening time
- Moving target opening time

Means were computed for each crew on each variable for Table VIII Day (D), Night (N) and Day and Night (D + N) combined. Point scores were computed using the standard Ft Carson Tank Gunnery Assistance Team (TGAT) procedures. On main gun engagements 75 points were awarded on each engagement where a target was hit within the allotted time (20 seconds on battlesight engagements or 30 seconds on precision engagements). In addition, between 0 and 75 points were awarded for opening time on any engagement wherein a target was hit. Maximum opening time points were awarded when opening times were less than 5 seconds on battlesight engagements, or less than 10 seconds on precision engagements. Longer opening times were awarded fewer points in accordance with the sliding scales for opening time points provided in Appendix E.

Machine gun points were computed on each engagement as follows: When the opening rounds were within the target area 20 points were awarded for opening times of 5 seconds or less. Opening times of longer than 5 seconds were awarded fewer points according to a sliding scale provided in Appendix F. In addition, up to a maximum of 20 points were awarded for target effect (4 points/hit for vehicle engagements or 4 points/each 5th of troop coverage on troop engagements). Finally, up to 10 points were awarded for "technique" based on the judgment of the TGAT NCO who scored the firing tank.

Stability questionnaire data was tabulated and handled just as in the first portion of the research.

EQUIPMENT FAMILIARITY

The unplanned assignment of a few Group 1 crews to unfamiliar tanks, and some Group 2, 3, and 4 crews to tanks on which one or more crewmembers had fired during annual gunnery permitted an evaluation of equipment familiarity which otherwise could not have been made. The planned evaluation of equipment familiarity was to be made in conjunction with an evaluation of personnel familiarity (comparison of Group 1 with Group 2); however, a separate analysis of equipment familiarity was possible.

To evaluate the effects of equipment familiarity crews were designated as "unfamiliar" with equipment if no crewmembers were assigned to the tank during the annual gunnery season, and "familiar" if the tank commander and/or gunner were assigned to the tank during annual gunnery. For each variable (D + N, D, and N), a 3 x 2 unweighted means Analysis of Variance (Winer, 1971, pp. 447) was computed. One factor was equipment familiarity, as defined above, while the second was Group assignment; 1, 2, or 3. There were too few unplanned tank assignments in Group 4 to enter into the analysis.

The results of the 36 Analyses of Variance (ANOVAs) indicated 4 main effects of familiarity: stationary battlesight targets hit (N), total main gun targets hit (N), total main gun points (N), and moving target opening time (D). In the first three cases crews on unfamiliar tanks performed better than those on familiar tanks. Familiarity interacted with Group assignment in only three cases: moving target opening time (D + N), stationary precision targets hit (N), and moving target opening time (D). The first interaction occurred because the three Group 2 crews on familiar tanks performed more slowly than their counterparts on unfamiliar tanks, while the second was due to the two group 3 crews on familiar tanks performing more poorly than their counterparts. Only the relationships with the opening time on the moving target (N) made sense; equipment-familiar crews opened fire more quickly than unfamiliar crews. This was interpreted as a chance occurrence. Consequently, all crews' results were treated according to their nominal group assignments in all further analyses, and equipment familiarity as a variable was given no further consideration. All summary data for analyses are provided in Appendixes G, H, and I.

BETWEEN GROUP DIFFERENCES

In order to determine whether significant group by company interactions existed, two-way unweighted means ANOVAs were computed on each variable. Significant group by company interactions would indicate that the treatment (group assignment) effects observed depended upon the companies from which the crews were drawn. Such a finding would limit the generalizability of the results. The ANOVAs, however, revealed no significant interactions (all $F \leq 2.40$, $p > .05$, $df = 3,36$). Accordingly, all further analyses were based on one-way ANOVA computations.

In order to evaluate between group differences, Dunnett tests (Winer, 1971, pp. 201) were computed for comparisons of the control group (Group 1) with the three experimental groups. Tukey tests (Steele and Torrie 1960, pp. 109) were computed for differences between experimental groups. Alpha levels were set at $p < .05$, 2 tailed, for all comparisons. The Dunnett and Tukey procedures were chosen as more conservative analyses than the Newman-Keuls.

An overview of the results indicated that numerically, Groups 1, 2, and 4 were comparable, while Group 3 performed more poorly. Typical results are shown in Figure 1 for Table VIII total points (D + N), main gun targets hit (D + N), main gun opening time (D + N), and machine gun points (D + N). Statistically significant between group differences were found for total points and opening time. A detailed description of the results is given in the following pages. Means and between-group comparison significance levels are provided in Tables 4 and 5.

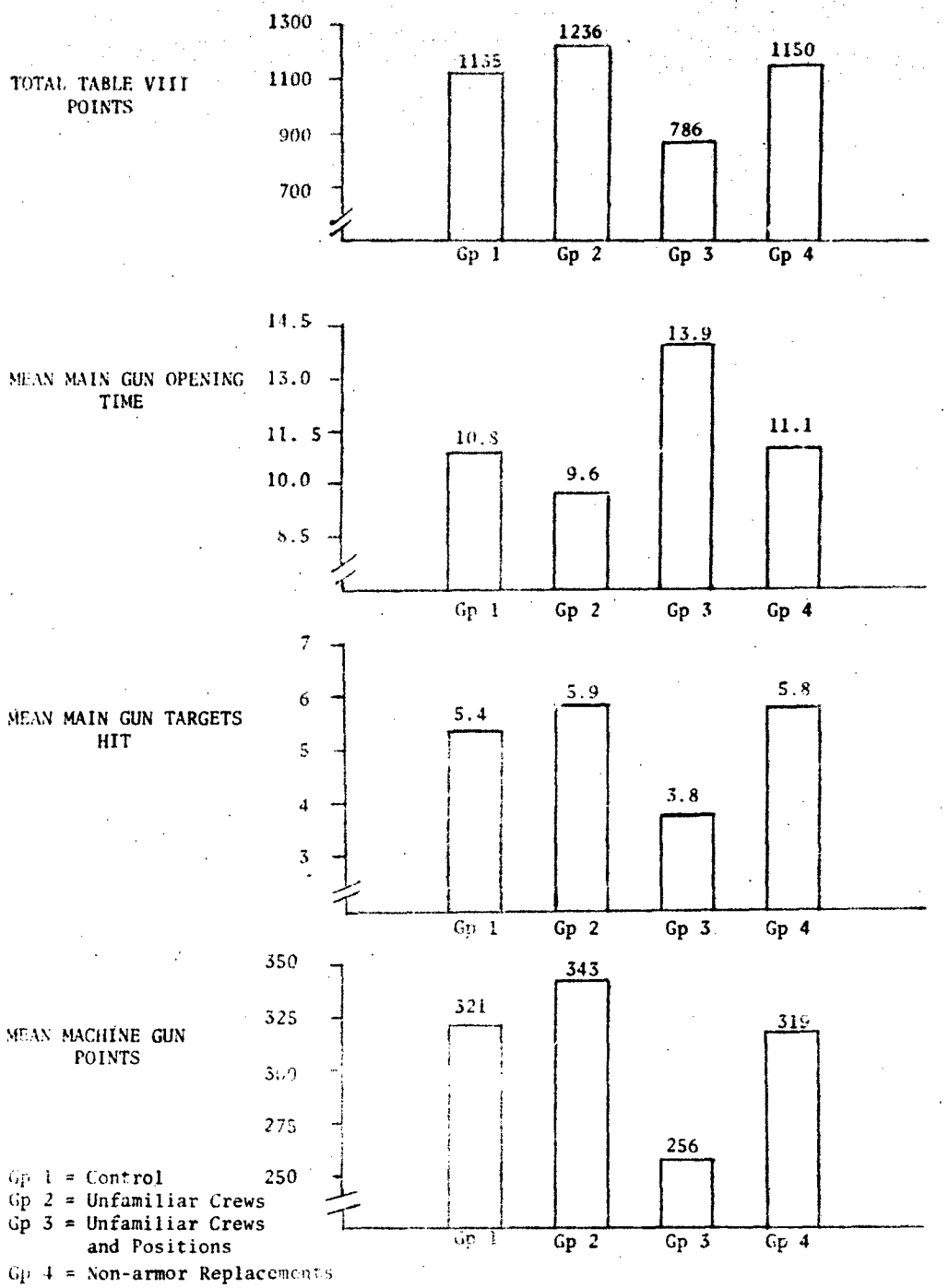


Figure 1. Tank Gunnery Performance as a Function of Group Assignment

Table 4

GROUP MEANS ON TANK GUNNERY PERFORMANCE VARIABLES

	Day and Night Combined				Day				Night			
Group:	1	2	3	4	1	2	3	4	1	2	3	4
OPENING TIME												
Stationary battlesight	7.16	6.85	10.47	8.00	6.00	5.95	8.66	7.35	8.32	7.75	12.28	9.15
Stationary precision	14.77	12.17	19.41	14.69	13.95	11.50	17.44	14.70	15.50	12.85	21.44	15.30
Moving target	10.55	10.20	12.55	9.90	12.45	12.50	14.67	11.30	8.73	7.90	10.44	8.50
TOTAL Main Gun	10.77	9.64	14.48	11.15	10.50	9.48	13.36	11.08	11.25	9.82	15.58	11.48
TARGETS HIT												
Stationary battlesight	3.27	3.40	2.11	3.10	1.55	1.40	1.22	1.70	1.73	1.90	0.78	1.40
Stationary precision	1.45	2.00	1.33	1.90	0.55	0.90	0.66	0.80	0.91	1.10	0.67	0.90
Moving	0.64	0.60	0.44	0.60	0.18	0.40	0.22	0.30	0.55	0.20	0.22	0.30
Within time standard	1.45	2.50	0.78	1.10	0.64	1.00	0.33	0.50	0.73	1.50	0.44	0.60
TOTAL Main Gun	5.36	5.90	3.78	5.80	2.27	2.70	2.11	2.80	3.09	3.20	1.67	2.50
TABLE VIII POINTS												
Machine gun points	321.36	342.90	256.33	318.60	156.64	178.60	137.22	170.60	164.73	164.30	119.11	153.00
Main gun points	763.55	845.80	438.11	788.40	328.82	395.40	277.89	400.70	434.73	450.40	210.22	387.70
TOTAL	1134.91	1236.20	786.11	1149.50	510.45	557.30	435.67	572.30	615.36	637.20	351.56	563.20

Table 5

RESULTS OF BETWEEN GROUP COMPARISONS OF TANK GUNNERY PERFORMANCE

	Significance level for: DAY AND NIGHT COMBINED						DAY						NIGHT					
	Dunnett Test of Groups			Tukey Test of Groups			Dunnett Test of Groups			Tukey Test of Groups			Dunnett Test of Groups			Tukey Test of Groups		
	1&2	1&3	1&4	2&3	2&4	3&4	1&2	1&3	1&4	2&3	2&4	3&4	1&2	1&3	1&4	2&3	2&4	3&4
OPENING TIME																		
Stationary battlesight	--	.01	--	.05	--	--	--	.05	--	--	--	--	--	.05	--	--	--	--
Stationary precision	--	.05	--	.01	--	--	--	--	--	--	--	--	--	.05	--	.01	--	--
Moving target	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL Main Gun	--	.01	--	--	--	--	--	--	--	--	--	--	--	.01	--	.05	--	--
TARGETS HIT																		
Stationary battlesight	--	--	--	--	--	--	--	--	--	--	--	--	--	.01	--	.01	--	--
Stationary precision	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moving	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Within time Standard	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL Main Gun	--	--	--	--	--	--	--	--	--	--	--	--	--	.05	--	--	--	--
TABLE VIII POINTS																		
Machine gun points	--	--	--	--	--	--	--	--	--	--	--	--	--	.05	--	--	--	--
Main gun points	--	--	--	--	--	--	--	--	--	--	--	--	--	.01	--	--	--	--
TOTAL	--	.05	--	--	--	--	--	--	--	--	--	--	--	.01	--	.05	--	--

.05 - $p \leq .05$, 2-tailed
.01 - $p \leq .01$, 2-tailed
Not significant, $p > .05$, 2-tailed

UNFAMILIAR CREWS

Comparison of Group 1 with Group 2. Group 1 and Group 2 differed in degree of personnel familiarity. Group 1 personnel fired the turbulence Table VIII with the same crewmen and in the same positions as on the qualification Table VIII two weeks previously. Group 2, on the other hand, was composed of crewmen who held the same positions as they held on the qualification Table VIII, but who were working with different crewmen. Thus, any differences between the groups could be attributed to differences in familiarity of crewmembers. Computation of Dunnett's t for comparisons of Group 1 with Group 2 on each of the 12 gunnery variables Day (D), Night (N), and Day and Night combined (D + N), revealed no significant differences between groups. Thus personnel familiarity did not contribute in a significant manner to performance variation on the turbulence Table VIII.

UNFAMILIAR POSITION

Comparison of Group 2 with Group 3. Because both Group 2 and Group 3 were conditions with reduced personnel familiarity, the comparison of Group 2 and 3 is appropriate for evaluating the effects of reduced position familiarity. The Tukey analyses indicated many significant effects. The crews which experienced only personnel changes had significantly more total points (N) and battlesight targets hit (N) and faster main gun opening times (N), precision opening times (N, and D + N), and battlesight opening times (D + N).

UNFAMILIAR CREWS AND POSITIONS

Comparisons of Group 1 and Group 3. Group 3 crews experienced both personnel and duty position turbulence. Because personnel familiarity, evaluated in comparisons of Group 1 and 2, yielded no significant differences, any differences between Group 1 and Group 3 can probably be attributed to unfamiliarity with positions. The Control crews had significantly more Table VIII points (D + N, and N), main gun points (N), main gun targets hit (N), battlesight targets hit (N), and machine gun points (N). In addition, Group 1 opening times were significantly faster over all main gun engagements (D + N, and N), battlesight engagements (D + N, D and N) and precision engagements (D + N, and N). Thus, while personnel differences alone did not lead to significant performance differences between Control Crews and Unfamiliar Crews, Unfamiliar Positions in addition to Unfamiliar Crewmembers led to numerous significant performance decrements.

NON-ARMOR REPLACEMENTS

Comparisons of Group 1 and 4. As with Groups 1 and 3, Groups 1 and 4 differed in personnel and duty familiarity, but involved a different kind of duty position turbulence. The Group 4 crews consisted of armor-trained tank commanders and drivers, and non-armor trained gunners and loaders. Because personnel turbulence did not lead to significant performance differences between Groups 1 and 2, any differences between Groups 1 and 4 could best be attributed to replacing crewmembers with non-armor personnel. The results, however, indicated no significant differences between Groups 1 and 4 on any of the gunnery variables evaluated.

Comparison of Groups 2 and 4. As with the evaluations of job familiarity above, Group 2 provides a control for the evaluation of the type of duty position turbulence created in Group 4. There were no significant differences between Groups 2 and 4 on any of the gunnery variables evaluated.

Comparison of Groups 3 and 4. Comparisons of Group 3 and 4 were used to evaluate the effects of the two different kinds of duty position turbulence. Although the performance of Group 4 was numerically superior to that of Group 3 on all variables, the differences did not reach acceptable levels of significance.

TABLE VIII RELIABILITY

The design of the turbulence research offered a unique opportunity to acquire test-retest data with which to address the reliability of Table VIII. The data was available because the Control crews had completed their qualification Table VIII with the same crewmembers, in the same duty positions, and on the same tanks as used for the turbulence Table VIII. In cases wherein a crew re-ran the Table VIII for qualification, the most recent data was used for analysis. Correlations of +.43 for total points, +.50 for main gun points, +.37 for main gun targets hit, and +.54 for main gun opening time were obtained. Because of the small sample size (N = 11) significance tests on the correlations are not particularly meaningful. These correlations are best considered as point estimates of test-retest relationships.

QUESTIONNAIRE RESULTS

Tank Crew Stability Questionnaires and Table VIII results from 44 crews were available for analyses. The questionnaires were handled as they were in Phase I. A summary of descriptive statistics including mean, median, standard deviation, and semi-interquartile range is provided in Table 6. Selected questionnaire variables identified in Phase I as significant were correlated with Table VIII gunnery measures. No significant relationships were indicated by these analyses. This can probably be explained by the smaller sample in Phase II.

Table 6

DESCRIPTIVE STATISTICS - PHASE II

Abbreviated Item Designation (N =)	Mean	Median	Standard Deviation	Semi Inter-Quartile Range
1. Months crew assigned together (52)	1.42	.50	2.93	.53
2. Months crew assigned on Table VIII tank (52)	1.02	.44	2.40	.44
3. Months crew trained together (52)	.77	.41	1.84	.40
4. Months TC and GR assigned together (52)	3.33	2.00	4.25	2.21
5. Months TC and GR assigned on Table VIII tank (52)	2.65	1.50	3.42	1.58
6. Months TC and GR trained together (52)	2.42	1.00	3.84	1.25
7. Months TC on Table VIII tank (52)	4.37	4.50	4.54	4.62
8. Months TC assigned as TC (52)	(16.90)*	12.00	(21.48)*	7.17
9. Months TC trained as TC (52)	(17.57)*	12.00	(22.56)*	7.17
10. Months TC on M60 tanks (52)	(24.08)*	24.00	(28.04)*	9.75
11. Months GR on Table VIII tank (50)	3.94	2.00	5.62	2.08
12. Months GR assigned as GR (50)	12.82	8.50	16.33	8.09
13. Months GR trained as GR (48)	11.04	5.00	17.55	6.34
14. Months GR on M60 tanks (48)	30.31	27.00	18.30	5.63
15. Months DR on Table VIII tank (50)	3.36	1.00	6.34	1.49
16. Months DR assigned as DR (50)	13.40	10.00	14.27	11.17
17. Months DR trained as DR (50)	12.16	11.00	11.81	9.25
18. Months DR on M60 tanks (49)	18.78	22.00	13.30	10.75
19. Months LR on Table VIII tank (48)	2.43	1.00	4.17	1.61
20. Months LR assigned as LR (48)	7.33	3.50	7.45	5.65
21. Months LR trained as LR (48)	7.27	2.00	8.45	6.42
22. Months LR on M60 tanks (48)	16.79	17.00	11.66	9.50

*Due to tabulation procedure mean and standard deviation statistics are conservative for items 8, 9, and 10.

DISCUSSION

The purpose of this research was to determine the effects of personnel, equipment and position familiarity on tank gunnery performance, as indicated by performance on Table VIII. To answer this question four groups of tank crews were assembled. Group 1 served as a control group with typical levels of personnel, equipment and job familiarity. Group 2 (unfamiliar Crews) was a personnel turbulence group in which crewmen served in their normal duty positions, but with different crewmen. Group 3 (Unfamiliar Crew and Duty Position) crews were identical to Group 2 with respect to personnel and equipment familiarity, but unfamiliarity with duty positions was added as a variable for the Group 3 tank commanders and gunners. Group 4 (Non-Armor Replacements) was also a condition of reduced personnel, equipment and position familiarity. Unfamiliarity of duty position was created by replacing the gunner and loader with non-armor personnel.

The results of this research indicate that unfamiliarity with the duties assigned to the tank commander and gunner had a serious effect on Table VIII gunnery performance. On almost every variable evaluated, the performance of Group 3 crews (Unfamiliar Crew and Duty Positions) was worse than that of Groups 1, 2, or 4, and many of the comparisons were statistically significant. The poorer performance of Group 3 crews overall was particularly evident in the night firing scores. Also, it is important to note that the analyses of Group 3 performance excluded 2 crews who were disqualified; therefore, the results presented here represent a conservative estimate of the effects of duty position turbulence. Had minimum scores been entered for disqualified crews, Group 3 means for points and hits would have been lower, and mean opening times would have been longer.

It is apparent that the gunners and loaders did not have sufficient cross training to prepare them for the tank commander and gunner positions. The battalion did provide cross-training for crewmen in classroom settings, but there was not sufficient time to provide hands-on cross training during the gunnery season. The realities of combat utilization of our tank forces, however, suggest that combat losses may necessitate the kinds of replacement procedures evaluated in this research.

The new 19E gunner/loader training implemented at Ft Knox should reduce the problem of replacing the gunner. However, this will not provide crewmembers qualified to replace the tank commander. Thus, serious consideration should be given to cross-training of crewmembers in tank commander's duties. Results from Phase I indicated that length of time tank commander and gunner worked together affected gunnery performance. This suggests that tank commander-gunner interaction is important and should be part of the cross training for tank commander replacements. A brief training program for tank commanders and gunners similar to the one used for Group 4 (Non-Armor Replacements) gunners and loaders may be an efficient way to incorporate cross training into the normal gunnery training.

Although crews in Group 4 (Non-Armor Replacements) also experienced unfamiliarity of personnel, equipment, and position, their overall performance was not significantly different from that of either Group 1 or 2. This can be explained in part by the fact that experienced tank commanders were present on the tanks, and had trained the non-armor personnel on Table VII prior to firing the Table VIII. Also, the non-armor crewmen had just completed three days of training designed specifically to prepare them for firing Table VIII.

The effects of personnel turbulence were evaluated by comparing the performance of the Unfamiliar Crews with that of the Control Crews. There were no statistically significant differences in performance between the Unfamiliar Crews and the Control Crews, indicating that this type of personnel turbulence does not significantly degrade gunnery performance. In fact, on many variables the Unfamiliar Crews had scores that were numerically superior to the Control Crews. The numerical results can be attributed to random rather than systematic group differences.

Although the results indicated that personnel turbulence did not seriously degrade Table VIII performance, the Tank Crew Stability Questionnaires showed that even the Control Crews (Group 1) had relatively little experience together. Thus, the Group 1 and Group 2 crews did not differ greatly in length of time together. Group 1 crews with significantly greater amounts of experience with one another might have performed better, leading to significant Group 1 - Group 2 differences. Such crews were not available in the battalion participating in the research, however. And data presented in Phase I and Larson et al. indicated that such crews are not readily available in today's Army.

The evaluation of equipment familiarity was conducted separately from personnel and position familiarity due to the fact that some crews were not able to fire the appropriate tanks. Of all the ANOVA comparisons run, only for moving target opening times at night did equipment familiar crews perform significantly better than unfamiliar crews. This may or may not reflect a chance occurrence. Based on the comparisons we can conclude that familiarity with a particular tank played only a minor role, if any, in Table VIII performance. Again, equipment familiarity might have been a more important factor if the controls had been assigned to their tanks for a substantially longer time.

The data presented in this research also provided some information on the reliability of Table VIII as a tank gunnery evaluation tool. That information is interesting in its own right, and is helpful in interpretation of the between group differences observed. The correlations considered as point estimates indicated moderate levels of reliability. Overall, the moderate levels of reliability were not suprising. No attempt was made to control for variables associated with weather, ammunition, or time of day/night when firing occurred. And motivational differences may have existed because the first Table VIII was for

qualification and the turbulence Table VIII did not directly affect the status of the crews.

The questionnaire data was used primarily as a tool for crew assignment. The descriptive statistics were useful, however, in evaluating the comparability of turbulence in the Ft Carson battalion with turbulence in the five USAREUR battalions observed in Phase I. The correlations between questionnaire variables and gunnery performance which yielded significant effects in Phase I did not produce the same results from the Ft Carson data. This apparent inconsistency is not suprising since the results obtained in the USAREUR study included data from approximately 200 crews, while complete data from only 44 crews were available at Ft Carson. Small effects of turbulence which could have been observed with the large sample could easily go unnoticed with the small sample.

GENERAL DISCUSSION AND CONCLUSIONS

The results of the research in Phase I revealed considerable levels of turbulence in 5 USAREUR battalions. These results were consistent with those of Larson et al. (1976) and Report of Tank Forces on Training Technology (1975). Personnel turbulence was most apparent with complete crews, which had typically been together only 1-2 months. There was less personnel turbulence among tank commander/gunner pairs, which had usually been together 1-3 months. There was a great deal of variation in the degree of personnel turbulence observed, however. Some crews, and tank commander/gunner pairs, had been together less than a month, while others had been together four months or more. The results suggest that stable crew assignments were far from a reality in the battalions observed.

Position turbulence was not as great as personnel turbulence. Most loaders had served in their positions longer than three months. And tank commanders, gunners, and drivers had typically held their positions more than six months. Variation was also great on these position turbulence variables. Thus, while most crewmen had a reasonable degree of experience with their duty positions, a number of them were quite new to their positions when firing Table VIII.

The research indicated that whole crew personnel familiarity did not have a significant effect on gunnery performance. Neither the Stability Questionnaire results from Phase I, nor the Group 1 and 2 comparisons from Phase II, suggested any evidence that entire crews which had been together for a moderate period of time fired better than those together a shorter time. The results are tempered by two factors. First, few crews which had been together a long time, even one year, were available. Such crews might perform better than the typical crews in today's armor forces. Second, the Stability Questionnaire results did indicate a small but significant relation between gunnery performance

and the time tank commanders and gunners trained together. Thus, tank commander and gunner turbulence may be an important factor in predicting gunnery performance.

The major findings of this research were related to duty position familiarity. In both phases of the research experience in a particular position appeared as a significant factor in gunnery performance. Both tank commander and gunner experience in their positions were related to gunnery performance in Phase I, and Phase II crews which included men in unfamiliar crew positions performed much more poorly than those in comparable crews who were familiar with their duties. Both Phase I and Phase II results speak strongly for emphasis on the training and retention of armor crewmen, particularly tank commanders and gunners, in their positions.

When the results were used to address the problem of how to replace armor crewmen, either by changing positions or by incorporating non-armor personnel, two findings were revealed. First, changing a crewman's duty position without training him for his new duties, leads to markedly reduced performance. The armor crewmen were not adequately cross-trained to assume their new positions, even though they had just completed annual gunnery and cross training in classroom subjects was provided as part of the gunnery program. The second finding was that incorporation of non-armor personnel into crews as gunners and loaders did not significantly degrade gunnery performance. However, the non-armor men were given three days intensive hands-on training specifically designed to prepare crewmen to fire Table VIII. Such personnel, given a short training package such as used in this research, may provide adequate replacement personnel in emergency situations. The same type of training packages could also be developed and incorporated into unit gunnery training to assist in cross-training armor crewmen.

Equipment familiarity appeared to have only a limited impact on gunnery performance. Only one relationship between increased equipment familiarity and improved performance (for tank commanders) was noted in Phase I, and only one (for moving target opening time at night) was observed in Phase II. Thus, if equipment familiarity played any role at all in the Table VIII performance observed, it was probably only a very small part.

Questions which remain unanswered address the degree to which turbulence factors affect performance on more structured tasks, such as Table VI gunnery, and less structured tasks, such as Table IX and ARTEP performance. Following the position of Wagner et al. expressed in the introduction, it appears reasonable to assume that neither personnel nor equipment familiarity would play a significant role on more structured tasks, and the effects of position familiarity would be reduced. On more unstructured tasks, however, personnel, and perhaps equipment familiarity, along with position familiarity, may play important roles in modulating crew performance.

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APPENDIXES

APPENDIX A

TANK CREW STABILITY QUESTIONNAIRE (PT 5188)

TANK CREW STABILITY QUESTIONNAIRE

TCs, please fill in your name, tank, company, Bn, gunner's name, driver's name, and loader's name. Then complete questions #1-10.

Have your gunner complete questions #11-14, your driver complete questions #15-18, and your loader complete questions #19-22.

When you and your gunner, driver, and loader have all completed their questions check the questionnaire to insure that all 22 questions have been answered. Then give questionnaire to the platoon sergeant who should give it to the company first sergeant.

Thank you for completing the questionnaire.

TC name_____ Tank_____ Company_____ Bn_____

What is your Table VIII gunner's name_____

What is your Table VIII driver's name_____

What is your Table VIII loader's name_____

In answering the following questions count only time in armor companies. Do not count time in 11E AIT or OSUT, or time in NCO courses, Master Gunner Courses, etc.

1. How many months have you and your complete crew been assigned together, with you as TC, your current gunner assigned as your gunner, your current driver assigned as your driver, and your current loader assigned as your loader? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

2. How many months have you and your complete crew been assigned together, with you as TC, your current gunner assigned as your gunner, your current driver assigned as your driver, and your current loader assigned as your loader, on the tank you used, or will use, to fire Table VIII? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

3. How many months have you and your complete crew actually been able to train together, with you as TC, your current gunner as gunner, your current driver as driver, and your current loader as loader? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

PT5188

4. How many months have you and your current gunner been assigned together, with you as TC and your current gunner as gunner? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

5. How many months have you and your current gunner been assigned together, with you as TC and your current gunner assigned as your gunner, on the tank you used, or will use, to fire Table VIII? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

6. How many months have you and your current gunner actually been able to train together, with you as TC, and your current gunner as gunner? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

7. How many months have you been assigned as the TC on the tank you used, or will use, to fire Table VIII? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

8. How long have you been assigned the duties of TC, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

9. How long have you actually had to train in the duties of TC, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

10. How long have you served in M60 tanks, regardless of the duty position you held?

_____YEARS _____MONTHS

HAVE YOUR GUNNER FILL OUT THE NEXT FOUR QUESTIONS.

GUNNER'S QUESTIONS

In answering the following questions count only time in armor companies. Do not count time in 11E AIT or OSUT, or time in NCO courses, Master Gunner Courses, etc.

11. How many months have you been assigned as the gunner on the tank you used, or will use, to fire Table VIII? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

12. How long have you been assigned the duties of gunner, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

13. How long have you actually had to train in duties of gunner, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

14. How long have you served on M60 tanks, regardless of the duty position you held?

_____YEARS _____MONTHS

HAVE YOUR DRIVER FILL OUT THE NEXT FOUR QUESTIONS.

DRIVER'S QUESTIONS

In answering the following questions count only time in armor companies. Do not count time in 11E AIT or OSUT, or time in NCO courses, Master Gunner Courses, etc.

15. How many months have you been assigned as the driver on the tank you used, or will use, to fire Table VIII? (Circle one)

Less than 1 month 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or more

16. How long have you been assigned the duties of tank driver, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

17. How long have you actually had to train in duties of tank driver, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

18. How long have you served on M60 tanks, regardless of the duty position you held?

_____YEARS _____MONTHS

HAVE YOUR LOADER FILL OUT THE NEXT FOUR QUESTIONS.

LOADER'S QUESTIONS

In answering the following questions count only time in armor companies. Do not count time in 11E AIT or OSUT, or time in NCO courses, Master Gu. er Courses, etc.

19. How many months have you been assigned as the loader on the tank you used, or will use, to fire Table VIII? (Circle one)

Less than 1 month . 1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24 or less

20. How long have you been assigned the duties of loader, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

21. How long have you actually had to train in duties of loader, regardless of the tank, crew, or company you may have been in?

_____YEARS _____MONTHS

22. How long have you served on M60 tanks, regardless of the duty position you held?

_____YEARS _____MONTHS

Loader - When you have completed questions #19-22 return the questionnaire to your TC.

Thank you.

APPENDIX B

CORRELATION MATRIX OF SUMMARY CRITERION VARIABLES

SUMMARY CRITERION VARIABLES

Variable Code	Description
302	Mean Main Gun Opening Time (Day)
303	Mean Main Gun Opening Time (Night)
304	Mean Main Gun Opening Time (Day and Night)
305	1st Round Main Gun Hits (Day)
306	1st Round Main Gun Hits (Night)
307	1st Round Main Gun Hits (Day and Night)
308	Main Gun Hits (Day)
309	Main Gun Hits (Night)
310	Main Gun Hits (Day and Night)
311	Standardized Measure of Opening Time (Day and Night)
312	Standardized Measure of Hits (Day and Night)

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSM - RELEASE 6.04

FILE TANK (CREATION DATE = 29 DEC 77)

PEARSON CORRELATION COEFFICIENTS

	VAR302	VAR303	VAR304	VAR305	VAR306	VAR307	VAR308	VAR309	VAR310	VAR311
VAR302	1.0000	.2607	.7578	-.1308	-.1160	-.1631	-.1126	-.1510	-.1603	.6686
	(0)	(184)	(184)	(196)	(194)	(193)	(196)	(194)	(193)	(184)
	S= .001	S= .001	S= .001	S= .034	S= .054	S= .012	S= .058	S= .018	S= .013	S= .001
VAR303	.2607	1.0000	.8274	-.2494	-.1081	-.2546	-.0904	-.1718	-.1582	.6419
	(184)	(0)	(184)	(191)	(189)	(188)	(191)	(189)	(188)	(184)
	S= .001	S= .001	S= .001	S= .001	S= .069	S= .001	S= .107	S= .009	S= .015	S= .001
VAR304	.7578	.8274	1.0000	-.2520	-.1364	-.2682	-.1440	-.1874	-.2051	.6227
	(184)	(184)	(0)	(183)	(181)	(180)	(183)	(181)	(180)	(184)
	S= .001	S= .001	S= .001	S= .001	S= .034	S= .001	S= .026	S= .006	S= .003	S= .001
VAR305	-.1308	-.2494	-.2520	1.0000	.0699	.8118	.6060	.1201	.5200	-.1843
	(196)	(191)	(183)	(0)	(207)	(207)	(210)	(207)	(207)	(183)
	S= .034	S= .001	S= .001	S= .001	S= .158	S= .001	S= .001	S= .042	S= .001	S= .006
VAR306	-.1160	-.1081	-.1364	.0699	1.0000	.6392	.1895	.6746	.4954	-.0296
	(194)	(189)	(181)	(207)	(0)	(207)	(208)	(207)	(207)	(181)
	S= .054	S= .069	S= .034	S= .158	S= .001	S= .001	S= .003	S= .001	S= .001	S= .346
VAR307	-.1631	-.2546	-.2682	.8118	.6392	1.0000	.5773	.4869	.6908	-.1594
	(193)	(188)	(180)	(207)	(207)	(0)	(207)	(207)	(207)	(180)
	S= .012	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .016
VAR308	-.1126	-.0904	-.1440	.6060	.1895	.5773	1.0000	.1970	.8586	-.1811
	(196)	(191)	(183)	(210)	(207)	(207)	(0)	(207)	(207)	(183)
	S= .058	S= .107	S= .026	S= .001	S= .003	S= .001	S= .001	S= .002	S= .001	S= .007
VAR309	-.1510	-.1718	-.1874	.1201	.6746	.4869	.1970	1.0000	.6718	-.0636
	(194)	(189)	(181)	(207)	(208)	(207)	(207)	(0)	(207)	(181)
	S= .018	S= .009	S= .006	S= .042	S= .001	S= .001	S= .002	S= .001	S= .001	S= .197
VAR310	-.1603	-.1582	-.2051	.5200	.4954	.6908	.8586	.6718	1.0000	-.1753
	(193)	(188)	(180)	(207)	(207)	(207)	(207)	(207)	(0)	(180)
	S= .013	S= .015	S= .003	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .009
VAR311	.6686	.6419	.6227	-.1843	-.0296	-.1594	-.1811	-.0636	-.1753	1.0000
	(184)	(184)	(184)	(183)	(181)	(180)	(183)	(181)	(180)	(0)
	S= .001	S= .001	S= .001	S= .006	S= .346	S= .016	S= .007	S= .197	S= .009	S= .001
VAR312	-.1133	-.1217	-.1545	.4978	.4664	.6567	.8532	.6287	.9734	-.1831
	(193)	(188)	(180)	(207)	(207)	(207)	(207)	(207)	(207)	(180)
	S= .058	S= .048	S= .019	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .008

(COEFFICIENT / (CASES) / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED)

Battalion 1

PEARSON CORRELATION COEFFICIENTS

	VAR302	VAR303	VAR304	VAR305	VAR306	VAR307	VAR308	VAR309	VAR310	VAR311
VAR302	1.0000	-.0427	.5705	-.0208	-.0840	-.0706	-.2096	-.0467	-.1746	.5705
	(0)	(45)	(45)	(45)	(45)	(45)	(45)	(85)	(45)	(45)
	S= .001	S= .390	S= .001	S= .446	S= .292	S= .322	S= .084	S= .380	S= .126	S= .001
VAR303	-.0427	1.0000	.7962	-.1030	-.1600	-.1810	-.0518	-.1285	-.0946	.7962
	(45)	(0)	(45)	(46)	(46)	(46)	(46)	(46)	(46)	(45)
	S= .390	S= .001	S= .001	S= .248	S= .144	S= .114	S= .366	S= .197	S= .266	S= .001
VAR304	.5705	.7962	1.0000	-.0996	-.1814	-.1921	-.1666	-.1322	-.1811	1.0000
	(45)	(45)	(0)	(45)	(45)	(45)	(45)	(45)	(45)	(45)
	S= .001	S= .001	S= .001	S= .258	S= .117	S= .103	S= .137	S= .193	S= .117	S= .001
VAR305	-.0208	-.1030	-.0996	1.0000	.0316	.7501	.5848	.1792	.5072	-.0996
	(45)	(46)	(45)	(0)	(46)	(46)	(46)	(46)	(46)	(45)
	S= .446	S= .248	S= .258	S= .001	S= .418	S= .001	S= .001	S= .117	S= .001	S= .258
VAR306	-.0840	-.1600	-.1814	.0316	1.0000	.6847	.3265	.6181	.5116	-.1814
	(45)	(46)	(45)	(46)	(0)	(46)	(46)	(46)	(46)	(45)
	S= .292	S= .144	S= .117	S= .418	S= .001	S= .001	S= .013	S= .001	S= .001	S= .117
VAR307	-.0706	-.1810	-.1921	.7501	.6847	1.0000	.6424	.5396	.7084	-.1921
	(45)	(46)	(45)	(46)	(46)	(0)	(46)	(46)	(46)	(45)
	S= .322	S= .114	S= .103	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .103
VAR308	-.2096	-.0518	-.1666	.5848	.3265	.6424	1.0000	.4171	.9162	-.1666
	(45)	(46)	(45)	(46)	(46)	(46)	(0)	(46)	(46)	(45)
	S= .084	S= .366	S= .137	S= .001	S= .013	S= .001	S= .001	S= .002	S= .001	S= .137
VAR309	-.0467	-.1285	-.1322	.1792	.6181	.5396	.4171	1.0000	.7463	-.1322
	(45)	(46)	(45)	(46)	(46)	(46)	(46)	(0)	(46)	(45)
	S= .380	S= .197	S= .193	S= .117	S= .001	S= .001	S= .002	S= .001	S= .001	S= .193
VAR310	-.1746	-.0946	-.1811	.5072	.5116	.7084	.9162	.7463	1.0000	-.1811
	(45)	(46)	(45)	(46)	(46)	(46)	(46)	(46)	(0)	(45)
	S= .126	S= .266	S= .117	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .117
VAR311	.5705	.7962	1.0000	-.0996	-.1814	-.1921	-.1666	-.1322	-.1811	1.0000
	(45)	(45)	(45)	(45)	(45)	(45)	(45)	(45)	(45)	(0)
	S= .001	S= .001	S= .001	S= .258	S= .117	S= .103	S= .137	S= .193	S= .117	S= .001
VAR312	-.1746	-.0946	-.1811	.5072	.5116	.7084	.9162	.7463	1.0000	-.1811
	(45)	(46)	(45)	(46)	(46)	(46)	(46)	(46)	(46)	(45)
	S= .126	S= .266	S= .117	S= .001	S= .001	S= .001	S= .001	S= .001	S= .001	S= .117

(COEFFICIENT / (CASES) / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED)

Battalion 2

- - - - - - - - - - - - - PEARSON CORRELATION COEFFICIENTS - - - - - - - - - - - - -

	VAR302	VAR303	VAR304	VAR305	VAR306	VAR307	VAR308	VAR309	VAR310	VAR311
VAR302	1.0000	.1727	.7074	-.0466	.2508	.0894	-.1332	.2273	.0148	.7074
	(0)	(40)	(40)	(39)	(37)	(36)	(39)	(37)	(36)	(40)
	S= .001	S= .143	S= .001	S= .389	S= .067	S= .302	S= .209	S= .088	S= .466	S= .001
VAR303	.1727	1.0000	.8184	-.0984	.0857	-.0381	-.1161	.1920	.0059	.8184
	(40)	(0)	(40)	(39)	(37)	(36)	(39)	(37)	(36)	(40)
	S= .143	S= .001	S= .001	S= .276	S= .307	S= .413	S= .241	S= .128	S= .486	S= .001
VAR304	.7074	.8184	1.0000	-.0978	.2002	.0221	-.1603	.2618	.0123	99.0000
	(40)	(40)	(0)	(39)	(37)	(36)	(39)	(37)	(36)	(40)
	S= .001	S= .001	S= .001	S= .277	S= .117	S= .449	S= .165	S= .059	S= .472	S=*****
VAR305	-.0466	-.0984	-.0978	1.0000	-.1524	.8018	.5656	.0171	.4573	-.0978
	(39)	(39)	(39)	(0)	(36)	(36)	(39)	(36)	(36)	(39)
	S= .389	S= .276	S= .277	S= .001	S= .187	S= .001	S= .001	S= .461	S= .003	S= .277
VAR306	.2508	.0857	.2002	-.1524	1.0000	.4684	.0245	.6937	.4494	.2002
	(37)	(37)	(37)	(36)	(0)	(36)	(36)	(37)	(36)	(37)
	S= .067	S= .307	S= .117	S= .187	S= .001	S= .002	S= .444	S= .001	S= .003	S= .117
VAR307	.0894	-.0381	.0221	.8018	.4684	1.0000	.5284	.4346	.6805	.0221
	(36)	(36)	(36)	(36)	(36)	(0)	(36)	(36)	(36)	(36)
	S= .302	S= .413	S= .449	S= .001	S= .002	S= .001	S= .001	S= .004	S= .001	S= .449
VAR308	-.1332	-.1161	-.1603	.5656	.0245	.5284	1.0000	.0109	.7843	-.1603
	(39)	(39)	(39)	(39)	(36)	(36)	(0)	(36)	(36)	(39)
	S= .209	S= .241	S= .165	S= .001	S= .444	S= .001	S= .001	S= .475	S= .001	S= .165
VAR309	.2273	.1920	.2618	.0171	.6937	.4346	.0109	1.0000	.6289	.2618
	(37)	(37)	(37)	(36)	(37)	(36)	(36)	(0)	(36)	(37)
	S= .088	S= .128	S= .059	S= .461	S= .001	S= .004	S= .475	S= .001	S= .001	S= .059
VAR310	.0148	.0059	.0123	.4573	.4494	.6805	.7843	.6289	1.0000	.0123
	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(0)	(36)
	S= .466	S= .486	S= .472	S= .003	S= .003	S= .001	S= .001	S= .001	S= .001	S= .472
VAR311	.7074	.8184	99.0000	-.0978	.2002	.0221	-.1603	.2618	.0123	1.0000
	(40)	(40)	(40)	(39)	(37)	(36)	(39)	(37)	(36)	(0)
	S= .001	S= .001	S=*****	S= .277	S= .117	S= .449	S= .165	S= .059	S= .472	S= .001
VAR312	.0148	.0059	.0123	.4573	.4494	.6805	.7843	.6289	99.0000	.0123
	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	S= .466	S= .486	S= .472	S= .003	S= .003	S= .001	S= .001	S= .001	S=*****	S= .472

(COEFFICIENT / (CASES) / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A COFFFICIENT CANNOT BE COMPUTED)

Regression

PEARSON CORRELATION COEFFICIENTS

	VAR302	VAR303	VAR304	VAR305	VAR306	VAR307	VAR308	VAR309	VAR310	VAR311
VAR302	1.0000 (0) S= .001	.5965 (35) S= .115	.7054 (33) S= .001	-.3229 (38) S= .042	-.1799 (38) S= .125	-.3308 (38) S= .021	-.2895 (35) S= .039	-.2079 (38) S= .105	-.3428 (38) S= .018	.7864 (38) S= .001
VAR303	.1964 (38) S= .118	1.0000 (0) S= .001	.7603 (38) S= .001	-.3937 (41) S= .006	.1163 (41) S= .234	-.2436 (41) S= .062	-.4023 (41) S= .005	.2160 (41) S= .087	-.2733 (41) S= .042	.7603 (38) S= .001
VAR304	.7564 (38) S= .001	.7603 (38) S= .001	1.0000 (0) S= .001	-.4729 (38) S= .001	-.0415 (38) S= .402	-.3796 (38) S= .009	-.4746 (38) S= .001	.0002 (38) S= .500	-.4201 (38) S= .004	99.0000 (38) S=*****
VAR305	-.3229 (38) S= .032	-.3907 (41) S= .006	-.4729 (38) S= .001	1.0000 (0) S= .001	.1020 (41) S= .263	.3409 (41) S= .001	.6514 (41) S= .001	-.0069 (41) S= .485	.5838 (41) S= .001	-.4729 (38) S= .001
VAR306	-.1909 (38) S= .125	.1163 (41) S= .234	-.0415 (38) S= .402	.1020 (41) S= .263	1.0000 (0) S= .001	.5242 (41) S= .001	.6528 (41) S= .372	.7597 (41) S= .001	.3643 (41) S= .010	-.0415 (38) S= .402
VAR307	-.3308 (38) S= .021	-.2436 (41) S= .062	-.3796 (38) S= .009	.3409 (41) S= .001	.6242 (41) S= .001	1.0000 (0) S= .001	.5403 (41) S= .001	.4127 (41) S= .004	.6567 (41) S= .001	-.3796 (38) S= .009
VAR308	-.2896 (38) S= .039	-.4023 (41) S= .005	-.4746 (38) S= .001	.6514 (41) S= .001	.6528 (41) S= .372	.5403 (41) S= .001	1.0000 (0) S= .001	.0256 (41) S= .437	.9112 (41) S= .001	-.4746 (38) S= .001
VAR309	-.2079 (38) S= .105	.2160 (41) S= .087	.0002 (38) S= .500	-.0069 (41) S= .485	.7597 (41) S= .001	.4127 (41) S= .004	.0256 (41) S= .437	1.0000 (0) S= .001	.4352 (41) S= .002	.0002 (38) S= .500
VAR310	-.3428 (38) S= .018	-.2733 (41) S= .042	-.4201 (38) S= .004	.5838 (41) S= .001	.3643 (41) S= .010	.6567 (41) S= .001	.9112 (41) S= .001	.4352 (41) S= .002	1.0000 (0) S= .001	-.4201 (38) S= .004
VAR311	.7864 (38) S= .001	.7603 (38) S= .001	99.0000 (38) S=*****	-.4729 (38) S= .001	-.0415 (38) S= .402	-.3796 (38) S= .009	-.4746 (38) S= .001	.0002 (38) S= .500	-.4201 (38) S= .004	1.0000 (0) S= .001
VAR312	-.3428 (38) S= .018	-.2733 (41) S= .042	-.4201 (38) S= .004	.5838 (41) S= .001	.3643 (41) S= .010	.6567 (41) S= .001	.9112 (41) S= .001	.4352 (41) S= .002	1.0000 (41) S= .001	-.4201 (38) S= .004

(COEFFICIENT / (CASES) / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED)

Battalion 4

PEARSON CORRELATION COEFFICIENTS

	VAR302	VAR303	VAR304	VAR305	VAR306	VAR307	VAR308	VAR309	VAR310	VAR311
VAR302	1.0000 (0) S= .001	.0427 (42) S= .394	.8490 (42) S= .001	.1513 (43) S= .166	.3438 (43) S= .590	.1377 (43) S= .189	.0268 (43) S= .432	-.0627 (43) S= .345	-.0055 (43) S= .486	.8490 (42) S= .001
VAR303	.0427 (42) S= .394	1.0000 (0) S= .001	.5643 (42) S= .001	-.3788 (42) S= .007	.0620 (42) S= .348	-.2528 (42) S= .053	-.1478 (42) S= .175	-.2958 (42) S= .029	-.2571 (42) S= .050	.5643 (42) S= .001
VAR304	.8490 (42) S= .001	.5643 (42) S= .001	1.0000 (0) S= .001	-.0713 (42) S= .327	.0648 (42) S= .342	-.0195 (42) S= .451	-.0589 (42) S= .356	-.2018 (42) S= .100	-.1399 (42) S= .188	1.0000 (42) S= .001
VAR305	.1513 (43) S= .166	-.3788 (42) S= .007	-.0713 (42) S= .327	1.0000 (0) S= .001	.1812 (43) S= .122	.8525 (43) S= .001	.7028 (43) S= .001	.2949 (43) S= .027	.7295 (43) S= .001	-.0713 (42) S= .327
VAR306	.0438 (43) S= .390	.0620 (42) S= .348	.0648 (42) S= .342	.1812 (43) S= .122	1.0000 (0) S= .001	.6686 (43) S= .001	.2762 (43) S= .037	.4969 (43) S= .001	.4587 (43) S= .001	.0648 (42) S= .342
VAR307	.1377 (43) S= .189	-.2528 (42) S= .053	-.0195 (42) S= .451	.8525 (43) S= .001	.6686 (43) S= .001	1.0000 (0) S= .001	.6783 (43) S= .001	.4871 (43) S= .001	.7954 (43) S= .001	-.0195 (42) S= .451
VAR308	.0268 (43) S= .432	-.1478 (42) S= .175	-.0589 (42) S= .356	.7028 (43) S= .001	.2762 (43) S= .037	.6783 (43) S= .001	1.0000 (0) S= .001	.0996 (43) S= .265	.8934 (43) S= .001	-.0589 (42) S= .356
VAR309	-.0627 (43) S= .345	-.2958 (42) S= .029	-.2018 (42) S= .100	.2949 (43) S= .027	.4969 (43) S= .001	.4871 (43) S= .001	.0996 (43) S= .265	1.0000 (0) S= .001	.5360 (43) S= .001	-.2018 (42) S= .100
VAR310	-.0055 (43) S= .486	-.2571 (42) S= .050	-.1399 (42) S= .188	.7295 (43) S= .001	.4587 (43) S= .001	.7954 (43) S= .001	.8934 (43) S= .001	.5360 (43) S= .001	1.0000 (0) S= .001	-.1399 (42) S= .188
VAR311	.8490 (42) S= .001	.5643 (42) S= .001	1.0000 (42) S= .001	-.0713 (42) S= .327	.0648 (42) S= .342	-.0195 (42) S= .451	-.0589 (42) S= .356	-.2018 (42) S= .100	-.1399 (42) S= .188	1.0000 (0) S= .001
VAR312	-.0055 (43) S= .486	-.2571 (42) S= .050	-.1399 (42) S= .188	.7295 (43) S= .001	.4587 (43) S= .001	.7954 (43) S= .001	.8934 (43) S= .001	.5360 (43) S= .001	99.0000 (43) S=*****	-.1399 (42) S= .188

(COEFFICIENT / (CASES) / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED)

Battalion 5

- - - - - - - - - - - - PEARSON CORRELATION COEFFICIENTS - - - - - - - - - - - -

	VAR302	VAR303	VAR304	VAR305	VAR306	VAR307	VAR308	VAR309	VAR310	VAR311
VAR302	1.0000 (0) S= .001	.5704 (19) S= .005	.8590 (19) S= .001	-.1880 (31) S= .156	-.2533 (31) S= .085	-.2785 (31) S= .065	.0042 (31) S= .491	-.2278 (31) S= .109	-.1366 (31) S= .232	.8590 (19) S= .001
VAR303	.5704 (19) S= .005	1.0000 (0) S= .001	.9255 (19) S= .001	-.3287 (23) S= .063	-.1678 (23) S= .222	-.3121 (23) S= .074	.0425 (23) S= .424	-.2906 (23) S= .089	-.1607 (23) S= .232	.9255 (19) S= .001
VAR304	.8590 (19) S= .001	.9255 (19) S= .001	1.0000 (0) S= .001	-.4704 (19) S= .021	-.2483 (19) S= .153	-.4326 (19) S= .032	.0243 (19) S= .461	-.2992 (19) S= .107	-.1781 (19) S= .233	99.0000 (19) S=*****
VAR305	-.1880 (31) S= .156	-.3287 (23) S= .063	-.4704 (19) S= .021	1.0000 (0) S= .001	-.0106 (41) S= .474	.7384 (41) S= .001	.4814 (41) S= .001	-.0592 (41) S= .356	.2495 (41) S= .058	-.4704 (19) S= .021
VAR306	-.2533 (31) S= .085	-.1678 (23) S= .222	-.2483 (19) S= .153	-.0106 (41) S= .474	1.0000 (0) S= .001	.6665 (41) S= .001	.1251 (41) S= .218	.7868 (41) S= .001	.5823 (41) S= .001	-.2483 (19) S= .153
VAR307	-.2785 (31) S= .065	-.3121 (23) S= .074	-.4326 (19) S= .032	.7384 (41) S= .001	.6665 (41) S= .001	1.0000 (0) S= .001	.4432 (41) S= .002	.4865 (41) S= .001	.5787 (41) S= .001	-.4326 (19) S= .032
VAR308	.0042 (31) S= .491	.0425 (23) S= .424	.0243 (19) S= .461	.4814 (41) S= .001	.1251 (41) S= .216	.4432 (41) S= .002	1.0000 (0) S= .001	.2940 (41) S= .031	.7873 (41) S= .001	.0243 (19) S= .461
VAR309	-.2278 (31) S= .109	-.2906 (23) S= .089	-.2992 (19) S= .107	-.0592 (41) S= .356	.7868 (41) S= .001	.4865 (41) S= .001	.2940 (41) S= .031	1.0000 (0) S= .001	.8208 (41) S= .001	-.2992 (19) S= .107
VAR310	-.1366 (31) S= .232	-.1607 (23) S= .232	-.1781 (19) S= .233	.2495 (41) S= .058	.5823 (41) S= .001	.5787 (41) S= .001	.7873 (41) S= .001	.8208 (41) S= .001	1.0000 (0) S= .001	-.1781 (19) S= .233
VAR311	.8590 (19) S= .001	.9255 (19) S= .001	99.0000 (19) S=*****	-.4704 (19) S= .021	-.2483 (19) S= .153	-.4326 (19) S= .032	.0243 (19) S= .461	-.2992 (19) S= .107	-.1781 (19) S= .233	1.0000 (0) S= .001
VAR312	-.1366 (31) S= .232	-.1607 (23) S= .232	-.1781 (19) S= .233	.2495 (41) S= .058	.5823 (41) S= .001	.5787 (41) S= .001	.7873 (41) S= .001	.8208 (41) S= .001	1.0000 (41) S= .001	-.1781 (19) S= .233

(COEFFICIENT / (CASES) / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A COEFFICIENT CANNOT BE COMPUTED)

APPENDIX C

COMPLETE DESCRIPTIVE STATISTICS AND FREQUENCY DISTRIBUTIONS

TANK CREW STABILITY QUESTIONNAIRE ITEMS

Variable code	Description
185	Months crew assigned together
186	Months crew assigned together on tank used for Table VIII
187	Months crew trained together
188	Months Tank Commander and Gunner assigned together
189	Months Tank Commander and Gunner assigned together on tank used for Table VIII
190	Months Tank Commander and Gunner trained together
191	Months Tank Commander on Table VIII tank
192	Months assigned as Tank Commander
193	Months trained as Tank Commander
194	Months Tank Commander was on M60 tanks
195	Months Gunner on Table VIII tank
196	Months assigned as Gunner
197	Months trained as Gunner
198	Months Gunner was on M60 tanks
199	Months Driver on Table VIII tank
200	Months assigned as Driver
201	Months trained as Driver
202	Months Driver on M60 tanks
203	Months Loader on Table VIII tank
204	Months assigned as Loader
205	Months trained as Loader
206	Months Loader on M60 tanks

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSM - RELEASE 6.04

FILE TANK (CREATION DATE = 20 OCT 77)

VAR185

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.	79	37.4	37.4	37.40
	1.	37	17.5	17.5	55.00
	2.	31	14.7	14.7	69.70
	3.	27	12.8	12.8	82.50
	4.	7	3.3	3.3	85.80
	5.	8	3.8	3.8	89.60
	6.	8	3.8	3.8	93.40
	7.	4	1.9	1.9	95.30
	8.	1	.5	.5	95.70
	9.	1	.5	.5	96.20
	10.	2	.9	.9	97.20
	12.	3	1.4	1.4	98.60
	19.	1	.5	.5	99.10
	24.	2	.9	.9	100.00
	TOTAL	211	100.0	100.0	

MEAN	2,199	STD ERR	[illegible]	MEDIAN	1.216
MODE	.000	STD DEV	[illegible]	VARIANCE	11.760
KURTOSIS	16.836	SKEWNESS	[illegible]	RANGE	24.000
MINIMUM	.000	MAXIMUM	[illegible]		
VALID CASES	211	MISSING CASES	0		

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR186

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.	80	37.9	38.1	38.10
	1.	41	19.4	19.5	57.60
	2.	32	15.2	15.2	72.90
	3.	26	12.3	12.4	85.20
	4.	5	2.4	2.4	87.60
	5.	8	3.8	3.8	91.40
	6.	5	2.4	2.4	93.80
	7.	3	1.4	1.4	95.20
	8.	3	1.4	1.4	96.70
	9.	1	.5	.5	97.10
	10.	2	.9	1.0	98.10
	12.	3	1.4	1.4	99.50
	19.	1	.5	.5	100.00
	9999.	1	.5	MISSING	100.0
	TOTAL	211	100.0	100.0	

MEAN	1.914	STD ERR	.185	MEDIAN	1.110
MODE	.000	STD DEV	2.685	VARIANCE	7.208
KURTOSIS	9.599	SKEWNESS	2.624	RANGE	19.000
MINIMUM	.000	MAXIMUM	19.000		
VALID CASES	210	MISSING CASES	1		

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR187

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.	93	44.1	44.1	44.10
	1.	45	21.3	21.3	65.40
	2.	32	15.2	15.2	80.60
	3.	18	8.5	8.5	89.10
	4.	5	2.4	2.4	91.50
	5.	4	1.9	1.9	93.40
	6.	3	1.4	1.4	94.80
	7.	5	2.4	2.4	97.20
	8.	1	.5	.5	97.60
	10.	2	.9	.9	98.60
	12.	2	.9	.9	99.50
	19.	1	.5	.5	100.00
	TOTAL	211	100.0	100.0	

MEAN	1.550	STD ERR	.170	MEDIAN	.778
MODE	.000	STD DEV	2.463	VARIANCE	6.068
KURTOSIS	14.521	SKEWNESS	3.214	RANGE	19.000
MINIMUM	.000	MAXIMUM	19.000		
VALID CASES	211	MISSING CASES	0		

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR188

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	47	22	22	6.	14	7	85	12.	6	3	98
1.	29	14	36	7.	3	1	86	15.	2	1	99
2.	26	12	48	8.	5	2	89	19.	2	1	100
3.	34	16	64	9.	5	2	91	24.	1	0	100
4.	18	9	73	10.	6	3	94				
5.	11	5	78	11.	2	1	95				

MEAN	5.530	STD ERR	.269	MEDIAN	2.603
MODE	.000	STD DEV	3.900	VARIANCE	15.212
KURTOSIS	4.983	SKEWNESS	1.931	RANGE	24.000
MINIMUM	.000	MAXIMUM	24.000		
VALID CASES	211	MISSING CASES	0		

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR189

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	47	22	22	6.	14	7	85	12.	5	2	98
1.	31	15	37	7.	5	2	88	15.	2	1	99
2.	28	13	50	8.	4	2	90	18.	1	0	99
3.	33	16	66	9.	4	2	91	19.	1	0	100
4.	17	8	74	10.	6	3	94	24.	1	0	100
5.	10	5	79	11.	2	1	95				

MEAN	3.431	STD ERR	.264	MEDIAN	2.482
MODE	.000	STD DEV	3.830	VARIANCE	14.665
KURTOSIS	5.371	SKEWNESS	1.995	RANGE	24.000
MINIMUM	.000	MAXIMUM	24.000		
VALID CASES	211	MISSING CASES	0		

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR190

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	54	26	26	6.	12	6	90	15.	1	0	98
1.	41	19	45	7.	4	2	91	16.	1	0	99
2.	29	14	59	8.	4	2	93	17.	1	0	99
3.	26	12	71	9.	2	1	94	19.	1	0	100
4.	15	7	78	10.	3	1	96	24.	1	0	100
5.	12	6	84	12.	4	2	98				

MEAN	2.919	STD ERR	.250	MEDIAN	1.862
MODE	.000	STD DEV	3.626	VARIANCE	13.151
KURTOSIS	8.050	SKEWNESS	2.441	RANGE	24.000
MINIMUM	.000	MAXIMUM	24.000		

VALID CASES	211	MISSING CASES	0

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR191

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	26	12	12	7.	9	4	67	14.	3	1	87
1.	20	9	22	8.	8	4	71	15.	3	1	88
2.	18	9	30	9.	7	3	74	17.	1	0	89
3.	28	13	44	10.	9	4	78	19.	2	1	90
4.	21	10	54	11.	3	1	80	20.	3	1	91
5.	5	2	56	12.	11	5	85	21.	2	1	92
6.	14	7	63	13.	1	0	85	24.	17	8	100

MEAN	6.859	STD ERR	.478	MEDIAN	4.143
MODE	3.000	STD DEV	6.943	VARIANCE	48.212
KURTOSIS	.747	SKEWNESS	1.304	RANGE	24.000
MINIMUM	.000	MAXIMUM	24.000		

VALID CASES 211 MISSING CASES 0

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSM - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR192

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	9	4	4	21.	1	0	47	51.	1	0	72
1.	6	3	7	22.	1	0	47	54.	1	0	72
2.	7	3	11	23.	1	0	48	56.	2	1	73
3.	13	6	17	24.	6	3	50	57.	1	0	74
4.	10	5	22	26.	2	1	51	58.	1	0	74
5.	5	2	24	27.	4	2	53	60.	7	3	77
6.	2	1	25	28.	1	0	54	62.	1	0	78
7.	3	1	26	30.	1	0	54	64.	1	0	78
8.	3	1	28	31.	1	0	55	66.	2	1	79
9.	1	0	28	32.	1	0	55	68.	1	0	80
10.	3	1	30	33.	1	0	56	72.	3	1	81
11.	3	1	31	34.	1	0	56	80.	1	0	82
12.	10	5	36	35.	3	1	58	84.	3	1	83
13.	4	2	38	36.	7	3	61	87.	1	0	84
14.	1	0	38	38.	3	1	63	91.	1	0	84
15.	3	1	40	39.	1	0	63	94.	1	0	85
16.	4	2	42	41.	1	0	63	96.	2	1	86
17.	2	1	43	42.	3	1	65	98.	1	0	86
18.	3	1	44	43.	3	1	66	99.	29	14	100
19.	2	1	45	48.	7	3	70				
20.	2	1	46	50.	3	1	71				

MISSING DATA

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	3				

MEAN	36.649	STD ERR	2.381	MEDIAN	24.333
MODE	99.000	STD DEV	34.339	VARIANCE	1179.166
KURTOSIS	-.847	SKEWNESS	.745	RANGE	99.000
MINIMUM	.000	MAXIMUM	99.000		

VALID CASES 208 MISSING CASES 3

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR193

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	7	3	3	18.	5	2	44	51.	1	0	71
1.	6	3	6	19.	1	0	44	54.	1	0	71
2.	7	3	10	20.	1	0	45	56.	1	0	72
3.	9	4	14	21.	1	0	45	60.	7	3	75
4.	7	3	17	22.	2	1	46	62.	1	0	76
5.	7	3	21	24.	8	4	50	64.	2	1	77
6.	4	2	22	25.	1	0	51	65.	1	0	77
7.	2	1	23	26.	2	1	52	66.	1	0	78
8.	4	2	25	27.	5	2	54	72.	5	2	80
9.	2	1	26	32.	1	0	55	80.	1	0	80
10.	3	1	28	36.	12	6	60	84.	2	1	81
11.	3	1	29	38.	1	0	61	87.	1	0	82
12.	13	6	35	40.	1	0	61	91.	1	0	82
13.	4	2	37	41.	1	0	62	96.	3	1	84
14.	2	1	38	42.	5	2	64	97.	2	1	85
15.	4	2	40	43.	2	1	65	98.	1	0	85
16.	2	1	41	48.	8	4	69	99.	31	15	100
17.	1	0	42	50.	3	1	70				

MISSING DATA

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	2				

MEAN	38.057	STD ERR	2.418	MEDIAN	24.437
MODE	99.000	STD DEV	34.951	VARIANCE	1221.545
KURTOSIS	-.969	SKEWNESS	.702	RANGE	99.000
MINIMUM	.000	MAXIMUM	99.000		

VALID CASES	209	MISSING CASES	2

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR194

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	2	1	1	23.	4	2	28	59.	1	0	61
1.	3	1	2	24.	12	6	34	60.	11	5	66
2.	2	1	3	25.	2	1	35	62.	1	0	67
3.	8	4	7	26.	3	1	37	64.	2	1	68
4.	8	4	11	27.	2	1	38	65.	2	1	69
5.	5	1	13	30.	5	2	40	66.	4	2	71
6.	2	1	13	32.	3	1	41	67.	3	1	72
7.	1	0	14	34.	1	0	42	69.	2	1	73
8.	4	2	16	35.	1	0	42	71.	1	0	74
9.	1	0	16	36.	9	4	47	72.	5	2	76
10.	1	0	17	37.	1	0	47	74.	1	0	76
12.	3	1	18	38.	2	1	48	75.	1	0	77
13.	3	1	20	41.	2	1	49	78.	1	0	77
14.	1	0	20	42.	1	0	50	79.	1	0	78
15.	1	0	21	45.	1	0	50	84.	4	2	80
16.	1	0	21	48.	9	4	54	85.	1	0	80
17.	3	1	23	49.	2	1	55	89.	2	1	81
18.	3	1	24	50.	2	1	56	91.	1	0	82
19.	1	0	25	54.	4	2	58	96.	1	0	82
20.	2	1	25	55.	1	0	59	99.	37	18	100
22.	2	1	26	57.	4	2	61				

MISSING DATA

CODE	FREQ	.	CODE	FREQ	CODE	FREQ
9999.	3					

MEAN	47.673	STD ERR	2.304	MEDIAN	45.500
MODE	99.000	STD DEV	33.225	VARIANCE	1103.892
KURTOSIS	-1.246	SKEWNESS	.263	RANGE	99.000
MINIMUM	.000	MAXIMUM	99.000		

VALID CASES 208 MISSING CASES 3

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR195

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	31	15	15	7.	7	3	77	17.	1	0	92
1.	28	14	29	8.	10	5	82	18.	1	0	93
2.	25	12	41	9.	6	3	85	19.	1	0	93
3.	21	10	51	10.	5	2	87	20.	2	1	94
4.	17	8	59	11.	4	2	89	22.	1	0	95
5.	14	7	66	12.	5	2	91	24.	11	5	100
6.	16	8	73	15.	1	0	92				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	4				

MEAN	5.348	STD ERR	.422	MEDIAN	3.429
MODE	.000	STD DEV	6.069	VARIANCE	36.830
KURTOSIS	2.887	SKEWNESS	1.850	RANGE	24.000
MINIMUM	.000	MAXIMUM	24.000		

VALID CASES 207 MISSING CASES 4

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR196

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	7	3	3	13.	2	1	67	27.	1	0	89
1.	18	9	12	14.	2	1	67	28.	2	1	89
2.	16	8	20	15.	2	1	68	29.	1	0	90
3.	13	6	26	16.	5	2	71	30.	4	2	92
4.	12	6	32	17.	2	1	72	33.	3	1	93
5.	13	6	38	18.	6	3	75	36.	6	3	96
6.	12	6	44	19.	1	0	75	37.	1	0	97
7.	6	3	46	20.	2	1	76	39.	1	0	97
8.	6	3	49	21.	1	0	77	48.	4	2	99
9.	4	2	51	22.	3	1	78	60.	1	0	100
10.	6	3	54	24.	17	8	86	61.	1	0	100
11.	6	3	57	25.	3	1	88				
12.	18	9	66	26.	1	0	88				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	2	.			

MEAN	12.627	STD ERR	.835	MEDIAN	8.875
MODE	1.000	STD DEV	12.076	VARIANCE	145.831
KURTOSIS	1.952	SKEWNESS	1.401	RANGE	61.000
MINIMUM	.000	MAXIMUM	61.000		

VALID CASES 209 MISSING CASES 2

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR197

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	6	3	3	14.	1	0	67	30.	2	1	91
1.	20	10	12	15.	2	1	67	31.	1	0	91
2.	17	8	21	16.	2	1	68	33.	1	0	92
3.	11	5	26	17.	1	0	69	35.	1	0	92
4.	18	9	34	18.	6	3	72	36.	4	2	94
5.	12	6	40	19.	2	1	73	38.	1	0	95
6.	14	7	47	20.	2	1	74	39.	1	0	95
7.	3	1	48	21.	2	1	75	48.	4	2	97
8.	4	2	50	22.	1	0	75	55.	1	0	98
9.	3	1	52	24.	26	12	88	60.	2	1	99
10.	4	2	54	26.	1	0	88	61.	1	0	99
11.	4	2	56	27.	2	1	89	84.	1	0	100
12.	21	10	66	28.	1	0	89	99.	1	0	100
13.	1	0	66	29.	1	0	90				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	2				

MEAN	15.526	STD ERR	1.029	MEDIAN	8.575
MODE	24.000	STD DEV	14.874	VARIANCE	221.250
KURTOSIS	7.349	SKEWNESS	2.261	RANGE	99.000
MINIMUM	.000	MAXIMUM	99.000		

VALID CASES 209 MISSING CASES 2

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSM - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR198

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	2	1	1	22.	2	1	33	41.	2	1	87
1.	2	1	2	23.	4	2	35	42.	2	1	88
2.	3	1	3	24.	37	18	53	44.	1	0	88
3.	2	1	4	25.	7	3	56	45.	1	0	89
4.	4	2	6	26.	7	3	60	46.	1	0	89
6.	8	4	10	27.	7	3	63	48.	5	2	92
8.	2	1	11	28.	3	1	64	50.	1	0	92
10.	2	1	12	29.	2	1	65	59.	2	1	93
11.	2	1	13	30.	6	3	68	60.	6	3	96
12.	8	4	17	32.	5	2	71	66.	1	0	97
14.	4	2	19	33.	1	0	71	68.	1	0	97
15.	4	2	21	34.	6	3	74	70.	1	0	98
16.	2	1	22	35.	3	1	75	72.	1	0	98
17.	2	1	23	36.	15	7	83	78.	1	0	99
18.	10	5	27	37.	3	1	84	92.	1	0	99
19.	4	2	29	38.	1	0	85	96.	1	0	100
20.	4	2	31	39.	2	1	86	99.	1	0	100
21.	2	1	32	40.	1	0	86				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	3				

MEAN	27.447	STD ERR	1.167	MEDIAN	24.338
MODE	24.000	STD DEV	16.834	VARIANCE	283.369
KURTOSIS	3.240	SKEWNESS	1.390	RANGE	99.000
MINIMUM	.000	MAXIMUM	99.000		

VALID CASES	208	MISSING CASES	3

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR199

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	43	21	21	8.	10	5	77	16.	5	2	93
1.	27	13	35	9.	5	2	79	18.	2	1	94
2.	20	10	45	10.	6	3	82	19.	1	0	95
3.	15	7	52	11.	5	2	85	20.	2	1	96
4.	8	4	56	12.	8	4	89	21.	2	1	97
5.	7	3	60	13.	1	0	89	24.	6	3	100
6.	18	9	69	14.	2	1	90				
7.	6	3	72	15.	1	0	91				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	11				

MEAN	5.410	STD ERR	.427	MEDIAN	3.167
MODE	.000	STD DEV	6.035	VARIANCE	36.424
KURTOSIS	1.430	SKEWNESS	1.403	RANGE	24.000
MINIMUM	.000	MAXIMUM	24.000		

VALID CASES	200	MISSING CASES	11

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSM - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR200

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	14	7	7	12.	7	3	69	27.	4	2	92
1.	24	12	19	13.	1	0	69	28.	1	0	92
2.	21	10	29	14.	3	1	71	29.	1	0	93
3.	14	7	36	15.	2	1	72	30.	2	1	94
4.	3	1	37	16.	2	1	73	32.	2	1	95
5.	2	1	38	18.	12	6	78	33.	1	0	95
6.	15	7	46	19.	3	1	80	36.	5	2	98
7.	6	3	49	20.	3	1	81	41.	1	0	98
8.	13	6	55	21.	2	1	82	42.	1	0	99
9.	8	4	59	22.	1	0	83	44.	1	0	99
10.	8	4	63	23.	2	1	84	60.	1	0	100
11.	5	2	65	24.	12	6	90	68.	1	0	100

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	7				

MEAN	11.088	STD ERR	.804	MEDIAN	7.731
MODE	1.000	STD DEV	11.483	VARIANCE	131.854
KURTOSIS	3.656	SKEWNESS	1.656	RANGE	68.000
MINIMUM	.000	MAXIMUM	68.000		

VALID CASES 204 MISSING CASES 7

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 8.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR201

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	14	7	7	13.	2	1	67	27.	1	0	90
1.	25	12	19	14.	3	1	69	28.	1	0	91
2.	20	10	29	15.	6	3	72	29.	1	0	91
3.	12	6	35	16.	2	1	73	30.	4	2	93
4.	9	4	39	17.	2	1	74	31.	1	0	94
5.	3	1	41	18.	10	5	78	32.	3	1	95
6.	13	6	47	19.	3	1	80	33.	1	0	96
7.	5	2	50	20.	3	1	81	36.	4	2	98
8.	13	6	56	21.	1	0	82	38.	1	0	98
9.	4	2	58	23.	2	1	83	42.	1	0	99
10.	4	2	60	24.	9	4	87	44.	1	0	99
11.	4	2	62	25.	3	1	89	60.	1	0	100
12.	9	4	66	26.	2	1	90	68.	1	0	100

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	7				

MEAN	11.216	STD ERR	.811	MEDIAN	7.577
MODE	1.000	STD DEV	11.585	VARIANCE	134.219
KURTOSIS	3.316	SKEWNESS	1.581	RANGE	68.000
MINIMUM	.000	MAXIMUM	68.000		

VALID CASES 204 MISSING CASES 7

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR202

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	6	3	3	17.	2	1	59	34.	1	1	89
1.	15	8	11	18.	12	6	65	36.	4	2	91
2.	14	7	18	19.	4	2	67	37.	2	1	92
3.	8	4	22	20.	2	1	68	38.	2	1	93
4.	3	2	23	21.	3	2	70	42.	2	1	94
5.	4	2	25	22.	2	1	71	43.	1	1	95
6.	10	5	30	23.	1	1	71	44.	2	1	96
7.	9	5	35	24.	9	5	76	48.	1	1	96
8.	12	6	41	25.	3	2	77	50.	1	1	97
9.	4	2	43	26.	3	2	79	56.	1	1	97
10.	3	2	44	27.	5	3	81	59.	1	1	98
11.	2	1	45	28.	3	2	83	60.	1	1	98
12.	10	5	50	29.	2	1	84	61.	1	1	99
13.	5	3	53	30.	4	2	86	72.	1	1	99
14.	1	1	53	31.	2	1	87	80.	1	1	100
15.	6	3	56	32.	3	2	88				
16.	4	2	58	33.	1	1	89				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	12				

MEAN	16.286	STD ERR	1.036	MEDIAN	12.450
MODE	1.000	STD DEV	14.619	VARIANCE	213.721
KURTOSIS	2.438	SKEWNESS	1.398	RANGE	80.000
MINIMUM	.000	MAXIMUM	80.000		

VALID CASES 199 MISSING CASES 12

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR203

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	49	25	25	7.	6	3	83	15.	1	1	95
1.	36	18	43	8.	7	4	86	16.	2	1	96
2.	25	13	56	9.	3	2	88	19.	1	1	97
3.	12	6	62	10.	6	3	91	20.	1	1	97
4.	15	8	69	11.	5	3	93	24.	5	3	100
5.	9	5	74	12.	2	1	94				
6.	12	6	80	14.	1	1	95				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	13				

MEAN	3.955	STD ERR	.361	MEDIAN	2.060
MODE	.000	STD DEV	5.086	VARIANCE	25.871
KURTOSIS	4.890	SKEWNESS	2.112	RANGE	24.000
MINIMUM	.000	MAXIMUM	24.000		

VALID CASES 198 MISSING CASES 13

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSM - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR204

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	14	7	7	11.	7	4	77	24.	7	4	95
1.	37	19	26	12.	9	5	82	25.	2	1	96
2.	25	13	38	13.	2	1	83	26.	1	1	97
3.	14	7	45	14.	1	1	83	29.	1	1	97
4.	16	8	53	15.	2	1	84	30.	1	1	98
5.	6	3	56	16.	2	1	85	32.	1	1	98
6.	14	7	63	18.	8	4	89	33.	1	1	99
7.	6	3	66	19.	2	1	90	36.	1	1	99
8.	8	4	70	20.	1	1	91	38.	1	1	100
9.	2	1	71	21.	1	1	91				
10.	5	3	74	23.	1	1	92				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	12				

MEAN	7.317	STD ERR	.571	MEDIAN	4.094
MODE	1.000	STD DEV	8.060	VARIANCE	64.965
KURTOSIS	1.945	SKEWNESS	1.560	RANGE	38.000
MINIMUM	.000	MAXIMUM	38.000		
VALID CASES	199	MISSING CASES	12		

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR205

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	15	7	7	11.	6	3	76	25.	2	1	95
1.	40	20	27	12.	12	6	82	26.	1	0	96
2.	26	13	40	14.	2	1	83	29.	2	1	97
3.	13	6	47	15.	2	1	84	30.	1	0	97
4.	13	6	53	16.	4	2	86	32.	1	0	98
5.	8	4	57	18.	9	4	90	35.	1	0	98
6.	9	4	62	19.	1	0	91	36.	1	0	99
7.	9	4	66	20.	1	0	91	38.	1	0	99
8.	2	1	67	21.	1	0	92	48.	1	0	100
9.	7	3	71	23.	1	0	92				
10.	4	2	73	24.	4	2	94				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	11				

MEAN	7.425	STD ERR	.605	MEDIAN	3.962
MODE	1.000	STD DEV	8.558	VARIANCE	73.241
KURTOSIS	3.491	SKEWNESS	1.803	RANGE	48.000
MINIMUM	.000	MAXIMUM	48.000		

VALID CASES 200 MISSING CASES 11

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.04

FILE TANK (CREATION DATE = 20 DEC 77)

VAR206

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
0.	8	4	4	13.	1	1	62	27.	2	1	86
1.	14	7	11	14.	2	1	63	28.	3	2	87
2.	17	9	20	15.	2	1	64	29.	2	1	88
3.	8	4	24	16.	5	3	66	30.	3	2	90
4.	9	5	28	18.	10	5	71	32.	2	1	91
5.	5	3	31	19.	2	1	72	33.	1	1	91
6.	16	8	39	20.	4	2	74	36.	9	5	96
7.	9	5	43	21.	3	2	76	37.	1	1	96
8.	8	4	47	22.	1	1	76	39.	1	1	97
9.	7	4	51	23.	2	1	77	41.	2	1	98
10.	5	3	53	24.	12	6	83	43.	1	1	98
11.	5	3	56	25.	1	1	84	48.	2	1	99
12.	11	6	61	26.	2	1	85	71.	1	1	100

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
9999.	12				

MEAN	13.447	STD ERR	.866	MEDIAN	9.286
MODE	2.000	STD DEV	12.221	VARIANCE	149.360
KURTOSIS	1.788	SKEWNESS	1.251	RANGE	71.000
MINIMUM	.000	MAXIMUM	71.000		

VALID CASES 199 MISSING CASES 12

APPENDIX D

OUTLINE OF THREE DAY TRAINING PROGRAM

OUTLINE OF THREE DAY TRAINING PROGRAM

PRETRAINING CONDITIONS: Given soldiers who are properly motivated and possess the physical and mental aptitudes required of MOS 11E and qualified tank commanders and drivers, gunners and loaders can be trained to perform the following operations in three days of training:

OBJECTIVES:

DAY 1

GUNNER. The gunner will be able to perform the following operations in an M60A1 during day or night.

1. Given an operational CVC helmet, the gunner will connect it to the Gunner's Control Box in an M60A1, adjust the volume of the incoming signal and communicate on intercom.

2. Given a protective mask, the gunner will mask, connect to the Gunner's M3 Heater in an M60A1 and check operation of the heater.

3. Given a direction from the commander to prepare the gunner's station for operation, the gunner will:

a. Manually elevate and depress the main gun.
b. Manually traverse the turret.
c. Prepare the Gunner's Telescope for operation with the HEP reticle.
d. Prepare the Gunner's Periscope for operation.
e. Place the turret in power operation.
f. Turn the Ballistic Computer on and adjust the illumination of the dials.
g. Operate the Azimuth Indicator.
h. Operate the Elevation Quadrant.

4. Given a direction from the Tank Commander to prepare-to-fire, the gunner will perform the gunner's duties in the Prepare-to-Fire checks.

5. Given a precision fire command for SABOT or HEAT from a stationary tank to a stationary target, the gunner will:

a. Turn main gun switch ON.
b. Identify the target and announce, IDENTIFIED.
c. Index the proper ammunition in the Ballistic Computer.
d. Take up the proper sight picture in the Gunner's Periscope within 10 seconds during daylight and 15 seconds at night.
e. Announce ON THE WAY and squeeze an appropriate trigger after receiving the command to fire.

6. Given a battlesight fire command from a stationary tank to a stationary target, the gunner will:

a. Identify the target and announce, IDENTIFIED.
b. Take up the proper sight picture in the Gunner's Periscope within 8 seconds during daylight and 12 seconds at night.
c. Announce, ON THE WAY and squeeze an appropriate trigger after receiving the command to fire.

7. Given a fire command and an unidentified target, the gunner will announce, CANNOT IDENTIFY within 8 seconds.

8. Given a HEP fire command and a range, the gunner will:

a. Identify the target and announce, IDENTIFIED.
b. Take up the proper sight picture in the Gunner's Telescope within 10 seconds during daylight and 15 seconds at night.
c. Announce ON THE WAY and squeeze an appropriate trigger after receiving the command to fire.

9. Given a fire command for range card lay to direct fire and range card data with no ammunition charge, the gunner will be able to fire a round within 45 seconds.

DAY 2

10. Given a SABOT or HEAT fire command to a moving target, the gunner will apply the appropriate lead, track the target and fire from the gunner's Periscope when given the command.

11. Given a HEP fire command to a moving target, the gunner will apply the appropriate lead, track the target and fire from the Gunner's Telescope when given the command.

12. Given a first round miss the gunner will sense the round, announce his sensing and apply BOT to stationary and moving targets.

13. Given a subsequent fire command, the gunner will apply the mil change and the target form methods of adjustment with the periscope and the range technique with the telescope.

14. Given a fire command to conduct area point or suppressive fire with the coax to a stationary target from a stationary or moving tank, the gunner will:

a. Index HEP on the Ballistic Computer.
b. Turn the coax switch ON.
c. Identify the target and announce IDENTIFIED.
d. Take up the proper sight picture and fire a burst within 5 seconds during daylight and 10 seconds at night.
e. Walk fire onto the target.
f. Execute the "Z" pattern of fire for area coverage.

15. Given a misfire of a 105mm round, the gunner will perform the gunner's portion of misfire procedures.

16. Given a stoppage of the coax, the gunner will perform the gunner's portion of the stoppage procedures.

17. Given a 105mm round, the gunner will hand it from the ground to a crew member standing on the tank.

DAY 3

18. Table VII Modified (subcaliber and main gun). Six main gun rounds were fired during the day and 4 were fired at night.

DAY 1

LOADER. The loader will be able to perform the following operations in an M60A1 during daylight or darkness.

1. Given a direction from the tank commander, the loader will turn the tank communications system ON or OFF at the AM 1780.

2. Given a CVC helmet, the loader will attach it to the Loader's Radio Control Box, adjust the volume of the incoming signal and transmit on the tank intercom system.

3. Given a protective mask, the loader will mask, attach to the tank gas particulate filter system and check operation of the M3 Heater in response to or direction from the tank commander.

4. Given one HEP, SABOT and HEAT round, the loader will identify each round by shape and color.

5. Given one belt of 7.62mm and one belt of .50 caliber ammunition, the loader will be able to identify the 7.62mm ammunition.

6. Given a direction from the tank commander, the loader will dismount the M219 machine gun from the tank.

7. Given a M219 machine gun and a direction from the tank commander, the loader will mount the coax in the tank.

8. Given a M219 machine gun and a direction from the tank commander, the loader will perform immediate action on coax.

9. Given two belts of 7.62mm ammunition and direction from the tank commander, the loader will link the belts together.

10. Given a belt of 7.62mm ammunication and a direction from the tank commander, the loader will fill the bananna box.

11. Given a belt of 7.62mm ammunition and a direction from the tank commander, the loader will load the coax machine gun.

12. Given a loaded coax machine gun and a direction from the tank commander, the loader will unload and clear the machine gun.

13. Given a direction from the tank commander, the loader will ground guide the driver.

14. Given 105mm rounds through the loader's hatch, the loader will properly stow the ammunition in all stowage areas.

15. Given the command to prepare-to-fire from the tank commander, the loader will perform the loader prepare-to-fire procedures.

DAY 2

16. Given a direction from the tank commander, the loader will manually open the main gun breech.

17. Given a fire command for a main gun battlesight engagement, the loader will within 3 seconds:

a. Clear the path of recoil.
b. Place the main gun safety switch to Fire and announce UP.
c. Secure another round of the same type and reload as required until commanded to cease fire.

18. Given an empty open breech, and a main gun fire command from the tank commander, the loader will within 5 seconds:

a. Select the proper type of ammunition.
b. Load the round into the breech.
c. Clear the path of recoil.
d. Place the Main Gun Safety Switch to Fire and announce, UP.
e. Secure another round of the same type and reload as required until commanded to cease fire.

19. Given an announcement of MISFIRE from the gunner, the loader will perform the loader misfire procedures.

20. Given a coax fire command, the loader will:

a. Insure that the coax is loaded, the safety is in the fire position and announce UP.

b. Standby the coax prepared to apply immediate action.

21. Given direction from the tank commander, the loader will change barrels on the coax within 15 seconds.

22. Given the announcement of STOPPAGE by the gunner, the loader will perform immediate action on the coax.

23. Given a direction by the tank commander, the loader will fire the coax manually.

24. Given a loaded main gun and a direction from the tank commander to load a different type of ammunition, the loader will unload, restow and reload the new type of ammunition within 20 seconds.

25. Given a direction by the tank commander, the loader will scan the loader's area of responsibility and identify targets by type, direction and range within 400 meters.

26. Given a direction by the tank commander, the loader will operate the turret vent blower.

27. Given a direction by the tank commander, the loader will dispose of coax brass.

DAY 3

28. Table VII

APPENDIX E

MAIN GUN OPENING TIME/POINT TABLE

MAIN GUN OPENING TIME/POINT TABLE

Battlesight Scale

Points	75	72	69	66	63	60	55	50	45	40	35	28	21	14	7	0
Time	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Precision Scale

Points	75	72	69	66	63	60	56	52	48	44	40	35	39	25	20	17	14	11	8	5	0
Time	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

APPENDIX F

MACHINE GUN OPENING TIME/POINT TABLE

MACHINE GUN OPENING TIME/POINT TABLE

Machine Gun Opening Time/Point Table											
	Suppressive Fire										
Points	20	19	18	17	16	15	12	9	6	3	0
Seconds	5	6	7	8	9	10	11	12	13	14	15
Points	10		9		8	7	6	4	2	1	0
Seconds	5	6	7	8	9	10	11	12	13	14	15

APPENDIX G

SUMMARY DATA FOR ANALYSIS OF EQUIPMENT FAMILIARITY

SUMMARY DATA FOR ANALYSIS OF EQUIPMENT FAMILIARITY

	Means Familiar Tank Group			Means Unfamiliar Tank Group			Equipment Effect	Equipment X Group Interaction
	1 n=7	2 n=3	3 n=2	1 n=4	2 n=7	3 n=7	df = 1,24	df = 2,24
OPENING TIME								
Stationary battlesight	7.32	8.00	10.63	6.80	6.36	10.43	0.61	0.41
Stationary precision	12.53	13.42	23.35	14.31	11.64	18.61	2.19	0.80
Moving target	9.93	11.16	8.75	11.63	9.65	13.65	1.85	4.04
TOTAL Main Gun	10.93	10.80	14.95	10.80	9.16	14.34	0.87	0.55
TARGETS HIT								
Stationary battlesight	3.14	3.33	1.50	3.50	3.43	2.14	0.64	0.24
Stationary precision	1.14	2.33	1.00	2.00	1.86	1.43	0.39	1.69
Moving	0.57	0.66	0.50	0.75	0.57	0.43	0.0001	0.16
Within time standard	1.57	1.67	0.00	1.00	3.00	1.14	1.00	1.64
TOTAL Main Gun	4.86	6.33	3.00	5.50	5.71	4.00	0.27	0.92
TABLE VIII POINTS								
Machine gun points	319.71	360.33	334.50	325.00	335.43	234.00	1.39	1.74
Main gun points	685.57	871.33	402.00	900.00	834.86	512.71	0.75	0.86
TOTAL	1054.86	1281.67	786.50	1250.00	1216.71	644.57	0.0008	1.15

APPENDIX H

SUMMARY DATA FOR ANALYSIS OF EQUIPMENT FAMILIARITY - DAY

SUMMARY DATA FOR ANALYSIS OF EQUIPMENT FAMILIARITY - DAY

	Means Familiar Tank Group			Means Unfamiliar Tank Group			Equipment Effect	Equipment X Group Interaction
	1 n=7	2 n=3	3 n=2	1 n=4	2 n=7	3 n=7	df = 1,24	df = 2,24
OPENING TIME								
Stationary battlesight	6.21	5.50	8.25	5.62	6.14	8.78	.04	.36
Stationary precision	14.42	12.16	22.50	13.12	11.21	16.71	2.57	1.73
Moving target	11.85	12.33	8.00	13.50	12.57	16.57	3.51*	3.83*
TOTAL Main Gun	10.68	9.53	13.90	10.20	9.45	13.22	.18	.06
TARGETS HIT								
Stationary battlesight	1.57	1.66	1.50	1.75	1.28	1.14	.35	.68
Stationary precision	.42	1.66	1.00	.75	1.28	.42	.38	1.29
Moving	.14	.66	.00	.25	.28	.28	.00	2.21
Within time standard	.71	1.33	.00	.75	1.57	.14	.14	.05
TOTAL Main Gun	2.00	3.33	2.50	2.75	2.42	2.00	.14	1.48
TABLE VIII POINTS								
Machine gun points	139.14	206.66	166.50	187.25	166.57	143.14	.04	2.56
Main gun points	287.85	484.00	334.50	400.50	357.42	261.71	.13	1.74
TOTAL	460.00	576.66	526.00	598.75	549.00	409.85	.00	1.10

*$p \leq .05$, 2-tailed.

APPENDIX I

SUMMARY DATA FOR ANALYSIS OF EQUIPMENT FAMILIARITY - NIGHT

SUMMARY DATA FOR ANALYSIS OF EQUIPMENT FAMILIARITY - NIGHT

	Means Familiar Tank Group 1 n=7	Group 2 n=3	Group 3 n=2	Means Unfamiliar Tank Group 1 n=4	Group 2 n=7	Group 3 n=7	Equipment Effect df = 1,24	Equipment X Group Interaction df = 2,24
OPENING TIME								
Stationary battlesight	8.42	10.50	13.00	8.12	6.57	12.07	1.36	1.15
Stationary precision	16.66	14.66	22.25	16.50	12.07	21.21	.40	.25
Moving target	8.00	10.00	9.50	10.00	7.00	10.71	.00	1.88
TOTAL Main Gun	11.17	12.06	16.00	11.40	8.85	15.45	.79	1.25
TARGETS HIT								
Stationary battlesight	1.71	1.66	0.00	1.75	2.00	.85	4.18*	2.88
Stationary precision	.71	1.33	0.00	1.25	1.00	1.00	2.59	4.93*
Moving	.42	.00	.50	.50	.28	.14	.00	1.85
Within time standard	1.14	.00	.00	.25	1.42	.42	.32	2.86
TOTAL Main Gun	2.85	3.00	.50	3.50	3.28	2.00	4.73*	1.87
TABLE VIII POINTS								
Machine gun points	172.14	153.66	168.00	151.75	168.85	105.14	1.36	2.70
Main gun points	397.71	387.33	67.50	499.50	463.50	251.00	4.12*	.59
TOTAL	594.85	566.00	260.50	651.25	667.71	377.57	2.00	.15

* $p \leq .05$, 2-tailed.

DISTRIBUTION

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1 Research Institute, HQ MASSTER, Ft Hood
1 USA Recruiting Cmd, Ft Sheridan, ATTN: USARCPM-P
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