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EVALUATION OF DIFFERENTIAL CLASSIFICATION TESTS FOR THE ACB

by WILLIAM H. HELME

Military Selection Research Laboratory

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J. E. Uhlaner
Director of Laboratories

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NOTICES

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FOREWORD

The NEW CLASSIFICATION TECHNIQUES Task applies psychological measurement methods to enable the Army to make the best use of the different skills and aptitudes of its enlisted personnel. In a continuing series of studies, research is conducted to attain increasingly accurate and differentiated measures of individual potential, and to relate these to the best available evaluations of Army training and job performance. The aptitude area measures used in enlisted classification are kept up-to-date and effective by developing new tests and improving existing tests for incorporation into the Army Classification Battery.

Periodically the aptitude area system undergoes major revision based on validity studies of operational and experimental tests across the full range of military occupational specialties. Results of these studies are integrated by both mathematical and Army occupational analysis methods to form a congruent system with the enlisted MOS classification structure.

The present Technical Research Note details an important step toward such a major revision scheduled for operational implementation in 1966. As the near-final phase of the development of new predictors, a large number of experimental tests, together with current operational tests, were analyzed for effectiveness in predicting training performance in a broad sampling of military occupational specialties.

The entire research task is responsive to special requirements of the Deputy Chief of Staff for Personnel and the U. S. Continental Army Command as well as to requirements of DA R&D Project No. 2J024701A722, "Selection and Behavioral Evaluation: Personnel Measurement."

J. E. Uhlaner
Director of Laboratories

EVALUATION OF DIFFERENTIAL CLASSIFICATION TESTS FOR THE ACB

BRIEF

Requirement:

To develop psychological measures that will increase the effectiveness of operational classification of enlisted men so that in training and assignment the Army can make optimal use of the potential and developed skills of its manpower resources. The current phase of research on classification techniques is directed toward integration of findings on test effectiveness in a reorganized Army Classification Battery and a reconstituted system of aptitude areas.

Procedure:

A battery of 21 experimental tests, plus current operational tests, was analyzed over a broad range of military occupational specialties (MOS) to identify the most effective tests or combination of tests for differential prediction of final grade in the appropriate Army training course. Twenty MOS samples with heavy representation of jobs in the electronics and electronics repair area were used. Tests selected for maximum absolute validity across MOS were compared with those selected to yield maximum differentiation among the MOS studied.

Findings:

Patterns of validity reflected the usefulness of key ACB tests--Arithmetic Reasoning, Automotive Information, Electronics Information, Verbal, and Army Clerical Speed--in differentiating between broad MOS groups. Newly developed motivation-type scales contributed substantially. Perceptual measures and arithmetic operations tests appeared promising.

Substitution of new or revised measures of special mechanical aptitudes for certain current ACB tests such as Mechanical Aptitude, Shop Mechanics, or Electronics Information would reduce the general ability component and enhance differentiation of potential for specific groups of MOS.

Utilization of Findings:

The measures identified as most promising have been incorporated with experimental tests from additional studies to form the Army Differential MOS Battery. This battery is currently being validated in a comprehensive research design across 150 MOS representative of all major Army occupational groupings.

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BACKGROUND AND PURPOSE

Initial classification to Military Occupational Specialty training is based largely on scores from the eleven tests of the Army Classification Battery (ACB). Currently, these test scores are combined in pairs to yield aptitude area scores differentially predictive of performance in occupational areas. Effort to increase the effectiveness of enlisted classification is devoted not only to improving existing tests and constructing new ones, but also to comprehensive analysis of the relationships among Military Occupational Specialty (MOS) training courses--and jobs--and measures of abilities and other personal characteristics needed for job success.

A battery of experimental tests, including both measures of ability and measures of personal noncognitive characteristics, was developed. The present report deals with a comprehensive analysis of these experimental measures as predictors of performance in Army school training courses. Twenty MOS and seven occupational areas were represented in the study.

This research was conducted for the purpose of determining which measures give promise of adding to the differentiation among abilities for groups of Army jobs afforded by the Army Classification Battery. Selected tests, revised to operational length, will be subject to final validation across MOS training programs and Army jobs before standardization for operational use and integration into the Army Classification Battery.

Within this general purpose, the following specific objectives were formulated:

1. To find indication of the most promising directions for development of new measures to improve differential prediction with the ACB.

2. To compare tests selected on the basis of maximum validity across MOS with those selected on the basis of maximum differential validity among the MOS studied.

3. To evaluate each experimental test and each operational ACB test to determine whether some current measures should be replaced.

DEVELOPMENT OF THE EXPERIMENTAL TESTS

Tests in the experimental Battery were the product of a long series of developmental studies. From the analysis of psychological requirements of enlisted jobs, nine major aptitudes were identified and defined (Table 1).

Table 1

MAJOR APTITUDES REQUIRED IN ENLISTED MOS

Aptitude	Duty Requirements
Verbal	Reading technical material, writing technical or administrative reports, composing correspondence
Reasoning	Diagnosing malfunctions, repair required; adapting or improving alternate procedures
Psychomotor	Skillful and precise handling of tools, electrical testing equipment, control devices; making precision adjustments; typing
Number	Precise measurement, calibrating test equipment; accounting
Mechanical	Assembling, repairing, operating and operational maintenance of mechanical equipment
Perceptual Patterning	Visual inspecting of mechanical and electrical equipment
Perceptual Speed	Rapid checking of printed material in abstracts or orders, rosters, requisitions
Spatial	Comparing actual equipment with diagrams, blueprints, schematics; perceiving how parts and components fit together and function
Memory	Learning radio code, Army regulations, administrative procedure, etc.

From factor analytic studies (1,2,3,4,5,6) five major domains and three minor domains were chosen for measurement. These domains, with the tests selected for each domain, are shown in Table 2.

Experimental measures of personal noncognitive characteristics were assembled from two sources: The first source consisted of empirical scales--sets of items previously validated for job performance in broad benchmark MOS. The second consisted of new items constructed to enhance differential measurement of occupational interests and selected on the basis of analysis of content areas identified in the same studies. Tests of the psychomotor domain proved cumbersome to score and were not included in the present analysis. Two ACB tests included--the Classification Inventory and the General Information Test--were not operational at the time data were collected but later became part of the ACB. The battery thus assembled was termed the Army Differential Aptitude Series.

Table 2

EXPERIMENTAL TESTS OF ABILITY DEVELOPED FOR DIFFERENTIAL CLASSIFICATION

Domain	Experimental Test
Psychomotor	Aiming Tapping Two-Hand Coordination
Spatial	Spatial Orientation Pattern Analysis
Reasoning	Practical Situations Word Squares (Deduction) Letter Combinations (Induction) Reaction to Signals
Perceptual Patterning	Patterns (Flexibility) Hidden Figures (Flexibility) Object Completion (Speed of Closure)
Perceptual Speed	Army Perceptual Speed, Form 2 (Pictorial) Attention to Detail (Letters)
Other	Associative Memory Subtraction and Division Mechanical Principles

The complete list of variables (Table 3) included 11 ACB tests, 14 experimental ability tests, 7 noncognitive scales, and the criterion measure--final course grade-- for each MOS training course. Background variables--age and years of civilian education completed--were also obtained but were not included in the test selection process.

Table 3

VARIABLES ANALYZED IN TEST SELECTION STUDY

Army Classification Battery

Verbal (VE)
Arithmetic Reasoning (AR)
Pattern Analysis (PA)
Mechanical Aptitude (MA)
Army Clerical Speed (ACS)
Army Radio Code (ARC
Shop Mechanics (SM)
Automotive Information (AI)
Electronics Information (ELI)
Classification Inventory[a] (CI), PT 3290
General Information Test[a] (GIT)
Form 1-X, PT 3306; Form 2-X, PT 3308

Experimental Aptitude Measures

Object Completion (OC), PT 2853
Word Squares (WS)[b]
Pattern Analysis (PA), PT 3212
Practical Situations (Pr), PT 2733
Reaction to Signals (RS), PT 2353
Mechanical Principles (MP), PT 2913
Spatial Orientation (SO), PT 3093
Letter Combinations (LC)[b]
Hidden Figures (HF), CRT 379
Attention to Detail (AD), PT 2613
Patterns (P), PT 2788
Perceptual Speed (PS), PT 2652
Associative Memory (AM)[b]
Subtraction and Division (SD)[b]

Noncognitive Scales

Clerk a priori (C-2)
Electronics a priori (E-2)
Mechanic a priori (M-2)
General Adjustment empirical (G-7)
Clerk empirical (C-7)
Mechanic empirical (M-7)
Mechanic Suppressor[c] (S-7)

Criterion Measure

Final Course Grade (each MOS sample)

[a]Operational forms of CI and GIT were not used in collecting data.

[b]No PT numbers were assigned to these tests.

[c]This scale was constructed in an earlier study from items which correlated high with the mechanic empirical scale but did not correlate with performance in mechanical jobs. The items reflect attitudes of keeping to one's self, dislike of control by others, self-doubts, etc.

METHOD

Samples

The Army Differential Aptitude Series was administered to enlisted men in the sixth week of training at Basic Combat Training Centers. Training assignments had been made, but specialist training had not begun.

Data were originally collected on about 30 MOS, but adequate samples were obtained on only 20. Of these 20, several samples proved too small to be analyzed separately. Excessive discrepancies appeared in the smallest samples when correlation among the experimental tests and between experimental tests and ACB tests, corrected to the pooled sample matrix, was compared with the zero-order matrix for the pooled samples. After minor adjustment was made of criterion scores, using the appropriate aptitude area score as basis for equivalence, the data were organized into 12 samples as shown in Table 4.

Analytic Approaches

Predictor data consisted of scores on the experimental tests and tests of the ACB. Criterion measures were final course grades in each MOS training course. A zero-order intercorrelation matrix was computed for each of the 12 MOS samples. Each matrix included the 32 predictors and the single criterion for a given sample (33 x 33). In addition, all samples were pooled and a predictor matrix (32 x 32) was computed.

Zero-order validity coefficients were corrected for restriction in range in two ways: Correction of the 13 matrices for multivariate selection on the nine operational ACB tests was carried out for each MOS sample, using intercorrelations in the 9 by 9 ACB matrix for the pooled sample as population parameters. Thus, a single matrix (32 x 44) of all predictors and the 12 criteria in a single sample was obtained. Secondly, the matrix was corrected using intercorrelations in the standard mobilization population matrix as parameters (7).

Two test selection procedures were carried out, using the correlation coefficients corrected through use of the mobilization input population covariance matrix. The first--or absolute validity--procedure selected tests in decreasing order of magnitude of the sum of squared validity coefficients (after each selected test, the squared residual validity coefficients) summed across all samples. The second procedure (8) selected tests in decreasing order of magnitude of the variances among the coefficients. Since Horst has shown that this procedure is equivalent to maximizing differences among criterion scores when all scores are available, results can be taken as emphasizing differential as contrasted with absolute validity.

Results from the two test selection methods were compared and regression weights for the separate MOS are reported to indicate the potential contribution of the tests to prediction.

Table 4

COMPOSITION OF MOS TRAINING SAMPLES FOR ANALYSIS

MOS Group	Component MOS[a]	N
22	223.1 Air Defense Missile Electronics Mechanic	111
25	250.0 Electronic Repair Helper	305
27-28	271.1 Fixed Station Receiver Repairman 281.1 Microwave Radio Repairman	110
29	293.1 Radio Relay and Carrier Operator	244
29	294.1 Field Carrier Equipment Repairman 296.1 Field Radio Repairman	188
31-32	310.0 Field Communications Crewman 321.1 Lineman	265
35	352.1 Engineer Missile Equipment Specialist	103
44	440.0 Metalworking Helper	157
51-53-55	511.1 Carpenter 530.0 Chemical Operations Helper 550.0 Supply Handler	275
62	626.1 Construction Machine Operator 627.1 Crane Shovel Operator	177
67-68	670.0 Aircraft Maintenance Crewman 680.0 Aircraft Components Repair Helper	264
72-05	723.1 Communications Center Specialist 724.1 Switchboard Operator 053.1 Radio Teletype Operator	281
	Total	2480

[a]Current MOS designations are given rather than those in use at the time.

RESULTS

Test Selection for Absolute Validity

The matrix of intercorrelations of all predictor variables in the pooled sample is given in Table A-1 of the Appendix. The predictor matrix, corrected for restriction in range using the mobilization input population as a source of parameters, appears in Table 5. Order of variables is the actual order of administration of the experimental measures. Table 6 shows the predictor-criterion matrix similarly corrected.

Test selection was carried out using the diagonal square root factoring procedure on a corrected correlation matrix (with unity in the diagonal) until all residuals were essentially zero. Table 7 presents the order of selection for absolute validity in which the test with the greatest sum of squared coefficients for the 12 criteria (that is, the test which provided the greatest increment in the averaged multiple R) was selected at each step. The multiple R for predicting each criterion is shown at given stages in the process.

In interpreting the results, note that the MOS groups in the present analysis were strongly representative of the Electronics Aptitude Area. There were seven MOS samples in that area in comparison with two in General Maintenance, two in Motor Maintenance, and one combined sample for the Clerical and Radio Code areas. This distribution of MOS may account for the selection of Arithmetic Reasoning, Automotive Information, and Electronics Information as the first three tests. The Arithmetic Reasoning Test has been demonstrated to be the most valid ACB test across all MOS. Performance in the General Maintenance and Motor Maintenance MOS is well predicted by the Automotive Information Test and performance in Electronics MOS by the Electronics Information Test. In contrast, the Army Radio Code Aptitude Test was the eleventh test selected, Army Clerical Speed the eighteenth.

Experimental measures selected earliest were mainly noncognitive, with the Mechanic Suppressor scale fourth, the Mechanical Orientation scale fifth, a Clerical scale seventh, and the Electronics scale eighth. The two measures in the perceptual speed domain--Perceptual Speed and Attention to Detail--were selected sixth and tenth, respectively. The ninth test selected, Mechanical Principles, is essentially a new form of the ACB Mechanical Aptitude Test, the latter being a component of both the Electronics and Motor Maintenance aptitude areas.

Thus, the battery with highest absolute validity for the samples in the present study appears to be a combination of current ACB tests (with parallel replacement of the Mechanical Aptitude Test), noncognitive scales, and perceptual speed measures.

Test Selection for Differential Validity

The results of test selection to maximize differential validity are presented in Table 8. The experimental Electronics noncognitive scale was selected first, a reflection of the value of this test in discriminating electronics repair MOS from other non-electronics MOS in the Electronics area. In five electronics MOS, coefficients ranged from .30 to .50. These were Air Defense Missile Electronics Mechanic (MOS 223), Electronic Repair Helper (250), Fixed Station Receiver Repairman (271), Field Radio Repairman (296), and Engineer Missile Equipment Specialist (352). The other two MOS currently in the Electronics area but not involving electronics maintenance are Radio Delay and Carrier Attendant (293) and two MOS mainly concerned with laying wire communications (310 and 321). Only one MOS which does not fall in the category of electronics repair job--Metalworking Helper (440)--was predicted at a level approaching that of the lowest coefficient for the electronics repair group.

Another noncognitive measure, the Classification Inventory, was the second test selected. The test added an average of .19 to prediction for MOS other than the electronics repair jobs, but an average of only .06 for the electronics MOS. Perceptual Speed and the Verbal test of the ACB were selected next. A Mechanic noncognitive scale was fifth. The Mechanic scale contributed added validity for two heavy-work construction MOS (310-321 and 626-627), but little elsewhere.

The five tests next selected were a noncognitive scale (the Mechanic Suppressor), the Automotive Information Test, the experimental Pattern Analysis designed as an ACB replacement measure, the General Information Test, and Subtraction and Division, a test highly correlated with the Arithmetic Reasoning Test of the ACB but simpler in content.

In sum, the absolute validity method--as expected--built up validity more rapidly than did the differential validity method. By the time a battery of ten tests was reached, however, the difference in average validity was about .025. The most substantial difference was for MOS 352, Engineer Missile Equipment Specialist. Considering the tests selected by the two methods, five are within the top ten by either method: Arithmetic Information, Mechanic Suppressor scale, Mechanic a priori scale, Perceptual Speed, and Electronics a priori scale.

Regression Weights of Selected Tests

Brogden (9) has demonstrated that a predetermined set of tests yields maximum differential allocation effectiveness when the tests are given the least square regression weights as computed separately against each performance criterion. Thus, use of this full regression equation to compute predicted performance scores for each job and the use of these scores in an optimalized assignment model will assure that the average predicted performance of the assigned men has been maximized. On the other hand, while no other set of weights could make this particular set of tests more effective, a particular test may be contributing so little that its removal

Table 5

INTERCORRELATIONS OF ACB AND ADAS EXPERIMENTAL PREDICTORS CORRECTED TO FULL MOBILIZATION POPULATION

Variables	VE	AR	PA	MA	ACS	ARC	SM	AI	ELI	GIT	CI	C-2	E-2	M-2	OC	WS	PA-X	Pr	RS	MP	SO	LC	HF	G-7	C-7	M-7	S-7	AD	P	PS	AM	SD
Verbal (VE)																																
Arithmetic Reasoning (AR)	72[a]																															
Pattern Analysis (PA)	57	66																														
Mechanical Aptitude (MA)	57	59	59																													
Army Clerical Speed (ACS)	58	63	53	45																												
Army Radio Code (ARC)	36	40	36	36	39																											
Shop Mechanics (SM)	61	61	58	72	45	30																										
Automotive Information (AI)	39	42	41	53	27	20	67																									
Electronic Information (ELI)	58	56	57	63	38	31	66	60																								
General Information Test (GIT)	68	64	53	57	48	35	60	48	54																							
Classification Inventory (CI)	48	46	34	40	36	24	41	33	26	51																						
Clerk a priori (C-2)	36	31	16	13	36	19	09	-04	08	23	29																					
Electronics a priori (E-2)	27	30	30	34	21	16	33	26	41	30	33	16																				
Mechanic a priori (M-2)	-10	-06	02	16	-13	-08	23	48	16	06	14	-33	13																			
Object Completion (OC)	40	39	50	42	36	27	42	30	44	40	27	11	21	05																		
Word Squares (WS)	65	68	57	50	53	35	50	33	50	55	39	25	25	-08	38																	
Pattern Analysis (PA-X)	47	57	69	51	42	32	50	34	49	44	31	15	27	02	48	53																
Practical Speed (Pr)	62	60	47	49	46	31	52	39	47	56	43	23	25	04	32	51	43															
Reaction to Signals (RS)	44	49	44	37	57	35	35	24	34	41	34	26	23	-05	34	40	38	39														
Mechanical Principles (MP)	59	62	6	67	40	34	66	57	63	57	39	11	33	15	43	56	56	50	36													
Spatial Orientation (SO)	45	49	54	52	38	37	50	41	45	47	33	10	24	09	41	46	51	40	37	55												
Letter Combinations (LC)	54	56	49	42	52	34	41	36	27	49	34	23	21	-06	36	52	44	42	45	42	43											
Hidden Figures (HF)	42	47	52	47	43	31	45	35	41	41	31	18	23	03	43	41	49	39	41	46	44	43										
General Adjustment empirical (G-7)	28	27	20	20	24	17	22	16	21	29	53	28	20	00	15	23	19	27	25	21	20	21	20									
Clerk empirical (C-7)	31	27	21	21	24	14	24	19	23	30	53	31	23	02	17	23	20	28	23	24	18	21	20	59								
Mechanic empirical (M-7)	-03	02	06	14	-07	01	22	38	20	07	20	-15	21	59	09	00	08	06	-01	17	12	-01	08	20	20							
Mechanic Suppressor (S-7)	-18	-15	-15	-12	-14	-10	-12	-06	-10	-18	-30	-10	-06	03	-12	-16	-12	-17	-16	-10	-11	-14	-13	-33	-43	01						
Attention to Detail (AD)	25	32	27	32	39	21	27	22	24	25	24	15	16	03	26	27	27	22	39	25	26	36	31	14	13	02	-10					
Patterns (P)	35	45	49	47	44	28	43	35	39	36	25	11	22	05	40	37	46	34	46	44	43	39	49	14	15	08	-12	46				
Perceptual Speed (PS)	39	45	43	39	52	27	38	27	35	38	26	16	17	-02	38	38	39	34	47	35	35	43	41	19	17	01	-10	45	53			
Associative Memory (AM)	29	35	29	26	33	20	24	17	24	30	24	20	18	-03	25	29	27	26	34	27	22	29	26	16	18	02	-10	30	34	35		
Subtraction and Division (SD)	61	76	51	44	65	37	45	26	38	55	39	34	22	-14	30	56	44	48	51	43	39	55	40	24	24	-04	-14	35	39	47	36	

[a] Decimal points omitted.

Table 6

VALIDITY COEFFICIENTS OF ACB AND ADAS MEASURES CORRECTED TO FULL MOBILIZATION INPUT

MOS	VE	AR	PA	MA	ACS	ARC	SM	AI	ELI	CI	GIT	C-2	E-2	M-2	OC	WS	PA-X	Pr Sit	RS	MP	SO	LC	HF	G-7	C-7	M-7	S-7	AD	P	PS	AM	SD
223	54[a]	61	52	54	54	32	54	42	48	16	42	00	32	11	49	55	55	47	38	57	48	42	42	-04	06	-01	27	16	42	45	17	47
250	60	67	60	51	52	29	57	37	56	34	53	14	32	-15	35	57	50	48	34	60	48	46	50	13	22	-02	-15	33	46	43	28	59
293	61	66	60	52	55	19	55	44	56	47	62	13	26	00	29	56	47	52	52	53	49	53	42	31	35	11	-18	33	47	50	46	62
294-6	58	66	54	59	45	37	61	56	63	41	60	15	40	11	36	52	50	58	42	57	50	43	42	33	35	22	-04	29	41	36	21	45
310-21	32	41	39	48	24	10	49	55	46	32	44	-10	20	38	31	30	36	42	32	49	43	37	31	22	21	22	-09	38	41	38	31	40
357	57	69	49	56	49	34	57	49	64	36	47	15	43	-13	30	52	44	48	44	58	41	41	26	26	14	-04	-30	05	33	22	33	42
440	63	65	58	57	45	36	64	50	58	52	59	18	33	17	46	55	54	55	35	68	42	37	45	24	40	08	-11	23	37	23	31	48
511-30-50	48	56	46	49	39	31	53	50	45	41	60	27	27	01	28	41	39	47	33	50	44	36	29	29	28	15	-11	18	28	32	33	41
627-7	49	57	45	48	37	34	57	55	52	37	46	12	13	23	29	35	32	34	29	55	36	39	31	06	22	19	01	32	33	28	31	44
670-80	66	67	55	63	51	39	66	59	60	37	60	09	29	12	37	55	49	55	41	66	51	41	41	20	24	13	-15	24	39	37	29	53
723-4	46	51	45	39	42	39	35	27	34	33	34	20	10	-08	24	39	35	34	33	38	34	28	35	18	20	00	-08	24	36	32	28	47
271-81	65	74	65	58	56	46	66	58	70	32	61	20	50	04	28	58	44	44	39	62	40	54	36	11	12	25	-01	21	56	51	25	60

[a]Decimal points omitted.

would have little effect. The amount of contribution a single test makes to differential allocation effectiveness is some function of the magnitude of variation of the regression weights across the different criteria. A test which has the same standard score regression weights for all criteria is therefore making no contribution to differential prediction. But this failure to contribute would be for a particular set of variables and criteria only, and a test with uniformly high regression weights would still be valued if there was reason to believe that it would yield smaller regression weights against performance in jobs not included in the set.

The personnel subsystem of the Army includes a number of important job families not included in the present study. Consequently, a combination of both absolute magnitude and variation of regression weights should be considered. In order to look at the contribution of individual tests to prediction in various MOS, the regression weights of each test were computed in each of the 12 samples for a particular set of 22 tests. The 22 tests include 19 of the first 20 tests selected by either the absolute or differential test selection method. Tables 7 and 8 indicate a trivial gain in validity when the number of tests selected approached 20.

Table 9 gives these weights. The order of the tests here roughly approximates the order of contribution in that it is based on average rank of test selection by the two methods (Table 10). By this combined rank criterion, six measures appear in the group of tests making the highest contribution (ranks 4 to 6), two at rank 10, and six at rank 13; the remaining eight are distributed from rank 15 to 20). Groupings represent broad levels of potential contribution; differences within levels are likely to be unimportant.

To consider prediction in each MOS sample, Table 11 was constructed showing the beta weights in order of magnitude for four samples. An arbitrary cutoff was set at .11 in order to highlight relationships. The weights shown are still in the context of a 22-variable prediction equation; and the remaining weights can be considered as lying in a single interval close to zero.

While the weights varied from sample to sample, a cluster of four MOS was identified in which a similar pattern appears: Electronic Repair Helper (MOS 250), Fixed Station Repairman (271), Field Radio Repairman (296), and Engineer Missile Equipment Specialist (352). The Arithmetic Reasoning Test was highest weighted and the Electronics Information Test had a positive weight for all four MOS. The Automotive Information Test and the Electronics a priori showed a positive weight for three of the four; and the Mechanic a priori scale showed a negative weight for three. Thus, prediction in these MOS, which all involve complex electronic or electrical equipment maintenance, was obtained by a combination of measures of technical and broad mechanical aptitude, with a negative weight for the most specific mechanical interest scale. This scale is apparently in contrast to higher electronics-technical interest tapped by the Electronics a priori scale. It is not that the mechanical interest as such has negative validity, but that the Mechanic a priori scale has a component whose removal increases the validity of certain other tests, sharpening the focus of these other more valid tests through suppression of extraneous variance.

Table 7

RESULTS OF TEST SELECTION FOR ABSOLUTE VALIDITY

Order of Selection	Selected Test	Multiple Validity Coefficients[a] MOS: 223	250	271	293	296	321	357	440	511	626	670	723
1	Arithmetic Reasoning (AR)	61	67	74	66	66	41	69	65	56	57	67	51
2	Automotive Information (AI)	63	68	80	69	73	58	72	70	63	66	75	51
3	Electronics Information (ELI)	64	71	83	71	75	59	76	71	63	67	76	52
4	Mechanic Suppressor (S-7)	74	71	84	71	76	59	78	71	63	68	76	52
5	Mechanic a priori (M-2)	74	73	84	71	76	63	82	72	65	68	76	52
6-7	Perceptual Speed (PS) Clerk empirical (C-7)	77	74	86	75	78	66	85	76	66	69	76	53
8-9-10	Electronics a priori (E-2) Mechanical Principles (MP) Attention to Detail (AD)	80	76	90	75	79	68	90	80	67	72	78	54
11-15	Army Radio Code ARC) General Information Test (GIT) Mechanic empirical (M-7) Associative Memory (AM) Object Completion (OC)	85	76	94	81	80	71	91	83	71	74	79	58
16-20	Subtraction and Division (SD) Clerk a priori (C-2) Army Clerical Speed (ACS) General Adjustment empirical (G-7) Verbal (VE)	89	79	95	83	81	76	84	84	72	76	81	59
32	All Tests	90	79	95	84	82	76	94	85	72	77	81	60

[a] Decimal points omitted.

Table 8

RESULTS OF TEST SELECTION FOR DIFFERENTIAL VALIDITY

Order of Selection	Selected Test	Multiple Validity Coefficients[a] MOS: 223	250	271	293	296	321	357	440	511	626	670	723
1	Electronics a priori (E-2)	32	32	50	26	40	20	43	33	28	13	29	10
2	Classification Inventory (CI)	33	40	53	48	50	33	49	54	44	37	41	33
3	Perceptual Speed (PS)	52	52	66	61	55	45	50	55	48	42	49	41
4	Verbal (VE)	64	65	78	69	65	46	64	69	55	53	68	50
5	Mechanic a priori (M-2)	66	66	78	69	66	59	66	71	55	59	70	50
6,7	Mechanic Suppressor (S-7) Automotive Information (AI)	75	69	84	71	72	63	78	73	64	66	76	52
8-10	Pattern Analysis (PA-X) General Information Test (GIT) Subtraction and Division (SD)	70	73	86	76	75	68	79	77	69	68	78	56
11-15	Arithmetic Reasoning (AR) Clerk empirical (C-7) Mechanic empirical (M-7) Object Completion (OC) Clerk a priori (C-2)	86	76	92	79	80	70	88	82	71	70	79	57
16-20	Attention to Detail (AD) Army Clerical Speed (ACS) Mechanical Principles (MP) General Adjustment empirical (G-7) Army Radio Code (ARC)	89	79	94	81	81	75	91	85	72	76	81	60
32	All Tests	90	79	96	84	82	76	94	85	72	77	81	60

[a] Decimal points omitted.

Table 9

STANDARD PARTIAL REGRESSION WEIGHTS OF 22 SELECTED TESTS

Selected Test	Average Rank	MOS: 223	250	271	293	296	321	352	440	511	626	670	723
		Regression Weights[a]											
Electronics a priori (E-2)	4.5	17	09	24	-05	11	-05	23	02	02	-18	02	-11
Automotive Information (AI)	4.5	07	06	21	05	19	18	36	04	33	18	24	10
Perceptual Speed (PS)	4.5	15	06	23	12	00	09	-13	-21	02	-06	-01	02
Mechanic Suppressor (S-7)	5	34	-05	02	01	17	03	-27	12	03	13	-04	04
Mechanic a priori (M-2)	5	15	-27	-20	-12	-07	26	-31	21	-20	13	01	-08
Arithmetic Reasoning (AR)	6	24	20	29	10	37	-03	51	18	24	30	15	17
Clerk empirical (C-7)	9.5	-04	06	-12	10	18	08	-27	28	01	17	02	04
General Information Test (GIT)	10.5	-10	03	07	19	17	11	-16	02	32	-03	04	-14
Electronics Information (ELI)	13	-10	14	23	19	15	10	25	05	-05	15	05	04
Verbal (VE)	13	20	06	11	07	05	-17	-01	15	-09	07	23	12
Attention to Detail (AD)	13	-16	07	-13	01	07	18	-25	00	-06	13	-05	02
Subtraction and Division (SD)	13	02	14	07	19	-13	33	-22	00	-10	05	06	12
Mechanic empirical (M-7)	13	-16	02	27	06	07	-10	-08	-19	10	02	-01	00
Mechanical Principles (MP)	13.5	14	20	03	03	-04	15	06	24	03	14	17	03
Object Completion (OC)	14.5	21	-04	-17	-14	-03	03	-04	11	-04	-01	-03	-02
Classification Inventory (CI)	15.5	-06	03	-08	08	-07	-02	08	13	04	12	-05	14
Clerk a priori (C-2)	16	-17	-16	02	-19	-07	-17	-09	-03	10	02	-12	-03
Army Radio Code (ARC)	16	04	-06	14	-19	08	-13	03	07	04	k2	09	19
Army Clerical Speed (ACS)	17.5	26	08	09	11	03	-18	21	04	00	-03	10	04
Pattern Analysis (PA-X)	18	16	04	-09	05	09	03	-03	11	03	-14	02	03
Associative Memory (AM)	18	-09	-02	-06	20	-07	11	15	06	11	11	03	07
General Adjustment empirical (G-7)	19.5	-07	-14	-13	02	08	10	10	-11	05	-24	-02	-03

[a] Decimal points omitted.

Table 10

FIRST TEN TESTS EXTRACTED BY TWO TEST SELECTION METHODS

Test Selected	Rank		Test Selected	Rank	
	Absolute	Differential		Differential	Absolute
Arithmetic Reasoning (AR)	1	11	Electronics a priori (E-2)	1	8
Automotive Information (AI)	2	7	Classification Inventory (CI)	2	29
Electronics Information (ELI)	3	21	Perceptual Speed (PS)	3	6
Mechanic Suppressor (S-7)	4	6	Verbal (VE)	4	22
Mechanic a priori (M-2)	5	5	Mechanic a priori (M-2)	5	5
Perceptual Speed (PS)	6	3	Mechanic Suppressor (S-7)	6	4
Clerk empirical (C-7)	7	15	Automotive Information (AI)	7	2
Electronics a priori (E-2)	8	1	Pattern Analysis (Exp) (PA-X)	8	28
Mechanical Principles (MP)	9	18	General Information Test (GIT)	9	12
Attention to Detail (AD)	10	16	Subtraction and Division (SD)	10	16

Table 11

REGRESSION PATTERNS OF SELECTED TESTS[a] FOR ELECTRONICS MAINTENANCE MOS

MOS 250 Electronic Repair Helper		MOS 271 Fixed Station Repairman		MOS 296 Field Radio Repairman		MOS 352 Engineer Missile Equipment Specialist	
AR	.20	AR	.29	AR	.37	AR	.51
MP	.20	M-7	.27	AI	.19	AI	.36
ELI	.14	E-2	.24	C-7	.18	ELI	.25
SD	.14	PS	.23	GIT	.17	E-2	.23
		ELI	.23	S-7	.17	ACS	.21
		AI	.21	ELI	.15	AM	.15
		VE	.11	E-2	.11		
G-7	-.14	C-7	-.12			PS	-.13
C-2	-.16	AD	-.13			GIT	-.16
M-2	-.27	G-7	-.13			SD	-.22
		OC	-.17			AD	-.25
		M-2	-.20			S-7	-.27
						M-2	-.31

[a]For identification of tests, see Table 3.

On the other hand, three MOS--Lineman (321), Metalworking Helper (440), and Construction Machine Operator (626)--show a pattern in which mechanical aptitude and interest measures play a consistent role (Table 12). The Mechanical Principles and Automotive Information tests and the Mechanics a priori scale were selected for all three MOS, while the electronic-technical orientation measures were absent. The three courses involve basic mechanical activities on a fairly concrete empirical level--the "what" to do rather than the "why" or "how".

The five remaining MOS showed heterogeneous patterns (Table 13). Two other mechanical MOS, Carpenter (511) and Aircraft Maintenance Crewman (670), shared the Arithmetic Reasoning-Automotive Information test combination, the former approaching the electronics patterns but without the Electronics Information Test or the Electronics a priori measures, and the latter the mechanical pattern but without the Mechanic a priori component. An electronics operator course (MOS 293) was predicted by a combination of perceptual, brief memory, electronics, and arithmetic operations skills, plus the General Information Test, but with negative weights for Radio Code and the clerical-mechanical interests. This pattern contrasts with the strong code and reasoning skills patterns of the communications and code operators in the Communications Center Specialist (723) and the Radio Teletype Operator (053) MOS combination. Finally, the Air Defense Missile Electronics Mechanic MOS (223) showed a unique pattern with the nonconformist lone-worker Mechanic Suppressor scale uppermost, followed by a series of weights on a wide variety of measures.

In general, the detailed patterns of weights reflected the usefulness of key ACB tests--Arithmetic Reasoning, Automotive Information, Electronics Information, Verbal, Army Clerical Speed--in differentiating between broad MOS groups. In conjunction with these aptitude measures, the new motivation-type scales contribute substantially, but in rather complex suppressor roles. Finally, the simple perceptual, memory, and arithmetic operations tests appear promising in differentiating among MOS in a way that might lead to a recombination of MOS to new groupings quite apart from the present occupational areas and subareas. Remember, however, that the MOS samples in the present study do not adequately cover the range of technical school courses. The results are nevertheless useful to indicate which ACB tests are worth retaining and which, such as the Mechanical Aptitude and Pattern Analysis tests, appear less effective differentially than their experimental replacements, Mechanical Principles and the Experimental Pattern Analysis. Results also gave indication of which new measures offer enhanced prediction of success in such training courses as were sampled here.

The most promising tests from the study have been incorporated with experimental measures from other studies (10,11,12,13,14,15) in the Army Differential MOS Battery, currently being validated in a comprehensive research design across samples of input to about 150 MOS representative of all major enlisted occupational groupings.

Table 12

REGRESSION PATTERNS OF SELECTED TESTS[a] FOR MECHANICAL MOS

MOS 321 Lineman		MOS 440 Metalworking Helper		MOS 626 Construction Machine Operator	
SD	.33	C-7	.28	AR	.30
M-2	.26	MP	.24	AI	.18
AI	.18	M-2	.21	C-7	.17
AD	.18	VE	.15	MP	.14
MP	.15	CI	.13	S-7	.13
GIT	.11	S-7	.12	M-2	.13
AM	.11	OC	.11	AD	.13
		PA-X	.11	CI	.12
				AM	.11
ARC	-.13	G-7	-.11	PA-X	-.14
C-2	-.17	M-7	-.19	E-2	-.18
ACS	-.18	PS	-.21	C-7	-.24

[a]For identification of tests, see Table 3.

Table 13

REGRESSION PATTERNS OF SELECTED TESTS[a] FOR FIVE HETEROGENEOUS MOS

MOS 511		MOS 670		MOS 223		MOS 293		MOS 723, etc.	
Carpenter, etc.		Aircraft Maint Crewman		AD Msl Electronics Mech		Radio Relay and Carrier Op		Communications Ctr Spec	
AI	.33	AI	.24	S-7	.34	AM	.20	ARC	.19
GIT	.32	VE	.23	ACS	.26	GIT	.19	AR	.17
AR	.24	MP	.17	AR	.24	ELI	.19	CI	.14
AM	.11	AR	.15	OC	.21	SD	.19	VE	.14
				VE	.20	PS	.12	SD	.12
				E-2	.17	ACS	.11		
				PA-X	.16				
				PS	.15				
				M-2	.15				
				MP	.14				
M-2	-.20	C-2	-.12	AD	-.16	M-2	-.12	E-2	-.11
				M-7	-.16	OC	-.14	GIT	-.14
				C-2	-.17	C-2	-.19		
						ARC	-.19		

[a] For identification of tests, see Table 3.

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APPENDIX

Table A-1

PREDICTOR INTERCORRELATION MATRIX - POOLED SAMPLE

Variables	VE	AR	PA	MA	ACS	ARC	SM	AI	ELI	GIT	CI	C-2	E-2	M-2	OC	WS	PA-X	Pr	RS	MP	SO	LC	HF	G-7	C-7	M-7	S-7	AD	P	PS	AM	SD
	Intercorrelation Coefficients[a]																															
Verbal (VE)																																
Arithmetic Reasoning (AR)	63																															
Pattern Analysis (PA)	48	54																														
Mechanical Aptitude (MA)	45	50	45																													
Army Clerical Speed (ACS)	36	47	37	33																												
Army Radio Code (ARC)	30	34	30	31	38																											
Shop Mechanics (SM)	48	46	45	57	32	26																										
AutomotiveInformation (AI)	26	31	31	54	13	17	59																									
Electronics Information (ELI)	49	43	44	50	21	21	54	51																								
General Information Test (GIT)	62	56	43	47	33	30	49	39	44																							
Classification Inventory (CI)	42	39	25	32	25	20	32	25	27	46																						
Clerk a priori (C-2)	33	28	12	11	30	17	05	-09	04	21	28																					
Electronics a priori (E-2)	21	23	23	27	13	11	25	29	36	24	29	14																				
Mechanic a priori (M-2)	-17	-11	-01	10	-15	-08	21	46	11	01	11	-34	11																			
Object Completion (OC)	32	29	45	33	26	23	33	22	36	32	20	08	16	03																		
Word Squares (WS)	59	61	49	41	39	30	39	24	41	48	32	22	19	-13	32																	
Pattern Analysis (PA-X)	39	49	65	41	30	26	39	25	39	36	24	11	21	-01	43	46																
Practical Situations (Pr)	57	53	37	40	32	26	41	29	38	50	37	21	19	00	25	44	35															
Reaction to Signals (RS)	32	39	34	29	49	31	25	15	23	32	28	22	17	-06	27	31	30	31														
Mechanical Principles (MP)	51	54	53	58	25	29	55	49	54	50	33	08	27	10	36	50	50	43	28													
Spatial Orientation (SO)	37	40	48	43	28	32	40	33	35	39	27	07	18	05	36	40	46	33	31	48												
Letter Combinations (LC)	46	48	41	34	41	30	31	17	27	42	28	20	16	-09	30	46	38	35	38	35	37											
Hidden Figures (HF)	32	37	44	37	33	27	35	27	30	32	24	14	17	01	37	33	43	31	34	38	38	36										
General Adjustment empirical (G-7)	24	23	14	15	17	14	16	11	16	26	52	27	18	-01	11	18	14	23	21	17	16	17	16									
Clerk empirical (C-7)	28	22	15	16	16	12	19	14	18	26	51	29	20	00	14	19	15	24	19	19	17	17	16	57								
Mechanic empirical (M-7)	-09	-03	01	08	-10	-01	19	36	.6	02	17	-16	19	58	06	-04	04	02	-03	12	09	-05	05	16	18							
Mechanic Suppressor (S-7)	-17	-13	-13	-10	-10	-08	-09	-03	-07	-17	-29	-09	-04	04	-11	-14	-10	-16	-13	-08	-09	-13	-11	-32	-43	02						
Attention to Detail (AD)	13	23	17	25	33	18	18	15	15	16	18	12	11	02	20	18	19	14	35	17	19	30	25	10	09	00	-08					
Patterns (P)	21	35	40	39	[illegible]	24	32	26	27	26	17	07	16	03	34	27	39	24	41	35	36	32	43	09	10	05	-09	42				
Preceptual Speed (SP)	26	34	33	30	45	23	27	18	24	28	18	12	11	-04	32	29	31	25	41	25	28	36	35	14	12	-01	-07	41	48			
Associative Memory (AM)	21	29	22	20	27	17	17	11	17	24	19	18	15	-04	20	23	22	21	29	21	16	24	21	13	15	00	-08	26	30	30		
Subtraction and Division (SD)	50	71	39	35	54	33	32	15	25	47	32	32	16	-18	21	49	35	40	44	33	30	49	32	20	19	-08	-11	28	30	39	30	

[a]Decimal points omitted.

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13. ABSTRACT

In a continuing series of studies, the NEW CLASSIFICATION TECHNIQUES Task conducts research to attain increasingly accurate and differentiated measures of individual potential to enable the optimal assignment, training, and use of Army manpower resources. The present Technical Research Note reports on a current phase of research directed toward integration of findings on test effectiveness in a revised Army Classification Battery (ACB) and a reconstituted aptitude area system.

A battery of 21 experimental tests plus current operational tests of the ACB was analyzed over a broad range of military occupational specialties (MOS) to identify the most valid tests or combination of tests for Army school training courses. 20 MOS samples with heavy representation of jobs in the electronics and electronics repair area were used. Comparison was made of tests selected on the basis of maximum validity across MOS and those selected to yield maximum differential validity among the MOS studied. Validity patterns reflected the usefulness of key ACB tests--Arithmetic Reasoning, Automotive Information, Electronics Information, Verbal, and Army Clerical Speed--in differentiating between broad MOS groups. In conjunction with these aptitude measures, newly developed motivation-type scales contributed substantially. Perceptual measures and arithmetic operations tests also appeared promising.

The measures identified as most promising have been incorporated with experimental tests from additional studies to form the Army Differential MOS Battery (ADMOSB). This battery is currently being validated in a comprehensive research design across 150 MOS representative of all major Army occupational groupings.

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