Technical Report 707

Predicting Performance of M1 Gunners

Barbara A. Black and Karen J. Mitchell

ARI Field Unit at Fort Knox, Kentucky
Training Research Laboratory

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This research was designed to evaluate a battery of M1 gunner performance prediction tests. Specifically, the work sought to (1) determine the relationship between hands-on job sample tests and computerized counterparts, (2) ascertain how these relate to Armed Services Vocational Aptitude Battery-based ability measures, and (3) determine how the tests relate to tank gunnery measures. Data were obtained for 123 M1 tank gunners from 4 battalions. Composite scores were derived for five hands-on predictor tasks: (1) tank engagement, (2) snakeboard tracking, (3) computer panel enter/check data, (4) computer (Continued)

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20. (Continued)

tank engagement, and (5) computer tracking. Data were also obtained on a motivation inventory, the Armed Forces Qualification Test, and the Pattern Analysis subtest of the Armed Services Vocational Aptitude Battery, Forms 6/7. Criterion data included supervisor ratings and Table VIII annual gunnery scores. Results for the target engagement test suggested that this task might be successfully computerized. Performance on M1 Computer Panel Tests was found to relate to the Armed Forces Qualification Test. While no relationships for supervisor ratings and Table VIII day scores and predictor tests were observed, some hands-on measures were seen to correlate with Table VIII night scores.

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Barbara A. Black and Karen J. Mitchell

ARI Field Unit at Fort Knox, Kentucky
Donald F. Haggard, Chief

Training Research Laboratory
Seward Smith, Acting Director

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

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FOREWORD

The difference between a weapons system's potential and achieved capabilities is in large measure a function of crew performance. To maximize armor system effectiveness, the U.S. Army is committed to optimally selecting and training tank crewmembers. Early identification of high-ability crewmembers can lead to improvement in overall tank crew performance and in the cost effectiveness of training programs. This work focuses on a battery of M1 gunner performance prediction tests. Findings speak to the relationships between job sample ability testing and on-the-job gunner performance.

EDGAR M. JOHNSON
Technical Director

PREDICTING PERFORMANCE OF M1 GUNNERS

EXECUTIVE SUMMARY

Requirement:

This research was designed to evaluate a battery of M1 gunner performance prediction tests. Specifically, the work sought to (1) determine the relationship between hands-on job sample tests and computerized counterparts, (2) ascertain how these relate to Armed Services Vocational Aptitude Battery-based ability measures, and (3) determine how the tests relate to tank gunnery measures.

Procedure:

Data were obtained for 123 M1 tank gunners from four battalions. Composite scores were derived for five hands-on predictor tasks: (1) Tank engagement, (2) Snakeboard tracking, (3) Computer panel enter/check data, (4) Computer tank engagement, and (5) Computer tracking. Data were also obtained on a motivation inventory, the Armed Forces Qualification Test, and the Pattern Analysis subtest of the Armed Services Vocational Aptitude Battery, Forms 6/7. Criterion data included supervisor ratings and Table VIII annual gunnery scores.

Findings:

Results for the target engagement test suggested that this task might be successfully computerized. Performance on M1 Computer Panel Tests was found to relate to the Armed Forces Qualification Test. While no relationships for supervisor ratings and Table VIII day scores and predictor tests were observed, some hands-on measures were seen to correlate with Table VIII night scores.

Utilization of Findings:

- Pending further research on job sample ability tests, a multiple hurdle approach to M1 gunner selection may be suggested. Selection of crewmembers may be affected by job sample ability testing for position-specific requirements in combination with the on-site commander's evaluation of crewmember performance. These findings suggest that it may be feasible to develop Unit Conduct-of-Fire (UCOFT) based tests for use by command personnel to assign crewmembers to positions within the M1 tank.

PREDICTING PERFORMANCE OF M1 GUNNERS

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PREDICTING PERFORMANCE OF M1 GUNNERS

OVERVIEW

Potential weapon system capability and achieved capability differ in large measure as a function of crew performance. To maximize Armor system effectiveness, the U.S. Army is committed to optimally selecting and training tank crewmembers. Within the four-man tank crew, specific emphasis has been placed on identifying soldiers who possess the requisite aptitudes and abilities to become proficient Armor tank commanders (TCs) and gunners. Early identification of these high-ability soldiers can lead to improvement in overall tank crew performance and in the cost effectiveness of training programs.

In Armor table of organization and equipment (TOE) units, the unit commander is responsible for assigning soldiers to fill vacated crew positions. This command decision is usually based on the soldier's date of rank, career history, and the commander's professional judgment of the soldier's ability to function in the new position. This process can, however, result in a trial-and-error approach to assignment whereby soldiers are removed when they fail to perform satisfactorily and new soldiers are assigned until an effective TC or gunner is found. In addition, this approach may exacerbate already deleteriously high levels of tank crew turbulence in Armor units (Eaton & Neff, 1978).

To improve the current TC and gunner selection/assignment process, it would be advantageous to administer, by means of a tank simulator device, assessment procedures that indicate soldiers' potential for successful performance in given crew positions. This test or battery of tests would provide unit commanders with objective data to support, but not supplant, decision-making responsibility. This should decrease position turbulence within the unit and give commanders more information on which to base decisions concerning soldiers recently assigned to their units.

The realization of this goal is contingent on possessing the capability to measure abilities that have been identified as critical to job success and then being able to demonstrate the relationship between those abilities and actual job performance. The first step in this process is the analysis of job requirements for each position under consideration; the second step is the development of ability measures or tests. The U.S. Army Research Institute has for several years conducted research in job analysis and the development of tests for the prediction of Armor crewmember performance. This research has involved the development of tests for predicting success in basic and advanced individual Armor training, as well as in TOE units.

The present effort involves the evaluation of a battery of M1 gunner performance prediction tests. By virtue of the human factors engineering of the M1 weapon system, the M1 gunner has more responsibility for fire control than the gunner on any other U.S. tank system. This increased responsibility, combined with the knowledge that from the soldiers selected and assigned

as gunners come the future tank commanders of the Armor force, makes it important to optimize the selection and assignment of M1 gunners. A brief review of recent work in the prediction of tank crewmember performance will serve as background for the current effort. This review will include literature from both paper-and-pencil testing and job sample testing. Research concerning intervening variables, such as motivation, that affect soldier performance will also be reviewed.

Paper-and-Pencil Tests

Initial efforts to evaluate predictors of performance in tank firing, driving, and loading used paper-and-pencil tests because they are the most cost effective and least time-consuming approach to performance prediction. Greenstein and Hughes (1977) used Armor trainees and limited their effort to the use of paper-and-pencil tests in the psychological literature or in use by the Army at that time. For example, they include Lauer's (1952) tests of Visual Memory and Attention-to-Detail, as well as the Armed Forces Qualification Test (AFQT) and three composites of subtests from the Army Classification Battery (ACB): Combat Operations (CO), Field Artillery (FA), and Motor Maintenance (MM). Correlations were obtained between the paper-and-pencil tests and loading errors and driving performance. None of the 11 paper-and-pencil tests in the study predicted tank firing scores.

In addition to seven of the Greenstein and Hughes tests, Eaton (1978) used Mechanical Abilities and Object Completion tests to predict Table VIII gunnery scores for a sample of TCs and gunners. No significant correlations were obtained for TC performance; only the Locations Test approached significance for gunner performance ($r = -.30$, $p < .10$). Eaton, Bessemer, and Kristiansen (1979) identified six gunnery predictors and seven driving predictors from the Armed Services Vocational Aptitude Battery (ASVAB) subtests and several specialized paper-and-pencil tests. These tests initially correlated with gunnery and driving criterion measures, but the relationships failed to replicate their findings with either a second sample of trainees or a sample of TCs and gunners.

In a study commonly referred to as the Gideon report, Wallace (1982) presented the results of the 1982 European Canadian Cup trophy competition. He correlated the AFQT scores of tank commanders on the American team with their crew's live-fire gunnery scores and obtained a coefficient of .739 ($p < .01$, $N = 13$). This correlation has prompted considerable interest in the existence and strength of relationships between the mental abilities of TCs and successful tank crew performance.

In general, paper-and-pencil tests have resulted in few significant correlations with gunnery scores for either trainees or TOE unit personnel. Paper-and-pencil tests are limited because they tap only perceptual and/or cognitive aptitudes, not the additional perceptual-motor or psychomotor components of gunnery. The utility of these tests can be assessed only if, or when, gunnery tasks become more cognitively weighted. Wallace's findings may be an example that falls into this category. The trophy competition scoring

procedures and range setup may have placed greater emphasis on deciding where and when to fire than on the "how-to" of firing, thus imposing higher cognitive requirements than psychomotor ones.

Job Sample Tests

Recent research efforts have centered on an alternative to paper-and-pencil tests, a technique referred to as job sample testing. This approach consists of hands-on tests built to assess particularly critical aspects of the gunner's and tank commander's jobs. Eaton, Johnson, and Black (1980) used three groups of Armor trainees to test the predictive validity of a battery of gunnery-oriented job sample tests. One group of soldiers was tested prior to training, one at the 10th week of training, and one at the end of training. Tests were validated against end-of-training live-fire exercises. Results indicate that performance on job sample tests administered before or during training (10th week) failed to relate to live-fire performance. However, when tests were administered at the end of training in conjunction with live-fire exercises, significant correlations were obtained. Thus, job sample tests, or at least this set of tests, may have tapped some learned elements in addition to the underlying psychomotor aptitude.

Campbell and Black (1982) administered both the ASVAB and a battery of gunnery-oriented job sample tests, similar to the Eaton et al. (1979) tests, to two companies of M1 trainees before training. Results indicate that the best and most reliable predictor of performance in M1 training was Combat Operations (CO), the ASVAB aptitude area score currently designated as the selector for Armor. However, six job sample tests (two based on the M1 computer panel and four psychomotor measures) did improve upon ASVAB and biographical predictors, some by as much as 15%. Neither job sampled nor biographical measures alone correlated higher than CO with the criteria. The authors point to difficulties in obtaining valid and reliable measures of "success in training" as one possible reason for the low correlations.

Biers and Sauer (1982) documented the development of equipment-oriented job sample tests for M1 gunners and TCs and attempted to validate them against self-reported Table VIII performance history. They noted that ordinary least squares (OLS) combinations of job sample tests for TCs and other test combinations for gunners did account for significant portions of the Table VIII variance. Black (in preparation) reports the validation of these same job sample tests against criterion measures collected on these TCs and gunners 6 months after the original predictor testing. These data demonstrate promising relationships for the job sample tests in relation to success in M1 transition training and live-fire gunnery. However, interpretation of these results is qualified by sample size limitations; for example, only 33 TCs and 55 gunners were available for the evaluation.

The results of meta-analysis on 15 data sets available from previously published research on predicting tank crewmember performance indicate that job sample tests were, across studies, better predictors of performance by job incumbents than were paper-and-pencil tests (Black & Campbell, 1982). Drawbacks to job sample testing do exist; they are very similar to those

identified in the psychomotor testing programs of the 1940s and 1950s: cost, increased administration time, and equipment unreliability (Melton, 1947). However, the advent of microprocessors and the increasing availability of high fidelity simulators may remove or reduce several of the major concerns in the use of job sample tests, specifically, the requirement for special equipment, the need for continuous calibration, and the difficulties involved in unit-collocated testing facilities. Job sample tests developed for incorporation into on-line or forthcoming unit-located simulators may improve the cost effectiveness of testing, reduce testing time requirements, and eliminate the need for special equipment apart from the simulator itself.

Additional Variables

As many of the technological problems associated with job sample testing are overcome, the researcher must attend to other variable relevant to the predictor-criterion relationship. Two variables that previous research has shown to be important to gunner performance are prior Armor experience and soldier motivation (Eaton & Neff, 1978; Eaton, 1978).

Certain demographic variables have been found to correlate with gunnery scores across numerous studies for the past few years. These findings characterize the successful tank crew as being commanded by (a) a noncommissioned officer (NCO) with more time in the TC position than other TCs, (b) a TC who has trained longer with the gunner with whom he fired (Eaton & Neff, 1978), and (c) a TC who has a history of having qualified crews (Biers & Sauer, 1982). None of these findings is particularly unexpected, but unfortunately, none is useful in the early identification of high-performing TCs. Yet this information is valuable in terms of providing data on variables whose covariance with the predictor measure may obscure the relationship of interest.

Soldier motivation also affects measured individual and crew performance. Eaton (1978) reported a multiple correlation of .68 ($p < .001$) between indexes of tangible reward and recognition motivation and Table VIII scores. This indicates that motivation strategies initiated by the unit chain of command can have a direct effect on tank crew performance in exercises similar to Table VIII. In addition, Eaton found that for "TCs, drivers, and loaders, performance generally was positively related t recognition-based motivation, and negatively related to motivation based on tangible reward.... For gunners, however, performance was negatively related to recognition-based motivation" (p. viii). Thus, depending on the individuals' crew position, one strategy can potentially produce different effects on individuals' performance. Questions concerning whether source of motivation can be used to distinguish between high and low performers remain unanswered.

Criterion Measures

While previous research indicates that certain testing techniques hold promise for Armor crewmember performance and more information is now available concerning important intervening variables, the availability of appropriate and useful criteria against which to validate predictor tests has

remained a problem. Criterion measures used in past research include scores from live-fire gunnery exercises, Multiple Integrated Laser Engagements System (MILES) exercises, supervisory ratings, peer ratings, Skill Qualification Tests (SQTs), specially administered hands-on skill tests, and both hands-on and written tests administered during the course of normal Armor training. Efforts to explain the inconsistencies found in past research have brought to light many disadvantages associated with the current job performance criteria available in Armor, especially those associated with gunnery.

Scores obtained from live-fire gunnery exercises often provide data that are not comparable between units or even between tanks. It is conceivable that with a company of tanks firing over a period of several days, the condition of the weather, tank equipment, and range equipment could change to such a degree that no tanks fire the same engagements. In addition, for any specific tank, changes in ammunition characteristics, equipment performance, and firing conditions may reduce the reliability or increase the error variance for within-tank performance measures. Thus, low reliability of the criterion measure may have been a large contributing factor to the relatively inconsistent findings of past research.

In addition, it should be pointed out that tank gunnery tables are collective exercises. Engaging targets and measuring the results of those behaviors in such values as "time to engage" or "proportion of hits" produces a crew-level evaluation or, in the case of Table IX, a platoon-level evaluation. The relative contributions of individual crewmembers are difficult to ferret out. In fact, it is not uncommon for unit commanders who are short on high-quality personnel to pair mature, experienced TCs with novice or ineffective gunners to ensure that the tank crew will by rated "qualified." On the other hand, very effective gunners may find themselves in crews with ineffective TCs and fail to qualify their tanks during annual gunnery, thus making it virtually impossible to use the results of tank table exercises to make statements about individual performance. Many of these comments also apply to MILES exercises, such as those conducted at the National Training Center.

Like firing exercises, ratings or rankings by supervisors have inherent flaws. Specifically, the subjective nature of ratings makes the susceptible to biases associated with behaviors that are unrelated to gunnery task performance. Soldiers may be rated high if they tend to be courteous or low if they have disciplinary problems regardless of their gunnery ability. Alternative approaches to the criterion problem have included administering specially developed hands-on criterion tests or simply collecting existing evaluations, such as end-of-course exam scores. While the former approach is preferable to using existing data, sampling representative tasks to form criterion tests is always limited by time constraints and equipment availability.

A review of past research suggests that constant time and equipment constraints often force investigators to settle for the available criterion measures rather than the preferred. Therefore, it is not surprising that validation results have failed to identify effective predictor measures. To address this problem, it is necessary to look in two directions: first, to

determine what constitutes appropriate criteria; second, to determine how those criteria can be reflected in specific predictor tests. In looking toward the criterion or evaluation side, it is apparent that the Army is interested particularly in predicting combat skill. While on the predictor side, previous research supports a job sample testing approach.

Statement of the Problem

Past research has failed to demonstrate a reliable, valid relationship between Armor crewmember performance prediction tests and any one of a number of Armor job performance measures. Specifically, while the U.S. Army wants to select soldiers for duties as M1 gunners crewmembers who demonstrate the greatest potential for success in combat, it appears almost impossible to obtain reliable, appropriate performance measures against which to validate that potential. For example, threat doctrine indicates that M1 gunners will most likely engage targets employing evasive maneuvers, yet U.S. Armor live-fire gunnery exercises employ no such engagement requirements. U.S. gunnery tables contain moving targets, but these are most often flank constant-speed tank silhouettes. Therefore, the psychomotor skills necessary to obtain combat kills against an evasive target are not developed by tank tables nor can tank tables be used as a criterion against which to evaluate all combat skills.

The lack of appropriate criteria against which to validate combat skills also denotes the existence of a training gap. If the necessary combat "evaluation" environment cannot be produced, then the necessary combat "training" environment probably cannot be produced either. However, the Army is moving to bridge this gap through the use of high fidelity computer-controlled simulators, which can provide the necessary visual stimulus-and-response devices required for testing tank crewmembers. Simulators such as the M1 Unit Conduct of Fire Trainer (UCOFT) will allow M1 gunners to train against realistic threat arrays using M1 control handles that respond the way the M1 tank does. A variety of threat scenarios can be presented, ranging from single-target stationary (easy) to multitarget moving (difficult), up to and exceeding the best estimates of threat capability. Thus, using the M1 UCOFT, a soldier's advanced gunnery skills can be evaluated against realistic combat criteria.

In summary, the UCOFT offers a time- and cost-effective means of using the job sample testing approach for predicting combat performance. Considerable effort will be required to develop tests for implementation on the UCOFT or UCOFT-like simulators that mirror the hands-on requirements for combat-level tank gunnery. Once developed, these tests must be validated against their hands-on counterparts (e.g., skill tests) and against realistic job performance criteria. Furthermore, their relationship to general ability measures (e.g., AFQT) remains to be established. Initial evaluations from research with small samples indicates such relationships may exist (Wallace, 1982). A proposed criterion continuum is present in Table 1. Note that mental ability tests represent the initial and most abstract predictors of combat performance, followed by skill tests and then tests administered by means of simulators. Live-fire exercises currently occupy positions demonstrating the greatest point-to-point specificity (i.e., fidelity) with actual

Table 1

Level of Gunnery Skill Tested in Successive Levels of Combat Performance Prediction

	Combat Performance Predictors						
	Combat	National Training Center	Fire Coordination Exercises	Tank Gunnery Tables	Training* Devices (simulators)	Skills Tests	Mental Ability Paper-and-Pencil Tests
Basic and intermediate	Yes	Yes	Yes	Yes	Yes (e.g., VIGS)	Yes (e.g., Tank Crew Gunnery Skills Test)	?** (ASVAB-CO)
Advanced	Yes	Yes	Yes	Yes	Yes (e.g., UCOFT)	Yes (e.g., Equipment-Oriented Job Samples)	? (AFQT)
Tactical	Yes	Yes	Yes	Yes	Yes Platoon Trainers (e.g., SIMNET)	Yes (Cognitively-Oriented Job Samples)	? (AFQT and Perceptual)

* VIGS (Videodisc Gunnery Simulator); UCOFT (Unit Conduct of Fire Trainer); SIMNET (Simulation Network)

** Paper-and-pencil test relationships not fully established.

combat. However, future high fidelity devices, including the UCOFT, may provide even greater fidelity using combat simulation than can be achieved in live-fire exercises that are constrained by safety requirements. Thus, it is even more important to develop and evaluate simulation-based, computer-controlled prediction tests in preparation for the delivery of UCOFT or similar devices.

Present Research

Research is needed (a) to determine the relationship between hands-on job sample tests and their computerized counterparts, (b) to ascertain how these tests relate to ASVAB-based ability measures, and (c) to determine how each test relates to measures of tank gunnery performance. The goal of this research is to establish that computer-based tests, like those that may be implemented on the UCOFT, relate to hands-on performance. A motivation inventory and biographical questionnaire will also be included. These instruments may be useful in providing data on moderator or suppressor variables within the tested relationships.

METHOD

Subjects

The subjects, 123 M1 tank gunners representing four battalions, were selected for participation based on supervisors' ratings. Ratings were completed by company commanders and a senior NCO of their choice. The two raters from each company were instructed to reach a consensus rank order for gunners, based on each gunner's demonstrated ability in performing gunnery-related tasks and on their availability for testing (see Appendix A). Raters were asked to disregard gunners' performance in such nongunnery areas as military courtesy. In addition, raters were asked to consider the gunners' performance apart from that of their respective tank commanders or crews; that is, to rate gunners high if they were proficient, even though their crews may not have qualified on the most recent gunnery exercise. Eight gunners were selected for testing from each company. The four rated most proficient in each company and the four rated least proficient were tested. One company was exempted from the testing because of prior commitments.

Predictor Tests

The job sample tests used in this research were originally developed and reported by Biers and Sauer (1982). These tests formed a battery intended for administration using M60A1 tanks and Apple computers. For the present research, however, the M60A1 on-track tests were modified for use on M1 tanks, thus forming M1 on-tank and M1 computerized test versions. The battery include two hands-on (on-tank) tests and three computer-based (off-tank)

tests. Also, five subtests of the ASVAB including AFQT and pattern analysis were administered as were motivation inventory (Eaton, 1978) and a biographical questionnaire.

Tracking Test. This hands-on test used a snakeboard, an M1 tank, and an M55 laser bore, sighted with the main gun. A specially built device was used to pulse the laser automatically once per second for periods of 60 seconds. Soldiers were instructed to use the gunner station power control handles to track the snakeboard 12 times, 6 times from left to right and 6 times from right to left. To determine the gunners' accuracy on each trial the test administrator counted the number of laser pulses that fell on the snake. Speed was determined by recording the location of the final pulse, thus indicating the distance tracked during the 60-second trial. See Appendix B for details about the equipment used for this test.

Target Engagement Test. Soldiers were evaluated on both speed and accuracy in a hands-on target engagement task using an M1 tank, an M55 laser, and three 35 mm slide projectors. A TC confederate initiated the fire commands and laid the main gun for direction in each of the 15 engagements. Three slides were presented simultaneously on a 1.82m x 5.49m screen; however, only one of the three slides in any given engagement contained a target. After the TC laid the gun for the direction, the gunners were instructed to call "identified" when they located the target in the Gunner's Primary Sight (GPS). The TC then released control of the main gun, and the gunner continued the engagement by laying on the target and firing the M55 laser. The test administrator recorded the time from slide presentation to laying the gun as well as the time from the gun lay to firing. These data were obtained from electronic stopwatches wired to microswitches on the TC's and gunner's control handles. The test administrator also recorded hit or miss on the engaged target. Appendix C contains details concerning the equipment utilized for this test.

Computerized Tracking Test. A compensatory tracking task was administered to soldiers, using a microcomputer, a video monitor, and a joystick control. The video monitor contained a fixed reticle and a moving dot or target (approximately .16 cm square). This target moved randomly across the screen at one of three speeds. The soldiers' task was to bring the target into contact with the reticle and maintain the target on the reticle cross hair during each of the 3-minute trials. The target dot moved at a higher speed on each successive trial. Scores from this test included "time-on-target" and the "root mean square (RMS) distance error" for each of the three trials.

Computerized Target Engagement Test. This test required a microcomputer with video monitor, a 35 mm slide projector, a joystick control, and an image combiner. Slides that simulated the M1's 3X and 10X sight pictures were prepared. Each slide contained one target: either a tank, a jeep, or an armored personnel carrier (APC) embedded in a wooded scene. The image combiner allowed the reticle and four-digit range data that appeared on the video monitor to be superimposed on the 3X and 10X slide sight pictures. For each engagement, soldiers were instructed to view the 3X sight picture, locate the target, and place the center of the reticle on the target using the

joystick. The next steps in the engagement procedure were to (a) press a button labeled "10X" that advanced the slide projector to a 10-power sight picture of the target area, (b) relay the reticle on the target, and (c) range to the target by pressing a button labeled "Lase." Pressing the Lase button caused a change in the four-digit range number at the bottom of the sight picture. If the new range number had a bar over it, indicating a multiple return, soldiers were instructed to range again and then to fire by pressing a button labeled "Fire." If the range number did not have a bar over it, soldiers were instructed to maintain the reticle on target and to press the Fire button. Soldiers were given 2 practice engagements during the instructional phase and 18 engagements in the test phase. The microcomputer recorded the distance between the center of the reticle and the target when the 10X, Lase, and Fire buttons were pressed. Elapsed times were recorded from the onset of the 3X target scene to the button presses for 10X, Lase, and Fire. Laser ranging procedures were scored as correct or incorrect for each engagement. Hit and miss data were also recorded. See Appendix D for details on the collocated equipment used for this test as well as for the Computerized Tracking Test.

M1 Computer Panel Test. Soldiers were tested on three operations of the M1 ballistic computer by means of a microcomputer-controlled simulation of the computer's panel. The simulator used a screen digitizer or touch panel placed over the face of a 12-in. color monitor. The operations consisted of enter data, check data, and run computer self-test. The software for the M1 computer test was developed to provide the soldiers with 3 instructional trials for each type of operation followed by 10 scored or test trials. The number of correct on each operation and the time required to complete each test trial were recorded. Appendix E provides details on the Computer Panel test.

ASVAB. Four subtests from a research version of the ASVAB were used to obtain estimates of soldier scores on the AFQT. Because of time constraints imposed on the overall testing process, a scaled-down version of each subtest was used. Subtests were shortened by randomly selecting 50% of the questions for administration. The AFQT consists of a combined score obtained from the following ASVAB subtests: Numerical Operations (NO), Paragraph Comprehension (PC), Arithmetic Reasoning (AR), and Word Knowledge (WK). In addition, as ASVAB 6/7 subtest, Pattern Analysis (PA), was administered to index spatial or perceptual skill.

Motivation Inventory. A motivation inventory developed by Eaton (1978) was administered. Based on Vroom's (1964) theory, this inventory yielded scores on four separate scales: recognition, tangible reward, intrinsic reward, and self-actualization. A copy of the inventory is given in Appendix F.

Biographical Questionnaire. This questionnaire provided information on soldier's time in the Army and amount of Armor experience. A copy of the questionnaire is given in Appendix G.

Criterion Measures

The criterion measures include the supervisors' ratings and Table VIII scoresheets from the soldiers' most recent gunnery. Each gunner's overall Table VIII percentage was recorded as were separate totals for day and night engagements. Subtotals were computed from both the day and night totals for the moving maingun engagements.

Procedures

The validation effort was conducted double-blind; that is, neither the soldiers tested nor the test administrators were aware of the supervisors' ratings. The testing schedule allowed four soldiers to be tested in the morning and four in the afternoon. Each session began with a rotation schedule for completing the individually administered job sample tests (see Appendix H). The biographical questionnaires were completed during the time available between job sample tests. When all soldiers had completed the job sample tests, the ASVAB and motivation inventory were administered in a group testing session. Thus, testing was completed in 16 working days, 4 days per battalion. One-half day was later set aside for makeup testing for soldiers whose computerized-target engagement test data were not recorded because of computer failure.

Data Quantification

Preparing test data for analysis involved utilizing both microcomputer and manual methods. The raw data for each computerized test were tabulated and several derived measures computed using the same Apple II Plus computers used to collect the data. Data on the administrator's scoresheets were tabulated by hand, and some derived measures were computed manually. For example, for each of the 12 trials, the tracking test scoresheets contained the location of the final pulse. This location was converted to a measure representing the number of inches tracked during a 60-second trial, using a table of location values derived from measurements of the actual snakeboard. The remaining measures were computed and analyses conducted utilizing the Statistical Analysis System (SAS) (SAS Institute, Inc., 1979).

Table 2 provides a brief definition of the major derived measures and labels for each measures. Appendix I contains a comprehensive annotated list of predictor and criterion variables collected in the course of this research.

RESULTS AND DISCUSSION

This section is divided into three subsections, each addressing a separate research question. The first section, Comparability of Battalions, presents the results of analyses comparing data from each of the four battalions on the biographical questionnaire, the predictor tests, and the

Table 2

Derivations and Labels for Major Predictor Variables from Job Sample Tests

Test	Variable	How derived
Hands-on tests:		
Tracking	FTRH	Sum of hits for trials 3-12
	FTRD	Sum of distance in inches for trials 3-12
	FTR	Sum of hits (3-12) added to the sum of the distance (3-12)
Target engagement	FTET	Sum of the engagement times for trials during which hits occurred
	FTEH	Total number of hits divided by the total number of engagements fired
	FTE	Total number of hits divided by the total number of engagements fired minus the sum of engagement times for trials where hits occured
Computerized tests:		
Computerized tracking	FCTE	Average root mean square (RMS) error across 3 trials
	FCTT	Average time-on-target across 3 trials
	FCT	Average time-on-target minus average RMS error
Computerized target	FCDT	Sum of engagement times for trials 2-18
	FCDH	Sum of engagement hits for 10X, Lase, and Fire for trials 2-18
	FCD	Sum of hits for 10X, Lase, and Fire (trials 2-18) minus sum of engagement times (trials 2-18)
M1 computer panel	FCPEC	Total number of correct enter/check data (ECD) trials
	FCPET	Average time on ECD trials
Computerized tests:		
M1 computer panel (continued)	FCPE	Total correct ECD trials minus average ECD time
	FCPCC	Total number of correct computer self-test (CST) trials
	FCPCT	Average time on CST trials
	FCPC	Total correct CST trials minus average CST time

criterion measures. The second section, Predictor Test Relationships, examines the intercorrelations among predictors with particular emphasis on the relationships between hands-on tests and their computerized counterparts. The third section, Predictor-Criterion Relationships, presents the results of analyses conducted to establish the existence of relationships between predictor and criterion measures.

Comparability of Battalions

Data were tabulated and descriptive statistics were computed for each battalion and for all variables. Because subjects for this research effort were drawn from four separate battalions, comparability among the battalions was initially evaluated.

It was of interest to ascertain whether or not gunners in these battalions had essentially equivalent Armor experience. This was especially true for these four battalions because each had recently been transition trained from M60A1 tanks to the M1. The order in which battalions were transitioned as well as the means and standard deviations for four biographical variables for each battalion are presented in Table 3. While gunners from the four battalions appeared equivalent in the number of months they had served in the gunner position, gunners from Battalion 1, the second battalion to be transitioned, had more M1 gunnery experience. The only explanation for this is that by the time the second battalion transitioned, soldiers who had trained on the M1 at Fort Knox began transferring to fill slots in Europe. This was true for both cadre (E-6 and E-7) and for recent initial entry training (IET) graduates. It was also of interest to determine whether or not battalions differed on the paper-and-pencil ability measures, namely AFQT and PA. Table 4 shows that differences do exist; scores were standardized by battalion.

Descriptive statistics were subsequently computed for each battalion on the raw scores from the job sample predictor tests. Table 5 presents those statistics for major job sample predictor tests. It is apparent that no one battalion is consistently superior. However, discrepancies among battalions suggest that subsequent analyses should use scores standardized by battalion.

Criterion variables included both the supervisors' ratings and measures derived from the Table VIII scoresheets. With regard to the supervisors' ratings, the original design for this research called for 120 subjects, 30 from each battalion. Each battalion was to provide 15 of its best gunners. Selecting the top 15 and bottom 15 and not testing the remaining 24 gunners in each unit optimizes the opportunity to demonstrate the discriminability of the predictor tests. Unfortunately, the units involved could not provide gunners of the exact type and quantity specified. Table 6 presents the number of gunners from each battalion falling into each rating category. The decrement in Battalion 2 is a result of having on of their four companies designated as a Canadian Army Trophy Cup competitor.

Table 3

Means and Standard Deviations by Battalion for Biographical Data

Experience (in months)		Battalion 1	2	3	4
In Army	$\bar{x}$	49.4	55.3	60.6	57.8
	SD	21.1	22.9	19.8	20.4
	N	33	26	32	32
As gunner	$\bar{x}$	21.0	23.6	23.0	22.2
	SD	15.7	19.7	14.9	16.3
	N	32	25	32	32
As M1 gunner	$\bar{x}$	12.0	8.8	8.1	8.1
	SD	10.3	5.2	4.1	6.4
	N	32	25	32	32
In present unit	$\bar{x}$	18.2	22.6	17.5	16.3
	SD	6.8	9.7	6.9	12.3
	N	33	26	32	32
Transition training order		2nd	1st	3rd	4th

Table 4

Means and Standard Deviations by Battalion for AFQT and PA

		Battalion 1	2	3	4
AFQT	$\bar{x}$	59.20	57.10	58.00	59.80
	SD	24.00	29.20	26.70	25.10
	N	33	26	32	32
PA	$\bar{x}$	10.30	9.27	10.19	9.84
	SD	3.87	3.94	3.77	3.16
	N	33	26	32	32

Table 5

Means and Standard Deviations by Battalion for Job Sample Measures

		Battalion			
		1	2	3	4
Tracking					
Hits (FTRH)	$\bar{x}$	487.1	464.3	502.9	495.7
	SD	46.5	56.5	40.7	42.1
	N	32	26	32	32
Distance (FTRD)	$\bar{x}$	3389.3	3284.9	3008.1	2906.6
	SD	661.0	806.6	847.6	635.8
	N	32	26	32	32
Target engagement					
Time (FTET)	$\bar{x}$	36.6	36.6	38.0	35.8
	SD	52.2	10.4	11.4	9.6
	N	33	26	32	32
Hits (FTEH)	$\bar{x}$	.7	.7	.7	.7
	SD	.2	.1	.1	.1
	N	33	26	32	32
Computerized tracking					
Time (FCTT)	$\bar{x}$	32.4	32.0	33.1	33.7
	SD	7.7	9.6	8.1	7.0
	N	33	25	32	32
Error (FCTE)	$\bar{x}$	27.1	25.5	24.6	24.9
	SD	11.9	3.4	2.2	1.8
	N	33	25	32	32
Computerized target engagement					
Time (FCDT)	$\bar{x}$	369.9	557.4	581.3	516.1
	SD	141.0	245.9	215.0	171.8
	N	31	22	25	32
Hits (FCDH)	$\bar{x}$	19.3	13.0	11.6	12.5
	SD	5.3	6.6	4.2	4.7
	N	33	25	32	32
M1 computer panel					
ECD correct (FCDEC)	$\bar{x}$	9.8	9.5	9.8	9.6
	SD	.4	.7	.5	.6
	N	33	26	37	32
ECD time (FCPET)	$\bar{x}$	19.6	20.0	19.6	19.3
	SD	3.9	6.3	4.2	5.2
	N	33	26	32	32
CST correct (FCPGC)	$\bar{x}$	9.6	9.2	9.2	8.9
	SD	.7	1.3	1.4	1.3
	N	33	26	32	32
CST time (FCPCT)	$\bar{x}$	17.4	18.6	18.6	18.7
	SD	1.9	2.6	4.0	2.7
	N	33	26	32	32

Table 6

Number of Gunners Rated High and Low by Battalion

	Battalion				Total
	1	2	3	4	
Number of gunners rated high	16	12	15	15	58
Number of gunners rated low	17	14	17	17	65
Total	33	26	32	32	123

Table VIII data were tabulated to derive the following measures: percent total hits (PTOTAL), percent day hits (PDAY), percent night hits (PNIGHT), percent day moving hits (PDMOVE), and percent night moving hits (PNMOVE). Raw score means and standard deviations for these variables are presented in Table 7. Battalion 3's lower percent scores were attributed to its having fired at a different location from the other three battalions and on a range fraught with numerous target equipment difficulties. Percentage scores were therefore standardized by battalion prior to computation of zero-order correlations with the obtained predictor measures.

Predictor Test Relationships

Hands-on versus Computerized Tests. To address the initial goal of this research effort, that is, to determine the relationship between the hands-on job sample tests and their computerized counterparts, intercorrelations among all predictor measures were computed (see Appendix J). The Tracking Test, using an actual M1 tank and a large snakeboard, was a hands-on test; its counterpart was the more abstract, psychomotor tracking task using the Apple II joystick. The Target Engagement Test, employing an M1 tank and three 35 mm slide projectors to present three target slides simultaneously, was the hands-on counterpart of the Computerized Target Engagement Test. The M1 Computer Panel Test was unique because it was administered via an Apple II microcomputer and a mylar touch panel, but in essence, it was a hands-on test incorporating all the procedural, cognitive, and perceptual-motor requirements of operating the actual M1 computer panel.

Hands-on tracking measures failed to correlate with any of the computerized tracking measures. This may point to the need for greater specificity between hands-on and computerized tracking tasks, a requirement certainly fulfilled in the UCOFT. The Apple II joystick-controlled psychomotor test requirements were apparently unrelated to the psychomotor aptitudes necessary to operate the M1 gunner's sophisticated controls.

Table 7

Means and Standard Deviations by Battalion for Table VIII Criterion Measures

Table VIII measures		Battalion 1	2	3	4
PTOTAL	$\bar{x}$	84.0	79.5	74.3	89.2
	SD	12.1	8.6	10.8	7.7
	n	31	23	29	31
PDAY	$\bar{x}$	85.7	84.4	73.3	87.3
	SD	15.5	9.5	10.7	9.9
	n	31	24	31	31
PNIGHT	$\bar{x}$	82.3	73.0	76.2	93.1
	SD	15.5	17.0	14.7	8.0
	n	32	23	28	31
PDMOVE	$\bar{x}$	73.1	82.4	71.9	85.9
	SD	31.5	17.5	16.8	11.8
	n	32	24	31	31
PNMOVE	$\bar{x}$	75.7	76.0	69.9	92.4
	SD	33.7	17.7	26.5	9.3
	n	32	22	29	31

The hands-on Tracking Test did relate to the computerized target engagement test. Specifically, the composite tracking score (FTR), which combined number of hits and distance tracked, correlated with two measures from the Computerized Target Engagement Test, total time (FCDT) and the composite measure (FCD) ($r = -.230$, $p < .016$ and $r = .248$, $p < .009$), respectively. The composite measure is a function of engagement time and number of hits. This correlation indicates that gunners who were better at snakeboard tracking also had shorter computerized engagement times.

The hands-on Target Engagement Test was related to its computerized counterpart. Target engagement time (FTET) was correlated with computerized target engagement time (FCDT) ($r = .220$, $p < .021$); and the relationship between proportion of target engagement hits (FTEH) and computerized engagement hits (FCDH) approached significance ($r = .167$, $p < .066$). Thus, gunners who engaged targets more quickly on the actual M1 tank were also quicker on the computerized version. These findings lend initial support to the usefulness of these measures for implementation on the M1 UCOFT or UCOFT-like simulators.

The M1 computer panel measures were related to performance on both hands-on tests. This finding was rather unexpected given the divergent

nature of the computer panel task. Although it is a necessary prelude to effective gunnery correct preparation of the computer panel has none of the psychomotor components common to gunnery tasks (i.e., tracking and firing at targets). Operating the M1 computer is, however, a highly cognitive task; and to the extent that certain cognitive abilities are common to all three tasks, a quantifiable relationship may exist.

The correlations between the M1 computer panel measures and measures from both the hands-on Tracking Test and the hands-on Target Engagement Test are found in Table 8. All correlations are in the appropriate direction for high performance gunners. For example, an effective M1 gunner should have a high ECD Composite Score (FCPE) and a high number of hits (FTRH). The positive correlation (r = .178, p < .049) indicates that this is indeed the case. In addition, it is reasonable to assume that an effective M1 gunner should know the ECD task well and therefore complete it in a short time and that the gunner should acquire and engage targets quickly. Thus, a correlation between ECD time (FCPET) and Target Engagement time (FTET) should be positive, and that is the case (r = .225, p < .012).

AFQT versus Predictor Tests. As is true with all correlational research, finding significant intercorrelations among the predictors points to the possibility that the predictors have a common underlying component. In an attempt to interpret the obtained relationships between the M1 Computer Panel Test and the two hands-on tests, it was hypothesized that the common component might be level of cognitive ability. Administration of the ASVAB subtests provided a measure of cognitive ability referred to as AFQT. Significant correlations between AFQT and job sample test measures are presented in Table 9. Of particular interest is the finding that of the six M1 Computer Panel Test measures, five were related to AFQT. This confirms the notion that this task has a relatively high cognitive component.

It is also interesting to note that AFQT correlated with number of hits for the hands-on tracking task (FTRH) (r = .360, p < .0001), indicating that gunners with higher AFQTs had more hits; that is, they were more accurate. Because tracking hits (accuracy) and tracking distance (speed) were negatively correlated (r = -.444, p < .0001), it is conceivable that gunners with a higher AFQT approached the tracking test with a different emphasis on speed and accuracy than did low AFQT gunners. Tracking distance did not correlate with AFQT. It is not possible to test the interaction between AFQT and the speed/accuracy tradeoff with these data. AFQT was also related to performance on the Computerized Target Engagement Test. Higher AFQT gunners took less time to engage targets but did not achieve more hits. The fact that AFQT did not relate to performance on the hands-on Target Engagement Test is not surprising; indeed, it is consistent with previous research, which has demonstrated the AFQT relationship between target engagement only for tank commanders not for gunners (Wallace, 1982).

AFQT is more commonly reported in its grouped or categorized form, that is, by AFQT category. Table 10 shows how AFQT percentile scores are converted to AFQT categories. Table 11 presents average gunner scores by AFQT category for three job sample composite measures. These measures include the ECD Composite Score (FCPE), the CST Composite Score (FCPC), and a third

Table 8

Significant Correlations Between M1 Computer Panel Test and Hands-on Tests

M1 Computer Panel	Hands-on tests: Tracking	Hands-on tests: Target engagement
ECD time (FCPET)	Hits (FTRH) $r = -.215$ $p < .017$	Time (FTET) $r = .225$ $p < .012$
	Composite (FTR) $r = -.335$ $p < .0002$	
ECD composite (FCPE)[a]	Hits (FTRH) $r = .178$ $p < .049$	Time (FTET) $r = -.208$ $p < .021$
	Composite (FTR) $r = .237$ $p < .008$	
CST time (FCPCT)	Hits (FTRH) $r = -.311$ $p < .0005$	
	Distance (FTRD) $r = .186$ $p < .041$	
CST composite (FCPC)[a]	Hits (FTRH) $r = .252$ $p < .005$	
	Distance (FTRD) $r = -.191$ $p < .035$	

[a]The composite measures are a function of time and accuracy scores.

composite score called the General Ability Composite (GAC), formed by totaling FCPE, FCPC, and FTR (the Tracking Composite Score). This three-task composite was developed using stepwise regression techniques; it was found to yield the most accurate prediction of AFQT. Average gunner scores were obtained by taking the average standardized score, adding a constant, then multiplying by 100. Note that AFQT category 3B and 4 personnel do not perform as well as personnel in categories 1-3A. The correlation between GAC

and AFQT was r = .49 (p < .0001). It is interesting to note that while the category I through category IIIa personnel comprise only about 66% of the total sample, they account for about 90% of the scoring in each of the three tests (See Table 12). Furthermore, the category IV personnel made up 20% of the sample but contributed less than 4% of the scoring in all three composites.

Table 9

Job Sample Measures That Correlated with AFQT

Tests and measures	r (p <)
Tracking	
Hits (FTRH)	.360 (.0001)
Composite (FTR)[a]	.316 (.0004)
M1 Computer Panel	
ECD Correct (FCPEC)	.214 (.0172)
ECD Time (FCPET)	-.513 (.0001)
ECD Composite (FCPE)	.444 (.0001)
CST Time (FCPCT)	-.339 (.0001)
CST Composite (FCPC)	.237 (.0082)
Computerized Target Engagement	
Time (FCDT)	-.240 (.0115)
Composite (FCD)	.216 (.0232)

[a]FTR is a function of tracking hits and tracking time.

Table 10

AFQT Category as Derived from AFQT Percentile

AFQT category	AFQT percentile
1	93-100
2	65-92
3A	50-64
3B	31-49
4	10-30
5	1-9

Table 11

Average Gunner Score by AFQT Category

Job sample	AFQT category 1 (N = 13)	2 (N = 41)	3A (N = 27)	3B (N = 17)	4 (N = 25)
ECD composite (FCPE)	198	141	139	47	19
CST composite (FCPC)	170	151	91	55	10
General ability composite[a]	346	211	105	26	5

[a]Sum of standardized scores for FCPE, FCPC, and FTR.

Table 12

Cumulative Scoring Contributions by AFQT Category

AFQT Category	N	Sample Size Cummulative Percent	ECD Scores Cummulative Percent	CST Scores Cummulative Percent	GAC Scores Cummulative Percent
I	17	11%	19%	18%	27%
II	41	33%	62%	69%	79%
IIIa	27	66%	90%	89%	96%
IIIb	17	80%	96%	97%	99%
IV	25	100%	100%	100%	100%
Total	123				

Additional Variables. Other intercorrelations among predictor variables of interest include those for the biographical measure, time as gunner (GNTM), which was found to relate to performance on both hands-on tests. GNTM correlated with both target engagement time (FTET) ($r = -.173$, $p < .058$) and with the tracking composite (FTR) ($r = .209$, $p < .022$). This finding is consistent with prior research demonstrating that the more time a soldier has served as a gunner the better his gunnery-related performance (Eaton & Neff, 1978).

Motivation questionnaire measures were analyzed with respect to other predictor measures. Results of these analyses are presented in Appendix I. While significant correlations were obtained, their nature and direction did not portray meaningful or readily interpretable relationships.

Predictor-Criterion Relationships

The third goal of this research effort was to determine how the obtained predictor measures related to the available criterion measures. The supervisory rating criterion measure failed to correlate with any of the job sample predictor tests. This result was not totally unexpected given the subjective nature of such a criterion. However, the Table VIII measures also failed to correlate with predictors, for two night measures, PNIGHT and PNMOVE, which correlated only with hands-on job sample tests (see Table 13). It is not clear why a relationship was observed for the night measures with these tasks when a similar relationship was not observed for the day measures. No relationships were noted for computerized measures.

Table 13

Significant Correlations Between Table VIII Measures and Job Sample Test Measures

Table VIII criterion measures	Job sample measures
PNIGHT	Tracking composite (FTR) $r = .219$ ($p < .020$)
	Target engagement time (FTET) $r = .182$ ($p < .053$)
PNMOVE	Tracking distance (FTRD) $r = .202$ ($p < .032$)
	Tracking composite (FTR)[a] $r = .182$ ($p < .054$)

[a]The tracking composite is a function of distance and number of hits.

Several disadvantages of Table VIII scores as criterion measures were discussed in general terms in the introduction. In the course of this research some specific problems were noted, and these may have accounted for the relatively small number of significant predictor-criterion relationships. For example, performance on the M1 Computer Panel Test failed to correlate with any of the criterion measures. Given that hitting targets with an M1 tank is in large measure a function of properly setting the M1 ballistic computer, it was surprising that these measures failed to correlate. Discussions with cadremen from these units revealed that prior to commencing a Table VIII run, all the computer functions are checked and, if necessary, reset by the unit's master gunner. This step eliminates or severely reduces the possibility that a tank would be sent down range and fail to qualify because its gunner did not or could not properly conduct the M1 computer panel preparation procedures. This would not, of course, be true in combat.

In addition, many of the job sample tests were constructed with a combat criterion in mind. The snakeboard used in the hands-on tracking task involved tracing an extremely circuitous route, more similar to a threat target employing evasive maneuvers than to the slow-moving flank silhouette targets found on a Table VIII range. The Target Engagement Test required the gunner to acquire actual vehicle targets photographed in defensive, camouflaged positions, as opposed to Table VIII's easier task of locating high contrast wooden panels.

Thus, we can expect to obtain significant correlations with combat performance predictor measures only with the development of criterion measures that accurately reflect combat requirements. The role of the UCOFT for M1 may be a dual one: it may serve as the vehicle whereby unit commanders can administer concise combat performance predictor tests to aid them in assignment decisions and it may provide test developers with the appropriate criteria against which to validate predictor tests because it will allow simulation of entire engagement scenarios typical of those expected in combat.

Conclusion

The present effort has involved the development and evaluation of skills tests for use as combat performance predictors. Results for the target engagement task suggest that this hands-on test could be successfully computerized. While no relationships were observed for the supervisors' ratings and Table VIII day scores, some hands-on measures were found to correlate with Table VIII night scores. These findings suggest that a UCOFT-implemented sample testing approach may be feasible. Performance on the M1 Computer Panel Tests was found to relate to AFQT.

Pending further research on job sample ability testing, a multiple hurdle approach to M1 gunner and tank commander selection may be suggested. Job sample ability testing for position-specific requirements may be combined with the on-site commander's evaluation of crewmember performance. This testing may offer a feasible approach to crewmember selection. Further research is required to assess how job sample testing can apply to tank commander selection. Finally, following delivery of the UCOFT, UCOFT-implemented job sample tests would have to be validated for both TC and gunner positions.

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APPENDIX A

INSTRUCTION TO RATERS

GEN Thurman, the Vice Chief of Staff of the Army, has directed the Army Research Institute (ARI) to conduct research in M1 tank gunner performance. Your assistance in providing thoughtful evaluations of the gunners in this battalion is a major cornerstone in this research project. The ratings you provide will not be given to anyone; they are for research purposes only. The ratings will not affect the careers of the men rated in either a positive or a negative way. The ratings will however provide the Army's personnel managers with some valuable information concerning what field supervisors value in the performance of M1 gunners.

When you evaluate the gunners on this list please note that we as Armor researchers are aware that gunnery is a crew level exercise, a tank may qualify because it has a top-notch TC who performs extremely well even though he has a relatively poor gunner or another tank may fail to qualify with a top-notch gunner because the TC was poor in target acquisition or slow to lay the main gun. For this reason we are asking you for your opinion/evaluation of the battalion's gunners, rather than using only Table VIII scores.

Please do not, repeat do not, discuss your ratings or the conduct of this research with anyone. A soldier's motivation to perform to the best of his ability is very important.

APPENDIX B

TRACKING TEST

EQUIPMENT

1. M1 Tank
2. M55 Laser Device
3. Laser Pulser Device to pulse the M55 laser device at controlled rates for fixed periods of time.
4. Snakeboard consisting of 1 inch wide engineering tape placed on a 1.8 meter x 1.8 meter board in a circuitous path.

APPROXIMATE ADMINISTRATION TIME

Instructions	2 minutes
12 Tracking Trials	20 minutes
Total	22 minutes

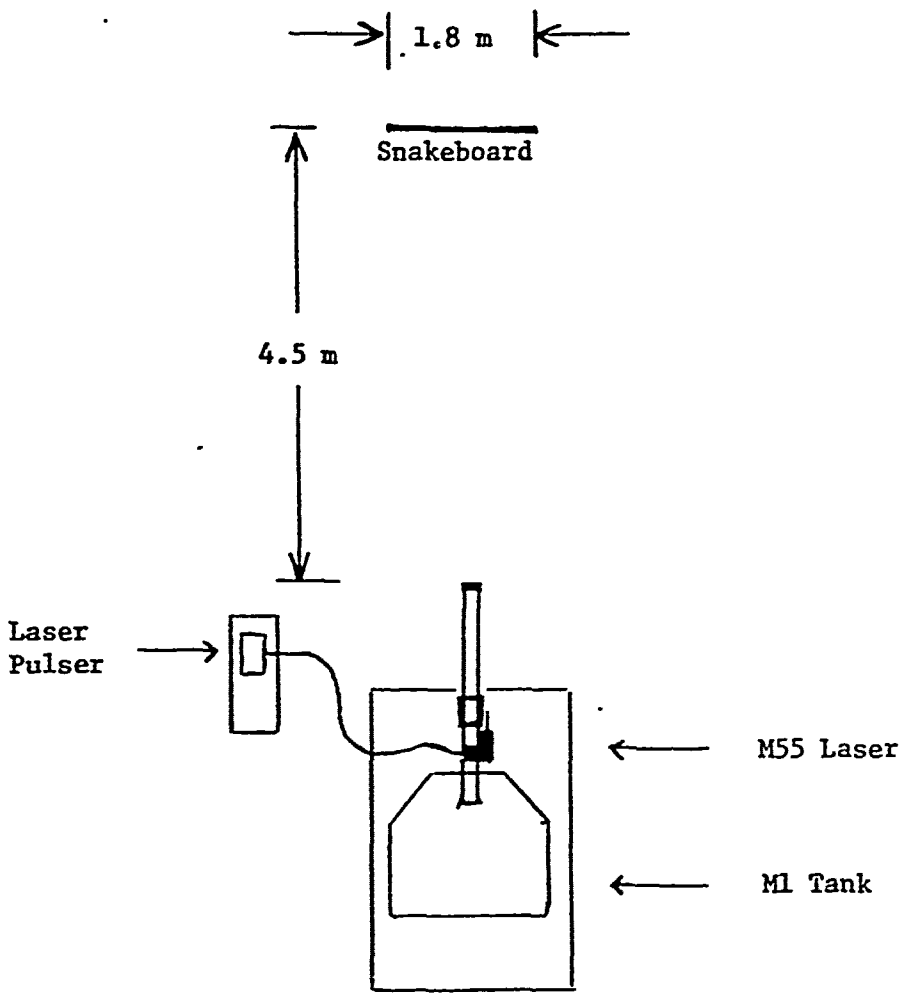

Figure B-1. Equipment Setup for Tracking Job Sample Test

HANDS-ON TRACKING SCORE SHEET

Name/Rank _____ Crew Position _____

Date _____ Experimenter _____

Position (TC/Gunner)	Direction (LR/RL)	Hits	Distance	
			Reference Point	% Next Point

TOTAL HITS FROM GUNNER STA. _____ _____ TOTAL PTS FROM GUNNER STA.

$\bar{X}$ _____ _____ $\bar{X}$

SD _____ _____ SD

INSTRUCTIONS FOR TRACKING TASK

Your task will be to track the snakeboard here in front of the tank using the gunner's cadillac controls. You must track as accurately and as quickly as you can. You will start from one end of the snake and track for 60 seconds; if you reach the other end of the snake before you hear this buzzer (BUZZ), simply reverse direction and continue to track. How accurately you track will be determined by how many times the M55 laser pulse hits the snake outline. The laser is set to automatically pulse once per second; you do not have to squeeze the trigger at any time during this task to make the laser pulse. It will automatically flash. You will track the snake twelve times alternating the side from which you begin. I will tell yc which side to start from and when to begin. Do you have any questions?

APPENDIX C

TARGET ENGAGEMENT TEST

EQUIPMENT

1. M1 tank
2. Control-timer device was used to:
   - o Measure Time Data
   - o Control Target Scene Presentation
3. M55 Laser Device
4. Kodak carousel projectors
5. Remote control junction box for simultaneous presentation of target slides
6. Slide screen

APPROXIMATE ADMINISTRATION TIME

Instructions		3 minutes
14 Scored Trials		20 minutes
	Total	23 minutes

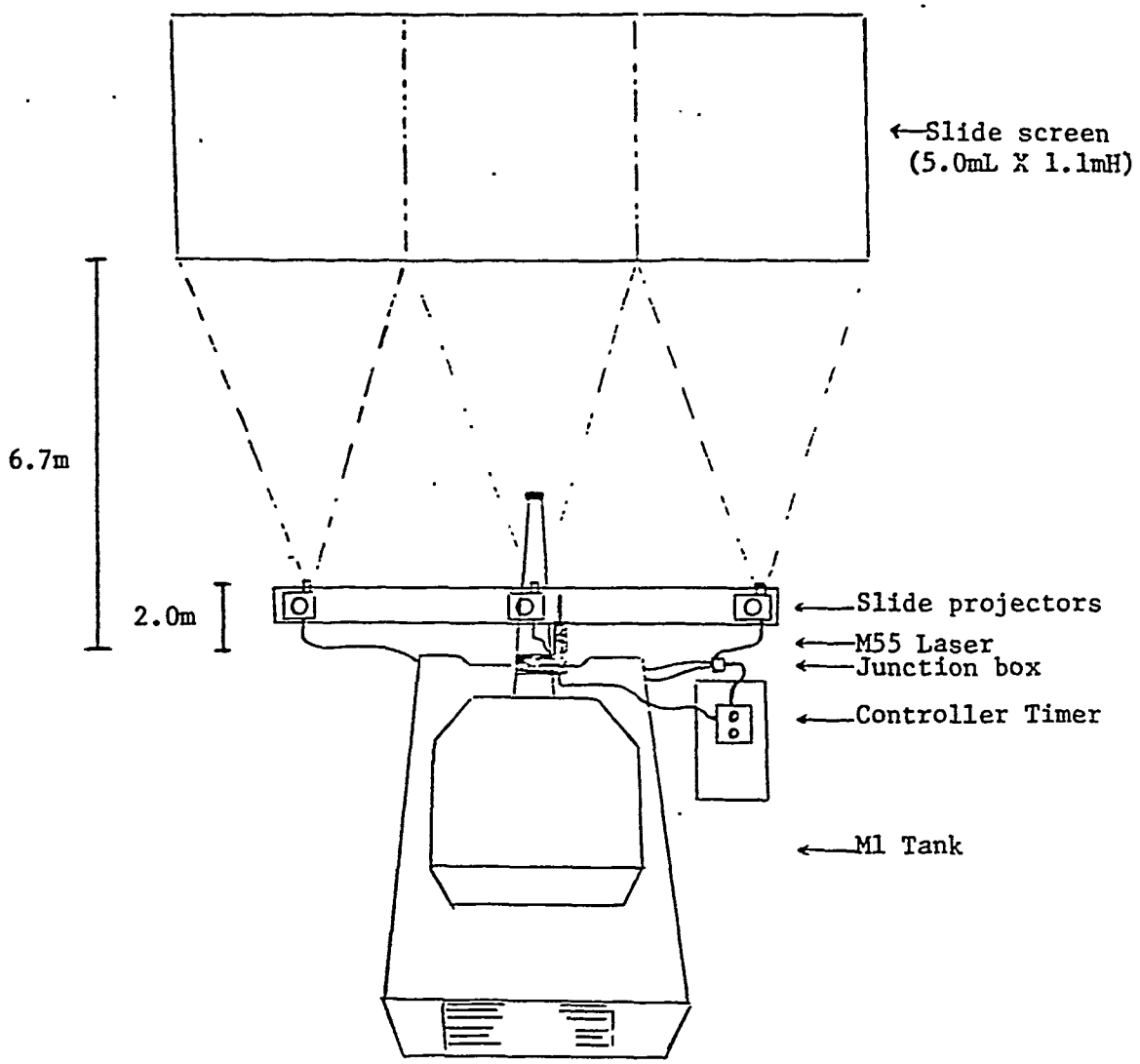

Figure C-1. Equipment Setup for Target Engagement Test

GUNNER ENGAGEMENT SCORE SHEET

Name/Rank_____ Crew Position_____

Date_____ Experimenter_____

TRIAL	TC TIME	FIRE TIME	HIT/MISS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
TOTAL			
$\overline{X}$			
SD			

TARGET ENGAGEMENT TEST INSTRUCTIONS

The task you are about to perform is called gunner target engagement. From the gunner's position you will engage stationary targets presented on the screen in front of the tank. The slides will appear and your TC will lay the main gun in the target area. When you see the target say "identified." The TC will release the override and you will lay on the center-of-mass of the target and fire. After you fire the TC will give you a "cease fire." You will not re-engage. You will not lase during the engagement. When you fire, the M55 laser mounted on the gun tube will simulate a round striking the target area. The M55 has been boresighted with the GPS in 3 power. The GPS should remain in 3 power for the duration of the task. There will be one and only one target on the screen during each engagement. If you cannot identify the target after the TC has layed the main gun in the target area, say "cannot identify" and that engagement will be terminated. Do you have any questions? Get into the gunners seat. Adjust the seat and browpad, then let the TC know when you are ready to begin.

APPENDIX D

COMPUTERIZED TRACKING TEST
AND
COMPUTERIZED TARGET ENGAGEMENT TEST

EQUIPMENT

1. Apple II Plus Microcomputer with two disk drives.
2. 35mm slide projector with remote control.
3. Image Combiner box with 45° one-way mirror.
4. 12" Color Monitor.
5. Joystick control box with three response buttons.
6. 8" Black and White Monitor.

APPROXIMATE ADMINISTRATION TIME

Instructions		8 minutes
20 Engagements		27 minutes
	Total	35 minutes

COMPUTERIZED TARGET ENGAGEMENT TASK INSTRUCTIONS

The equipment on the table in front of you will be used to simulate target engagements from the gunner's position in an M1 tank. It consist of: (1) a slide projector to present the target scenes, (2) an Apple computer to present the reticle, and (3) a joystick control box to allow you to move the reticle and place it on target before firing.

I am going to teach you how to use this equipment to engage targets. After you have practiced you will be given several engagements to fire on your own. Targets in this task will be either jeeps, tanks, or APCs. There will be one and only one target in each scene. If you have questions during the practice engagements please feel free to ask them. After you have completed the three practice trials, I cannot answer any more questions.

The first scene contains a tank target. Locate it and use the joystick to place the reticle near the center-of-mass of the tank. In an M1 tank, the gunner will normally acquire targets in 3 power magnification as represented here, then switches to 10 power magnification in order to make a fine lay on the target. To switch to 10 power with this equipment, press the red button on the joystick control box labeled 10X. Continue to hold the reticle steady. The slide projector will advance to a 10 power slide of this same target scene. Locate the target again and place the reticle on the center-of-mass.

You are now ready to range to the target using the laser rangefinder. Continue to hold the reticle on target and press the red button labeled LASER. You will see a four digit number appear in the bottom of your sight picture. This is the range to the target. After you have lased you are ready to fire. Press the red button labeled FIRE. If the laser beam encountered any extraneous material prior to reaching the target or after hitting it you might have gotten what is called a "multiple return bar." This bar would have shown up as a line over the top of the four digit range at the time the range was updated. Should you get a multiple return bar after you lase, simply lase again, then fire. Even if you get a multiple return bar on the second lase go ahead and fire. Remember, each time you engage a target you must: (1) locate it in 3 power, (2) press he 10X button, (3) locate the target in 10 power, (4) range to the target by pressing the LASER button, (5) determine whether or not you have a multiple return bar, and (6) if you do not have a multiple return bar press the FIRE button or if you do have a multiple return bar press the LASER button again, then FIRE.

Do you have any questions? After you fire, the Apple computer will score the amount of time it took you to engage the target and how accurate you were. Both speed and accuracy are important. The clock starts when the three power target scene is displayed. You have two more practice engagements, then you are on your own.

COMPUTERIZED TRACKING TASK INSTRUCTIONS

(Instructor turns black box so that red button will be right hand side.) This task is much like a computer game. When you begin you will see a reticle on the screen and a small white dot or blip. Your job is to use the joystick to bring the blip in contact with the crosshair of the reticle. Each time the blip meets the crosshair, you will hear a click from the computer. Try to get as many clicks as you can in the time in which the task runs. There will be three trials. Each trial lasts about two minutes. Do you have any questions? Press the red button closest to you to begin.

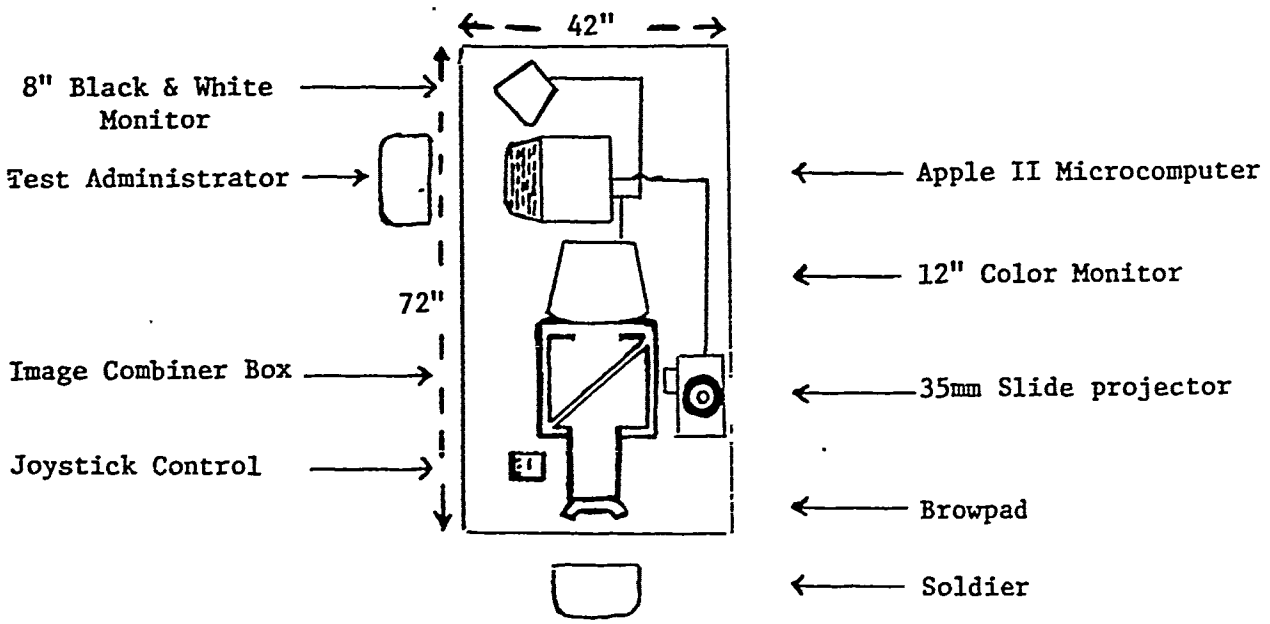

Figure D-1. Equipment Setup for Computerized Tracking and Target Engagement Tests

APPENDIX E

M1 COMPUTER PANEL

EQUIPMENT

1. Apple II Computer
2. TSD Mylar Touch Panel
3. 13" Color Monitor

APPROXIMATE ADMINISTRATION TIME

Instructions	10 minutes
Computer Panel Trials	20 minutes
Total	30 minutes

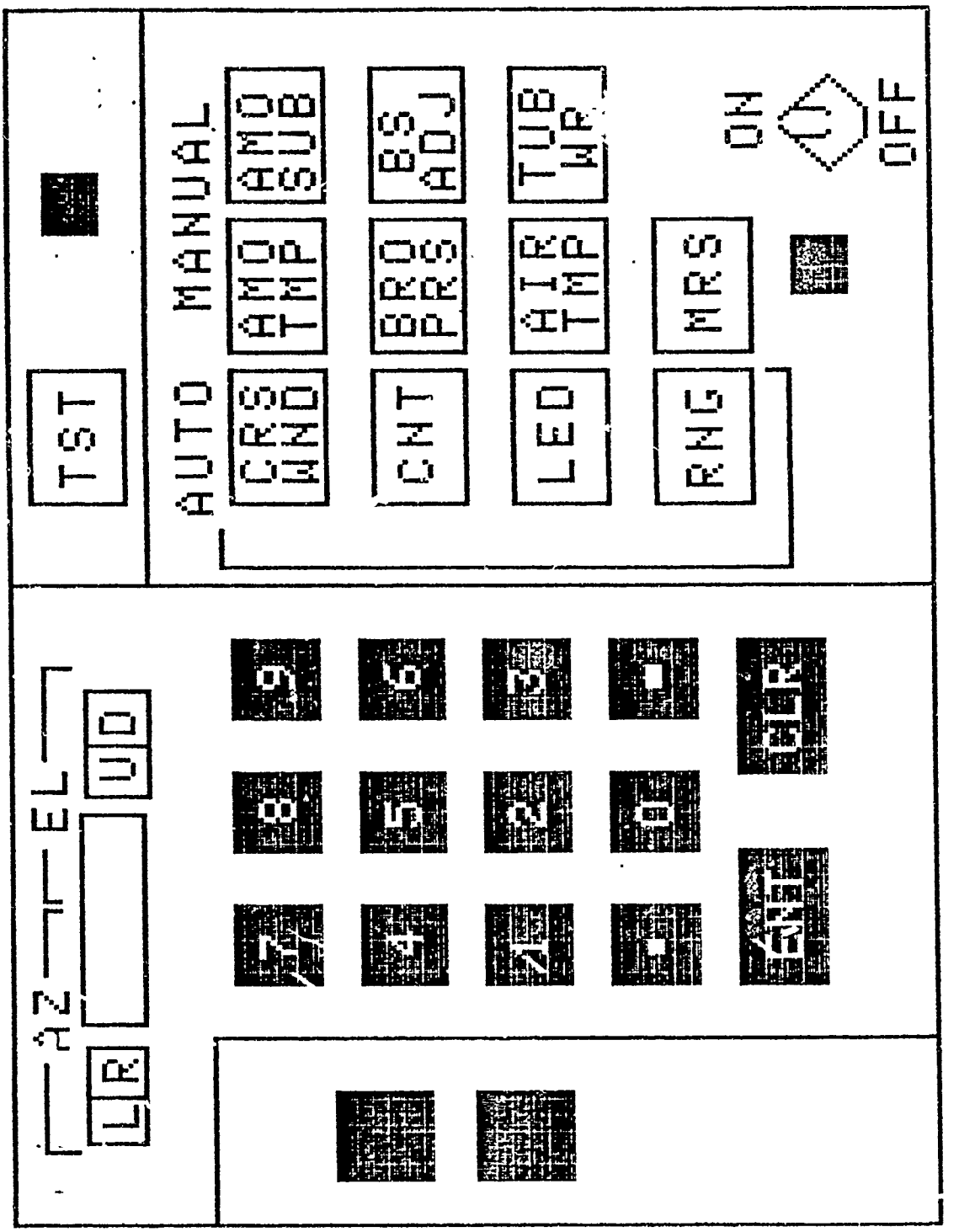

Figure E-1. M1 Computer Panel

INSTRUCTIONS TO SUBJECTS

We would like to show you how to operate this mockup of the M1 computer panel. We are going to teach you how to perform three tasks which are quite similar to the tasks an M1 gunner performs. They are: check data, enter data and run a computer self test. You will practice each of these tasks and then you will do some on your own. What you see on the screen is a mockup of an M1 computer panel which consists of certain automatic inputs: crosswind, cant, lead, and range. These four pieces of information are automatically fed into the computer. However, several additional pieces of information are manually placed in the computer by the gunner. They are ammo temp, baro press, air temp, MRS, ammo subdes, BS adjust, and tube wear. On the left side of the computer panel you will see a number pad much like a calculator would have and two additional keys: one marked ENTER and a key marked CLEAR. Turn the computer on by touching the ON button. Notice how little pressure it takes to operate the panel. Please do not touch the panel with your fingernails. Information which you will need to perform the check data task is found at the bottom of the panel. It says check BARO PRESS, correct BARO PRESS 29.50. Your job is to check the baro press. Place your finger directly on the BARO PRESS button and hold it there until you see it light up. When it lights up, remove your finger from the button. You will see that the BARO PRESS button light is lit and the barometric pressure appears in the display window. The barometric pressure which was in the computer previously is displayed in the window. The correct barometric pressure is given at the bottom of the panel in your instructions. If the correct barometric pressure is the same as the pressure displayed in the window, simply press the ENTER button and hold it until you hear the beep. You have just completed a check data task. If you press the wrong button you will get a message saying trial terminated. However, the computer will soon give you a new trial. Now try two on your own. Your new instructions indicate that the correct barometric pressure is 10.01. Your task is to check baro press. Again place your finger on the BARO PRESS button. The button will light up and the barometric pressure currently in the computer will be displayed. The pressure displayed in the window is different from the correct baro press. Your job is to enter the correct baro press using the number pad. Do this by pressing the 3, the 0, the decimal point, the 0, and then the 1. Wait for each number to appear in the display. Should you make a mistake, press the CLEAR button and begin again. When you have the correct baro press in the display window, press ENTER. You must now check to make sure that the correct baro press did in fact enter the computer. To perform a data check for baro press, touch the BARO PRESS button making sure that the numbers in the display window match the numbers in the instructions. If they do, press ENTER. You have now completed the task of entering and checking data. Entering and checking manual data for any of other seven pieces of information is performed exactly like you did it for baro press. Now practice two trials on your own. Now you will try a new test. This is called run computer test. To start the computer test you place your finger on the TEST button at the top of the panel. You can see that after the lights flash for the automatic inputs checks, the letters P A S S appear in the display window. This indicates a computer test has been performed and no malfunctions were found. Run another test. Notice in the second test that the CANT button is flashing. This indicates a malfunction in the CANT system. You could at this point stop the

test and try to fix the CANT system, but the more accepted procedure is to complete the test for all systems and then follow normal troubleshooting procedures. To continue the computer test you must bypass the failed CANT system. You do this by touching the flashing CANT button and then touching the ENTER button. You will see that the word FAIL appears in the display window and the NO GO light is lit. This does not mean you failed. It means that the computer test encountered a malfunction. Now try a test on your own. You have just completed a computer test in which only two of several automatic inputs failed to operate properly. Had you pressed the wrong automatic input button, you would have received a trial terminate message. There are more automatic inputs which were checked during the computer test than the four which appear on the panel. These additional inputs have been assigned numbers. The numbers which have been assigned to these inputs are 7, 5, 6, and 1. Should any of these systems fail their assigned numbers will appear in the display just before the FAIL appears. For practice, run another computer test. Your CANT system has failed, bypassed the failed system. Watch the display for additional system failures. Did you see the 7, 5, and then the 6 appear in the display? Your job would normally be to write these down. However, we are going to ask you to acknowledge that you have seen them by entering them back into the computer one at a time in the order in which they were presented. Now enter 7 in the display, press the ENTER button, enter 5 in the display, press the ENTER button, enter 6 in the display, press the ENTER button. If you do not enter the correct numbers or if you enter them in the wrong order you will get a message at the bottom of the panel which says trial terminated. Now try two tests on your own. You will be on your own from this point on. You will be given a series of instructions to enter and check data. Then you will be given a series of computer tests to run. Remember to touch only the button which you want to touch, hold it until it beeps and then remove your finger from the computer panel. The computer will record how long it takes you to complete each task and whether or not you performed them correctly. Both speed and accuracy are important. Do you have any questions about how to perform these tasks?

APPENDIX F

PERFORMANCE MOTIVATION INVENTORY
(PT 5102A(R))

Last Name	First Name	Service number	Tank

Please fill in your name, number, and tank above. As soon as possible your data will be coded and your name, number, and tank will be clipped off this sheet and destroyed. No part of any soldier's individual scores will be entered into his records or be available to anyone other than Army Research Institute personnel for research uses only.

In the following sections we want to find out what you think the odds are for certain specific happenings. Then we want to know how you might feel <u>if</u> <u>they</u> <u>did</u> happen to you.

SECTION I — What are the odds?

For each general question below please circle the odds (chances in 10) which best tells how certain <u>you</u> are that the statement is true. Choose any odds from the following:

no chance	very very little chance	very little chance	little chance	some chance	50-50 chance	fairly good chance	good chance	very good chance	very very good chance	perfect 100% chance
0/10	1/10	2/10	3/10	4/10	5/10	6/10	7/10	8/10	9/10	10/10

Example: What are the odds that if you do very well on tank gunnery the Commanding General will shake your hand and congratulate you?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

If you feel there is <u>very</u> <u>little</u> <u>chance</u> that this would happen circle 2/10

YOUR ANSWERS WILL BE KEPT CONFIDENTIAL. PLEASE ANSWER CAREFULLY AND HONESTLY. THANK YOU.

1. What are the odds that if you do very well in tank gunnery you will receive praise from your superior for doing good work?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

2. What are the odds that if you do very well in tank gunnery you will feel really proud of having done a good job?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

3. What are the odds that you will receive a promotion in rank if you do very well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

4. What are the odds that you will do very well in tank gunnery if you really put in a lot of effort?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

5. What are the odds that you will be held more personally accountable for your work if you do very well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

no chance	very very little chance	very little chance	little chance	some chance	50-50 chance	fairly good chance	good chance	very good chance	very very good chance	perfect 100% chance
0/10	1/10	2/10	3/10	4/10	5/10	6/10	7/10	8/10	9/10	10/10

6. What are the odds that you will feel that you are carrying your share of the load if you do very well on tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

7. What are the odds that if you do very well on tank gunnery you'll have more free time to yourself?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

8. What are the odds that you will be given a more responsible position if you do very well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

9. If you do very well in tank gunnery what are the odds that you will receive a "Well done" from your platoon sergeant?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

10. What are the odds that you will be given a three-day pass if you do very well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

11. If you exert yourself and concentrate what are the odds that you will perform very well on tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

12. If you do very well in tank gunnery what are the odds that you will receive recognition from the Company Commander for doing a good job?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

13. What are the odds that you will feel you've done an honest day's work if you do very well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

14. If you do very well in tank gunnery what are the odds you will be given more challenging opportunities in your job?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

15. What are the odds that you'll be given two hours of free time on one day if you do very well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

no chance	very little chance	very little chance	little chance	some chance	50-50 chance	fairly good chance	good chance	very good chance	very very good chance	perfect 100% chance
0/10	1/10	2/10	3/10	4/10	5/10	6/10	7/10	8/10	9/10	10/10

16. What are the odds that if you work hard you will do very well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

17. If you do very well in tank gunnery what are the odds that you will get an individual award for superior crew performance?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

18. What are the odds that you will feel you have achieved a worthwhile goal if you do well in tank gunnery?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

19. If you do very well in tank gunnery what are the odds that you will receive additional training in your job area?

0/10 1/10 2/10 3/10 4/10 5/10 6/10 7/10 8/10 9/10 10/10

SECTION II — How do you feel about it?

In this section we are asking how you feel about the happenings you saw in Section I. We would like to know how you would feel if it happened to you.

Dislike it extremely	Dislike it greatly	Dislike it a lot	Dislike it some	Dislike it a little	Don't care	Like it a little	Like it some	Like it a lot	Like it greatly	Like it extremely
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5

Example: How would you feel about being congratulated by the Commanding General for doing very well in tank gunnery?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

If you would like it a lot circle +3.

YOUR ANSWERS WILL BE KEPT CONFIDENTIAL. PLEASE ANSWER CAREFULLY AND HONESTLY. THANK YOU.

20. How would you feel about getting a three-day pass?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

21. How would you feel about knowing that you've done an honest day's work?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

22. How would you feel about receiving additional training in your job area?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

Dislike it extremely	Dislike it greatly	Dislike it a lot	Dislike it some	Dislike it a little	Don't care	Like it a little	Like it some	Like it a lot	Like it greatly	Like it extremely
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5

YOUR ANSWERS WILL BE KEPT CONFIDENTIAL. PLEASE ANSWER CAREFULLY AND HONESTLY. THANK YOU.

23. How would you feel about receiving praise from your superior?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

24. How would you feel about being given more challenging opportunities in your job?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

25. How would you feel about believing that you have achieved a worthwhile goal?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

26. How would you feel about being able to carry your share of the load?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

27. How would you feel about being really proud of having done a good job?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

28. How would you feel about being given two hours of free time on one day?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

29. How would you feel about receiving a "Well done" from your platoon sergeant?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

30. How would you feel about getting an individual award for superior crew performance?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

31. How would you feel about receiving a promotion?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

32. How would you feel about receiving recognition from the Company Commander for doing a good job?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

33. How would you feel about being given a more responsible position?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

34. How would you feel about having more free time to yourself?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

35. How would you feel about being held more personally accountable for your work?

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

APPENDIX G

BIOGRAPHICAL QUESTIONNAIRE

1. Name: _____ Date: _____

2. Social Security Number: ___-___-____ Unit: _____

3. Please give your rank, pay grade MOS, and skill level below:

RANK	PAY GRADE	MOS	SKILL LEVEL
_____	_____	_____	_____

4. Please give the dates for the following events:

	MONTH	YEAR
a. When were you inducted into the Army?	_____	_____
b. When were you assigned to your present unit?	_____	_____
c. What is your ETS date?	_____	_____
d. When will your current assignment in this unit end?	_____	_____

5. What was your MOS in Basic/AIT? _____

6. What was your first job after Basic/AIT? _____

7. On the chart below, circle the tanks you have served on. Beneath each tank, fill in the number of months you served as:

		MONTHS SERVED ON			
		M60A1	M60A2	M60A3	M1
Months as:	TC	_____	_____	_____	_____
	LDR	_____	_____	_____	_____
	GNR	_____	_____	_____	_____
	DVR	_____	_____	_____	_____

8. How long had you and the tank commander you fired your most recent gunnery with been assigned together? _____

9. List the courses you have completed since joining the Army, where you completed them, and when.

COURSE?	LOCATION?	WHEN?
_____	_____	_____
_____	_____	_____

e.g. PLC, BNCOC, etc.

10. When did you fire on Table VIII? Fill in the boxes of years in which you fired.

		1983	1982	1981	1980	1979	1978	1977	1976
Unit Assigned									
Type Tank									
Crew Position									
RATING	Distinguished								
	Qualified								
	Unqualified								

11. How frequently do you play video games?

once a month_____ once a week _____ almost everyday_____ everyday _____

PT5448R

APPENDIX H

TESTING ROTATION SCHEDULE

	SNAKE BOARD (20 min)	GNR TAR-ENG (20 min)	COMBO (30 min)	M1 COMPUTER (30 min)
1ST HOUR	A	B	C	D
	B	A	D	C
	QUESTIONNAIRE			
2D HOUR	C	D	A	B
	D	C	B	A
	QUESTIONNAIRE			
3D HOUR	A	B	C	D
	ASVAB TESTS			
	MOTIVATION			

DATE: ____ - ____ - 83

SOLDIER A: _____

B: _____

C: _____

D: _____

APPENDIX I

VARIABLE LABELS AND DERIVATIONS

Variable	Criterion/Test	Derived Measure
GROUP	Criterion	. High/low (1, 0) evaluation by supervisor
PTOTAL	Criterion	. Percent hits on total Table VIII
COMPDEP	Criterion	. PTOTAL divided by 100 and then added to GROUP evaluation
AFQT	ASVAB	. Combined scores from Paragraph Comperhension, Arithmetic Reasoning, Word Knowledge and Numerical Operation subtests
PA	ASVAB	. Score from the Pattern Analysis subtest from ASVAB
GNTM	Biographical	. Time as gunner (M60A1 + M60A2 + M60A3 + M1)
FEP	Motivation Inventory	. Effort factor
FRECOG	Motivation Inventory	. Recognition factor
FTANGREW	Motivation Inventory	. Tangible reward factor
FINTRNSC	Motivation Inventory	. Intrinsic factor
FACTUALZ	Motivation Inventory	. Self-actualization factor
FTRH	Tracking Test	. Sum of tracking hits in trials 3 through 12
FTRD	Tracking Test	. Sum of distance in inches for trials 3 through 12
PDAY	Criterion	. Percent hits: Daytime Table VIII
PNIGHT	Criterion	. Percent hits: Night Table VIII
PDMOVE	Criterion	. Percent day moving targets on Table VIII
PNMOVE	Criterion	. Percent night moving target hits on Table VIII

Cont. Variable	Criterion/Test	Derived Measure
FCDT	Computerized Target Engagement	. Sum of engagement times for trials 2 through 18
FCDH	Computerized Target Engagements	. Sum of engagement hits for 10X, LASE and FIRE for trials 2 through 18
FCTT	Computerized Tracking	. Average time-on-target across 3 trials
FCTE	Computerized Tracking	. Average root mean square (RMS) error across 3 trials
FCPEC	M1 Computer Panel	. Total number of correct enter/check data (ECD) trials
FCPET	M1 Computer Panel	. Average time on ECD trials
FCPCC	M1 Computer Panel	. Total number of correct computer self-test (CST) trials
FCPCT	M1 Computer Panel	. Average time on computer self-test (CST) trials
FTET	Target Engagement	. Sum of the engagement times for trials during which hits occurred
FTEH	Target Engagement	. Total number of hits divided by the total number of engagements fired
FTR	Tracking	. Sum of hits (trials 3-12) added to the sum of the distance (trials 3-12)
FCD	Computerized Target Engagement	. Sum of hits for 10X, LASE and FIRE (trials 2-18) minus the sum of engagement times (trials 2-18)
FCT	Computerized Tracking	. Average time-on-target minus average root mean square (RMS) error
FCPE	M1 Computer Panel	. Total correct enter/check data (ECD) trials minus average ECD time
FCPC	M1 Computer Panel	. Total correct computer self-test (CST) trials minus average CST time
FTE	Target Engagement	. Total number of hits divided by the total number of engagements fired minus the sum of engagement times where hits occurred

APPENDIX J

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	GROUP	PTOTAL	COMPDEP	AFQT	PA	GNTM	FEP	FRECOO	FTANGREW	FINTRNSC	FACTUALZ	FTRH	FTRD	PDAY	PNIGHT	PDMOVE	PNMOVE
GROUP	1.00000 0.0000 123	0.29409 0.0015 114	0.97993 0.0001 114	-0.01984 0.8344 123	-0.08588 0.3449 123	0.13588 0.1373 121	-0.09418 0.3184 118	-0.04498 0.6398 111	-0.02759 0.7787 114	-0.23782 0.0105 115	-0.08812 0.3968 114	0.06445 0.4806 122	0.07591 0.4060 122	0.29189 0.0016 117	0.17286 0.0659 114	0.24659 0.0071 118	0.06681 0.4801 114
PTOTAL	0.29409 0.0015 114	1.00000 0.0000 193	0.47872 0.0001 114	0.07790 0.4108 114	-0.04289 0.6566 114	0.19954 0.0349 112	0.14205 0.1406 109	0.02456 0.8065 102	-0.00457 0.9629 106	-0.05769 0.5569 106	0.03588 0.7169 105	0.09859 0.2989 113	0.07058 0.4088 113	0.79296 0.0001 193	0.69927 0.0001 192	0.50558 0.0001 193	0.53305 0.0001 192
COMPDEP	0.97993 0.0001 114	0.47872 0.0001 114	1.00000 0.0000 114	0.02885 0.7606 114	-0.07528 0.4268 114	0.14933 0.1161 112	-0.04624 0.6338 109	-0.01286 0.8979 102	-0.03355 0.7328 106	-0.28302 0.0364 106	-0.04837 0.6241 105	0.09606 0.3115 113	0.03857 0.6858 113	0.43489 0.0001 114	0.31892 0.0008 113	0.32683 0.0004 114	0.18557 0.0491 113
AFQT	-0.01984 0.8344 123	0.07790 0.4108 114	0.02885 0.7606 114	1.00000 0.0000 123	0.38688 0.0001 123	-0.08649 0.3436 121	0.24596 0.0073 118	0.05865 0.5409 111	-0.11812 0.2107 114	0.15365 0.1011 115	-0.02582 0.7851 114	0.36027 0.0001 122	-0.02726 0.7657 122				
PA	-0.08588 0.3449 123	-0.04289 0.6566 114	-0.07528 0.4268 114	0.38688 0.0001 123	1.00000 0.0000 123	-0.08268 0.3673 121	-0.01567 0.8662 118	0.01033 0.9143 111	-0.01885 0.9155 114	-0.07418 0.4312 115	-0.05001 0.5972 114	0.13589 0.1356 122	0.08862 0.3317 122				
GNTM	0.13588 0.1373 121	0.19954 0.0349 112	0.14933 0.1161 112	-0.08649 0.3436 121	-0.08268 0.3673 121	1.00000 0.0000 121	0.03937 0.6748 116	0.06207 0.5214 109	0.08376 0.3799 112	0.18148 0.2848 113	0.18534 0.2698 112	0.15527 0.0984 120	0.05796 0.5295 120	0.18635 0.0461 115	0.18313 0.2792 112	0.07729 0.4096 116	0.13245 0.1639 112
FEP	-0.09418 0.3184 118	0.14205 0.1406 109	-0.04624 0.6338 109	0.24596 0.0073 118	-0.01567 0.8662 118	0.03937 0.6748 116	1.00000 0.0000 118	0.43802 0.0001 111	0.36935 0.0001 114	0.69038 0.0001 115	0.51378 0.0001 114	0.08078 0.3866 117	-0.01345 0.8856 117	0.11869 0.2453 112	0.03835 0.6922 109	0.09964 0.2937 113	0.07714 0.4253 109
FRECOO	-0.04498 0.6398 111	0.02456 0.8065 102	-0.01286 0.8979 102	0.05865 0.5409 111	0.01033 0.9143 111	0.06207 0.5214 109	0.43802 0.0001 111	1.00000 0.0000 111	0.69333 0.0001 109	0.62475 0.0001 110	0.68196 0.0001 109	0.01725 0.8588 110	0.02167 0.8222 110	0.01787 0.8628 105	0.00862 0.9315 102	0.07143 0.4668 106	0.07337 0.4637 102
FTANGREW	-0.02759 0.7787 114	-0.00457 0.9629 106	-0.03355 0.7328 106	-0.11812 0.2107 114	-0.01885 0.9155 114	0.08376 0.3799 112	0.36935 0.0001 114	0.69333 0.0001 109	1.00000 0.0000 114	0.46977 0.0001 113	0.69281 0.0001 112	-0.05184 0.5855 113	0.03224 0.7346 113	0.03552 0.7152 108	-0.02253 0.8187 106	0.02485 0.7976 109	0.03922 0.6897 106
FINTRNSC	-0.23782 0.0105 115	-0.05769 0.5569 106	-0.28302 0.0364 106	0.15365 0.1011 115	-0.07418 0.4312 115	0.18148 0.2848 113	0.69038 0.0001 115	0.62475 0.0001 110	0.46977 0.0001 113	1.00000 0.0000 115	0.65038 0.0001 113	0.00847 0.9960 114	-0.00856 0.9288 114	-0.06555 0.4983 109	-0.04993 0.6112 106	0.06925 0.4723 110	0.04842 0.6221 106
FACTUALZ	-0.08812 0.3968 114	0.03588 0.7169 105	-0.04837 0.6241 105	-0.02582 0.7851 114	-0.05001 0.5972 114	0.18534 0.2698 112	0.51378 0.0001 114	0.68196 0.0001 109	0.69281 0.0001 112	0.65038 0.0001 113	1.00000 0.0000 114	-0.03377 0.7225 113	-0.07998 0.3997 113	0.08317 0.3921 108	-0.02384 0.8093 105	0.09244 0.3398 109	0.04163 0.6733 105
FTRH	0.06445 0.4806 122	0.09859 0.2989 113	0.09606 0.3115 113	0.36027 0.0001 122	0.13589 0.1356 122	0.15527 0.0984 120	0.08078 0.3866 117	0.01725 0.8588 110	-0.05184 0.5855 113	0.00847 0.9960 114	-0.03377 0.7225 113	1.00000 0.0000 122	-0.44356 0.0001 122	0.03178 0.7369 116	0.13729 0.1470 113	-0.10188 0.2748 117	-0.00496 0.9584 113
FTRD	0.07591 0.4060 122	0.07058 0.4088 113	0.03857 0.6858 113	-0.02726 0.7657 122	0.08862 0.3317 122	0.05796 0.5295 120	-0.01345 0.8856 117	0.02167 0.8222 110	0.03224 0.7346 113	-0.00856 0.9288 114	-0.07998 0.3997 113	-0.44356 0.0001 122	1.00000 0.0000 122	0.01678 0.8581 115	0.09805 0.3015 113	0.16295 0.0792 117	0.28161 0.0322 113
FCDT	0.15596 0.1837 118	-0.07133 0.4748 103	0.10824 0.2765 103	-0.24619 0.0115 118	-0.12812 0.2113 118	-0.14619 0.1311 108	-0.11252 0.2508 106	-0.03804 0.7071 100	0.07984 0.4204 104	-0.13564 0.1698 104	0.05576 0.5759 103	-0.11808 0.2214 109	-0.12378 0.1997 109	-0.08789 0.9428 105	-0.18291 0.3018 103	-0.03728 0.7057 105	0.02719 0.7862 102
FCDH	0.03958 0.6657 122	0.06823 0.5263 113	0.04325 0.6492 113	0.00172 0.9850 122	0.15654 0.0831 122	0.02023 0.8264 120	-0.12877 0.1665 117	-0.23128 0.0151 110	-0.09806 0.3015 113	-0.24559 0.0084 114	-0.14399 0.1281 113	0.09519 0.2990 121	-0.03376 0.7132 121	-0.03898 0.6778 116	0.13573 0.1517 113	0.03589 0.7008 117	0.16807 0.0752 113
FCTT	0.00137 0.9880 122	-0.06537 0.4915 113	0.03593 0.7056 113	0.14508 0.1109 122	0.25108 0.0053 122	0.01654 0.8577 120	-0.07785 0.4089 117	-0.04456 0.6439 110	-0.19348 0.0400 113	-0.07938 0.4017 114	-0.17421 0.0650 113	0.13269 0.1468 121	0.01374 0.8811 121	-0.18931 0.2428 116	-0.04462 0.6389 113	-0.04377 0.6393 117	-0.12687 0.1805 113
FCTE	0.04750 0.6034 122	0.01480 0.8764 113	0.05075 0.5935 113	-0.01910 0.8346 122	-0.18799 0.0381 122	-0.06692 0.4677 120	0.13158 0.1573 117	0.02233 0.8169 110	0.09345 0.3249 113	0.04202 0.6571 114	0.14708 0.1200 113	-0.00929 0.9196 121	-0.07725 0.3997 121	0.07636 0.4276 116	-0.05118 0.5904 113	0.11304 0.2249 117	0.00846 0.9291 113

	GROUP	PTOTAL	COMPDEP	AFQT	PA	GMTM	FEP	FRECOG	FTANGREW	FINTRNSC	FACTUALZ	FTRH	FTRD	PDAY	PNIGHT	PDMOVE	PNMOVE
FCPEC	-0.13518 0.1428 123	0.01627 0.8636 114	-0.11983 0.2041 114	0.21447 0.0172 123	0.13838 0.1586 123	0.15221 0.0956 121	0.04652 0.6169 118	-0.08318 0.9742 111	0.03697 0.6962 114	0.15287 0.1029 115	-0.05499 0.5611 114	0.07649 0.4024 122	-0.02099 0.8185 122	0.03668 0.6946 117	0.01054 0.9114 114	-0.08882 0.9998 118	-0.04725 0.6176 114
FCPET	0.04560 0.6165 123	-0.06834 0.5236 114	0.02466 0.7945 114	-0.51286 0.0001 123	-0.25569 0.0043 123	-0.02527 0.7832 121	-0.01452 0.8768 118	0.02317 0.8092 111	0.14543 0.1226 114	0.03227 0.7321 115	0.16333 0.0825 114	-0.21581 0.0174 122	-0.13829 0.1288 122	-0.01958 0.8341 117	-0.06826 0.4705 114	-0.02229 0.8106 118	0.01829 0.8135 114
FCPCC	0.08664 0.9419 123	0.04866 0.6675 114	0.02456 0.7953 114	0.09941 0.2748 123	0.12348 0.1736 123	-0.01546 0.8663 121	0.01719 0.8534 118	0.02617 0.7851 111	0.03385 0.7207 114	-0.04321 0.5821 115	0.03575 0.7057 114	0.15532 0.0876 122	-0.16774 0.0648 122	0.08695 0.3513 117	0.00838 0.9074 114	-0.03780 0.6845 118	-0.06474 0.4938 114
FCPCT	0.06749 0.4583 123	-0.02581 0.7917 114	0.04768 0.6158 114	-0.33895 0.0001 123	-0.19736 0.0287 123	-0.03627 0.6929 121	-0.03543 0.7033 118	-0.02888 0.7642 111	0.05149 0.5870 114	-0.02778 0.7683 115	0.01288 0.8924 114	-0.31182 0.0005 122	0.18572 0.0406 122	-0.08121 0.9897 117	-0.08416 0.3733 114	0.03733 0.6882 118	0.06267 0.5077 114
FTET	0.01338 0.8839 123	-0.14858 0.1148 114	-0.02952 0.7552 114	-0.13115 0.1482 123	0.00041 0.9396 123	-0.17267 0.0582 121	-0.07791 0.4017 118	0.08144 0.3955 111	0.03986 0.6737 114	0.00198 0.9839 115	0.03887 0.6816 114	-0.25483 0.0048 122	-0.01288 0.8956 122	-0.03358 0.7193 117	-0.18151 0.0533 114	-0.01815 0.8453 118	-0.12368 0.1899 114
FTEH	0.11577 0.2023 123	-0.02224 0.8143 114	0.09754 0.3019 114	-0.04831 0.6588 123	0.09653 0.2882 123	0.10948 0.2319 121	-0.14125 0.1271 118	-0.10279 0.2830 111	-0.19227 0.0404 114	-0.15446 0.0993 115	-0.14149 0.1332 114	-0.04367 0.6529 122	0.18189 0.0449 122	-0.04713 0.6138 117	-0.02814 0.8316 114	-0.03281 0.7243 118	-0.07112 0.4521 114
FTR	0.13385 0.1448 122	0.16778 0.0758 113	0.12791 0.1778 113	0.31568 0.0004 122	0.21282 0.0186 122	0.20868 0.0222 120	0.06431 0.4989 117	0.03823 0.6917 110	-0.01875 0.8437 113	-0.00791 0.9334 114	-0.11014 0.2455 113	0.52752 0.0001 122	0.52741 0.0001 122	0.04617 0.6226 116	0.21896 0.0198 113	0.05587 0.5496 117	0.18188 0.0540 113
FCD	-0.08978 0.3509 110	0.09575 0.3360 103	-0.05449 0.5846 103	0.21633 0.0232 110	0.22660 0.0173 110	0.14388 0.1398 108	-0.04585 0.6466 106	-0.14744 0.1432 100	-0.15558 0.1148 104	-0.09178 0.3546 104	-0.18388 0.0643 103	0.13748 0.1540 109	0.12337 0.2012 109	-0.04886 0.6206 105	0.17708 0.0736 103	0.05116 0.6042 105	0.09577 0.3383 102
FCT	-0.02602 0.7760 122	-0.04586 0.6356 113	-0.00868 0.9288 113	0.09292 0.3087 122	0.24823 0.0058 122	0.04727 0.6082 120	-0.11879 0.2021 117	-0.03788 0.6958 110	-0.16324 0.0841 113	-0.06984 0.4654 114	-0.18327 0.0529 113	0.08833 0.3811 121	0.05134 0.5760 121	-0.10353 0.2687 116	0.00484 0.9661 113	-0.08854 0.3425 117	-0.07686 0.4233 113
FCPE	-0.10951 0.2279 123	0.04639 0.6241 114	-0.08812 0.3512 114	0.44436 0.0001 123	0.23593 0.0086 123	0.10764 0.2399 121	0.03752 0.6867 118	-0.01614 0.8665 111	-0.06678 0.4807 114	0.07919 0.4002 115	-0.13576 0.1498 114	0.17833 0.0494 122	0.07212 0.4299 122	0.03464 0.7124 117	0.04803 0.6118 114	0.01364 0.8835 118	-0.03689 0.7030 114
FCPC	-0.03388 0.7171 123	0.03548 0.7078 114	-0.01235 0.8963 114	0.23721 0.0082 123	0.17342 0.0551 123	0.01126 0.9025 121	0.02834 0.7697 118	0.02934 0.7599 111	-0.08938 0.9218 114	-0.01985 0.8333 115	0.01283 0.8922 114	0.25210 0.0051 122	-0.19886 0.0352 122	0.04748 0.6112 117	0.04546 0.6318 114	-0.04854 0.6030 118	-0.06857 0.4685 114
FTE	0.08536 0.3479 123	0.07672 0.4172 114	0.09478 0.3158 114	0.05529 0.5436 123	0.07398 0.4161 123	0.20349 0.0252 121	-0.06121 0.5103 118	-0.13977 0.1435 111	-0.18533 0.0484 114	-0.12782 0.1761 115	-0.14197 0.1319 114	0.13625 0.1345 122	0.13498 0.0885 122	-0.01568 0.8675 117	0.18652 0.2593 114	-0.01488 0.8884 118	0.02776 0.7694 114

	FCDT	FCDH	FCTT	FCTE	FCPEC	FCPET	FCPCC	FCPCT	FTET	FTEH	FTR	FCD	FCT
GROUP	0.15596 0.1037 110	0.03950 0.6657 122	0.08137 0.9888 122	0.04758 0.6834 122	-0.13518 0.1428 123	0.04560 0.6165 123	0.08664 0.9419 123	0.06749 0.4583 123	0.01336 0.8839 123	0.11577 0.2023 123	0.13385 0.1448 122	-0.08978 0.3509 110	-0.02602 0.7760 122
PTOTAL	-0.07133 0.4748 103	0.06823 0.5263 113	-0.06537 0.4915 113	0.01489 0.8764 113	0.01627 0.8636 114	-0.06834 0.5236 114	0.04866 0.6675 114	-0.02581 0.7917 114	-0.14858 0.1148 114	-0.02224 0.8143 114	0.16778 0.0758 113	0.09575 0.3360 103	-0.04586 0.6356 113
COMPDEP	0.10824 0.2765 103	0.04325 0.6492 113	0.03593 0.7056 113	0.05875 0.5935 113	-0.11983 0.2041 114	0.02466 0.7945 114	0.02456 0.7953 114	0.04768 0.6158 114	-0.02952 0.7552 114	0.09754 0.3019 114	0.12791 0.1778 113	-0.05449 0.5846 103	-0.00868 0.9288 113
AFQT	-0.24019 0.0115 110	0.00172 0.9850 122	0.14508 0.1109 122	-0.01918 0.8346 122	0.21447 0.0172 123	-0.51286 0.0001 123	0.09941 0.2748 123	-0.33895 0.0001 123	-0.13115 0.1482 123	-0.04831 0.6588 123	0.31568 0.0004 122	0.21633 0.0232 110	0.09292 0.3087 122
PA	-0.12012 0.2113 110	0.15654 0.0851 122	0.25108 0.0053 122	-0.18799 0.0381 122	0.13838 0.1586 123	-0.25569 0.0043 123	0.12348 0.1736 123	-0.19736 0.0287 123	0.00691 0.9396 123	0.09653 0.2882 123	0.21282 0.0186 122	0.22660 0.0173 110	0.24823 0.0058 122

	FCDT	FCDH	FCTT	FCTE	FCPEC	FCPET	FCPCC	FCPCT	FTET	FTEH	FYR	FCD	FCT
GHTM	-0.14619 0.1311 108	0.02823 0.8264 120	0.01656 0.8577 120	-0.06692 0.4677 120	0.15221 0.0956 121	-0.02527 0.7837 121	-0.01546 0.8663 121	-0.03627 0.6929 121	-0.17267 0.0582 121	0.18948 0.2319 121	0.28868 0.0222 120	0.14308 0.1398 108	0.04727 0.6082 120
FEP	-0.11252 0.2508 106	-0.12877 0.1665 117	-0.07785 0.4089 117	0.13158 0.1573 117	0.04652 0.6169 118	-0.01452 0.8760 118	0.01719 0.8534 118	-0.03543 0.7033 118	-0.07791 0.4017 118	-0.14125 0.1271 118	0.06431 0.4909 117	-0.04505 0.6466 106	-0.11879 0.2021 117
FRECOG	-0.03604 0.7071 108	-0.23128 0.0151 110	-0.04456 0.6439 110	0.02233 0.8169 110	-0.00318 0.9742 111	0.02317 0.8092 111	0.02617 0.7851 111	-0.02680 0.7642 111	0.08144 0.3955 111	-0.18279 0.2838 111	0.03823 0.6917 110	-0.14744 0.1432 100	-0.03780 0.6950 110
FTAHGREW	0.07984 0.4284 104	-0.09806 0.3015 113	-0.14348 0.0406 113	0.09345 0.3249 113	0.03697 0.6962 114	0.14543 0.1226 114	0.03365 0.7207 114	0.03140 0.5878 114	0.03986 0.6737 114	-0.19227 0.0404 113	-0.01875 0.8437 104	-0.15558 0.1148 104	-0.16324 0.0861 113
FINTRNSC	-0.13564 0.1678 104	-0.24559 0.0084 114	-0.07938 0.4017 114	0.06282 0.5571 114	0.15289 0.1029 115	0.03227 0.7321 115	-0.06321 0.5021 115	-0.02778 0.7683 115	0.08198 0.3839 115	-0.15446 0.0993 115	-0.00791 0.9334 114	-0.09178 0.3546 104	-0.06984 0.4656 114
FACTUALZ	0.05576 0.5759 103	-0.14395 0.1281 113	-0.17421 0.0650 113	0.14786 0.1200 113	-0.03499 0.5611 114	0.16333 0.0825 114	0.03575 0.7057 114	0.01280 0.8924 114	0.03887 0.6814 114	-0.14149 0.1332 114	-0.11014 0.2455 113	-0.18308 0.0643 103	-0.18327 0.0520 113
FTRH	-0.11808 0.2216 109	0.09519 0.2990 121	0.13249 0.1468 121	-0.00929 0.9194 121	0.07649 0.4024 122	-0.21581 0.0174 122	0.15532 0.0076 122	-0.31102 0.0005 122	-0.25403 0.0048 122	-0.04367 0.6329 122	0.52752 0.0001 122	0.13748 0.1540 109	0.08833 0.3811 121
FTRD	-0.12378 0.1997 109	-0.03376 0.7132 121	0.01376 0.8811 121	-0.27725 0.0027 121	-0.02099 0.8185 122	-0.13829 0.1288 122	-0.16774 0.0648 122	0.18572 0.0406 122	-0.01200 0.8956 122	0.18189 0.0449 122	0.52741 0.0001 122	0.12337 0.2012 109	0.05134 0.5760 121
FCDT	1.00000 0.0000 110	0.19497 0.0412 110	-0.25380 0.0140 110	0.27760 0.0033 110	0.04378 0.6497 110	0.33214 0.0004 110	0.00550 0.9545 110	0.20029 0.0359 110	0.22048 0.0206 110	0.10504 0.2748 110	-0.22975 0.0163 109	-0.62789 0.0001 110	-0.29813 0.0021 110
FCDH	0.19497 0.0412 110	1.00000 0.0000 122	0.18027 0.0469 122	-0.07376 0.4194 122	0.02534 0.7817 122	0.00161 0.9859 122	0.14403 0.1135 122	-0.16378 0.0715 122	0.02196 0.8103 122	0.16678 0.0663 122	0.05897 0.5206 121	0.64894 0.0001 110	0.14369 0.1144 122
FCTT	-0.23388 0.0140 110	0.18027 0.0469 122	1.00000 0.0000 122	-0.56515 0.0001 122	0.00720 0.9372 122	-0.18638 0.2435 122	-0.03209 0.7257 122	-0.03371 0.7124 122	-0.03747 0.6828 122	0.06161 0.5002 122	0.14031 0.1248 121	0.32046 0.0006 110	0.88508 0.0001 122
FCTE	0.27760 0.0033 110	-0.07376 0.4194 122	-0.56515 0.0001 122	1.00000 0.0000 122	-0.03354 0.7138 122	0.07254 0.4272 122	-0.03160 0.7297 122	0.06945 0.4472 122	0.12397 0.1737 122	-0.00888 0.9304 122	-0.08276 0.3668 121	-0.27186 0.0041 110	-0.88419 0.0001 122
FCPEC	0.04378 0.6497 110	0.02534 0.7817 122	0.00720 0.9372 122	-0.03354 0.7138 122	1.00000 0.0000 123	-0.33634 0.0001 123	-0.02813 0.7574 123	-0.09598 0.2909 123	-0.11524 0.2043 123	0.00616 0.9461 123	0.05261 0.5649 122	-0.00250 0.9795 110	0.02388 0.8014 122
FCPET	0.33214 0.0004 110	0.00161 0.9859 122	-0.18638 0.2435 122	0.07254 0.4272 122	-0.33634 0.0001 123	1.00000 0.0000 123	-0.16605 0.0664 123	0.50251 0.0001 123	0.22549 0.0122 123	0.02433 0.7893 123	-0.33491 0.0002 122	-0.29452 0.0018 110	-0.18116 0.2675 122
FCPCC	0.00558 0.9565 110	0.14403 0.1135 122	-0.03209 0.7257 122	-0.03160 0.7297 122	-0.02813 0.7574 123	-0.16605 0.0664 123	1.00000 0.0000 123	-0.71405 0.0001 123	0.09183 0.3124 123	-0.04911 0.5896 123	-0.01176 0.8977 122	0.12508 0.1932 110	-0.00834 0.9970 122
FCPCT	0.20829 0.0359 110	-0.16378 0.0715 122	-0.03371 0.7124 122	0.06945 0.4472 122	-0.09598 0.2909 123	0.50251 0.0001 123	-0.71405 0.0001 123	1.00000 0.0000 123	0.11568 0.2026 123	0.03631 0.6901 123	-0.11879 0.1925 122	-0.38748 0.0011 110	-0.05827 0.5237 122
FTET	0.22048 0.0206 110	0.02196 0.8103 122	-0.03747 0.6828 122	0.12397 0.1737 122	-0.11524 0.2043 123	0.22549 0.0122 123	0.09183 0.3124 123	0.11568 0.2026 123	1.00000 0.0000 123	0.18492 0.2481 123	-0.25219 0.0051 122	-0.13236 0.1481 110	-0.89116 0.3188 122
FTEH	0.10504 0.2748 110	0.16678 0.0663 122	0.06161 0.5002 122	-0.00800 0.9304 122	0.00616 0.9461 123	0.02433 0.7893 123	-0.04911 0.5896 123	0.03631 0.6901 123	0.18492 0.2481 123	1.00000 0.0000 123	0.13102 0.1503 122	0.04378 0.6497 110	0.03960 0.6666 122
FYR	-0.22975 0.0163 109	0.05897 0.5206 121	0.14031 0.1248 121	-0.08276 0.3668 121	0.05261 0.5649 122	-0.33491 0.0002 122	-0.01176 0.8977 122	-0.11879 0.1925 122	-0.25219 0.0051 122	0.13102 0.1503 122	1.00000 0.0000 122	0.24808 0.0093 109	0.12608 0.1682 121

	FCDT	FCDH	FCTT	FCTE	FCPEC	FCPET	FCPCC	FCPCT	FTET	FTEH	FTR	FCD	FCT
FCD	-0.62789 0.0001 118	0.64094 0.0001 118	0.32046 0.0006 118	-0.27186 0.0041 118	-0.00250 0.9793 118	-0.29452 0.0018 118	0.12508 0.1932 118	-0.30748 0.0011 118	-0.13236 0.1681 118	0.04378 0.6497 118	0.24800 0.0093 109	1.00000 0.0000 110	0.33539 0.0003 118
FCT	-0.29013 0.0021 118	0.14369 0.1144 122	0.88508 0.0001 122	-0.88419 0.0001 122	0.02308 0.8014 122	-0.10116 0.2675 122	-0.00034 0.9970 122	-0.85827 0.5237 122	-0.09116 0.3180 122	0.03948 0.6666 122	0.12608 0.1682 121	0.33539 0.0003 110	1.00000 0.0000 122
FCPE	-0.17289 0.0709 118	0.01455 0.8736 122	0.06938 0.4476 122	-0.06487 0.4775 122	0.81860 0.0001 123	-0.81623 0.0001 123	0.08601 0.3555 123	-0.36536 0.0001 123	-0.20822 0.0208 123	-0.01106 0.9034 123	0.23741 0.0085 122	0.17540 0.0668 118	0.07588 0.4061 122
FCPC	-0.10456 0.2770 118	0.16633 0.0671 122	0.00097 0.9915 122	-0.05465 0.5499 122	0.03688 0.6855 123	-0.36172 0.0001 123	0.92522 0.0001 123	-0.92629 0.0001 123	-0.01327 0.8842 123	-0.04611 0.6125 123	0.05807 0.5252 122	0.23272 0.0144 118	0.03138 0.7315 122
FTE	-0.05758 0.5502 118	0.12248 0.1790 122	0.07642 0.4028 122	-0.99136 0.3169 122	0.08245 0.3646 123	-0.13169 0.1465 123	-0.18178 0.2638 123	-0.04815 0.5969 123	-0.58643 0.0001 123	0.74408 0.0001 123	0.27599 0.0021 122	0.12124 0.2071 118	0.09481 0.2989 122

	FCPE	FCPC	FTE
GROUP	-0.10951 0.2279 123	-0.03388 0.7171 123	0.08536 0.3471 123
PTOTAL	0.04639 0.6241 114	0.03548 0.7078 114	0.07672 0.4172 114
COMPDEP	-0.08812 0.3512 114	-0.01235 0.8963 114	0.09478 0.3158 114
AFQT	0.44436 0.0001 123	0.23721 0.0082 123	0.05529 0.5436 123
PA	0.23593 0.0086 123	0.17342 0.0551 123	0.07398 0.4161 123
GHTM	0.18764 0.2399 121	0.01126 0.9025 121	0.20349 0.0252 121
FEP	0.03752 0.6867 118	0.02834 0.7607 118	-0.06121 0.5103 118
FRECOD	-0.01614 0.8665 111	0.02934 0.7599 111	-0.13977 0.1435 111
FTANGREM	-0.06478 0.4807 114	-0.00938 0.9218 114	-0.18533 0.0484 114
FINTRMSC	0.07919 0.4002 115	-0.01985 0.8333 115	-0.12702 0.1761 115
FACTUALZ	-0.13576 0.1498 114	0.01283 0.8922 114	-0.14197 0.1319 114

	FCPE	FCPC	FTE
FIRH	0.17833 0.0494 122	0.25218 0.0051 122	0.13625 0.1365 122
FIRD	0.07212 0.4299 122	-0.19086 0.0352 122	0.15490 0.0885 122
FCDT	-0.17289 0.0709 118	-0.10456 0.2778 118	-0.05758 0.5502 118
FCDH	0.01455 0.8736 122	0.16633 0.0671 122	0.12248 0.1790 122
FCTT	0.06938 0.4476 122	0.00097 0.9915 122	0.07642 0.4028 122
FCTE	-0.06487 0.4778 122	-0.05465 0.5499 122	-0.09136 0.3169 122
FCPEC	0.81868 0.0001 123	0.03688 0.6855 123	0.08245 0.3646 123
FCPET	-0.81623 0.0001 123	-0.36172 0.0001 123	-0.13169 0.1465 123
FCPCC	0.08401 0.3555 123	0.92522 0.0001 123	-0.10178 0.2630 123
FCPCT	-0.36536 0.0001 123	-0.92629 0.0001 123	-0.04815 0.5969 123
FIET	-0.20822 0.0208 123	-0.01327 0.8842 123	-0.58643 0.0001 123
FIEH	-0.01106 0.9034 123	-0.04611 0.6125 123	0.74408 0.0001 123
FIR	0.23741 0.0085 122	0.05807 0.5252 122	0.27599 0.0021 122
FCD	0.17548 0.0668 118	0.23272 0.0144 110	0.12124 0.2071 118
FCT	0.07588 0.4061 122	0.03138 0.7315 122	0.09481 0.2989 122
FCPE	1.00000 0.0000 123	0.24323 0.0067 123	0.13089 0.1498 123
FCPC	0.24323 0.0067 123	1.00000 0.0000 123	-0.02864 0.7531 123
FTE	0.13089 0.1498 123	-0.02864 0.7531 123	1.00000 0.0000 123