UNCLASSIFIED

AD _____

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION ALEXANDRIA, VIRGINIA

DOWNGRADED AT 3 YEAR INTERVALS:
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10



UNCLASSIFIED

THIS REPORT HAS BEEN DECLASSIFIED
AND CLEARED FOR PUBLIC RELEASE.

DISTRIBUTION A
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

AD No. 69477
ASTIA FILE COPY

PRS REPORT 981
APTITUDE TESTS FOR ARMY MOTOR VEHICLE OPERATORS

BY:
A.R. LAUER, ET AL
PRINCIPAL TECHNICIAN
THE DRIVING LABORATORY
INDUSTRIAL SCIENCE RESEARCH INSTITUTE
IOWA STATE COLLEGE
AMES, IOWA

A CONTRACT RESEARCH REPORT TO

DEPARTMENT OF THE ARMY

PERSONNEL RESEARCH SECTION

PR & P BR-PERS BUR-TAGO

PRS REPORT NO. 981

APTITUDE TESTS FOR ARMY MOTOR VEHICLE OPERATORS

by

A.R. Lauer, Principal Technician
Gloria L. Grace, Assistant
Gerald C. Helmstadter, Assistant
Chester C. Collins, Assistant
Moreon E. Lampman, Assistant
Ted Campbell, Assistant
Charles E. Schumacher, Assistant
Gilbert E. Miller, Assistant
Paul W. Porter, Assistant
Lewis R. Vavra, Assistant
Eugene L. Moore, Assistant
R.N. Kjerland, Technician

The Driving Laboratory
Industrial Science Research Institute
Iowa State College
Ames, Iowa

FINAL REPORT 31 October 1952

DEPARTMENT OF THE ARMY
Project No. 29565100 Subtask 78
RESEARCH CONTRACT NO. DA-49-083 OSA-191
PERSONNEL RESEARCH SECTION PR 6578

PRS Reports are technical reports. They are intended primarily for research agencies in the Armed Forces as a means of guiding further research in the area of human resources. As research findings accumulate and suggest official action, recommendations are made separately to appropriate military agencies. Information of more general interest is presented in the Foreword to this report.

FOREWORD

This report is of primary interest to research workers concerned with the selection and training of personnel for specific Military Occupations. Specific selection tests of known efficiency are needed for the most economical assignment of recruits, replacements, and transfers to Military Occupational Specialties. The objective of this project was to develop such selection procedures for assigning Army personnel to Army transportation units.

New tests were needed to measure the non-intellectual and non-personality traits which contribute to success as a driver in Army driving operations. Tests of sensory ability (such as ability to remember what has just been seen) and of motor performance (for example, strength of grip) were studied as possible predictors of good drivers. Information on Army Personnel Records was reviewed to ascertain what might be used to improve driver selection efficiency. Tests of skills and aptitudes believed to be required for efficient driving were tried out.

To gather the necessary information for constructing selection instruments, proposed tests were administered to over 1400 Army drivers. Scores on these experimental procedures were then compared with ratings received on a drivers' rating form developed by the Adjutant General's Office, DA. The best predictors of good driving performance were found to be knowledge of motor-vehicle operation, experience in driving, other personal background factors and attitudes, judgment in traffic situations, conscientiousness in following detailed assignments, and general muscular coordination.

Field runs showed that group tests designed to measure these characteristics are from three to five times as efficient as the individual tests currently in operation as selection procedures and require considerably less effort and time to administer.

PREFACE AND ACKNOWLEDGMENT

The inauguration of this project is due largely to the foresight shown and groundwork laid by Dr. Julius E. Uhlaner, Chief, Research Operations II of The Personnel Research Section, P.R. and P. Branch, The Adjutant General's Office, Department of the Army. Others who have advised and otherwise facilitated the project from the above office were Dr. Donald E. Baier, Chief; Dr. Edward A. Rundquist, Research Manager; Dr. Hubert E. Brogden, Research Adviser; Mr. Harry H. Harman, Chief, Research Services; Dr. Erwin K. Taylor, former Contract Research Officer; Dr. Robert Perloff of the Contract Research Office and Dr. Arthur J. Drucker, Acting Contract Research Officer, as well as numerous other staff assistants who have aided in various ways.

The splendid cooperation of the Army Safety Director, Mr. Elliot Parker and his staff, especially the counsel of Mr. Donald S. Buck, was most helpful in the study. Safety Officers of the Second, Fourth and Fifth Armies: Mr. Wm. A. Buhrman, Mr. H.T. Buchanan and Mr. L.L. Quintal, respectively, have also done much to render the visits to installations successful and pleasant. The various Post safety officers have done a splendid job of making arrangements for the testing work and without their aid the project would not have been feasible.

It would be impossible to name all the Army Officers and personnel who have aided in some way by securing clearance, providing men and otherwise aiding in making the project fruitful and pleasant. To all of these and to the men in the ranks who served as subject we owe a debt of thanks.

The undersigned and assistants are also indebted to Dr. Charles E. Friley, President; Dr. H.V. Gaskill, Dean of the Division of Science; Dr. John A. Greenlee, Assistant to the Dean of Science; Mr. Campbell Mosier, Manager of the IBM Office; all of Iowa State College and others who have worked on the project, for their personal interest throughout the study.

(Signed) A.R. Lauer, et al
Director, Driving Research Laboratory
Industrial Science Research Institute

October 31, 1952

APTITUDE TESTS FOR DRIVERS

CONTENTS

	Page
INTRODUCTION	1
REVIEW OF THE LITERATURE	1
SCOPE OF THE PRESENT STUDY	2
Purpose Variables Population	
THE FIRST RUN	5
Purpose Procedure Results	
THE SECOND RUN	7
Cross-validation of pencil-and-paper tests Preliminary run on additional tests	
THE THIRD EXPERIMENTAL RUN	12
Purpose Procedure Results	
SELECTION OF THE BATTERY	15
SUMMARY AND CONCLUSIONS	16
REFERENCES	17
References cited General related reading list	
APPENDIXES	21

TABLES

Table No.		Page
1.	Possible predictors selected for further development on the basis of Run One results.	7
2.	Intercorrelations of ten most promising predictors from Run Two-A data.	9
3.	Intercorrelations of fourteen most promising predictors from Run Two-B data.	11
4.	Tests selected for Run Three.	12
5.	Intercorrelations of thirty-two most promising predictors from Run Three data.	14
6.	Battery of tests for driver selection.	15
7.	Battery of four driver tests.	15
8.	Battery of three driver tests.	16

APTITUDE TESTS FOR DRIVERS

INTRODUCTION

The problem of efficient driver selection is of paramount importance to the Army as well as to our national economy. The Army in 1951 drove nearly one billion vehicle miles in its world-wide operation (exclusive of the Far East Command). During the 1951 period military vehicles were involved in 18,999 accidents in this large area of operation, at a cost in excess of four million dollars. The military index is about 1.9 accidents per 100,000 miles of travel, which is approximately equivalent to the accident rate of civilian males between 19 and 25 years of age. The high incidence of accidents among the male population of military age, exclusive of military accidents, further emphasizes the enormous problem the Army faces in building up an efficient mechanized fighting force.

Today every recruit has a record of his abilities and aptitudes on his Form 20. Upon entering the Army he is given tests to show his capacity as a clerical worker, a mechanic, and other occupational specialties. However, no comparable tests of the soldier's background as a driver or his aptitude for driving are employed. The objective of this study was to find ways of classifying men with respect to driving aptitude and ability.

REVIEW OF THE LITERATURE

A partial list of related references has been attached to the list of cited references for those who may wish to go further into the literature than is warranted here.

The problem of selecting drivers to improve the average efficiency level is not new and was adequately covered by others (5, 10). It has been handled in various ways, but no highly satisfactory results have been obtained. This is partly due to the fact that the criterion used for selection has usually been accident records. The reliability of such records as kept in public files has long been open to question (1, 3, 5, 12). To abandon the accident-index in any form as a primary criterion of driving performance or as an operational selection technique is not, of course, to deny that a driver with a high accident record is a poor risk. But the establishment of a statistical relationship between the number of accidents and some index of expert driving may be difficult. Particularly is this true in the Army where one or two accidents usually disqualifies a driver and where periods of observation are limited. It would appear that adequate ratings may be better indexes of good driving than accidents.

At best it may be said that devices for the selection of drivers developed to the present may be considered valuable mostly for spotting a few extreme cases that should not be driving. After a careful screening by the Army through induction and enlistment methods employed, it is doubtful if many of those highly unfitted for driving get into the Service. The real problem

in driver selection is that of probing the psychological makeup of the soldier to ascertain which of his characteristics and capacities correlate with successful Army vehicle driving performance. It would seem that the factors which correlate with ratings would be the best operational criterion of selection.

The various methods of streetcar, bus, and motor vehicle operator selection and improvement previously used, for example, (2, 4, 7, 9, 11) may be classified into the following categories:

1. Performance tests designed merely to alert the prospective employee to an awareness that he is being carefully and critically considered. They appear to have had the psychological effect of scaring off the highly incompetent and neurotic applicants, and of keeping conscientious employees at a high level of efficiency, particularly when the labor market is flooded.

2. The adaptation of standard psychological tests such as reaction time, strength of grip, measurements of vision and color vision, motor coordination, and other tests of hypothesized functions assumed to be related to driving or similar performance.

3. Various pencil-and-paper tests designed to measure such psychological characteristics as:

   a. Intelligence.
   b. Introversion - extroversion.
   c. General personality characteristics.
   d. Mechanical aptitude and knowledge.
   e. Mastery of the principles of safe driving.
   f. Certain combinations or adaptations of the above assumed to have validity as criteria of driving performance.

4. Complex performance devices simulating driving variously named the drivometer, driver-rater, reactometer, etc.

These suggestions from the literature were considered in choosing and constructing tests for the present study.

SCOPE OF THE PRESENT STUDY

PURPOSE

Since the Personnel Research Section, Personnel Research and Procedures Branch, The Adjutant General's Office, Department of the Army, has done considerable work in the area of attitude and personality measurement, the present project emphasized two phases of the problem: 1) The development of pencil-and-paper tests which might assay the functions ordinarily measured by "so-called" psychophysical tests-- a category of standard psychological tests. 2) The modification of currently used and other possible cognitive group tests which might be employed in driver selection.

The hypotheses to be tested in this study may be stated as follows:

1. Driving aptitude can be measured successfully by pencil-and-paper tests designed to measure functions related to driving apart from intelligence.

2. A satisfactory battery of group tests may be selected and developed to give a higher selection efficiency than those in current use.

The design of this research program was essentially a three-stage validation study in which each stage or experimental run served a specific purpose. In general, the purpose of Run One was to gather information necessary for a preliminary estimate of the characteristics of an original group of tests. Run Two included: 1) a cross-validation of the tests (utilizing the most efficient keys developed in Run One) found to be promising; and 2) a study of additional tests suggested by the results of the first run or available since the first run was completed. The objective of Run Three was to make a final check before selecting combinations of tests for an operational battery.

It will be more appropriate to describe in detail specific purposes, and the particular tests, populations, and procedures used at the time each run is considered.

VARIABLES

The Predictors. Within the framework of the contract specifications, the rationale of approach was to devise, assemble, or adapt tests to measure the following functions assumed to be determiners of driving aptitude:

1. Physical activity or motility.
2. Gross eye-hand coordination.
3. Finer coordinations.
4. Spatial relations.
5. Speed and accuracy of perception.
6. Visual perception.
7. Visual memory.
8. Judgment factors.
9. Personality patterns involved in driving behavior.
10. Knowledge of motor-vehicle traffic laws and regulations as well as acceptable driving habits.

Tests were assembled and chosen for direct use or modification on the basis of the following criteria:

1. Do they appear to measure the functions listed above?
2. Would they seem reasonable to the average Army driver as tests of driving, i.e., do they have "face validity"?
3. Do they appear to be long enough to be reliable, but short enough to be used effectively in a battery under operational conditions?
4. Are they clear in meaning with a minimum of verbiage?
5. Can they be objectively scored?

Some of the tests administered in this study are described with specimens in Appendix A. Administrative procedures are described in Appendix B. For the most part these predictors are of the cognitive, pencil-and-paper type. About one-third of them were developed by the contracting staff. Four were furnished by the contractor. Others were borrowed and adapted with permission of the owners or commercial representatives.* In only one test was there a question of copyright involved.

Some of the tests in the battery were adopted without revision since they had been previously given to thousands of subjects. Most of the new tests, however, were tried out on smaller groups of students and driver-education classes. The battery of possible predictors was also tried out on 70 National Guard drivers of Boone, Iowa, upon invitation of the local commander who was interested in encouraging safe driving in his unit. Since these administrations were entirely preliminary to establish time limits, check and revise directions, and gather similar administrative data, the details of these studies are not included in this report.

The Criterion. The instrument used to validate the driver selection tests investigated in this study was Ratings for Drivers, Form X-2, DA AGO PRT 2408. It was administered in each run of the study. This criterion instrument was developed (12) by the Personnel Research Section, Personnel Research and Procedures Branch, The Adjutant General's Office, Department of the Army. It consists of: a "halo" scale on Appearance and Military Bearing which is used as a suppressor to draw off the personal feelings of the rater toward the ratee; four criterion rating scales on Near Accidents, Reaction to Sudden Changes, Effect of Temper on Driving, and Knowledge of Own Limitations; and a check-list of 15 undesirable driving habits.

In scoring the criterion instrument, means and standard deviations of raw scores on the scale and check-list portions are involved. For the second and third runs of this study, the criterion score was calculated on each roster rather than on the entire population, using the corresponding means and standard deviations. This was advisable since the assumption of equal variance across rosters was not sustained when subjected to test of homoscedasticity. This procedure was not necessary for the first run, since the tests were given to smaller groups which tended to restrict administration to only certain installations and units. Further details of group differences in criterion scores are discussed in Appendix C.

The criterion instrument is so scored that a low score is indicative of good performance. The reverse is true of the predictor tests used in this study--a high score is indicative of good performance. Hence, correlations between a good predictor and the criterion will be negative in sign. Since the correlation coefficients computed in this study have not been reflected, a high but negative quotation is desirable in the tables of data to be presented.

*Note: See Appendix A, page 4 for detailed list and explanations.

POPULATION

The examinee required by the design of the present study was the enlisted man who had sufficient driving experience in the Army and who was well enough known to associates and supervisors at his installation to be rated properly by them. Installations were selected for each run of the study on the basis of the availability of the desired types and number of troops and for economy in time required to collect data. As much as possible enlisted men were used who drove for at least 50 per cent of their working time, drove at least 100 miles a month or had been military drivers for at least three months, and who were known to at least five associates and superiors for a minimum of three months. Most drivers were well above these criteria limits for inclusion in the experimental group.

Complications occasionally arose which reduced the number of desired subjects. Despite advanced scheduling and excellent cooperation, variation in training quotas and transfer of personnel affected in some instances the number of men available for a given test. Because of these and related circumstances, the same number of men did not take each test in Run One.

Drivers in tactical units often drive only on maneuvers or to and from the drill area. Most of their time is spent in cleaning and maintaining their vehicle. Thus it was sometimes difficult to establish the actual proportion of time a man spent in driving without a personal interview or individual observation. This may have limited the number of men available for a given group selected primarily on the amount of driving they did. Drivers from headquarters companies and certain pools seldom drive with other drivers. While they do spend most of their time driving, there are few raters who know them well enough to rate them or those who do know them may not have come to the experimenters' attention due to their association with units not scheduled for testing. As a further example, men are frequently assigned to a certain vehicle one day and to another the next day. Although they drive every day, few persons at the installation know exactly how well they drive. Unless the vehicle is damaged or some adverse report is made by the personnel for whom they have driven, direct information about them may not be available.

Some of these factors would undoubtedly reduce the validity coefficients obtained in this study. Many of the difficulties were overcome or corrected by suitable methods of selection or analysis, but it is still probable that the validity coefficients presented in this report are on the conservative side.

RUN ONE

PURPOSE

The objectives of this exploratory first run of test administrations were: 1) to secure sufficient data for preliminary estimates of the relative validities of the proposed tests so as to select for further study those showing

promise of predicting driver aptitude and to eliminate at the outset those showing no predictive efficiency or which have too much overlap with Aptitude Area I of the Army Classification Battery; and 2) to modify or develop scoring keys for use in cross-validation of the most usable tests in the second run designated here as Run Two.

PROCEDURE

The first testing runs were started in July, 1951 at Fort Sheridan, Illinois; Camp Atterbury, Indiana; Fort Leavenworth, Kansas; and Camp Carson, Colorado. Because of flood conditions, testing at Fort Leonard Wood, Missouri was postponed until August 1951 and the scheduled visit to Fort Riley, Kansas was cancelled.

During this run groups of 20 drivers were scheduled each half day. In all 480 men were tested; of these 468 had sufficiently complete records, adequate driving experience, and a sufficient number of ratings.

The tests used in Run One are described in the first section of Appendix A. Attempts were made to find scoring methods which would give the highest possible predictive efficiency. These details are described in Appendix F, along with information on additional tests related to, but not made a part of this study. For the results to be presented, only the scoring found to give the best validity and most practical was used.

Item analysis was made of the tests for which its use was appropriate. The procedure is discussed in Appendix G. Due to the size of correlations with the Criterion, the significance of biserials obtained was not sufficiently above chance to warrant confidence in the results. However, the item analysis served very useful purposes in revealing unsatisfactory items (which were deleted) and in constructing keys for the various tests based upon rational considerations supplemented by the item-analysis results.

RESULTS

The results of Run One on tests are shown in the first section of Appendix D.

As indicated by the correlations and later by item analysis and sectional analysis, certain of the tests did not appear to give promise and were not carried in Run Two. These were the speed of perception tests.

Certain other tests, although the validity coefficients were low, had for various reasons shown some promise and were revised or lengthened. For example: In activity or motility, checks against laboratory measures were made. Any form of test which showed highest relation to this function was considered a legitimate instrument as the problem was to cross-validate the function rather than the test itself.

In some instances the desirable items were carried over in condensed form, or entirely new types of tests were made to measure assumed aspects of the function postulated to be measured. In most cases the procedure was merely that of developing a key from the item analysis or of combining two tests into one as in the case of Activity I and Activity II, CRT 63. In Spatial Relations, CRT 206 - Form A and CRT 59 - Form B were combined into CRT 214 - Form X. Also in Driving Judgment, CRT 45 - Form A and CRT 203 - Form B were combined into CRT 88 - Form X. This consisted in combining the useful items of two forms into another form and using the original key for the items used.

Since Line Tracing, CRT 67 showed a higher validity coefficient than most others, and also since it was the only test of the function, a parallel test was developed to give higher precision in scoring, and another test called Pattern Tracing, CRT 195 was added.

The tests assembled from the results and item analyses of Run One for use in Run Two are shown in Table 1.

Table 1. Possible Predictors Selected for Further Development on the Basis of Run One Results.

Activity II	CRT 63	Object Identification	CRT 65
Driving Judgment	CRT 88	Pattern Tracing	CRT 195
Emergency Driving	CRT 196	Space Judgment	CRT 69
Emergency Judgment	CRT 87	Spatial Relations	CRT 214
Lateral Perception	CRT 66	Traffic Observation	CRT 201
Line Tracing	CRT 67	Visual Acuity	CRT 202
Motto Test	CRT 208		

RUN TWO

The second run has two parts due to the availability of additional tests after the study was underway. The objective of one part was the cross-validation of the pencil-and-paper tests selected or suggested by the results of Run One. The results are described as Run Two-A. The Run Two-B covers the preliminary study of certain new tests introduced. Additional tests used in Run Two-A and Run Two-B are described in the second section of Appendix A.

CROSS-VALIDATION OF PENCIL-AND-PAPER TESTS

Procedure. The following installations were selected for Run Two-A: Fort Leonard Wood, Missouri; Fort Riley, Kansas; Fort Knox, Kentucky; and Fort Sheridan, Illinois. Of the 326 men tested, 289 usable cases were available. Later, because of presumed cultural influences, the roster was further reduced to 203 cases of more or less homogeneous nature. All correlations used in later calculations were computed from scores on this latter group.

The tests given were suggested by the results of Run One as described earlier. The schedule called for testing 20 men a day during an 8-hour testing period. In order to offset systematic effects which might unduly influence the first or last test given during the day, the order of tests was rotated. Blocks of tests were given in such a way as to provide relief from ennui or boredom and the greatest saving in time. As nearly as possible the Criterion, PRT 2406, was given in the forenoon or early afternoon.

Results. The results of this part of the second run (Run Two-A) are presented in Appendix D. In order to reduce the number of predictors, ten of those showing the highest validity were intercorrelated to determine their separate contributions. The results are shown in Table 2. The last column of this Table shows the validity coefficient for each of these tests (unreflected). The intercorrelations were used in later calculations.

PRELIMINARY RUN ON ADDITIONAL TESTS (Run Two-B)

Purpose. The primary objective of this second part of Run Two was a field investigation of the Driver's Self-Description Blank, DA AGO PRT 2457, which was not ready for use until after Run One had been completed. Occasion was also taken to investigate the following groups of tests:

1. Physical Aptitude Tests, Examination for Motor Vehicle Operations, WD AGO PRT 565. This is the battery of currently used Army driver selection tests. Though a collection of several tests, the battery was so organized and weighted (6) as to produce the composite PRT 565 score used in this study. Run Two-B offered the opportunity of firming-up the administration and scoring procedures of PRT 565 so that in Run Three these physical tests could be compared with the pencil-and-paper tests being developed in the present study.

2. Several scores from the Soldier Record Form 20 that are generally available for use in classifying enlisted men.

3. Supplementary psychophysical tests (described in the second section of Appendix A) either suggested by the results of Runs One and Run Two-A or modified forms of certain PRT 565 tests.

4. Some of the border-line tests from Run One and Run Two-A were rechecked.

Table 2. Intercorrelations of Ten Most Promising Predictors from Run Two-A Data.

	Predictor	Army Designation	1	2	3	4	5	6	7	8	9	10	Validity
1	Driving Judgment	CRT 88	---	.53	.60	.46	.57	.37	.22	.43	.40	.45	-.19
2	Visual Acuity (II, III & IV)	CRT 202		---	.49	.41	.42	.48	.30	.47	.38	.45	-.19
3	Emergency Driving	CRT 196			---	.51	.58	.27	.24	.45	.32	.52	-.14
4	Emergency Judgment	CRT 87				---	.45	.32	.23	.37	.34	.31	-.21
5	Driver Know-How	PRT 2412					---	.29	.24	.47	.29	.32	-.12
6	Attention to Detail	PRT 2347						---	.34	.43	.38	.31	-.14
7	Two-Hand Coordination	PRT 2387							---	.24	.31	.29	-.12
8	Word Matching	CRT 207								---	.33	.36	-.16
9	Educational Level										---	.38	-.11
10	Mechanical Aptitude											---	-.13

Procedure. Tests were administered at three installations: Fort Riley, Kansas; Fort Leonard Wood, Missouri; and Camp Atterbury, Indiana. Five examiners tested 40 men a day; 20 men reported for the group tests and 20 for the psychophysical tests in the morning and then exchanged places in the afternoon. Special care was taken by trained personnel to administer the PRT 565 according to specific instructions so that the results would be as accurate as possible. As a result correlation coefficients obtained for PRT 565 in this study are undoubtedly higher than would have been obtained under operational conditions.

Although 220 men were tested, 140 cases were usable after careful gleaning on the basis of sufficient driving experience and adequate ratings; complete records on all the tests were available, however, for only 124 men. Absences due to flood conditions and emergency assignments were primarily responsible for this shrinkage in the number of available cases.

Results. Information on the fourteen most promising predictors is presented in Table 3. The validity coefficients, presented in the last column of this Table, may be compared with similar information presented in the last column of Table 2, for Run Two-A. The intercorrelations shown in Table 3 were used in later calculations.

Table 3. Intercorrelations of Fourteen Most Promising Predictors from Run Two-B Data

		1	2	3	4	5	6	7	8	9	A	B	C	D	E	O
1	Visual Acuity - CRT 202 (II, III & IV)	---	.38	.42	.07	.20	.41	.17	.23	.54	.45	.49	.42	.37	.37	-.08
2	Difference Detection - CRT 216 (All Items)		---	.27	.00	.08	.30	.14	.26	.40	.31	.28	.22	.19	.16	-.19
3	Lateral Perception - CRT 66			---	-.10	.21	.32	.06	.29	.48	.45	.29	.28	.15	.24	-.18
4	Driver's Self-Description Blank - PRS 2457 Driver's Background				---	.22	.01	.22	.10	.09	.11	.18	.10	.35	.06	-.14
5	Driver's Self-Description Blank - PRS 2457 Personality & Attitudes					---	.20	.10	.27	.18	.20	.14	.25	.22	.17	-.14
6	Educational Level						---	.18	.03	.56	.56	.51	.57	.41	.48	-.24
7	Strength of Grip							---	.04	.11	.03	.16	.11	.27	.15	-.02
8	Composite PRT 565 Score								---	.16	.02	.12	.11	-.01	.08	-.23
9	Aptitude Area I									---	.79	.63	.55	.48	.52	-.19
A	Arithmetic Information										---	.62	.62	.50	.50	-.10
B	Mechanical Aptitude											---	.66	.69	.59	-.14
C	Shop Mechanics												---	.70	.46	-.15
D	Automotive Information													---	.51	-.17
E	Electrical Information														---	-.16
O	Criterion															---

Legend: The code values here refer to this matrix only and were used for convenience in IBM work.
N = 124

It was decided from the evaluations made in Run Two to use the following predictors in the third run (Table 4).

Table 4. Tests Selected for Run Three

Test	Army Designation
1 Attention to Detail	PRT 2374
2 Driver's Self Description Blank (Several scores)	PRT 2457
3 Driving Judgment (Combination of items from two tests)*	CRT 88
4 Emergency Judgment	CRT 87
5 Lateral Perception	CRT 200
6 Path Tracing	PRT 2382
7 Two-Hand Coordination	PRT 2387
8 Word Matching	CRT 207

* Two verbal-type tests, Driving Judgment (CRT 88) and Emergency Driving (CRT 196) were combined and a key based on item analysis of the two tests from Run One was used. The test retained the name Driving Judgment.

RUN THREE

PURPOSE

The objective of the third run was to cross-validate the battery of tests being developed in this study and compare them with the operational battery, PRT 565. Other tests were added in Run Three in order to obtain additional information on them.

PROCEDURE

The final experimental run was begun in May 1952 and completed on 13 June 1952. Installations selected were: Fort Sill, Oklahoma; Camp Chaffee, Arkansas; Fort Campbell, Kentucky; and Fort Knox, Kentucky. The testing schedule for Run Three was the same as that used in Run Two-B. Of the 553 men tested, 331 cases were acceptable from the criteria of useability set up. (See page 5)

RESULTS

Means, standerd deviations, and validity coefficients for the tests used in Run Three are presented in Appendix D. The last column (W) of Table 5 presents the correlations between the Criterion and the 32 most promising variables investigated in Run Three. Again, for use in later calculations, intercorrelations are also presented. Intercorrelations between some of these variables and four scores from the Army Classification Battery of tests, are, for convenience, presented in Appendix D. Additional results on visual acuity tests are presented in Appendix F.

It is to be noted that the validity coefficient for the operational battery, PRT 565, -.12 (unreflected r) is not among the highest of those quoted in the last column of Table 5. Also, since PRT 565 is actually a battery of tests, it is legitimate to compare PRT 565 with the other tests taken as a group. In Run Three a multiple R, after shrinkage, of -.39 (unreflected r) was obtained for seven of these predictors. This result is considerably higher than the -.12 obtained for PRT 565.

Table 5. Intercorrelations of Thirty-two Most Promising Predictors from Main Three Data

Name of Test	Army Designation	Var.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Word Matching	CRT 207	0	—	.51	.37	.51	.42	.35	.24	.26	.27	-.11	-.08	.36	-.09	-.09	.04	-.01	.13	-.18	.15	-.03	.06	-.12	-.09	.15	.15	-.11	-.14	-.18	.43	.33	.51	.46	-.13*
Lateral Perception	CRT 200	1		—	.52	.48	.42	.42	.28	.30	.16	-.08	-.11	.49	-.13	-.09	.07	-.08	.14	-.13	.14	-.09	.06	-.06	-.09	.02	.13	-.04	-.11	-.18	.48	.24	.35	.44	-.15**
Emergency Judgment	CRT 87	2			—	.51	.34	.29	.25	.34	.14	-.08	-.08	.30	-.02	-.04	.00	-.04	.09	-.13	.05	-.09	.07	.00	-.07	.01	.08	-.07	-.12	-.08	.32	.20	.32	.43	-.19**
Driving Judgment	CRT 88	3				—	.48	.40	.36	.43	.20	-.06	-.01	.32	.00	.10	.01	.06	.18	-.15	.11	-.09	-.01	-.02	-.09	.09	.19	-.06	-.15	-.06	.48	.22	.42	.38	-.21**
Driving Know How	PRT 2412	4					—	.35	.22	.42	.29	-.08	.03	.33	.09	.15	.01	.14	.14	-.13	.18	-.03	.16	-.05	-.10	.14	.14	-.10	-.16	.02	.38	.30	.39	.34	-.28**
Differences Detection	CRT 216	5						—	.20	.30	.16	-.05	-.02	.36	-.04	-.01	.08	.02	.10	-.01	.15	-.06	.06	-.06	.01	.08	.15	-.09	-.11	-.14	.22	.10	.27	.30	-.15*
Two-Hand Coordination	PRT 2387	6							—	.26	.07	-.02	-.01	.32	-.06	-.08	.16	.01	.06	-.08	.34	-.13	.07	-.11	.02	.08	.14	-.09	-.14	-.11	.26	.17	.28	.24	-.20**
Visual Acuity (II, III & IV)	CRT 202	7								—	.15	-.07	-.11	.40	-.12	-.07	.03	-.10	.12	-.16	.16	-.06	-.01	-.09	-.03	.03	.15	-.06	-.04	-.11	.42	.18	.32	.41	-.14*
Path Tracing (Army % right)	PRT 2382	8									—	-.09	-.03	.11	.00	-.04	.09	.04	.07	-.14	.08	.02	.12	.03	-.04	.06	.15	-.03	-.01	-.09	.16	.11	.22	.17	-.07
Driver's Self-Description Blank Side 1, Box "E"	PRT 2457	9										—	.65	-.01	.08	.08	.09	.13	.53	.74	.06	.04	-.03	-.01	.03	.03	-.02	.03	-.08	.06	-.01	.01	-.07	-.01	.00
Side 1, Box "F"		A											—	-.02	.90	.45	.15	.46	.39	.60	.06	.04	-.01	-.05	-.03	.04	.04	.05	.10	.14	-.07	.13	-.07	.03	-.10
Attention to Detail	PRT 2374	B												—	-.04	-.05	.05	-.02	.13	-.09	.18	-.04	.09	-.11	.00	.12	.23	-.09	-.09	-.09	.36	.23	.38	.30	-.29**
Driver's Self-Description Blank Side 1, Box "A"***	PRT 2457	C													—	.60	-.56	.75	.00	.14	-.06	.03	-.02	-.07	-.07	.05	.03	.04	.08	.20	-.14	.23	-.10	.02	-.10
Side 1, Box "B"		D														—	-.41	.67	.04	.12	-.02	.03	-.02	-.03	-.08	.01	.03	.09	.10	.15	-.07	.10	.00	.08	-.08
Side 1, Box "C"		E															—	.20	.05	.02	.12	-.02	.06	-.01	.02	.00	.06	-.04	-.04	-.07	.05	.00	.09	.05	-.10
Side 1, Box "D"		F																—	.06	.17	.03	.02	.01	-.07	-.08	.04	.08	.05	.08	.17	-.11	.21	-.04	.09	-.18**
Side 2, Box "B"		G																	—	.12	.07	.06	.05	-.06	-.20	.06	.14	-.03	.01	.05	.19	.14	.13	.14	-.12*
Side 2, Box "A"		H																		—	.03	.02	-.09	-.01	-.21	.04	-.10	.05	.09	.04	-.08	.00	-.12	-.06	.05
Steadiness	MA	I																			—	-.12	.05	-.11	.02	.10	.15	-.10	-.08	-.01	.15	.14	.17	.19	-.10
Choice Reaction Time (Mean)	MA	J																				—	-.04	.00	-.01	-.09	-.16	-.10	.56	.02	.01	-.03	-.01	-.03	.06
Field of Vision	PRT 565	K																					—	-.07	-.07	.07	.03	-.11	-.04	.06	.03	.32	.10	.09	.00
Visual Acuity (Armed Forces Test)	MA	L																						—	.06	-.01	-.06	.04	.02	-.08	-.07	-.32	-.06	-.05	.03
Driver's Self-Description Blank Side 2, Box "C"	PRT 2457	M																							—	-.06	-.09	.01	.01	.02	-.11	-.14	-.10	-.08	.04
Strength	MA	N																								—	.14	-.11	-.12	.16	.16	.03	.12	.15	-.19**
Motility	MA	O																									—	-.13	-.17	.02	.15	.10	.11	.15	-.06
Choice Reaction Time (Errors)	MA	P																										—	.17	-.12	-.14	-.07	-.11	-.11	.17*
Choice Reaction Time (Variability)	MA	Q																											—	.03	-.11	-.06	-.10	-.12	.06
Age	ATR#	R																												—	-.18	.00	-.03	-.01	-.12*
Educational Level	APR	S																													—	.12	.59	.49	-.18**
Composite PRT 565	PRT 565	T																														—	.27	.23	-.12*
Aptitude Area I	APR	U																															—	.67	-.18**
Mechanical Aptitude	APR	V																																—	-.23**
Criterion		W																																	—

Legend: # - Army Personnel Record
N = 332
* - Significant at the 5% level
** - Significant at the 1% level
*** - See PRS Scoring Directions for 2457 - Key to Blk
MA - Not Assigned

Criterion variable only marked. (W)

SELECTION OF THE BATTERY

Once information on the individual tests was available, it remained to select tests for combination into the most effective battery of predictors. Combinations of different tests and of varying numbers of tests were investigated. The results of combining tests according to beta weights are presented in Appendix E. These results, however, are very similar to the validity coefficients determined for combinations of the same tests each weighted equally.

The results in general show that beyond five or seven tests, little is gained in validity with the addition of more predictors. Further, combinations of five or so tests were found to all have about the same predicitive efficiency. Feasibility of administering the tests, then, was the primary consideration in choosing the following battery:

Table 6. Battery of Tests for Driver Selection.

Age	
Attention to Detail	PRT 2374
Driver's Self Description Blank	PRT 2457
Driving Know-How	PRT 2412
Emergency Judgment	CRT 87
Two-Hand Coordination	PRT 2387
Word Matching	CRT 207

The validity coefficient for this battery was found to be .38 (reflected r).

Should it be desirable to have available for operational use more than one battery, this larger battery can be broken down into two smaller batteries with very little loss in predictive efficiency. Using seven previous tests, the smaller batteries listed in Tables 7 and 8, are suggested:

Table 7. Battery of Four Driver Tests.

Driver's Self Description Blank	PRT 2457
Age	
Attention to Detail	PRT 2374
Driving Know-How	PRT 2412

Validity coefficient = .39 (reflected r)

Table 8. Battery of Three Driver Tests

Emergency Judgment	CRT 87
Two-Hand Coordination	PRT 2387
Word Matching	CRT 207

Validity coefficient = .24 (reflected)

These two batteries could be used to supplement each other if retesting or alternate forms are required, or if tests for initial screening as well as at unit level are desired.

SUMMARY AND CONCLUSIONS

From three experimental runs using a total of over 1400 men, nearly 1100 cases were usable when selected on the basis of sufficient driving experience and adequate ratings. The mean validity coefficient of the possible predictors administered to these men increased from .09 in the first run, to .14 in the second, to .20 in the final experimental run (the coefficients have been reflected.) From the data of Run Two-A a multiple R of .26 was found for a battery of seven tests. A multiple R of .33 was found for six predictors used in Run Two-B. In Run Three a multiple R of .42 was found for seven predictors. After shrinkage this coefficient reduced to .39.

A battery of equally-weighted tests selected from the second run was found to have a cross-validity in the third run of .38. It should be pointed out that this battery of seven tests can be subdivided into two smaller batteries--one of four tests, the other of three--with very little loss in stability of results. Validity coefficients for the smaller batteries were found to be .39 and .24. These smaller batteries may lend themselves more readily to operational use in an Army selection program.

The average validity coefficient for a composite score on PRT 565, the currently used driver selection battery on two runs, was about .18 (reflected r). Predictors were developed, however, which have about five times the predictive efficiency of PRT 565. Considering that the new batteries may be given to groups and may be scored objectively, the advantages are obvious.

Within the limitations of the present study, it may be concluded that:

1. The first hypothesis, which was to be tested in this study, is confirmed; driving aptitude can be measured by pencil-and-paper tests using combined associates and supervisors ratings as the criterion.

2. The second hypothesis is also confirmed; a battery of pencil-and-paper tests may be used to give an improved estimate of Army driving aptitude and ability over methods now used.

REFERENCES CITED

1. Allgaier, E. and Lauer, A.R., A preliminary analysis of the psychophysical correlates of automotive manipulation. Amer. Jour. Optom., 1941, 18, #2, 49-57.

2. Cleeton, G.U., Measuring susceptibility to accidents in streetcar operators. Psychol. Bull., 1935, 32, 704.

3. Emonds, E.J.; Grace, G.L.; Grace, H.A. and Lauer, A.R., Factors associated with the accidents of commercial drivers. Ms. Driving Research Laboratory, Iowa State College, 1951.

4. Gheselli, Edwin E. and Brown, Clarence W., The prediction of accidents of taxicab drivers. J. Appl. Psychol., 1949, 33, 540-546.

5. Johnson, H.M., The detection and treatment of accident prone drivers. Psychol. Bull., 1946, 43, 489-532.

6. Lauer, A.R., Learning to Drive Safely. Burgess Publishing Co., Minneapolis, Minn., 1949, p. 36.

7. Miller, Charles and Lauer, A.R., The mechanical aptitude of drivers in relation to performance at the wheel. Proc. Iowa Acad. of Sci., 1946, 53, 273-275.

8. Seashore, R.L., Individual differences in motor skills. J. Gen. Psychol., 1930, 3, 38-66.

9. Snow, A.J., Tests for chauffeurs. Indus. Psychol., 1926, 1, 30-45.

10. Thorndike, Robert L.; Duker, Sam; Hagen, Elizabeth and Flanagan, J.C., Human factors in accidents. School of Aviation Medicine, American Inst. for Research, 1950, 174 pp. (Restricted)

11. Vitelles, M.S., II. Methods devised for Milwaukee Electric Railway and Light Co. J. Pers. Res., 1925, 4, 173-199.

Reports of the Personnel Research Section, Personnel Research and Procedures Branch, The Adjutant General's Office, Department of the Army.

12. PRS Report 935. The development of criteria of safe driving for the individual. 1952, 19 pp.

GENERAL RELATED READING LIST (Does not include references directly cited.)

Allgaier, E., What the Ford tests showed. Pub. Safety, 1941, 19, 14-15.

Allgaier, E., Evaluation of driver tests. Amer. J. Optom. Arch., Amer. Acad. Optom., 1941, 18, 345-347.

Baker, J.S., Studying the accident-prone driver. Pub. Safety, 1934, 5, 22-23.

Barsantee, H., Accident-addicts. The Trav. Standard, 1938, 26, 21.

Bonnardel, R., La psychometrie et la prevention des accidents du travail. Travail Hum., 1949, 12, 1-15.

Brody, L., Personal Factors in Safe Operation of Motor Vehicles. Center for Safety Educ., New York, 1947, (2nd. Ed.), 96 pp.

Brown, Clarence W. and Ghiselli, Edwin E., Accident proneness among street-car motormen and motor coach operators. J. Appl. Psychol., 1948, 32, 20-23.

Burtt, H.E. and Frey, O.C., Suggestions for measuring recklesness. Person. Jour., 1934, 13, 39-46.

Canty, Alan, A note concerning the examination of traffic offenders. Jour. Appl. Psychol., 1936, 20, 493-498.

Chambers, E.G., A preliminary inquiry into the part played by character and temperament in accident causation. J. Ment. Sci., 1939, 85, 115.

Csillag, I. and Hedri, E., Personal factors of accident proneness. Indus. Med., 1949, 18, 29-30.

De Silva, H.R., Why We Have Automobile Accidents. John Wiley & Sons, Inc., New York, 1942, 394 pp.

De Silva, H.R., Robinson, P. and Forbes, T.W., Some psychological factors in accident-repeater drivers. Jour. Abn. and Soc. Psychol., 1939, 34, 124-128.

Dunbar, F., Susceptibility to accidents. Med. Clin. N. Amer., 1944, 28, 653-662.

Eno Foundation for Highway Traffic Control, Personal characteristics of traffic accident repeaters. Saugatuck, Conn., The Eno Foundation, 1948.

Eno Foundation for Highway Traffic Control, The Motor-Vehicle Driver: His Nature and Improvement. Saugatuck, Conn., The Eno Foundation, 1949.

Fletcher, Edwin D., The effect of special tests on driving performance. Calif. Highway Patrolman, 1939, 3.

Forbes, T.W., The normal automobile driver as a traffic problem. J. Gen. Psychol., 1939, 20, 471.

Harris, Frank K., A comparison of the personality characteristics of accident and non-accident industrial populations. Amer. Psychol., 1949, 279.

Johnson, La Verne and Lauer, A.R., The effect of induced manual handicaps on motor performance of a complex nature. Jour. of Appl. Psychol., 1937, 21, 85-93.

Keane, F.L. and O'Connor, J., A measure of mechanical aptitude. Pers. J., 1927-28, 6, 15-24.

Kramer, Milton D. and Lauer, A.R., The psychology of safety and safe human conduct. The Jour. of Educ. Soc., 1946, 20, 107-113.

Kraft, Merwin A. and Forbes, T.W., Evaluating the influence of personal characteristics on the traffic-accident experience of transit operators. Proc. Highway Res. Board, 1944, 278-291.

Lauer, A.R., Fact and fancy regarding driver-testing procedures. Jour. of Appl. Psychol., 1937, 21, 173-184.

Lauer, G.I., Cutler, Max and Lauer, A.R., Exposure risk as a criterion of traffic accident hazards in Iowa. Proc. Iowa Acad. Sci., 1945, 52, 261-263.

Lawsche, C.H., Jr., A review of the literature related to the various ps psychological aspects of highway safety. Lafayette, Ind., Purdue Univ. Eng. Exp. Sta. Res. Series No. 66, 1939.

Mallart, J., Causes psicological de los accidentos y modo de eliminarias. (Psychological causes of accidents and means of eliminating them.) Psicotecnica, 1943, 4, 142-147.

Marbe, K., The psychology of accidents. Human Factor, 1935, 9, 100-104.

Miles, G.H., The psychology of accidents. Jour. Nat. Inst. Indus. Psychol.

Pennsylvania Department of Motor Vehicles, Deaf mutes are safest motorists on Pennsylvania's highway system. Bull. Am. Assoc. Mot. Veh. Admin., 1940, 5, 15.

Ream, M.J., The tapping test: A measure of motility. Psychol. Monog., 1922, 31, 140, 293-319.

Reid, W.G., Drivers aptitude tests of the thir armored division. Harper Hosp. Bull., 1942, 1, 97-102.

Ruch, F.L. and Wilson, C.L., A new system for selecting safe drivers.. Comm. Cer. J., 1948, 76, 66-68.

Ryan, A.H. and Warner, M., The effect of automobile driving on the reaction time of the driver. Amer. Jour. of Psych., 1936, 48, 403-421.

Selling, I.S., Personality traits observed in automobile drivers. J. Crim. Psychopath., 1940, 1, 258-263.

Siebrecht, Elmer B., Measuring Driver Attitudes. Center for Safety Educ., New York, 1941, 29 pp.

Slocombe, C.S. and Bingham, W.V., Men who have accidents; individual differences among motormen and bus operators. Person. Jour, 1927, 124-267.

Slocombe, C.S. and Brakeman, E.R., Psychological tests and accident-proneness. Brit. J. Psychol., 1930, 21, 29.

Stump, N.F., A statistical study of visual functions and industrial safety. J. Appl. Psychol., 1945, 29, 467-470.

Tillman, W.A. and Hobbs, G.E., The accident-prone automobile driver; a study of psychiatric and social background. Amer. Jour. Psychiat., 1949, 106, 321-331.

U.S. Congress, Motor vehicle traffic conditions in the U.S. The accident prone driver. House Document No. 462, Part VI, 1938.

U.S. War Department, Driver selection, training and supervision; wheeled vehicles. U.S. War Dept. Tech. Manual, 1945, 21-300. (Pub. Bd. #18977, Washington, D.C.)

Uthoff, Lualis and Lauer, A.R., Empirical study of compensation. Proc. Iowa Acad. of Sci., 1939, 46, 352-359.

Waits, J.V., The use of the American Transit Motor Ability Test in the selection of bus and streetcar operators. Proc. Highway Res. Board, 1946, 340-353.

Weiss, Albert P. and Lauer, A.R., Psychological Principles in Automotive Driving. The Ohio State Univ., Columbus, Ohio, 1930.

Wilson, Clark L. Jr., The use of biographical information blank in predicting labor turnover among bus and streetcar operators. USC Abstr. Dissert., Los Angeles, 1948, 188-191.

APPENDIXES

		Page
Appendix A.	Description of Tests	1
Appendix B.	Standard Directions and SOP Used in the Field	12
Appendix C.	Correction of Criteria Data	23
Appendix D.	Statistical Results	27
Appendix E.	Selection of Tests	31
Appendix F.	Special Data and Explorations	41
Appendix G.	Discussion of Item-Analysis Methods	45

Appendix A - Description of Tests

Copies of the tests developed are on file with Personnel Research & Procedures Branch, TAGO, Department of Army. Sample items are shown and described here. It was not thought necessary to make copies large enough to be legible. Each will be designated as to Plate and number on the plate. Some of the conventional type of pencil-and-paper tests will be described in a sentence and a sample item given to illustrate the form of questions. See Plates I, II and III pp. 5-7. NA indicates no CRT number was assigned.

TESTS USED IN RUN ONE

1. CRT 63 - Activity I (not shown here but similar to Plate II-7.) A pencil-and-paper test of activity or motility having a reliability above .80 and a validity of .45 when correlated with actual tapping using Ream's method. It is set up to be scored by IBM.

2. CRT 63 - Activity II. A variant of Activity I in which the strokes required were altered from single down stroke to a down-and-up stroke.

3. CRT 60 - Tracing Coordination (not shown). Similar to an IBM scoring key with connecting lines leading towards the center of the page. The subject uses two pencils, starting with left hand at upper left and with the right hand at lower right. Moving along the lines and towards the center, the subject blacks in each circle as reached. The tests are scored on IBM machines.

4. CRT 67 - Tracing Ability. This test of finer coordination was originally run to match an IBM scoring sheet in which samplings of the accuracy of tracing a line were randomly chosen as the method of scoring. Due to complications introduced from printing, the tests were hand-scored but could be easily adapted for regular machine work. (See Plate I-1)

5. CRT 206, CRT 59 and CRT 197 - Spatial Relations. This is an adaption of the O'Connor Block Test to pencil-and-paper form. The examinee is shown the complete block assembly, then is given a partly assembled block with five alternate possibilities for fitting one of five blocks into a given position. His score is the correct number of choices. (See Plate II-6)

6. CRT 68 - Visual Recognition. A perception test in which a circular pattern design is presented at the left-hand side of the page. Five similar looking designs are set at the right for comparison. The subject selects the one like the sample. (See Plate II-5)

7. CRT 199 - Letter Block. A test designed to measure speed and accuracy of perception. The blocks of letters are presented and the task is to go through quickly and pick out the row in each block which has a wrong letter in it. Each block of letters is an item. (See Plate I-7)

8. CRT 63 - Object Identification. A test of observation with two objectives. The examinee must, (a) search over the page for the right numbered item, and (b) answer the question which relates to accuracy of observation. (See Plate I-5 and I-6)

9. CRT 61 - Speed of Perception. A number-checking test after Evans and others in which serial numbers about 3/4 inch in height are placed at random on a page. The examinee traces the serial numbers in order as far as he can go in a given time and then puts a cross over the last one he reaches. The score is the number he reaches. (Not shown on plate)

10. CRT 62 - Speed of Perception (Revised). The same as before but with every alternate number reduced in size to ordinary reading type. The rationale is that the time required for the eye to accomodate, a type of near-far fixation, might be measured. (Not shown on plate)

11. CRT 66 - Lateral Perception. Hypothesized as an indirect measure of visual efficiency in the periphery of vision. The subject compares two rows of random letters for differences or sameness presented in groups of five. The successive groups alternate from the center of the page to the side. (See Plate II-8)

12. CRT 202 - Visual Acuity. A test in five parts designed to measure detailed visual perception. The test is structured to avoid linguistic and higher mental activity effects as far as possible. Each part has a different design, graduated in size, to increase difficulty in seeing. The score is the number right. (See Plate II-9 and II-10, and Plate III-1 and III-2)

13. CRT 207 - Word Matching. A visual perception test in which a key word at left is matched by one of five choices at right. The task requires sufficient vision to read the word correctly. The size is successively reduced past the threshold of readability for one with subnormal vision.

14. CRT 201 - Traffic Observation. An adaptation of the classic Aussage test made up of traffic situations. Objective questions (shown at the right of picture) are presented after a short period of study. (See Plate I-2 and I-3)

15. CRT 64 - Visual Memory. A type of immediate recognition of forms. It was hypothesized as a measure of a driver's tendency to notice and then forget dangers in the environment. The designs used were the same as for Visual Recognition (shown on Plate II-5) except differently arranged. In certain respects it is similar to Traffic Observation except the designs are abstract.

16. CRT 69 - Space Judgment. A test after Ghiselli in which spatial intervals are compared. The subject selects the letter which is closest to the standard or reference letter of each item. (See Plate I-4)

17. CRT 87 - Emergency Judgment. Pictorial presentation of traffic situations are made. The subject indicates his choice of solutions in a

five-answer multiple choice item. (See Plate II-2)

18. CRT 196 - Emergency Driving. Questions of the conventional four and five-answer type on information designed to measure one's reactions to emergencies in driving. The aim was to concentrate on emergency situations if they could be differentiated. Two forms were used.

19. CRT 88 - Driving Judgment. Similar to the above but emphasis was placed on judgment with respect to ordinary driving practices. The two forms, A and B, were merged into Form X for the second run, retaining the best items only.

20. CRT 208 - Motto Test. A set of common proverbs and axioms involving mechanisms hypothesized to be related to proper behavior in traffic situations. Three responses are possible: (A) Agree with, (B) Don't know, (C), Do NOT agree. A weighting system of from 1 to 3 is used in reverse order. Sample items are:

1. Nothing succeeds like success. (A) Agree (B) Don't know (C) Do NOT*agree
2. Knowledge is power. (A) Agree (B) Don't know (C) Do NOT* agree

*NOT is capitalized for emphasis.

TESTS USED IN RUN TWO

The tests described below are mostly group tests of cognitive nature with the exception of PRT 565 and were added to the battery on the second run.

1. PRT 565 - These tests are the regular Army driver selection tests. They were given according to Army specifications, both as to construction of the test, design of the apparatus and test administration. A full description is given in the Manual "Examinations For Motor Vehicle Operators," MVO-I, M, WD AGO PRT-565 and need not be given here.

2. PRT 2387 - Army Two-Hand Coordination. A motor coordination test in which special hand pegs are alternately aimed at circles to the right and to the left, starting with the center columns. The score is the number of targets hit according to standards set up. (See Plate III-3) Note the starting point is marked. The carbon is placed on the back and the score is the number of targets hit within the circle.

3. CRT 195 - Pattern Tracing. A standard IBM form is over-printed with a pattern to be traced on the separate answer sheet without the pattern. Control and close observation are necessary.

4. PRT 2382 - Army Path Tracing. A maze is over-printed on standard IBM sheets. The subject traces through the maze. Per cent right was used as a score. The test is designed for IBM scoring but because of some printing irregularities they were doubly scored by machine and some hand scored to assure a reliable measure. Only slight discrepancies were noted on the two sets of scoring and a mean was taken for the two. (See Plate II-4

for general layout.)

5. PRT 2374 - Attention to Detail. Army test composed of rows of O's, a number of which are broken. The task is to determine how many are broken in each line. Used only in Run Two-A and Run Three.

6. PRT 2457 - Driver's Self Description Blank. Described elsewhere by PRS. A driver's background and personality-attitude blank. Several scores are available.

7. PRT 2412 - Driver Know-How Test. Developed by PRS and consists of 48 items involving knowledge of driving and safety behind-the-wheel. Score is the number right.

8. Experimental Test. CRT 217 - Perseveration. A combination of sense and nonsense, and word combinations which may be either true, false, or pure nonsense being answered (A), (B), or (C) accordingly. (See Plate I-9 for general layout).

9. Experimental Test. CRT 218 - Accuracy. A tedious and boring test in which items consist of different numbers of certain letters, numbers or symbols appearing in a mixed line, e.g.,

1. Which number occurs most often? 1 3 9 7 6 5 4 3 7 2 6 5 4 3 4 7 2 3

(A) = 3 (B) = 7 (C) = 2 (D) = 4 (E) = 6

10. Experimental Test. CRT 216 - Difference Detection. An observation test set near the discrimination threshold. Pictures of commonplace and automotive-type apparatus are presented with a structuring sentence to direct attention to proper detail. This test was cross-validated. Score is number right. (See Plate I-10).

11. Experimental Test. CRT 215 - Motility. This test is a further development of CRT 63, Activity I and Activity II. The general format is shown (Plate II-7). The first part involves blackening in the triangles as rapidly as possible. The second part is essentially the same as CRT 63.

TESTS OR ELEMENTS NOT ENTIRELY ORIGINAL

Test	Army Designation	Credit Due	Permission granted for experimental use
Speed of Perception	61	Author unknown	
Speed of Perception (Rev.)	62	rights expired	Dr. J.E. Evans, ISC
Activity	63	Adapted for exp.	
Motility	215	use on IBM	IBM, Des Moines
Visual Memory	64	Rights expired if ever entered	J.E. Evans, ISC
Space Judgment	69	Edwin E. Ghiselli	Dr. Ghiselli, Berkeley, Calif. through PRS
Visual Acuity	202	For use of targets in Part II	R.A. Sherman Bausch & Lomb, Rochester

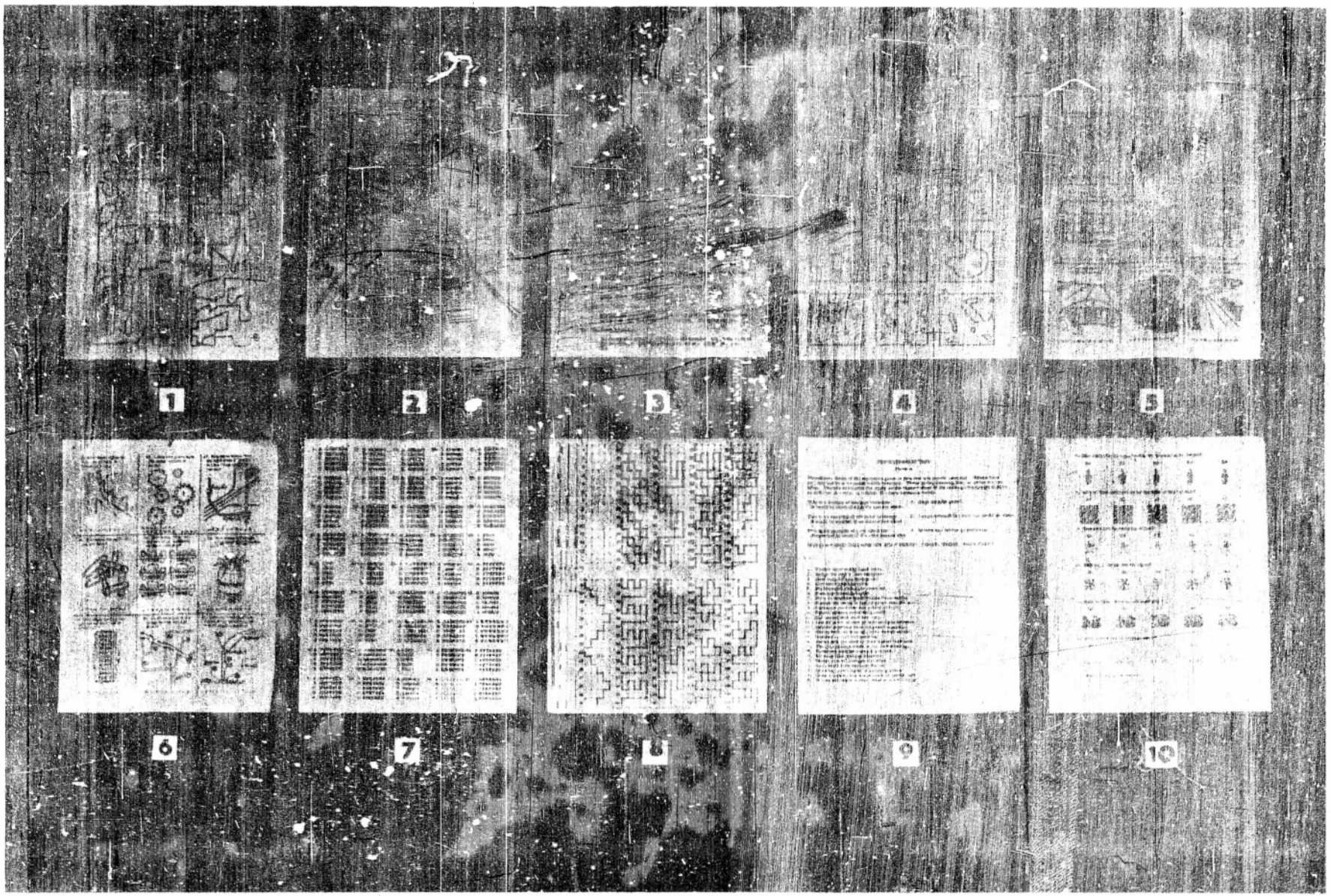


PLATE I

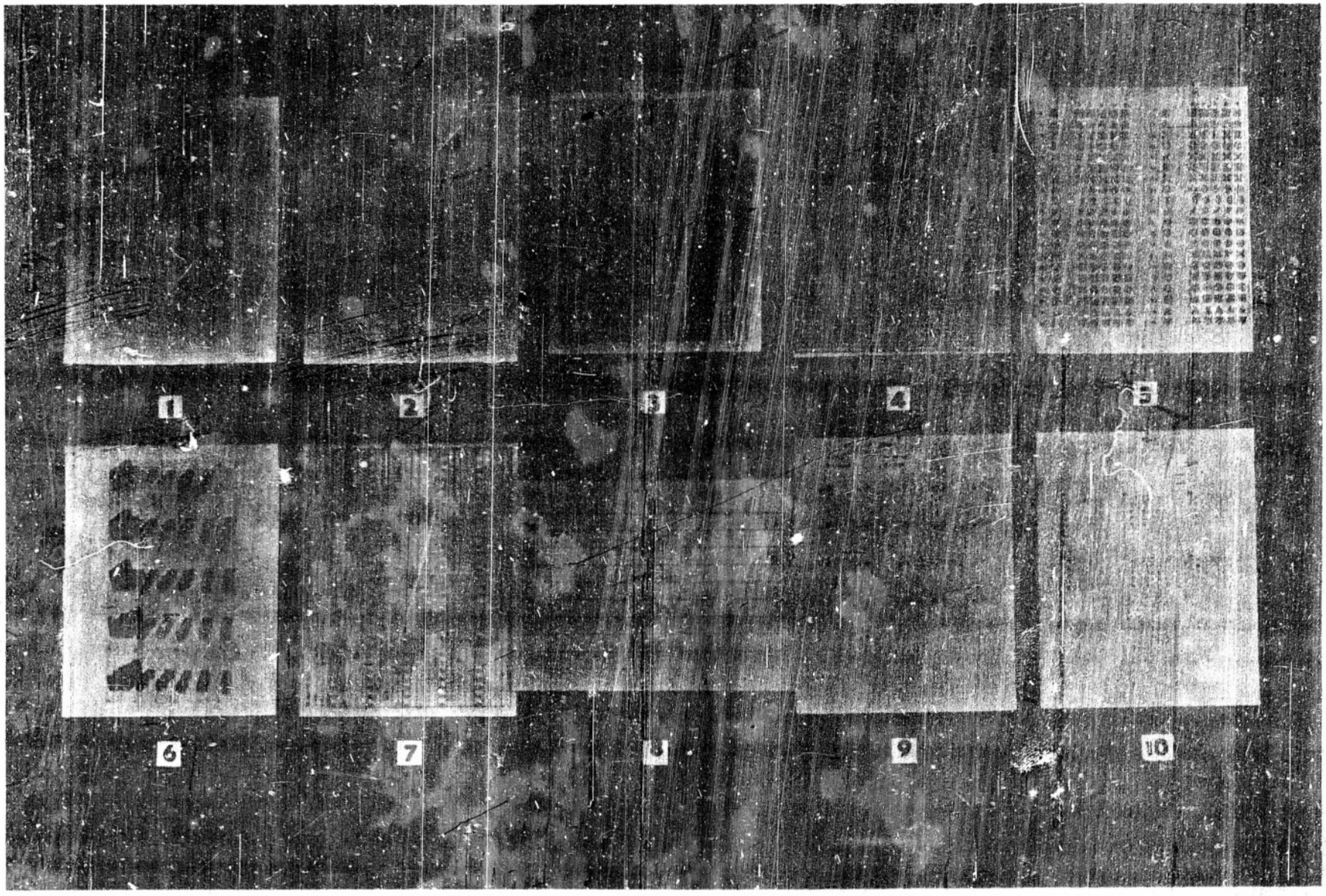


PLATE II

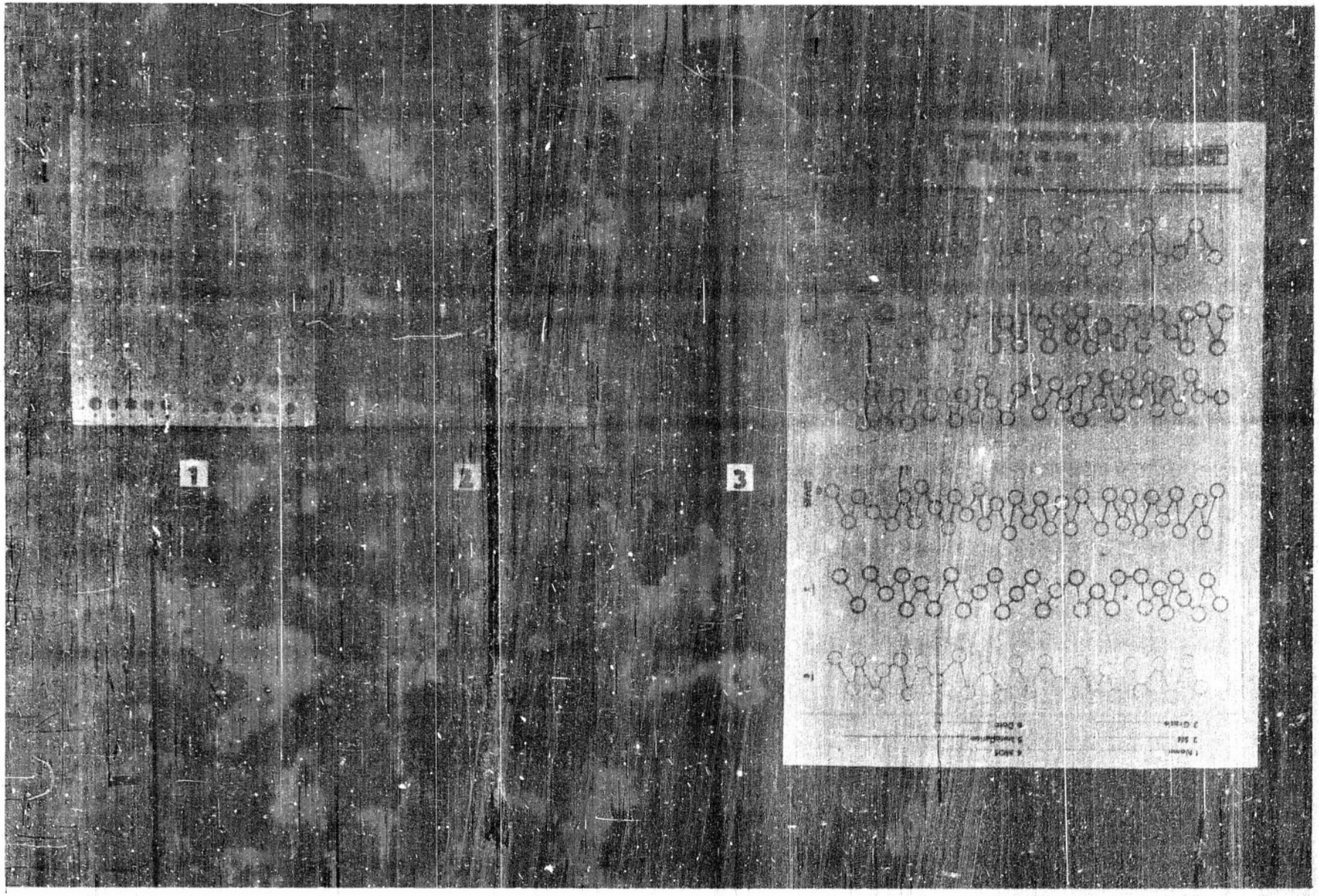
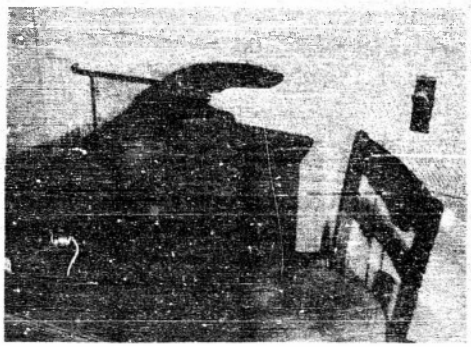
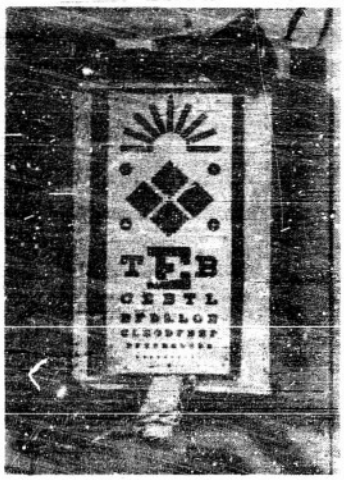


PLATE III

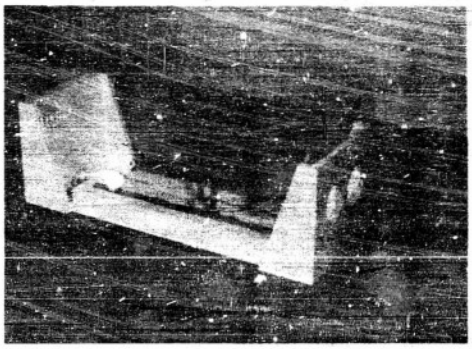
PRT 565 PSYCHOPHYSICAL TESTS CONSTRUCTED ACCORDING TO ARMY SPECIFICATIONS



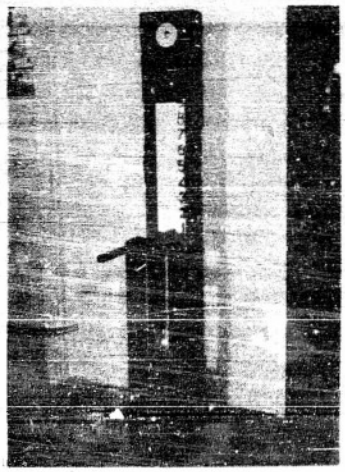
2



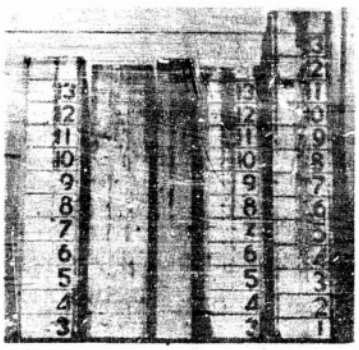
1



3



4



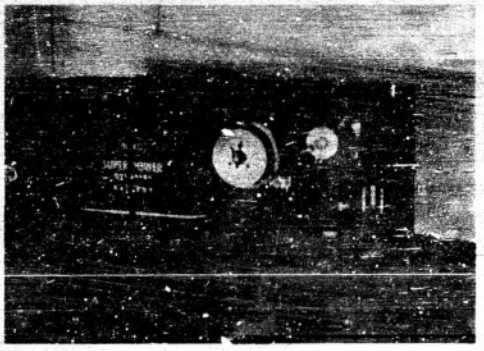
5

PLATE IV

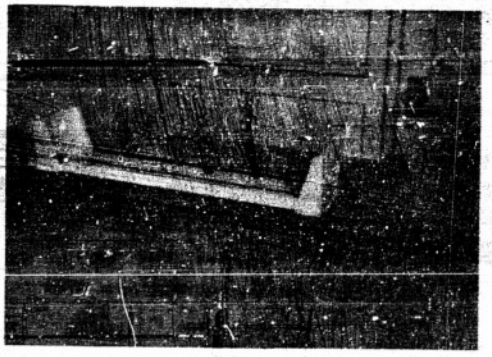
SUPPLEMENTARY PSYCHOPHYSICAL TESTS USED IN PRELIMINARY AND EXPERIMENTAL RUNS



1



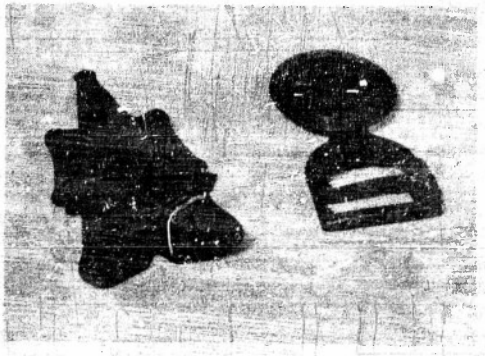
2



3



4



5

PLATE V

The following supplemental psychophysical tests were evaluated as predictors of driving aptitude and/or ability.

1. Armed Forces Vision Test as described by the Armed Forces Vision Committee (not shown here). It comprises an objective test of visual acuity, muscle imbalance and color vision.

2. Motility Test. A measure of activity developed by Ream (G). The sum of four trials of 10 seconds each was used as a score. A telegraph key with self-timer and counter gives a reliability of .94. The key is standardized at 3 mm. throw and 50 grams pressure resistance. (See Plate V-2).

3. Strength of Grip. The Smedley (hand dynamometer) calibrated in kilograms was used to make the measurements. The sum of four successive trials (R, L, R & L) was used as the score. When given under proper conditions of motivation the reliability is .95 or above. (See Plate V-5 right).

4. Ocular Dominance. A variant of the Parson's Manometer adapted by using a red filter over the right eye and blue filter over the left eye. While the test has shown differences between accident and non-accident drivers in previous studies, the method of administration is new and because of an apparent systematic error introduced by the colored filters the results were not used. A quantitative scoring is obtained by totaling the number of R sightings made in seven trials. (See Plate V-5 left).

5. Choice Reaction Time. An electronic variant of the regular PRT 565 test using a falling board, but with both red and green lights being used. The subject reacts only when the red light appears. The contact key, when pressed lightly by the foot, closes the chronoscope circuit which is instantaneously released upon reaction by the subject. This eliminated the systematic "action time" error pointed out by others. Any false move on a green signal which starts the clock is recorded as an error. Three scores were calculated: (a) reaction time as such (mean of 20 trials), (b) variability between successive trials, and (c) error or "false start" score. The latter is assumed to be a measure of the tendency to become nervous or to lack of self-control.

6. Steadiness Test. A modification of Whipple's Steadiness Test has been commonly used as a measure of driving aptitude. The subject stands before the instrument and moves the stylus down a narrowing V-slot until contact is made with the side. This closes a circuit and a red light flashes. Readings are made at the point of contact on a calibrated scale. (See Plate V). The score is computed as the sum of 8 trials as shown in inches of travel on the scale. This function is assumed to be related to the path, line and other tracing tests which in certain instances showed some promise as predictors of driving. None of these functions held up on cross-validation.

7. Depth Perception or Distance Judgment. A modification of the Army PRT 565 version of the Howard-Dohlman test but made somewhat longer, using a variable-placed stationary peg, was employed. A friction control cord attached to the movable peg tended to minimize the possibility of "cheating" by using certain non-visual cues. This test was found to be slightly more reliable than that built according to Army PRT 565 specifications. (See Plate V-3).

The Self Rating item was placed on the data sheet as an afterthought to test the hypothesis that certain persons and groups tend to overestimate or underestimate themselves. (See Appendix B, page 22).

The apparatus shown in (Plate IV-3) is that of the regular Army PRT 565 and need not be described further here. The exact specifications for dimensions, lighting, practice instructions and scoring methods were followed literally from the Army manual. Specific instructions and SOP for all the tests are given in Appendix B.

At the bottom (Plate IV-5) is shown some of the boards used on the PRT 565 fall apparatus for measuring reaction time. The device was found to be extremely troublesome and not dependable. Besides being slow in administration, it was found to require almost as much time for servicing as that required for actual testing. Note excessive wear.

A composite was made of PRT 565 scores by pre-determined weightings made to give the best predictive values of the composite score for driving aptitude. (See Lauer 6). It is herein designated as PRT Composite and indicates the predictive efficiency of currently used Army driver selection tests given as prescribed in the Army manual.

Appendix B - Standard Directions and SOP Used in the Field

INSTRUCTIONS FURNISHED INSTALLATIONS

A full set of directions for the convenience of local Safety Directors and Officers who were to make arrangements on the Post as per contract plan, were sent out as follows:

INFORMATION BULLETIN FOR TEST RUNS ON DRIVER APTITUDE TESTS
(Adapted to fit the run, installation, dates and other details)

re: Contract DA-49-083 CSA-191 Driver Aptitude Tests.

In a Department of Army Contract Research Project on Driver Aptitude Tests authorized by the Department of Army, Adjutant General 's Office, Washington, D.C., we are to visit several installations on the first test run at which time we need about _____ men, 40 a day for four hours, who have the following qualifications as requested by the Department of Army.

1. Army drivers in uniform holding an Army driver's license.

2. Groups of 20 men from one unit or closely related units who know each other reasonably well and who know something of each other's driving skill, experience and habits so that they may rate each other.

3. Men who drive or have driven light and medium heavy Army equipment.

4. Men who are known to from 2-6 supervisors who would be able to rate them as drivers.

The purpose of the study is to develop a screening test for Army drivers that could be used to classify and select drivers of Army motor vehicles. The results of such tests might possibly go on Form 20 along with mechanical aptitude, clerical aptitude and other abilities after suitable evaluation and selection of testing units. The Adjutant General's Office at Washington has authorized the study and will lend its full support and authority. You no doubt have received this information through channels by this time.

A room will be needed for this testing program that is provided with tables to seat 20 men. Two groups of 20 each will be needed for four hours testing each day which we may designate as Group A and Group B. Group A takes the tests in the morning and Group B in the afternoon. Both groups appear at 0800 or the regular scheduled beginning hours observed at the Post. One group will be needed for four hours in the forenoon and the other for four hours in the afternoon. The men will stay to complete all records started. The tests are interesting and the soldiers usually enjoy them. The immediate results of the program will be to dignify and encourage the work of the Safety Director or Officer who arranges the schedule, the place of testing and other details.

We are advised from Washington that the original authorization and directive from the Adjutant General's Office issued at the beginning of the research in March of 1951 gives clearance for the complete contract. This is the first run and subsequent visits may be necessary to complete the contract. If there are any questions about the plans we will be pleased to write or call in persons to help clarify them.

It is our plan now to visit the following installations under your command in compliance with our obligations of the contract:

(List of installations and dates inclusive are inserted here)

All equipment and tests will be furnished by the examining personnel which will consist of the following persons:

Dr. A.R. Lauer, Director of the Project
Ted Campbell, Research Assistant
Gerald C. Helmstadter, Research Assistant
(Personnel for other runs or installations listed accordingly)

Provisions for quartering these men on the Post for the dates given are desired. Also two or more enlisted men with some clerical ability and who know their way around the Post will be needed to help in proctoring and in securing personnel records of drivers.

The research team will arrive on the afternoon of the day before beginning the tests in order to have everything ready for starting early the first morning scheduled at the installation. They will leave the late afternoon of the last date and will not need quarters for that night. In other words, they will arrive at about _____ o'clock on (Day, month, date) and leave (Day, month, date).

The best results have been obtained when the units selected for furnishing the men are notified by written letter and the list of cooperating organizations is run in the Post Bulletin over the signature of the Commanding Officer. It is essential that all men used report punctually and stay until the completion of the tests.

It is suggested by the Department of Army that local arrangements be made by the Post Safety Officer or Director acting under the proper higher command. This is a project in which the whole Army has considerable at stake and your full cooperation is solicited.

Thanking you most sincerely for your help and cooperation.

Very sincerely yours,

(Signature)
A.R. Lauer, Director of Project
Driving Research Laboratory
Industrial Science Research Institute
Iowa State College, Ames, Iowa

GENERAL PRECAUTIONS

1. Keep the directions before you at all times and read them to each subject. Make the reading of directions conversational in style.

2. Motivation of the subject is very important for administration of tests. Try to keep every subject trying to beat his own record.

3. Tests which come in contact with the body should be sterilized twice each half day or after each subject has been tested in certain cases. Keep sterilizing agent away from paint on commercial instruments. This applies only to psychophysical tests.

4. Record each setting or trial as completed. Never rely on your memory.

5. Be on the alert constantly for any attempt at collusion or otherwise beating the tests.

1. INTRODUCTION TO WRITTEN TESTS
Read to the Examinees

"My name is (give name) and this is (give name). We are working under orders from the Department of Army at Washington, down through channels, and by authority of the Chief of Staff of this Post. We were also in uniform during World War II and had our share of active service.

"The Department of Army is particularly anxious to reduce accidents, both at home and in the combat zone. They are convinced that improved selection and training methods for drivers will help do this. Therefore, we ask that you please give your best cooperation in the following ways:

1. Mark the tests as quickly and accurately as you can.

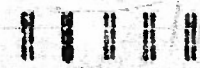
2. Do not talk or bother others. If you have a question, raise your hand and we will help you if the nature of the test permits. Work as quietly as possible.

3. Give your full attention to the job. Do your best.

"Since you have been assigned here during the day it is our duty to report back to your company the completeness of all records started. Be sure your test papers are all complete before you leave. Check with us before you leave so we may make a good report for the day. (Examiner specifically indicates those to do checking out)

"The purpose of the study is to evaluate selected tests for drivers developed and given here and at several other installations. Eventually some form of these will probably be used to classify every recruit as he comes into the Army the same as the other tests of clerical aptitude and mechanical ability which most of you have taken.

"You have been especially selected as a group of the most experienced drivers in the Army and your scores will be used as a standard of classification for new drivers. Therefore it is important that you do your best.

"You will find the tests interesting, for the most part, and if you care to know something of your record when you check out we will be glad to tell you anything we can. The test papers may eventually go to Washington, so please be as neat and careful with your paper as possible. Remember you must use the special pencil handed out so that the scoring machine will pick up the line. Mark clearly between the lines, to blacken it in, thus  on the answer sheet to indicate the correct answer for the question. Most of the tests will be timed so watch that you start and stop exactly with the signal which will be given as: READY - BEGIN and STOP when the bell rings at the end of the test."

(In the morning the examiner adds further:) "This afternoon you will report back for the psychophysical tests." (In the afternoon session say:) "First we will fill out your roster data sheet, the long slip which has been handed you." The directions were then read as given.

2. INSTRUCTIONS FOR ADMINISTRATION OF THE CRITERION RATING FORM

"In this next part we are going to give you a roster of drivers, most of whom you know, and ask you to tell us how well each man does on the different things that go into making up an all-around good, safe driver. Some of the things you will rate him on are: his military bearing, how often he has near-accidents, and how he reacts to sudden changes, and others.

"Here are the booklets that you will use. DO NOT OPEN THESE BOOKLETS UNTIL I TELL YOU TO.

"Notice the words on the cover: 'EXPERIMENTAL-FOR RESEARCH PURPOSES ONLY.' This means that the information you give us will not be known to anyone at this Post and no man will be affected in any way by this information.

"You will notice the two numbers on the front of the booklet. These two numbers indicate the PLACE and the GROUP. We do this so we will not have to use your name when rating other drivers. We keep record of the ratings by these two numbers and the letters on the scales.

"Notice the column of lettered boxes at the right hand side of the page. Pull out the roster sheet and line up the roster with the lettered boxes - A with the A box, B with the B box, and so on. (Demonstrate)

"Now find your own name on the roster. Put a circle in the box next to your own name and cross your name off of the roster. You will not rate yourself. Is there any driver on your roster that you do not know or that you do not know his driving? If there is, put a circle in the box next to his name and cross his name off the roster. You will not rate anyone you have crossed off of the roster. If there are some drivers you do know but you are not sure of being able to rate them, put an X in the boxes next to their name. YOU WILL RATE THEM TO THE BEST OF YOUR ABILITY - MAKE THE BEST ESTIMATE YOU CAN OF THEM. Are there any questions?

"Now we are ready to rate the drivers you know on the first scale. Turn to Page 2 and line up the letters on the right hand side of the page, A with the A box, B with the B box, and so on. The question we are rating on is: 'How does he rate on personal appearance and military bearing?' If he is tops, one of the best, he rates a 1, a 2, or a 3. If he is about average, like most drivers, he rates a 7, 8 or 9. If he is one of the poorest, he rates a 13, 14 or 15. Each time you rate a man you first decide which section he belongs in, then decide which number on the scale best fits him. Then put that number in the box next to his name. DO NOT RATE ANYONE YOU HAVE CROSSED OFF OF THE ROSTER. MAKE THE BEST GUESS YOU CAN ON THIS BASIS OF WHAT YOU DO KNOW ABOUT EACH DRIVER."

(Examiner please refer to Page 5 of the directions and follow the SOP carefully.)

3. INTRODUCTION TO PSYCHOPHYSICAL TESTS

"My name is (give name) and my assistant's name is (give name). We also have been in uniform at various times and understand your problems. We are acting under orders from the Department of Army in Washington and you have been assigned here for the day by the Commanding Officer of the Post. We are all working together to improve the methods of selecting and training of drivers. You have been particularly selected as experienced drivers whose records are to be used as a standard of comparison for future selection of men who will do a good job handling motor vehicles.

"Since we can take only four or five drivers at one time through the psychophysical tests, will you please remain in your seats and complete the two written tests which will be handed out in a few minutes. There is no time limit on the written tests and after you get started we will call some of you to do the individual tests of reaction time, strength, activity, vision, etc. Then you can return to your seat and complete the written tests. All are to be completed before you leave. Please do not waste time so all may get through together if possible.

"We are passing out three forms in a folio together with one answer sheet. Keep all these together in the folio. They are to be filled out as follows:

a. One form is to be used with your psychophysicals. Fill out the first page down the row of 0's - 000000000 at the lower part of the page. This is merely a division line.

b. The Driver's Written Test. Put the answers to this on your answer sheet marked #DA-AGO PRT 2410, starting in columns 3 and 4 with item 91. The answer to question 1 will be in the #91 place on the answer sheet, question 2 in #92, etc. Use special pencil provided by us in all these tests. If one breaks ask for another.

c. The Driver's Self Description Blank covers certain experiences that you have had. The answers to these questions will be placed on the same sheet starting on Side 1 at 1. You are to answer all the questions required on the blank. (Examiner reads directions from the booklet as given and gives any needed directions regarding the marking of questions.)

"Since we have to account to your organization for completeness of records made today, will you please check out with me so that we may give you a clean slate on completion of the tests."

4. DIRECTIONS FOR PSYCHOPHYSICAL TESTS

a. Steadiness.

Explain the test briefly, then say: "Take this stylus and stand with your arm directly in front of the test. (Demonstrate) Insert stylus carefully and move down as far as possible without touching sides which will flash the red light. Work carefully and try to get all the way through." When the light flashes say: "You made _____ that time. Try to do a little better the next trial, etc. You will have eight trials." Take readings on 8 trials and record each as taken.

b. Strength of Grip

Explain the test and then say: "Take this dynamometer and give us all the grip you can. Hold it like this (demonstrate) at your side but do not let it touch your side or clothing. Do your best. This is a contest." Make four alternate right and left trials and record each as taken. Do not allow adjustment of dynamometer to be made. Set on line marked. Note reasons if one hand is noticeably weaker. Record the alleged reason.

c. Color Vision.

Explain test and say: "Read the numbers when I turn the page as quickly as possible." Merely write the numbers on the record sheet above those listed if they are different. If all are read correctly merely write O:K. at the end of row.

d. Activity or Motility.

Explain the test and say: "We want to see how active you are. Take the key between your thumb and two fingers like this (demonstrate) and move up and down as fast as you can. Remember this is a speed test. READY - BEGIN!" Give four trials after the subject understands. The key must be held lightly with thumb and first finger and not released while

tapping. Keep motivating subject while working. Do not allow interim trials and have the person relax by shaking the hand vigorously. Keep the key set at 50 grams resistance and 3 millimeters of throw up and down.

e. Handedness.

Merely ask the subject which hand he uses best - Right, Left or Both.

f. Choice Reaction Time.

Explain the test and say: "Please sit down in the chair with your left foot on the rubber mat and the toe of your right on the red button at the right. Depress it lightly to make contact. Watch for the lights. (Indicate). If a red light flashes, move the foot over to the pedal at center as quickly as possible. If a green light flashes make no movement at all but wait for a red light. READY!" Record each reaction as made. Tally the times the subject makes a false move on the green light. Any movement of the chronoscope hand is a false move.

Give 9 greens and 20 reds in the following order: 1. G, 2. R, 3. G, 4. R, 5. R, 6. R, 7. G, 8. R, 9. R, 10. R, 11. G, 12. R, 13. G, 14. R, 15. R, 16. G, 17. R, 18. R, 19. R, 20. R, 21. G, 22. R, 23. R, 24. G, 25. R, 26. G, 27. R, 28. R, 29. R.

Record number of errors or false starts on green and the time for each reaction to red. (Note: if a color blind person is found who cannot tell colors, give red lights only.)

g. Hearing.

Give exact directions prescribed in PRT 565. (Use the manual as you give the test and be sure it is kept out of sight so that no one sees it at any time.)

h. Simple Reaction Time. (Foot pedal reaction)

Explain the test, then say: "Please sit down with your left foot on the white footprint on the floor. Look at the red dot under #7 on the falling board. (Indicate). When the board starts to drop, hit the pedal as quickly as possible and hold it down. READY - FIXATE!" Record 20 trials. Tally any misses on sheet as blanks. Be sure and vary the time between "Ready" and the actual release from ½ to 2 seconds.

Alternate Test. Hand reaction time using apparatus and procedure outlined on page 252, FM 25-10, Basic Field Manual, Motor Transport, 1942.

i. Distance Judgment and Depth Perception. (Depth Perception apparatus built to specifications from PRT 565 Manual.)

Explain the test, then say: "Please sit on the chair and set the two black pegs at equal distance from you, even. They should line up exactly even, crosswise. (Demonstrate). Do this quickly." Make recordings

at each setting and then repeat by saying, "Same thing again, we want several trials. Now another trial, etc." Have strings released after each trial to avoid cues. Have a 40 watt ceiling light directly above the pegs. Make eight trials, recording only last six.

j. Visual Acuity using Snellen Chart. (Apparatus, directions and procedure taken exactly from PRT 565 Manual.

k. Astigmatism using Snellen Chart

Explain the test, then say: "Holding this card over your right eye, look at the fan-dial at the top of the vision chart. Do the lines look equally dark?" If the answer is 'no' ask further, "At what hand of the clock are they darker? Are the lines slightly or markedly darker?" Record as same, slightly, or markedly, and indicate meridian by the clock fact as 9, 10, 11, 12, 1, 2, 3, etc. You need use only the upper half of clock dial. Do same for the left eye.

l. Field of Vision.

Explain test and say: "Please sit down at the perimeter just touching it about one inch under your eyes. Look directly at red button ahead. (Indicate). When you see this target (let them see it) moving at the side say 'now'." Same at left. Reset perimeter each time and record settings. Repeat as before. Place it directly under a ceiling light. Examiner stands or sits just across the table to note any tendency to peek. Two trials on each side.

m. Armed Forces Vision Test. (See Standard Directions furnished with instrument.)

Slide 1. Vertical Phorias. Say, "Do you see a red dotted line? Do you see the number steps? Looks like an L upside down. What number step or L is nearest the red dotted line?" Alternate and additional directions if examinee fails to understand.

Slide 2. Horizontal Phorias. Say, "Now look again. To which number does the arrow point? To which is it closest?" Have examinee blink eyes if he sees either or above only - arrow or the number. A malingerer may see only one.

Slide 3. Right and Left Acuity (normal).* Read the letters in line 5. Now the letters in line 8 (or 8a). The score is the smallest line in which not more than 3 letters are missed. Move up or down from line 8 or 8a. (See Manual for letters.)

Slide 4. Right and Left Acuity (subnormal). Same directions as 3. (See Manual, pages 12 & 13 for letters.)

*This procedure was varied slightly for the final run at the suggestion of Dr. Julius E. Uhlaner. The results were recorded on sheets filed with PRS. The longer directions and procedures would not be suitable for operational use.

Slide 5. Same as 3 but for both eyes (normal). Same directions as 3. (See Manual, pages 12 & 13 for letters.)

Slide 6. Both Eyes (subnormal). Same directions as 3. (See Manual, pages 12 & 13 for letters.)

Slide 7. Color Slide. "You will see four circles with various colored dots. Read me the number outlined in different colors you see within Top circle, Right circle, Bottom circle, Left circle, etc. as they are presented." Record numbers seen.

n. Ocular Dominance.

Do not explain test. The subject should be naive. Merely ask the examinee to keep both eyes open and to look at a black target with white symbols and report if the symbols are "bluish" or "pinkish" in color. The following targets were designed but only the cross and star were used: 1. Disk, 2. Triangle, 3. Star, 4. Square, 5. Cross, 6. Half circle, 7. Diamond, Targets were about 5 inches across and displayed at 18 feet or more. The color only was recorded. Lower scope each time.

5. PSYCHOPHYSICAL TESTS AND AUXILIARY DATA SHEET
(Project on Driver Aptitude Tests - Contract No. DA-49-083 OSA-191)

Form X-3 Restricted Date_____

Name_____Installation_____

Unit_____Rank____Months in Army____Main job in Army_____

Age____Height____Weight____Reach____Chest____Waist____Years of schooling

____Job in civilian life_____Pay you got a month at this

job_____What do you wish to do when discharged?_____

Home address_____
Street Town State

How many accidents have you had when driving (a) an Army vehicle?_____

(b) a civilian vehicle?____. (Damage of $10 or more, or someone needed first aid.) Describe briefly - two examples:

No. 1 - Time of day_____Number of persons in car____Age of car____.

Also in a line or so just what happened (confidential)._____

_____

No. 2 - Time of day_____Number of persons in car____Age of car____.

Also in a line or so just what happened (confidential)._____

---

1. Steadiness: 1___2___3___4___5___6___7___8___ Mean_____

2. Strength: R___L___R___L___ Mean_____

3. Color Perception: 12 6 7 5 3 15 75 2 6 45 97 5 16 00 00 26 42
(Cross out those missed and write below digits read in their place.)
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
Summary_____

4. Motility 1___2___3___4___ Mean_____

5. Handedness: R___L___B___

6. Choice Reaction Time: 1___2___3___4___5___6___7___8___9___
10___11___12___13___14___15___16___17___18___19___20___
Errors or false attempts_____ Mean_____ Mean Variability_____

7. Hearing: R. 1___2___3___ L. 1___2___3___ Mean_____

8. Simple Reaction Time: 1___2___3___4___5___6___7___8___9___
10___11___12___13___14___15___16___17___18___19___20___

9. Depth Perception: 1___2___3___4___5___6___7___8___
(Use last six recorded trials) Mean_____

10. Snellen Chart:

(a) Acuity Right___Left___Both___ Summary_____

(b) Astigmatism Right___Left___Both___ Summary_____

11. Field of Vision: R. 1___2___3___ L. 1___2___3___ Mean_____

12. Visual Efficiency:

1. Vertical Phorias_____
2. Horizontal Phorias_____
3. Acuity Right___Left___Both___
4. Color Top___Right___Left___Bottom___ Summary_____

13. Ocular Dominance: 1___2___3___4___5___6___7___ Summary_____

14. Score on Army Written Test: - _____

15. Score on Road Test (from Army Records):- - - - - - - - - - - - - - _____

16. Self-rating. If you were to take a complete test of driving including knowledge, skill, experience, etc., how would you rate yourself on a 100 point scale with 50 being average. Put a cross on the line at nearest 5 per cent level.

0	10	20	30	40	50	60	70	80	90	100

Appendix C - Correction of Criterion Data

THE EFFECT OF HOMOGENEOUS GROUPING OF VALIDITY COEFFICIENTS

During the analysis of Run Two-A data it was noticed that the test groups varied widely from installation to installation and also within installations. As was confirmed in later runs, certain cultural groups low in general ability tended to over-estimate their immediate associates as drivers. They did not include their own name on the PRT 2408 rosters and no self-ratings were made. However in Run Two-B self-ratings were requested on the psychophysical data sheet and the same tendency in self-rating was noted.

This tendency was thought to be detrimental to the validity indexes obtained and it was suggested by PRS that the mean zero r's from sub-groups be calculated separately and mean r's from given predictors be obtained from z-transformation of the coefficients. To do this it was first necessary to group those rosters having greatest similarity. The relationship between the mean and standard deviations on the criterion was decided upon as the most logical index to use. Since no great consistency seemed to hold for either of these parameters, as such, the coefficient of variability was found to give rather discrete groupings of rosters. This ratio $C = \frac{\bar{X}}{M_x}$ was considered to be the most satisfactory index for classifying rosters into sub-groups for calculation of zero r's. As the scores were standardized by rosters this was possible within installations in order to reduce the task of making the calculations since the procedure required treating each group as a separate matrix in the analysis.

In all, seven sub-groups were thus created and analysis of variance made of the groups. The F values were calculated for each of the selected battery of tests chosen as the most useful battery for cross-validation in the third and final run.

TABLE C-1

Comparison of Sub-groups
for Difference in Means of Predictors

(F value for Sub-groups by Variables)

	Variable							
	0	1	2	3	4	6	7	8	B
F =	3.893**	5.213**	2.703*	1.178	4.667**	3.569**	2.315*	1.765	3.236**

All but two of the predictors showed significant F values confirming the hypothesis that the sub-groups were sufficiently different to warrant corrective treatment.

Further calculation of r's from the sub-groups and taking the mean of the z-transformations as the best estimate of validity gave r's somewhat higher than those calculated from the composite of all groups as will be noted from perusal of Table C-2.

TABLE C-2

Sub-group Validities and Mean Validity Obtained with z-transformation for Selected Variables (Run Three N = 331)

		Variable - raw zero r's (See Table p. 14)								
Group	N	0	1	2	3	4	6	7	8	B
A	68	.0831	.0580	.2014	.2446	.2752	.2296	.1816	.0840	.1748
B	38	.0165	.4849	.3127	.2885	.1483	.2482	.2522	.0711	.4057
C	43	.1887	.0253	.2061	.2453	.3427	.1502	.0668	.0979	.1462
D	74	.1725	.0992	.1508	.1703	.1952	.1542	.1379	.1630	.1368
E	35	.2812	.3275	.1950	.1862	.2894	.4240	.0089	.0910	.5580
F	47	.1278	.1563	.1651	.2885	.5804	.1685	.3345	.0893	.4570
G	26	.2365	.1498	.2250	.2453	.3590	.0914	.1245	.1229	.4580
Validities for Total Group - Corrected										
Total	331	.1484	.1684	.1974	.2260	.3095	.2070	.1489	.0798	.3004
Validities for Total Group - Uncorrected										
Total	331	.1294	.1475	.1907	.2125	.2787	.2011	.1360	.0665	.2855

There was a slight tendency for transformed validities to be larger than the composites.

Legend for Table C-2:

Groups - Arbitrary designation. Grouping made on basis of means and sigmas within installation.

Variables:
- 0 - Word Matching
- 1 - Lateral Perception
- 2 - Emergency Judgment
- 3 - Driving Judgment
- 4 - Driver Know-How
- 6 - Two-Hand Coordination
- 7 - Visual Acuity
- 8 - Path Tracing (% right)
- B - Attention to Detail

Note: Variable 5 was not used in this analysis.

The results corrobrate the reasoning leading up to this corrective treatment and the mean r's were used in the cross-validations in which they were needed.

TESTS FOR THE NEED OF FURTHER CORRECTION OF SUB-GROUP MEANS ON THE CRITERION

The problem of recalculating a composite r after correction of the

criterion for possible differences in predictor means of sub-groups was considered. It was decided to first make these corrections and then determine whether a significant difference existed. Since there were nine variables it was obvious that nine different sets of criteria could not be used and the predicted criterion means for each of the nine variables were averaged to obtain a composite sub-group criterion.

In order to test the significance of differences which might exist the mean criterion scores for each sub-group were predicted for each of nine variables, using the regression equation:

$$\bar{y}' = byx\ (x - \bar{x}) + \bar{y}$$

where:

$\bar{y}'$ = predicted mean criterion score for sub-group
x = sub-group mean for variable x
$\bar{x}$ = population mean for variable x
$\bar{y}$ = population mean criterion score

$$byx = \bar{r}\ \frac{s_y}{s_x}$$

where:

$\bar{r}$ = mean correlation coefficient of variable x with criterion y
s_y = standard deviation of criterion
s_x = standard deviation of variable x

These individual predicted mean criterion scores were averaged giving the following predicted mean criterion scores for the seven sub-groups as shown in Table C-3.

TABLE C-3

Comparison of Mean and Predicted Values of Criterion Scores for Seven Sub-Groups

Sub-Group	Predicted Mean Criterion Score	Difference
1	150.8397*	+1.6615
2	148.1418	-1.0364
3	148.8249	- .3533
4	148.5898	- .5884
5	149.1459	- .0323
6	149.4675	+ .2893
7	148.6236	- .5546

*The values are carried to four places only for emphasis in this comparison. Actually the means are not significant beyond integral values.

Since the standard error of estimate of the population mean criterion score, as calculated by the formula shown below is 1.3910, only one predicted subgroup mean criterion score showed a difference from the population mean greater than the standard error of estimate and none were significantly greater.

$$\sigma_{\bar{x}} = \frac{s}{\sqrt{N - 1}}$$

where:

$\sigma_{\bar{x}}$ = standard error of estimate of the mean

s = standard deviation of criterion

N = number of subjects

It is quite certain that any effects on correlation of a composite score if carried out would be negligible and not worth the time required to make the additional computations.

Appendix D - Statistical Results

RUN ONE DATA

Postulated Function		Army Designation	Reliability r	r with Aptitude Area I	Validity r
Activity	Activity I	63	.67	+.06	+.02
	Activity II	63	.67	-.02	-.07
Gross Coordination	Tracing Coordination	60	---	+.13	
Fine Coordination	Line Tracing	67	.65	+.02	-.20
Perception and Coordination	Spatial Relations				
	Form A	206	.62	+.15	
	Form B	59		+.22	
Speed and Accuracy of Perception	Visual Recognition	68	.84	+.49	
	Letter Block	199	.89K*	+.52	+.10
	Object Identification	65	.86	+.22	
	Speed of Perception	61	---	+.37	-.01
	Speed of Perception (Revised)	62	---	+.36	+.01
	Lateral Perception	66	.63	+.50	-.05
Visual Perception	Visual Acuity	202			
	Part I		---	+.40	
	Part II		---	+.42	
	Part III		---	+.38	
	Part IV		---	+.24	
	Part V		---	+.39	
	Total		.91	----	
	Word Matching	207	.93	+.37	-.08
Visual Memory	Traffic Observation	201	.82	+.20	
	Visual Memory	64	.74	+.34	
Judgmental Factors	Space Judgment	69	.87	+.28	
	Emergency Driving	196	.81K	+.38	
	Emergency Judgment	87	.61	+.41	
	Driving Judgment				
	Form A	45	.71	+.31	
	Form B	203	.89	+.12	
Personality and Compensation	Motto Test	208	.82	+.20	

*K indicates use of Kuder-Richardson Formula. Others odd-even technique corrected by the Spearman-Brown formula.

RUN TWO-A DATA

Army Designation	Name	Scoring Method	Validity	Mean	S.D.	Maximum*
CRT 63	Motility	No. right	+.04	155.0	43.6	293 M
PRT 2387	Two-Hand Coordination	Total right	-.12	103.9	26.6	173 M
CRT 60	Tracing Coordination	Total right	-.07	85.0	33.8	209 T
CRT 67	Tracing Ability Sample pts.	No. right	+.06	18.8	11.2	44 M
CRT 195	Pattern Tracing " "	" "	-.03	232.2	59.1	313 M
PRT 2382	Army Path Tracing	Per cent right	+.09	75.1	22.8	100 M
CRT 206	Spatial Relations (Form X)	No. right	-.01	13.9	5.9	40 T
CRT 68	Visual Recognition	No. right	-.09	27.8	7.9	40 T
CRT 199	Letter Block	No. right	-.08	31.7	9.6	45 T
CRT 65	Object Identification	No. right	-.11	16.8	4.6	27 T
PRT 2374	Attention to Detail	No. right	-.14	27.4	7.3	50 M
CRT 66	Lateral Perception	No. right	-.08	30.6	9.0	50 T
CRT 202	Visual Acuity (Parts II, III, IV & V)	No.	-.16	45.3	12.0	96 T
CRT 202	Visual Acuity (Parts II, III & IV)	right	-.19	39.3	7.4	84 T
CRT 207	Word Matching	No. right	-.16	39.0	7.9	50 T
CRT 201	Traffic Observation	No. right	-.05	34.1	9.9	50 T
CRT 64	Visual Memory	No. right	-.07	6.6	4.6	20 T
CRT 69	Space Judgment	No. right	-.04	16.6	5.9	48 T
CRT 196	Emergency Driving	No. right	-.14	16.3	5.1	35 T
CRT 87	Emergency Judgment	No. right	-.21	15.4	5.7	30 T
CRT 88	Driving Judgment (Form X - Selected items from Run I)	Cross validated	-.19	10.3	3.3	23 T
CRT 88	Driving Judgment (Form X - all items)	Cross validated	-.12	17.1	5.9	40 T
CRT 208	Motto Test	Special	-.04	61.7	12.9	120 T
PRT 2412	Driver Know-How	No. right	-.12	29.5	7.0	40 M
AGCT	Aptitude Area I	(A)	-.09	94.4	18.1	144 M

*Followed by M = Maximum score made; by T = Total items in the test.

RUN TWO-B DATA

CRT 202	Visual Acuity (Parts II, III & IV)	No. Rt.	-.08	41.3	13.7	84 T
CRT 216	Difference Detection (All items)	No. Rt.	-.19	12.1	3.6	25 T
CRT 66	Lateral Perception	" "	-.18	37.0	7.5	50 T
PRT 2457	Driver's S-D Blank, Side 1, Box D	(A)	-.14	35.7	6.3	51 M
PRT 2457	Driver's S-D Blank, Side 2, Box B	(A)	-.14	27.0	4.0	35 M
APR*	Educational Level	(A)	-.24	9.8	1.9	13 M
PP**	Strength (Total 4 trials)		-.02	203.2	26.7	279 M
PRT 565	Composite Psychophysical	(Weighted)	-.23	241.0	30.1	303 M
AGCT	Aptitude Area I	(A)	-.19	96.7	17.6	
APR	AR	"	-.10	91.1	21.5	
APR	MA	"	-.14	101.8	19.4	
APR	SM	"	-.15	102.0	18.1	
APR	AI	"	-.17	103.8	21.3	
APR	EI	"	-.16	94.8	25.5	

*Army Personnel Record **Psychophysical Test

RUN THREE DATA

CRT 88	Driving Judgment	No.Rt.	-.21	15.0	5.1	30 T
CRT 87	Emergency Judgment	" "	-.19	18.5	3.8	30 T
PRT 2412	Driver Know-How	" "	-.28	28.4	6.1	41 M
PRT 2374	Attention to Detail	" "	-.29	26.1	7.2	47 M
PRT 2387	Two-Hand Coordination	" "	-.20	109.3	24.4	166 M
CRT 207	Word Matching	" "	-.13	40.5	6.2	50 T
CRT 216	Difference Detection (Selected items)		-.15	6.6	2.1	12 M
CRT 216	Difference Detection (Total items)		-.18	12.3	3.1	25 T
CRT 66	Lateral Perception	No.Rt.	-.15	33.9	8.3	50 T
CRT 202	Visual Acuity (Parts II, III & IV)	" "	-.14	41.4	11.4	84 T
PRT 2382	Army Path Tracing	% Correct	-.07	93.9	9.2	100 M
PRT 2457	Driver's S-D Blank, Side 1, Box E (A)		.00	72.9	7.5	92 M
PRT 2457	" " " " 1, " F "		-.10	107.6	11.3	139 M
PRT 2457	" " " " 1, " A "		-.10	14.3	4.5	24 M
PRT 2457	" " " " 1, " B "		-.08	9.5	3.6	15 M
PRT 2457	" " " " 1, " C "		-.10	10.8	4.4	15 M
PRT 2457	" " " " 1, " D "		-.18	34.7	6.7	50 M
PRT 2457	" " " " 2, " B "		+.12	27.4	3.9	35 M
PRT 2457	" " " " 2, " A "		+.05	42.4	5.9	57 M
PRT 2457	" " " " 2, " C "		+.04	3.1	3.8	7 M
APR	Aptitude Area I	""	-.18	94.8	16.8	133 M
APR	RV	"	-.07	96.5	19.1	143 M
APR	AR	"	-.24	90.5	19.1	145 M
APR	PA	"	-.07	96.7	22.2	139 M
APR	ACS	"	-.06	86.7	18.5	140 M
APR	ARC	"	-.09	105.8	10.4	151 M
APR	SM	"	-.21	99.9	17.7	139 M
APR	AI	"	-.24	102.6	19.0	145 M
APR	MA	"	-.23	103.5	16.9	155 M
APR	EI	"	-.17	93.7	23.8	139 M
APR	RI	"	-.07	89.6	24.8	141 M
PP	Choice Reaction Time (errors or false starts)		+.17	3.0	1.8	
APR	Months in Army		+.11	25.5	19.5	
PP	Weight		-.10	166.4	21.4	
PP	Job Rating as Civilian (Barr Scale)		-.07	6.3	2.3	
APR	Average Miles a Month		+.10	807.1	428.5	
PP	Motility (Total of 4 trials ÷ 10)		-.06	27.1	3.0	
PP	Snellen Acuity		+.03	58.2	14.7	
ARP	Time Since Personnel Action (In Mos.)		+.09	9.9	10.5	
PRT 565	Composite (Weighted)		-.12	252.0	29.9	
PP	Strength (Total of 4 trials ÷ 10)		+.19	19.4	2.9	
APR	Length of Present Assignment (In Mos.)		+.02	10.6	10.3	
APR	Months Exp. in Driving Army Vehicles		+.05	17.9	19.3	
APR & PP	Accidents Driver Has Had		+.05	0.4	0.3	
PP	Self Rating (On a 10 pt. scale)		+.07	6.4	1.8	
PP	Age (In yrs.)		-.12	22.8	2.8	
PP	Educational Level (Yrs. in school)		-.18	9.9	2.2	
PP	Steadiness (total of 8 trials)		-.10	81.0	12.8	
PP	Choice Reaction (Mean x 2)		+.06	63.9	8.7	
PP	Field of Vision (Total field)		.00	175.5	10.8	
PP	Armed Forces Vision Test (Same as Snellen)		+.03	58.7	45.3	
PP	Choice Reaction Time (Total variability ÷ 10)		+.06	13.1	5.0	

Supplementary intercorrelations from Run Three are presented below using the same numerical designation used in Table 5 shown in the main body of this report.

Predictor	Army Designation	AR 0	SM 1	AI 2	EI 3
Word Matching	CRT 207	.4383	.4058	.3137	.1966
Lateral Perception	CRT 200	.4887	.4282	.3491	.3080
Emergency Judgment	CRT 87	.4778	.3977	.3564	.2645
Driving Judgment	CRT 88	.4890	.5408	.4589	.3289
Driving Know-How	PRT 2412	.4893	.5266	.5355	.2930
Difference Detection	CRT 216	.2734	.2790	.1910	.1038
Two-Hand Coordination	PRT 2387	.2490	.2197	.1426	.0905
Visual Acuity (II, III & IV)	CRT 202	.4458	.3502	.2919	.2434
Attention to Detail	PRT 2374	.3652	.2605	.2499	.1330
Bib, Side 1 Box D	PRT 2457	-.0493	.0853	.2515	-.0571
Bib, Side 2 Box B	PRT 2457	.1833	.1737	.1822	.0896
Strength	Measured	.1223	.1293	.1877	.0767
Education al Level	APR	.5222	.4864	.3595	.3247
Composite PRT 565	PRT 565	.2588	.2640	.2656	.0722
Aptitude Area I	ACT	.7941	.6774	.5438	.4497
Mechanical Aptitude	ACT	.5221	.5930	.5669	.3864

Appendix E - Selection of Tests

Tests with significant zero-order coefficients (in Tables 3 and 5) were combined to determine the effectiveness of batteries composed of different tests and of varying numbers of tests.

Since the betas vary considerably with the particular combinations of variables in which they are found, it was thought advisable to try as many different combinations as the data would permit in order to provide alternate batteries. Consequently a number of combinations were made from the basic data and the cross-validation techniques applied to each. Because subjects in Run Two-A and Run Two-B were not common, cross-validations were made only on combinations of variables within each run.

The combinations are labelled, Table E-1, E-3, E-5, E-7, and E-9, to distinguish the predictor battery assembled. Each is set up separately for convenience of reference. When double cross-validations were possible, Tables E-2, E-4, and E-6 are given for comparison. Although the term has not been generally used, it might be convenient to speak of such treatment as forward or backward cross-validations. The former being used in the cases where betas from a subsequent run are multiplied by zero r's. This necessitates calculation of the multiple R's to obtain betas for use in the process, but the double set of values is useful for better comparisons.

TABLE E-1

Combination of Five Predictors from Run Two-A for Cross-Validation with Run Three Data

N = 203

Variable	Army Designation	Working Time in Minutes	Intercorrelations 2	3	4	5	6
1. Emergency Judgment	CRT 66	16	.3668	.4502	.0786	.3169	-.2074
2. Word Matching	CRT 207	8		.4729	.1559	.4273	-.1594
3. Driver Know-How	PRT 2412	20			.2418	.2917	-.1233
4. Driver's S-D Blank Side 1, Box D	PRT 2457	20				-.0065	.0197
5. Attention to Detail	PRT 2374	4					-.1382
6. Criterion	PRT 2408						
	Total working time -	68 minutes					

Non-cross-validated R = .2353 (reflected)

Cross-Validation Data

Variable	Validities from Run Three	Betas from Run Two-A	Order of Magnitude of Betas
1. Legend:	-.1974*	-.1614	1
2. (Same as above)	-.1489*	-.0825	2
3.	-.3095*	-.0087	4
4.	-.1781	.0468	-
5.	-.3004*	-.0490	3

Cross-validated R = .2306 (reflected)

*Mean validities from z-transformation used in cross-validation.

TABLE E-2

Combination of Five Predictors from Run Three for Cross-Validation using Run Two-A Data

N = 331

Variable	Army Designation	Working Time in Minutes	Intercorrelations 2	3	4	5	6
1. Emergency Judgment	CRT 66	16	.5101	.5414	-.0401	.3024	-.1974*
2. Word Matching	CRT 207	8		.4238	-.0103	.3553	-.1489*
3. Driver Know-How	PRT 2412	20			.1354	.3353	-.3095
4. Driver's S.D. Blank Side 1, Box D	PRT 2457	20				-.0246	-.1781
5. Attention to Detail	PRT 2374	4					-.3004*
6. Criterion	PRT 2408	—					

Total working time - 68 minutes

Non-cross validated R = .4058 (reflected)

*Mean validities from z-transformation used in cross-validation.

Cross-Validation Data

Variable	Validities from Run Two-A	Betas from Run Two-A	Order of Magnitude of Betas
1. Legend:	-.2074	-.0436	4
2. (Same as above)	-.1594	.0422	-
3.	-.1233	-.2025	2
4.	.0195	-.2382	1
5.	-.1382	-.1578	3

Cross-validation R = .2390 (reflected)

TABLE E-3

Combination of Six Predictors from Run Two-B for Cross-Validation with Run Three Data

N = 124

Variable	Army Designation	Working Time in Minutes	Intercorrelations 2	3	4	5	6	7
1. Lateral Perception	CRT 66	5	.2666	.3222	.2895	.1534	-.1035	-.1752
2. Difference Detection	CRT 216	6		.3032	.2761	.1925	-.0008	-.1909
3. Educational Level	APR	Available			.5134	.4092	.0064	-.2439
4. Mechanical Aptitude	ACT	Available				.6873	.1786	-.1393
5. Automotive Information	ACT	Available					.3541	-.1683
6. Driver's S-D Blank Side 1, Box D	PRT 2457	20						-.1409
7. Criterion	PRT 2408	—						

Total working time - 31 minutes

Non-cross-validated R = .3278 (Reflected)

Cross-Validation Data

Variable	Validities from Run Three	Betas from Run Two-B	Order of Magnitude of Betas
1. Legend:	-.1694*	-.1148	4
2. (Same as above)	-.1536	-.1157	3
3.	-.1773	-.1939	1
4.	-.2268	.0941	6
5.	-.2382	-.0619	5
6.	-.1731	-.1466	2

Cross-validated R = .3016 (reflected)

*Mean validities from z-transformation used in cross-validation.

TABLE E-4

Combination of Six Predictors from Run Three for Cross- Validation with Run Two-B Data

N = 331

Variable	Army Designation	Working Time in Minutes	Intercorrelations 2	3	4	5	6	7
1. Lateral Perception	CRT 66	5	.4250	.4822	.4418	.3491	-.0852	-.1694
2. Difference Detection	CRT 216	6		.2184	.3027	.1910	-.0246	-.1536
3. Educational Level	APR	Available			.4879	.3595	-.1057	-.1773
4. Mechanical Aptitude	ACT	Available				.5669	.0922	-.2268
5. Automotive Information	ACT	Available					.2515	-.2382
6. Driver's S-D Blank Side 1, Box 7	PRT 2457	20						-.1781
7. Criterion	PRT 2408	—						

Total working time - 31 minutes

Non-cross-validated R = .3188 (reflected)

Cross-Validation Data

Variable	Validities from Run Two-B	Betas from Run Three	Order of Magnitude of Betas
1. Legend:	-.1752	-.0431	6
2. (Same as above)	-.1909	-.0714	5
3.	-.2439	-.0865	3
4.	-.1393	-.0748	4
5.	-.1683	-.0963	2
6.	-.1409	-.1581	1

Cross-validated R = .3020 (reflected)

TABLE E-5

Six Predictors Combined From Two-A for Cross-Validation
with Run Three Data

N = 203

Variable	Army Designation	Working Time in Minutes	Validity Coefficients
1. Two-Hand Coordination	PRT 2387	10	-.1204
2. Driver Know-How	PRT 2412	20	-.1233
3. Driving Judgment	CRT 88	20	-.1684
4. Attention to Detail	PRT 2374	4	-.1382
5. Educational Level	APR	Available	-.1054
6. Mechanical Aptitude	ACT	Available	-.1273
7. Criterion	PRT 2408	—	

Total working time - 54 minutes

Non-cross-validated R = .2140 (reflected)

Cross-Validation Data

Variable	Validities from Run Three	Betas from Run Two-A	Order of Magnitude of Betas
1. Legend:	-.2070*	-.0612	2
2. (same as above)	-.3095*	.0009	-
3.	-.2260*	-.0701	1
4.	-.3004*	-.0577	3
5.	-.1773	.0039	-
6.	-.2268	-.0255	4

Cross-validation R = .2254 (reflected)
*Mean validities from z-transformation used in cross-validation.

TABLE E-6

Six Predictors Combined From Run Three for Cross-Validation
with Run Two-A Data
N = 331

Variable	Army Designation	Working Time in Minutes	Validity Coefficients
1. Two-Hand Coordination	PRT 2387	10	-.2070*
2. Driver Know-How	PRT 2412	20	-.3095*
3. Driving Judgment	CRT 88	20	-.2260*
4. Attention to Detail	PRT 2374	4	-.3004*
5. Educational Level	APR	Available	-.1773
6. Mechanical Aptitude	ACT	Available	-.2268
7. Criterion	PRT 2408	—	

Total working time - 54 minutes

Non-cross-validated multiple R = .3865 (reflected)

Cross-Validation Data

Variable	Validities from Run Two-A	Betas from Run Three	Order of Magnitude of Betas
1. Legend:	-.1204	-.0974	3
2. (Same as above)	-.1233	-.2259	1
3.	-.1684*	.0377	-
4.	-.1382	-.1952	2
5.	-.1054	.0122	-
6.	-.1273	-.0510	4

Cross-validated R = .2557 (reflected)

*Mean validities from z-transformation used in cross-validation.

TABLE E-7

Seven Best Predictors Combined from Run Three Data

Variable	Army Designation	Working Time in Minutes	Validity Coefficients
1. Emergency Judgment	CRT 87	16	-.1974*
2. Driver Know-How	PRT 2412	20	-.3095*
3. Two-Hand Coordination	PRT 2387	10	-.2070*
4. Attention to Detail	PRT 2374	4	-.3004*
5. Driver's S-D Blank (Side 1, Box D)	PRT 2457	20	-.1781
6. Mechanical Aptitude	ACT	Available	-.2268
7. Automotive Information	ACT	Available	-.2382
8. Criterion	PRT 2408	—	

Total working time - 70 minutes

Data for Multiple R
(Not cross-validated)

Variable	Validities from Run Three	Betas from Run Three	Order of Magnitude of Betas
1. Legend:	-.1974*	-.0087	7
2. (Same as above)	-.3095*	-.1705	2
3.	-.2070*	-.0951	4
4.	-.3004*	-.2015	1
5.	-.1781	-.1496	3
6.	-.2268	-.0140	6
7.	-.2382	-.0343	5

R = .4156 (reflected)
*Mean validities from z-transformation used in calculation of R.

TABLE E-8

Combination of Twelve Predictors based on Run Three Data
N = 331

Variable	Army Designation	Working Time in Min.	Intercorrelations 2	3	4	5	6	7	8	9	10	11	12	13
1. Word Matching	CRT 207	8	.5130	.3668	.4238	.3543	.2443	.3603	.3553	-.0103	.3339	.4607	.3137	-.1489*
2. Lateral Perception	CRT 66	5		.5198	.4176	.4250	.2834	.4953	.4875	-.0852	.2453	.4418	.3491	-.1684*
3. Emergency Judgment	CRT 87	16			.5414	.2941	.2455	.3442	.3024	-.0401	.2017	.4318	.3564	-.1974*
4. Driver Know-How	PRT 2412	20				.3500	.2165	.4215	.3353	.1354	.3046	.5401	.5355	-.3095*
5. Difference Detection	CRT 216	6					.1992	.2971	.3621	.0246	.1033	.3027	.1910	-.1536
6. Two-Hand Coordination	PRT 2387	10						.2578	.3156	.0071	.1745	.2406	.1426	-.2070*
7. Visual Acuity (II, III & IV)	CRT 202	12							.3968	-.1042	.1823	.4064	.2919	-.1489*
8. Attention to Detail	PRT 2374	4								-.0246	.2250	.3026	.2499	-.3004*
9. Driver's S-D Blank, Side 1, Box D	PRT 2457	20									.2095	.0922	.2515	-.1781
10. Psychophysical	PRT 565	30										.2265	.2556	-.1242
11. Mechanical Aptitude	ACT	Available											.5669	-.2268
12. Automotive Information	ACT	Available												-.2382
13. Criterion	PRT 2408	___												

Total working time -- 131 minutes

*Mean validities from z-transformation used in calculation of R.

Non-cross-validated R = .4215 (reflected)

After application of the shrinkage formula, R = .39

Table E-8, continued

Variable	Run Three Validities	Run Three Betas	Order of Magnitude of Betas
1. Legend:	-.1489*	.0312	-
2. (Same as preceding page)	-.1684*	.0447	-
3.	-.1974*	-.0278	7
4.	-.3095*	-.1892	2
5.	-.1536	.0057	-
6.	-.2070*	-.1053	4
7.	-.1489*	.0302	-
8.	-.3004*	-.2318	1
9.	-.1781	-.1444	3
10.	-.1242	.0313	-
11.	-.2268	-.0358	6
12.	-.2382	-.0410	5

Appendix F - Special Data and Explorations

As in any research program, new suggestions are constantly coming up and oftentimes a slight digression will yield most important data to guide further progress of the study. In order to avoid confusion of the reader as to the essential features of this study, all such secondary observations and explorations are brought together here for brief discussion. They will be presented in the order of development and under the respective headings outlined in this report.

RUN ONE

Some explorations were made of using the first five scales on the Army Rating Scale. Although Scale I was intended only as a suppressor, the results showed it merely tended to dilute the results as expected. Use of PRT 2408 was found superior to the five-scale version or any other combination of parts of the Criterion explored. These explorations were begun in an attempt to expand the Scale portion which was quite normal in order to minimize the Habit portion which was considerably skewed. Empirical tests of normalizing did not contribute positively nor in any appreciable way enough to warrant the extra effort.

A Driving Score Card has been used for several years for driver education students at Iowa State College. It is normally used as one rides in the car with a neophyte driver. Before PRT 2408 was available, and in some preliminary runs with certain tests using local National Guard units as subjects, this card was used as a basis of evaluation. It was slightly changed to be adaptable to group ratings. In the absence of any sort of criterion it was used and gave some degree of promise. In a later study during Run One it was given to a limited number of subjects and designated as the Short Criterion. A combination by simple addition of scores of PRT 2408 and the Short Criterion was also tried out on a limited number of variables. The sum of the two was arbitrarily designated as the Master Criterion. Neither of these alternate criteria used in the preliminary explorations added anything to the regular Army PRT 2408 and the results will not be reported in detail.

Different methods of scoring certain tests were also explored. Notable of these was the CRT 60, Tracing Coordination Test. (Not shown on Plate) The following methods were used: (a) total number right, (b) total of right-hand, (c) total of left-hand, and (d) difference between the right and left hands. No essential difference was found and since the total score was more reliable it was used in all further studies of this test.

RUN TWO-A

In this run several extra-contractural explorations were made on scoring methods. PRS had found some advantage for the inner trials (two adjacent columns of circles) in the PRT 2387, Two-Hand Coordination Test. (See Appendix A, Plate III-3). Correlations were made of the following scorings with the criterion: (a) total score, (b) "per cent error" of items

attempted was used as the score, (c) "inner" score, (d) "middle" score, and (e) "outer" score. No appreciable difference was found but the "per cent error" total score gave the lowest validity coefficient with the PRT 2408. Since the total score was most stable and yielded a reliability of +.63 on 89 cases by the test-retest method, it was used. The shorter scores would likely give insufficient consistency.

The PRT 2382 Army Path Tracing was scored in two ways: "number right" and "per cent right". The latter score gave a more satisfactory validity than the former, although neither was strong enough to place the test in the final battery.

Various combinations and forms of the Spatial Relations Test were used but none yielded adequate validities to place it in the final battery of predictors. (See Appendix A, Plate II-6)

RUN TWO-B

It was suggested that certain tests might give a better predictive index if they were given under distraction. Consequently the following tests were given both ways, alternating the "with" and "without" distraction from group to group: PRT 2382 - Army Path Tracing, CRT 60 - Two-Hand Tracing, and CRT 66 - Lateral Perception. Since the validities were all appreciably lower "with" distraction than "without" the further use of distraction was abandoned.

In the psychophysical tests it was found that the PRT 565 device for measuring depth perception was defective in several ways, notably in that it could be "adjusted" by the examinee to make a better score than deserved. This could be done in various ways: (a) by noting small cues on the string, (b) by moving to extremes, then setting the peg in the middle, (c) by signals from a colleague, (d) by feel of slight friction, and others. A larger model was constructed which allows: (a) the stationary pegs to be set at different points, (b) the movable peg to slip on the string, and (c) longer travel to offset the placement feature. This modified test gave considerably higher reliability

Further improvements for this test would be: (a) built-in-illumination, (b) hiding the target from view of on-lookers, and (c) use of a total integrating score mechanism, etc. From several sources of information and observation it is doubtful whether PRT 565 is usually given according to specifications outlined in the Manual.

RUN THREE

The only additional explorations made in Run Three was a test-retest of reliability made of PRT 2387 - Army Two-Hand Coordination which yielded a raw r of .63 on 89 cases. The test was used on the same group within a period of three hours. The test should probably be lengthened.

Several newer tests were developed later in the study which may have possibilities. These will be described briefly.

1. Perseveration Test. Since several investigators have mentioned perseveration in relation to accidents, the rationale is that a measure of the tendency to perseverate may indicate a tendency to be involved in an accident through a deficiency in the ability to adapt momentarily. This could well show up in ratings of a driver.

The nature of the test is that of a boring and tedious type of activity in which the responses are structured in one direction. At the end of a certain number of items the task is reversed, thus putting the examinee off guard. The per cent of errors made in the second section only is taken as a score. The items are of the following type:

Section I	Section II
1. Which letter is most frequent in the following line?	20. Which mark appears least often?
m n o m o n j k o m n k o j k o n	. , ! ? " ? . ! . ? " , . ? ! , .
(a) o (b) m (c) n (d) j (e) k	(a) . (b) , (c) ! (d) ? (e) "
2. Which symbol occurs most often?	21. Which number is used least often?
# - + % # - % $ % # + - + % # - #	1 2 1 4 3 5 4 5 3 4 2 1 4 3 4 5 1
(a) # (b) - (c) + (d) % (e) $	(a) 1 (b) 2 (c) 3 (d) 4 (e) 5

After attaining a set, the task is changed and the per cent of error after the change is hypothesized as a measure of the tendency to perseverate. The purpose of the test is disguised under the title Accuracy Test. Copies have been furnished PRS. Preliminary runs showed promising validities.

Another test of perseveration of somewhat different nature was used in an experimental way. It consists of the intermingling of nonsense syllables with sense material. In principle it was not unlike the disarranged sentenced test of the Army Alpha. The score is simply the number right. The rationale is that one willing to compensate in effort over a boring and senseless task may tend to give more careful attention to the job of driving at times when he may be more likely to have trouble. The following items are similar to those used and will indicate the nature of the test :

1. Men plumka now icko travel i pio by high booka altitude planes.

2. Ipke zebios hila ornos dimba.

3. Eska ostriches uo yield loma superior ilya des fur.

The first item would be marked (A) as true, the second (B) as being pure nonsense, and the third (C) as being untrue. Only preliminary studies were made of this test.

A special study was made of visual acuity tests as predictors of driving ability. While a complete matrix could not be set up due to the lack of common examinees, the following correlations were computed:

Various Correlations of Visual Tests
(All reflected r's N = 331)

Snellen Acuity with Armed Forces Vision Test	.67
Snellen Acuity with X Vision Test	.54
Snellen Acuity with Word Matching, CRT 207	.21
Snellen Acuity with Visual Acuity, CRT 202 (Parts II, III & IV)	.04
CRT 207 with Armed Forces Test	.13
CRT 202 with Armed Forces Test	.03
CRT 207 with CRT 202	.36

The fact that the examinees were a more or less homogeneous group by reason of having been doubly screened for visual acuity would tend to lower these correlations. Word Matching would seem to be the better test of visual acuity of the two written tests used. Acuity itself did not correlate significantly with ratings on the Criterion, but this, again, could be due to the screening of the men before they became drivers. Doubtful cases for the most part would have been screened out.

Appendix G - Discussion of Item-Analysis Methods

While item-analysis was made of tests to which it was applicable for both Run One and Run Two, subsequent check by cross-validation did not show stable results. A method used by PRS was employed. It consists of dividing the test group into five equal parts weighting each of the quintiles as follows: Two extreme quintiles x 1.476, quintiles next to extremes x .562 and zero weighting for the middle quintile. Estimated biserials are obtained from the Kolbe-Edgerton Table.

Also a short test composed of significant items chosen from several earlier tests, mostly not in the selected battery from Run Two-A, were composited and used in Run Three on an experimental basis. Despite the experimental cross-validation sample showed only an r of .10 in the proper direction of relationship with the criterion. Biserials averaged .25.

Thus the tests for usefulness suggested by Katzell (1951) do not seem to warrant item-analysis for the data under consideration here.

A number of similar explorations with forms of tests indicated that item-analysis and selection with the size of biserials to be expected and the number of cases in this study is not worth-while. Normal chance variation usually erases any selected item significance on cross-validation. It is suggested that chi square or some application of the phi coefficient might be used in order that significance of biserials be determined before a long and laborious process of calculation of coefficients be carried out. It is the writer's opinion, as a result of this study, that only biserial r's sufficient to show significance at the 10 per cent confidence level should be given consideration in item selection for data of this type.