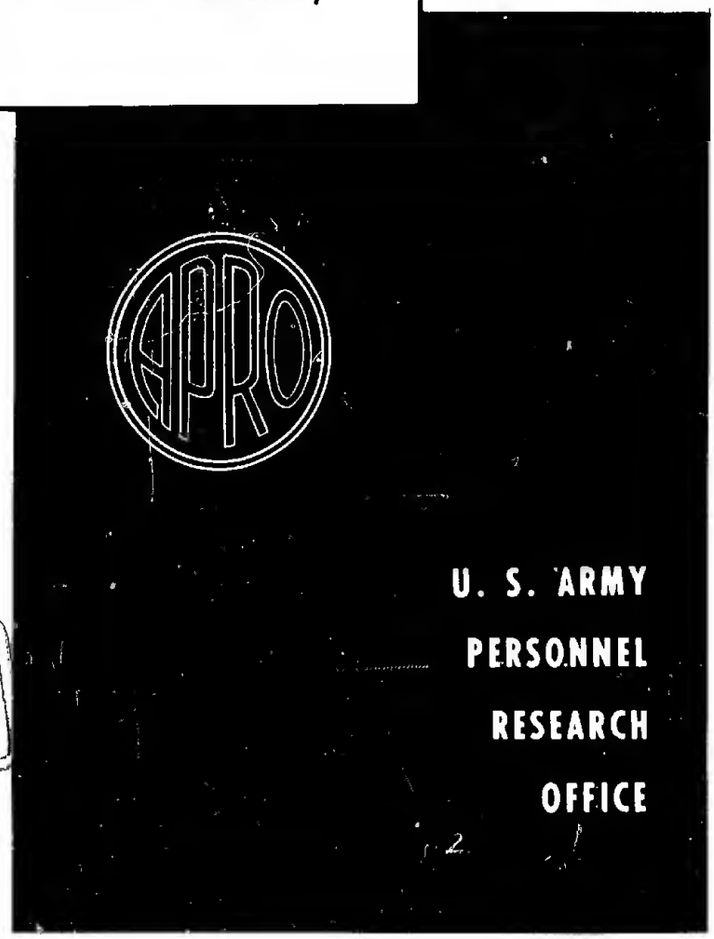
Technical Research Note 127

EVALUATION OF TESTS TO PREDICT SUCCESS IN AUTOMOTIVE MAINTENANCE HELPER COURSE,



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PREFACE

The present publication reports on a portion of Subtask a, "Development of New Predictors for the Army Classification Battery" of the NEW CLASSIFICATION TECHNIQUES Task, FY 1962 Work Program. The entire research task is responsive to special requirements of the Deputy Chief of Staff for Personnel, the Deputy Chief of Staff for Logistics, and the U. S. Continental Army Command.

Development of test materials that will increase the effectiveness of the operational Army Classification Battery (ACB) is a continuing task. The importance to the Army of personnel decisions made on the basis of the ACB makes it particularly necessary that these tests be kept current. Measures are also needed of human factors not yet provided for in the ACB, including measures of physical proficiency to predict whether an individual will continue to meet the physical requirements of his assignment. Additional measures of personal factors to indicate what a man will do on the job, as opposed to what he can do, are especially needed.

The primary objectives of the NEW CLASSIFICATION TECHNIQUES Task are to explore new test content that will increase the effectiveness of classification and assignment in the Army, and to construct up-to-date tests to maintain the effectiveness of tried and tested measures in operational use. A special requirement involves determination of effective combinations of screening and classification measures to evaluate the potential usefulness to the Army of applicants for enlistment and selective service registrants.

BRIEF

EVALUATION OF TESTS TO PREDICT SUCCESS IN AUTOMOTIVE MAINTENANCE HELPER COURSE

Requirement:

Army Classification Battery (ACB) tests provide effective means of assessing individual potential for mechanical jobs. Tests are needed to increase differentiation of abilities for specific mechanical job families within the broad mechanical field.

Procedure:

Experimental tests--Mechanical Knowledge (a tool knowledge test), Craftsman Aptitude-Mechanics, Craftsman Aptitude-Construction, and seven self-report personality measures--were administered to samples of trainees in the Automotive Maintenance Helper course at three widely separated training centers. Experimental tests were evaluated and compared with operational ACB selectors with respect to prediction of (1) written test score, (2) performance test score, and (3) cadre estimates of future success in an appropriate Army assignment.

Findings:

The Automotive Information Test of the (ACB) was the most heavily weighted test in composites predictive of success in the Automotive Maintenance Helper course. The experimental Mechanical Knowledge and Craftsman Aptitude tests, however, were somewhat more effective than the Mechanical Aptitude Test (ACB) in predicting estimated job success. Combined with findings from earlier studies, results indicate that the Mechanical Knowledge and Craftsman Aptitude tests have potential for contributing to differential classification in mechanical jobs.

Utilization of Findings:

New information tests modeled on the more promising information tests have been constructed--a tool knowledge test similar to the Mechanical Knowledge Test and two trade knowledge tests similar to the mechanics content of the Craftsman Aptitude Test. The new tests are being evaluated in field tryout as possible replacements for the Mechanical Aptitude and Shop Mechanics test of the ACB.

EVALUATION OF TESTS TO PREDICT SUCCESS IN AUTOMOTIVE MAINTENANCE HELPER COURSE

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EVALUATION OF TESTS TO PREDICT SUCCESS IN AUTOMOTIVE MAINTENANCE HELPER COURSE

The Army Classification Battery provides effective prediction of success in broad classifications of mechanical jobs. Two tests of mechanical aptitude--Mechanical Aptitude and Shop Mechanics--have proved highly effective in classification to mechanical jobs in general. The Automotive Information Test is an effective differential predictor for motor mechanics jobs and for related jobs in the Combat Occupational Area: Artillery, Armor, and Engineer MOS.

Validity patterns of aptitude area composites incorporating these tests have, however, indicated the need for additional battery content effective in differentiating potential for more specific mechanical job families. Two newly-constructed craftsman aptitude tests, the Mechanical Knowledge Test, Forms 1 and 2, constructed by the Navy with a view to its use by all the services, and seven noncognitive personality scales based on self-report material were evaluated as predictors of success in one Common Specialist Training Program--Automotive Maintenance Helper, MOS 630.

Scores on tests of the Army Classification Battery (ACB) are combined into two-test composites, the aptitude area scores, for use in assigning men to Army school or on-job training in appropriate occupational areas. In assessing the potential contribution of a test to the classification system, therefore, the effect of adding the test to the ACB, or of substituting it for a given operational test has to be determined with respect to the total effectiveness of the ACB. New measures are useful to the extent that they show unique validity for one job and relatively low validity for other jobs. In the present study, validity of the experimental measures could be directly determined only for a single entry job. Thus the findings here can be interpreted only in relation to two questions:

1. For the Automotive Maintenance Helper MOS (630), and by extension for the related Automotive Maintenance MOS--that is, MOS in the two-digit 63 group, do any experimental measures offer substantial improvement over the current ACB and Motor Maintenance Aptitude Area (MM) composite?

2. Assuming that the experimental measures prove useful for other MOS and occupational groups, what weight should be given the new measure or measures in predicting performance in Automotive Maintenance MOS?

THE EXPERIMENTAL TESTS

The Craftsman Aptitude Test

The 60 items of the Craftsman Aptitude Test are based on tools and operations used in mechanical maintenance and construction work. Two *a priori* keys were applied, one specific to 30 mechanics items (CAT-M) and the other to 30 construction items (CAT-C). The two keys offered the possibility of differentiating knowledge of construction crafts from more general mechanical ability.

The Common Core Mechanical Knowledge Test, Forms MK-1 and MK-2

Each form of the Mechanical Knowledge Test (MK) consists of 40 items based on tool usage and other mechanical association principles. The MK is exclusively pictorial in content, contrasting in this respect with the two general operational ACB tests of the mechanical domain: The Shop Mechanics Test (SM) which contains both all-verbal items and pictorial items with verbal content; and the Mechanical Aptitude Test (MA) consisting chiefly of Bennett-type items, the problems being stated in verbal form with alternative responses graphically presented. MK therefore offered the possibility of differentiating practical mechanical ability from the more theoretical comprehension and reasoning factors tested by current ACB measures.

The Mechanical Knowledge Test, constructed by the Department of the Navy for possible use by all the services in initial classification of enlisted men, has been evaluated in two previous studies. Helme and White (1956) found that the test appeared to be a possible substitute for the Shop Mechanics Test in composites to predict differentially performance in antiaircraft and guided missile crew jobs. Later evaluated for prediction of success in three Mechanical Maintenance courses (Helme, Trump, and Fitch, 1960), the Mechanical Knowledge Test held promise of contributing to differential classification, particularly for Motor Maintenance courses. For the Precision Maintenance occupational area, however, its performance as a substitute for SM in the selector composite was inferior to that of the operational composite. MK was judged to require additional evaluation before its introduction into the ACB could be considered.

The Army Differential Aptitude Series (ADAS)

An experimental battery of self-report items had previously been constructed with the objective of tapping noncognitive factors differentially related to success in the various occupational areas. Two personal inventories from this battery (a total of 605 items) were included in the present study. Four empirical keys had been developed for the ADAS-7 form--General Adjustment, Clerks, Mechanics, and Mechanics Suppressor. ADAS-2, scored with a priori keys, provided three experimental predictors--Clerks, Mechanics, and Electronics.

CRITERION MEASURES

In research to develop differential selectors for the several occupational areas, tests are validated against performance in the common specialist courses as the earliest measure of success in the area to which the individual has been classified. Additionally, successful completion of training is prerequisite to many MOS. The training criterion against which tests and composites have usually been validated is final course grade.

In the present study, an attempt was made to delineate more precisely what is admittedly a complex criterion by validating the experimental measures separately against written examination measures, against evaluations of performance in the practicum aspects of training, and finally, against estimates of future performance in an Army assignment. The noncognitive personality measures, and more specifically the job-related information tests which made up the experimental battery, were hypothesized to be more useful in predicting practical performance than in predicting academic success. If the effectiveness of the various tests in predicting parts of the school criterion is known, a battery of tests can be oriented toward prediction of the criterion element most closely related to on-job proficiency. The following criterion variables were used in the validity analysis:

Cumulative Written Test Score. This variable, an average of scores on all written tests given during the course, was considered to emphasize the more theoretical aspects of training.

Cumulative Performance Evaluation. A composite of ratings of performance during the course, this measure was considered more of a practicum grade, emphasizing doing the job rather than knowing about it.

Estimated Job Success. Two separate estimates of job potential were obtained from training supervisors: (1) a projection of performance of appropriate duties upon graduation (How good a job would the student do if he were assigned as a second echelon mechanic right now?); and (2) a projection of performance after one year experience (How good a job would the student do as a mechanic after a year of experience in an ordnance repair shop operating at the third or fourth echelon level?). The examinee was rated on each scale on four occasions: at the end of the fifth, sixth, seventh, and eighth week of training. Ratings on each scale were averaged. In effect, there was but one measure of job success. Scores on the two scales were so highly correlated that for cross-validation purposes the two coefficients of correlation with each test were averaged to yield a single value.

These "forecast" scales were designed for use in place of a follow-up on-job criterion for the six months reservists who made up a large proportion of the sample obtained for the present study and on whom no job criterion measure would be available. It was therefore necessary to devise a means of estimating from the individual's training performance what his job performance would be.

SAMPLES

Samples were obtained from three training centers located in the Fourth, Fifth, and Sixth Army areas to permit generalization of findings to Army-wide enlisted input. Three samples, one each at Fort Ord (N = 307), Fort Chaffee (N = 212), and Fort Leonard Wood (N = 226) were administered all experimental tests. Two additional samples, obtained for cross-validation purposes, one at Fort Chaffee (N = 388) and one at Fort Leonard Wood (N = 382), were administered the Mechanical Knowledge

Test and the Craftsman Aptitude Test, but not the ADAS self-report forms. ACB test scores and criterion measures were obtained for all examinees, with the exception that performance and estimated job success evaluations were not obtained for the Fort Ord sample. Data were collected during the last five months of 1958.

STATISTICAL PROCEDURES

It has been demonstrated that with a given battery, optimal differential classification as well as maximum validity for the individual criterion is obtained by use of the full standard regression weights for each criterion (Brogden, 1955). Since the experimental battery was designed to improve differential classification, test selection in the usual sense was not appropritate in a study limited to a single MOS. An adequate design for differential classification would involve administration of the experimental battery, including the tests particularly promising in the Motor Maintenance Area and related mechanical areas, to samples in other occupational areas. The full analysis would then involve obtaining standard regression weights in each sample, and eliminating only those tests yielding low weights in all samples.

In the present study, considered as a pilot study to determine whether experimental measures promised to add validity for Motor Maintenance jobs beyond that provided by the current ACB, the first step was to obtain full regression equations for each criterion measure. The standard regression weights obtained in each sample were averaged in order to eliminate specific sample bias and to permit generalization across installations. The full regression equations were then reduced by approximating all weights less than .10 as zero, and by substituting roughly proportionate integral weights for the others. Such an approximation would maintain to some extent the differential value of the full equation, so that if the battery were to be applied to other MOS with different weights, no change would need to be made in the weights obtained for MOS 630. Moreover, simplification of the regression equation permitted cross-validation on samples to which the full battery had not been given, provided only that zero weights were applied to the missing tests. Integer weights approximating the averaged standard regression weights were cross-validated on other samples. Correlation coefficients were corrected for restriction in range to the full mobilization population, using the nine operational ACB tests as variables of explicit selection and the standard matrix of ACB intercorrelations (Campbell, Johnson, Brown, and Birnbaum, 1952).

By correlation of sums, using average validity coefficients and average beta weights, the multiple correlation coefficient was computed across analysis samples. Unbiased coefficients were obtained by applying approximate integer weights in the cross-validation samples. Owing to high correlation between CAT-Mechanical and CAT-Construction, and between MK-1 and MK-2, only one form of each measure--in each case the more valid form--could be included in computing the full regression equations. Finally, the weights obtained on each criterion were generalized to the other criteria and validity compared with that of the current aptitude area composite, Motor Maintenance.

RESULTS

Prediction of Cumulative Written Test Score

Table 1 shows the standard regression weights and resulting multiple correlation coefficients in three samples administered the full experimental battery. The table also shows the average weights for each test and the multiple correlation coefficient resulting when correlation of sums was applied. This latter coefficient, although biased, indicates that similar validity was found among the three samples even though individual beta weights varied from sample to sample--for example, the Army Clerical Speed Test (ACS) yielded a beta weight of -.13 in the Fort Chaffee sample and +.20 in the Fort Leonard Wood sample.

Table 1

STANDARD REGRESSION WEIGHTS OF EXPERIMENTAL TESTS IN PREDICTING THE WRITTEN TEST CRITERION IN THREE AUTOMOTIVE MAINTENANCE HELPER COURSE SAMPLES

Test	Ord	Chaffee	Wood	Average
Automotive Information	26	39	40	35
Verbal	19	33	22	25
Arithmetic Reasoning	31	17	12	20
Craftsman Aptitude-Mechanics	23	16	05	14
General Adjustment	07	16	05	09
Army Radio Code Aptitude	-01	22	00	07
Mechanical Aptitude	16	00	03	06
Shop Mechanics	-19	00	05	-05
Mechanical Knowledge-1	00	04	07	04
Mechanics (empirical ADAS key)	-05	-04	-01	-03
Army Clerical Speed	02	-13	20	03
Pattern Analysis	-04	-06	01	-03
Electronics (a priori ADAS key)	04	00	02	02
Clerks (empirical ADAS key)	00	05	-02	01
Clerks (a priori ADAS key)	-03	05	00	00
Mechanics (a priori ADAS key)	05	-06	02	00
Electronics Information	12	-02	-09	00
Mechanics-Suppressor (empirical ADAS key)	-01	01	00	00
Multiple R	90	90	87	88[a]

[a] Obtained by correlation of sums using average validity coefficients and average betas.

Inspection of these weights indicated that two weighted composites appeared worth trying: 3AI+2VE+2AR+CAT-M and 2AI+VE+AR. All other tests were given zero weights in each composite. Table 2 compares the unbiased validity coefficients in the validation samples with the validity of the operational Motor Maintenance Aptitude Area, MM. The table also shows the average validity (biased) in the three analysis samples combined when integer-weighted composites were applied. Little difference in unbiased validity was noted between the three-test and the four-test integer-weighted composites.

Table 2

VALIDITY AND CROSS-VALIDITY COEFFICIENTS FOR COMPOSITES BASED ON AVERAGE BETA WEIGHTS AND ON INTEGER WEIGHTS FOR WRITTEN TEST CRITERION IN AUTOMOTIVE MAINTENANCE HELPER COURSE

Composites	No. of Tests	Average Validity Coefficient in Analysis Samples	Unbiased Validity Coefficient in Cross-Validation Samples		
			Chaffee	Wood	Average
Based on Average Beta Weights	18	.88	--[a]	--[a]	--[a]
Integer Weighted 3AI+2VE+2AR+CAT	4	.87	.89	.84	.87
2AI+VE+AR	3	.86	.88	.84	.86
Operational Motor Maintenance Aptitude Area (2AI+MA)	2	.78	.78	.78	.78

[a] Noncognitive measures not given to these samples.

No noncognitive scale was included in the composites. Only one noncognitive scale, General Adjustment, had shown an average weight approaching 10, and even that scale fell short of inclusion in the integer-weighted composites. Among the cognitive experimental tests, only the Craftsman Aptitude Test was included, and then only as a last choice in the longer composite, with a weighting of 1.

Apparently the more valid combination of tests for this criterion leans equally upon an academic component represented by the Verbal and Arithmetic Reasoning Tests of the ACB and on a mechanical information component represented by the Automotive Information Test (ACB) and the

Craftsman Aptitude Test. The Motor Maintenance Aptitude Area composite composed of a general mechanical test (the ACB Mechanical Aptitude) and a mechanical information test (Automotive Information), proved appreciably less valid than either of the two composites derived here.

Prediction of Performance Evaluation

The results of the full regression analysis in the Chaffee and Wood samples are shown in Table 3. When the weights were averaged, and the multiple correlation coefficient resulting from the correlation of sums compared to the multiple R obtained in each sample separately, it was noted that the validity was comparable to that for the less valid sample (Wood).

Two integer-weighted composites appeared worth trying in the cross validation samples: 2 AI + MK + CAT + MA + VE - SM and 2 AI + MK. All other tests were assigned zero weights in each composite. A comparison of the unbiased validity coefficients with that of the MM composite is shown in Table 4. Indicated also in the table are the average validity coefficients (biased) in the two analysis samples combined when the integer-weighted composites were applied.

For the performance criterion, the longer (six-test) composite was slightly superior, showing, on the average, a gain in validity of .04 over the two-test composite of AI and MK and the operational MM two-test aptitude area composite. The gain was not substantial considering that it resulted from the addition of four tests. The two-test integer-weighted composite was as valid as the current MM composite for the performance criterion. The longer and more valid six-test composite has an extended mechanical component represented by AI, MK, SM, CAT, and MA and a minor academic component represented by VE. The superiority of this composite seems to reflect the fact that the performance criterion tends to be less academically oriented and more of a practicum measure than the written test criterion.

Among the noncognitive measures only one scale, the Mechanics a priori key, obtained a beta weight of appreciable size (average weight -.15). Although this measure could not be cross-validated, it would be expected to function similarly to SM and to add little in terms of absolute validity. Among the cognitive experimental tests both MK and CAT were selected, MK being superior. It is evident that MK could be substituted for MA in the operational composite with no loss of validity.

Table 3

STANDARD REGRESSION WEIGHTS OF EXPERIMENTAL TESTS IN PREDICTING PERFORMANCE EVALUATIONS IN TWO AUTOMOTIVE MAINTENANCE HELPER COURSE SAMPLES

Test	Chaffee	Wood	Average
Automotive Information	38	33	35
Mechanical Knowledge-1	11	27	19
Shop Mechanics	-31	-01	-16
Mechanics (a priori ADAS key)	-20	-11	-15
Craftsman Aptitude-Mechanics	26	04	15
Mechanical Aptitude	23	03	13
Verbal	28	-05	12
Army Clerical Speed	-24	06	-09
Clerks (empirical ADAS key)	-08	-06	-07
Pattern Analysis	01	13	07
Mechanics (empirical ADAS key)	03	08	06
Army Radio Code Aptitude	03	08	05
Arithmetic Reasoning	12	-02	05
Electronics Information	01	-12	-05
Clerks (a priori ADAS key)	06	04	05
Mechanics-Suppressor (empirical ADAS key)	01	-01	-04
Electronics (a priori ADAS key)	-02	-11	-04
General Adjustment	13	-09	02
Multiple R	79	65	66[a]

[a] Obtained by correlation of sums using average validity coefficients and average betas.

Table 4

VALIDITY AND CROSS-VALIDITY COEFFICIENTS FOR COMPOSITES BASED ON AVERAGE BETA WEIGHTS AND ON INTEGER WEIGHTS FOR PERFORMANCE CRITERION IN AUTOMOTIVE MAINTENANCE HELPER COURSE

Composites	No. of Tests	Average Validity Coefficient in Analysis Samples	Unbiased Validity Coefficient in Cross-Validation Samples		
			Chaffee	Wood	Average
Based on Average Beta Weights	18	.66	--[a]	--[a]	--[a]
Integer-Weighted					
2AI+MK+CAT+MA+VE-SM	6	.65	.74	.55	.64
2AI+MK	2	.60	.68	.51	.60
Operational Motor Maintenance Aptitude Area 2AI+MA	2	.60	.69	.52	.60

[a] Noncognitive measures not given to these samples.

Prediction of Estimated Job Success

Table 5 shows standard regression weights and the resulting multiple correlation coefficients separately for each of the two job-success estimates in the analysis samples. Since the two estimates had highly similar weightings and multiple correlation coefficients, weights for the two estimates were averaged. The multiple correlation coefficient resulting from correlation of sums using average sample validity coefficients and average weights differed only .05 at most from any individual sample multiple R.

One composite appeared worth trying in cross-validation: 2AI+CAT+MK. Table 6 shows the results, plus average validity coefficients (biased) in the two analysis samples when the integer weight and average beta weight composites were applied. Validity coefficients of the MM composite are also shown for the combined analysis samples and for each validation sample. The current MM composite was as efficient as the three-test integer-weighted composite. Little absolute validity was lost when the three-test integer-weighted composite was applied in place of the average beta weights.

The most effective composite for this criterion consisted of a general mechanical factor. Although no noncognitive tests were worth including in the integer-weighted composite, the empirical keys for Mechanics measure (average weight .09) and the Mechanics-Suppressor measure (average weight .08) represent mechanical interest factors. Adequate measurement of mechanical information would appear to preclude the necessity of adding interest-type material for this criterion. Also of note are the low average weights associated with both VE (.04) and AR (-.03). Evidently the academic component has completely dropped out in prediction of the estimated job success criterion.

CRITERION DIFFERENTIATION

The differing weights obtained in predicting the several criterion measures is indicative of differentiation among the criterion elements commonly subsumed in a single criterion measure, final course grade. The pattern is best seen by the behavior of the Verbal and Arithmetic Reasoning Tests, the two ACB tests considered most predictive of academic performance in Army schools. Both obtained substantial weights for the written test criterion. AR failed to reappear among the tests selected for integer weighting for the performance evaluation criterion and VE dropped to the last test of a six-test composite. Both AR and VE dropped out for the criterion of estimated job success. In the mechanical domain, neither the Mechanical Knowledge test nor the Mechanical Aptitude test showed appreciable regression weights for the written test score. MK and CAT showed substantial weights for both the performance criterion and the estimated job success criterion. Their potential usefulness appears to be in predicting concrete job performance elements rather than the academic component of Automotive Maintenance Helper (MOS 630) training.

Table 5

STANDARD REGRESSION WEIGHTS OF EXPERIMENTAL TESTS IN PREDICTING ESTIMATED JOB SUCCESS IN AUTOMOTIVE MAINTENANCE HELPER COURSE

Tests	Chaffee		Wood		Average
	Estimate 1	Estimate 2	Estimate 1	Estimate 2	
Automotive Information	34	40	54	42	43
Craftsman Aptitude-Mechanics	30	28	07	16	20
Mechanical Knowledge-1	17	22	14	15	17
Electronics Information	-18	-13	-03	-08	-10
Mechanics (empirical ADAS key)	08	08	09	11	09
Pattern Analysis	-23	-21	03	06	-09
Mechanics-Suppressor (empirical ADAS key)	06	09	09	10	08
General Adjustment	17	17	-10	-02	06
Mechanical Aptitude	02	-03	02	18	05
Mechanics (a priori ADAS key)	05	04	-13	-15	05
Verbal	-03	-02	10	13	04
Army Radio Code Aptitude	00	-16	06	-05	-04
Electronics (a priori ADAS key)	-05	-05	13	12	04
Clerks (empirical ADAS key)	-02	02	10	04	03
Arithmetic Reasoning	13	11	-18	-18	-03
Clerks (a priori ADAS key)	02	00	04	02	02
Shop Mechanics	04	-06	-01	-03	-02
Army Clerical Speed	-11	-02	16	01	01
Multiple R	74	73	74	73	69[a]

[a] Obtained by correlation of sums using average validity coefficients and average betas.

Table 6

VALIDITY AND CROSS-VALIDITY COEFFICIENTS FOR COMPOSITES BASED ON AVERAGE BETA WEIGHTS AND ON INTEGER WEIGHTS FOR ESTIMATED JOB SUCCESS IN AUTOMOTIVE MAINTENANCE HELPER COURSE

Composites	No. of Tests	Average Validity Coefficient in Analysis Samples	Unbiased Validity Coefficient in Cross-Validation Samples		
			Chaffee	Wood	Average
Based on Average Beta Weights	18	.69	--[a]	--[a]	--[a]
Integer Weights 2AI+CAT+MK	3	.67	.71	.72	.71
Operational Motor Maintenance Aptitude Area 2AI+MA	2	.65	.68	.72	.70

[a] Noncognitive measures not given to these samples.

VALIDITY GENERALIZATION TO ALL CRITERIA

To evaluate effects of adding new tests to the ACB, or of substituting them for tests in the ACB, the validity of new composites for all criteria must be determined. Table 7 compares the composites selected for each criterion and the operational selector, Motor Maintenance, on all criteria. The addition of the Craftsman Aptitude Test and the Mechanical Knowledge Test, forming longer composites, increased validity by .05, while substitution of CAT and/or MK for MA yielded validity equal to that of the MM composite. Use of MK, and possibly of CAT, approximates more closely the full regression equations and therefore might be expected to enhance differential classification. This finding tends to confirm a study of several MOS in the Precision Maintenance and Motor Maintenance Areas (Helme, Trump, and Fitch, 1960), in which the Mechanical Knowledge Test offered promise of contributing to improved differential classification, particularly for Motor Maintenance courses.

Table 7

AVERAGE UNBIASED VALIDITY COEFFICIENTS OF ALL INTEGER-WEIGHTED COMPOSITES AND THE MOTOR MAINTENANCE APTITUDE AREA

Composites	No. of Tests	Written Test	Performance Evaluation	Estimated Job Success	Average For All Criteria
Written Test 3AI+2VE+2AR+CAT	4	.87	.64	.70	.74
2AI+VE+AR	3	.86	.64	.70	.73
Performance Evaluation 2AI+MK+CAT+MA+VE-SM	6	.84	.64	.73	.74
2AI+MK	2	.74	.60	.69	.68
Estimated Job Success 2AI+CAT+MK	3	.78	.62	.71	.70
Operational Motor Maintenance Aptitude Area 2AI+MA	2	.78	.60	.70	.69

CONCLUSIONS

The two experimental mechanical information tests--Mechanical Knowledge and Craftsman Aptitude--hold possibilities of increasing differential prediction for job families within the mechanical aptitude area. The operational Automotive Information Test of the ACB, plus one or both the experimental information tests, yielded validity equal to that of the current operational selector MM, composed of AI (weighted 2) and the Mechanical Aptitude Test MA. In full regression equations for prediction of the three criterion components studied here, the two experimental tests MK and CAT had higher weights than did the Mechanical Aptitude test of the ACB. (The AI, however, was the most heavily weighted predictor.)

The showing of the experimental measures MK and CAT in the present analysis suggests that their contribution to differential classification might be greater than that of MA, and possibly of SM. This conclusion stems in part from the differing patterns of weights for the three criteria in which the Mechanical Information tests showed progressively greater validity against the less academically oriented measures. This finding confirmed results on several mechanical MOS when MK was used in an earlier study.

As a result of these findings, new information tests modeled after MK and CAT and designed to measure more specific trade areas within the mechanical domain have been constructed. The Tool Knowledge Test, using the same picture format as MK, and two forms of the Trade Knowledge Test, using format and content similar to CAT except for greater specificity of information, are currently being validated for a broad range of mechanical MOS. On the basis of item analysis from this new study, development of tests to replace MA and the Shop Mechanics Test will be accomplished.

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APPENDIXES

APPENDIX A

UNBIASED VALIDITY COEFFICIENTS AND AVERAGE VALIDITY COEFFICIENTS FOR ALL INTEGER-WEIGHTED COMPOSITES AND THE CURRENT APTITUDE AREA COMPOSITE FOR THE THREE CRITERIA OF PERFORMANCE IN THE AUTOMOTIVE MAINTENANCE HELPER COURSE

Table A-1. Validity of composites for written test cumulative score

A-2. Validity of composites for performance evaluations

A-3. Validity of composites for estimated job success

Table A-1

VALIDITY OF COMPOSITES FOR WRITTEN TEST CUMULATIVE SCORE

Source of Composite	No. of Tests	Analysis Samples Average r	Cross-Validity Samples Chaffee r	Cross-Validity Samples Wood r
Written Test				
3AI+ 2VE+ 2AR+CAT	4	.87	.89	.84
2AI+VE+AR	3	.86	.88	.84
Performance Evaluation				
2AI+MK+ CAT+MA+ VE-SM	6	.82	.84	.84
2AI+MK	2	.72	.74	.73
Estimated Job Success				
2AI+CAT+MK	3	.76	.78	.77
MM Operational Composite				
2AI+MA	2	.78	.78	.78

Table A-2

VALIDITY OF COMPOSITES FOR PERFORMANCE EVALUATION

Source of Composite	No. of Tests	Analysis Samples Average r	Cross-Validity Samples Chaffee r	Cross-Validity Samples Wood r
Written Test				
3AI+VE+2AR+CAT	4	.62	.76	.52
2AI+VE+AR	3	.62	.75	.53
Performance Evaluations				
2AI+MK-SM+CAT+MA+VE-SM	6	.65	.74	.55
2AI+MK	2	.60	.68	.51
Estimated Job Success				
2AI+CAT+MK	3	.62	.71	.52
MM Operational Composite				
2AI+MK	2	.60	.69	.52

Table A-3

VALIDITY OF COMPOSITES FOR ESTIMATED JOB SUCCESS

Source of Composite	No. of Tests	Analysis Samples Average r	Cross-Validity Samples Chaffee r	Cross-Validity Samples Wood r
Written Test				
3AI+VE+2AR+CAT	4	.59	.68	.71
2AI+VE+AR	3	.60	.67	.72
Performance Evaluations				
2AI+MK+CAT+MA+VE-SM	6	.66	.70	.75
2AI+MK	2	.67	.69	.70
Estimated Job Success				
2AI+CAT+MK	3	.67	.71	.72
MM Operational Composite				
2AI+MA	2	.65	.68	.72

APPENDIX B

ZERO ORDER VALIDITY COEFFICIENTS FOR PREDICTION OF CRITERIA OF PERFORMANCE IN AUTOMOTIVE MAINTENANCE HELPER COURSE

Table B-1. Zero order validity coefficients for prediction of cumulative written test score in five samples

Table B-2. Zero order validity coefficients for prediction of cumulative performance evaluations in four samples

Table B-3. Zero order validity coefficients for two criteria of estimated job success in two samples administered all predictors and two samples not administered ADAS scales

Table B-1

ZERO ORDER VALIDITY COEFFICIENTS FOR PREDICTION OF CUMULATIVE WRITTEN TEST SCORE IN FIVE SAMPLES

Variables	Samples				
	Fort Ord (N=307)	Fort Chaffee (N=212)	Fort Wood (N=226)	Fort[a] Chaffee (N=388)	Fort[a] Wood (N=382)
ACB Tests					
VE	.66	.72	.65	.72	.64
AR	.74	.71	.65	.73	.66
PA	.58	.52	.55	.55	.61
MA	.71	.61	.64	.66	.67
ACS	.44	.36	.55	.40	.52
ARC	.40	.54	.37	.48	.37
SM	.70	.66	.70	.72	.67
AI	.73	.68	.73	.72	.73
ELI	.59	.53	.42	.51	.43
Experimental Cognitive Tests					
MK-I	.57	.56	.64	.59	.66
MK-II	.43	.63	.65	.66	.68
CAT-(Mech)	.76	.76	.76	.81	.77
CAT-(Const)	.71	.72	.76	.77	.73
ADAS Empirical Keys					
General Adjustment	.65	.54	.62		
Clerks	.51	.49	.58		
Mechanics	.48	.38	.46		
Mechanics-Suppressor	-.30	-.33	-.46		
ADAS a priori keys					
Clerks	.13	.02	.13		
Mechanics	.38	.30	.55		
Electronics	.48	.20	.44		

[a] ADAS scales were not administered to these samples.

Table B-2

ZERO ORDER VALIDITY COEFFICIENTS FOR PREDICTION OF CUMULATIVE PERFORMANCE EVALUATION IN FOUR SAMPLES

Variables	Samples			
	Fort Chaffee	Fort Wood	Fort[a] Chaffee	Fort[a] Wood
ACB Tests				
VE	.54	.30	.55	.37
AR	.56	.36	.60	.36
PA	.44	.42	.41	.36
MA	.58	.42	.56	.42
ACS	.18	.28	.23	.30
ARC	.37	.25	.29	.24
SM	.48	.44	.59	.41
AI	.59	.55	.66	.50
ELI	.48	.28	.47	.25
Experimental Cognitive Tests				
MK-I	.35	.54	.56	.47
MK-II	.53	.52	.60	.45
CAT-(Mech)	.63	.53	.70	.49
CAT-(Const)	.55	.50	.65	.47
ADAS Empirical Keys				
General Adjustment	.48	.34		
Clerks	.36	.34		
Mechanics	.31	.39		
Mechanics-Suppressor	-.28	-.27		
ADAS a priori keys				
Clerks	.03	-.01		
Mechanics	.27	.42		
Electronics	.24	.32		

[a] ADAS scales were not administered to these samples.

Table B-3

ZERO ORDER VALIDITY COEFFICIENTS FOR TWO CRITERIA OF ESTIMATED JOB SUCCESS IN TWO SAMPLES ADMINISTERED ALL PREDICTORS AND TWO SAMPLES NOT ADMINISTERED ADAS SCALES

Variables	Job Success-Estimate I				Job Success-Estimate II			
	Fort Chaffee	Fort Wood	Fort Chaffee	Fort Wood	Fort Chaffee	Fort Wood	Fort Chaffee	Fort Wood
ACB Tests								
VE	.26	.40	.44	.49	.23	.38	.41	.50
AR	.38	.35	.50	.45	.34	.34	.48	.45
PA	.18	.40	.34	.47	.16	.39	.34	.47
MA	.46	.50	.56	.52	.41	.55	.56	.54
ACS	.08	.35	.28	.44	.06	.22	.27	.40
ARC	.18	.31	.34	.40	.08	.21	.31	.36
SM	.52	.53	.63	.56	.47	.52	.60	.56
AI	.63	.68	.64	.71	.62	.67	.65	.71
ELI	.35	.37	.47	.46	.36	.34	.47	.45
Experimental Cognitive Tests								
MK-I	.53	.58	.58	.60	.52	.61	.58	.61
MK-II	.60	.60	.64	.64	.57	.60	.63	.64
CAT (Mech)	.60	.62	.70	.66	.58	.66	.70	.68
CAT(Const)	.54	.56	.67	.63	.52	.56	.65	.63
ADAS Empirical Keys								
General Adjustment	.38	.43			.34	.42		
Clerks	.26	.46			.24	.44		
Mechanics	.43	.45			.40	.48		
Mechanics-Suppressor	-.09	-.24			-.08	-.22		
ADAS *a priori* keys								
Clerks	-.16	.02			-.18	-.03		
Electronics	.11	.40			.09	.38		

APPENDIX C

INTERCORRELATIONS AMONG PREDICTOR VARIABLES

The intercorrelation matrix for the experimental predictor variables presented was prepared by combining data from available samples in the present study. Intercorrelation coefficients for tests of the Army Classification Battery are values in the standard matrix representative of an unrestricted input population (Campbell, et al, 1952). Intercorrelations involving ADAS variables were based on data from three samples, one each from Fort Ord, Fort Chaffee, and Fort Leonard Wood. Coefficients in each sample were averaged, r's for all samples being equally weighted. Values reported for MK and CAT--with the exception of their intercorrelations with ADAS variables--were based on the two samples from Fort Chaffee, the two from Fort Leonard Wood, and a single sample from Fort Ord, the five being equally weighted.

Table C-1

MATRIX OF INTERCORRELATIONS OF EXPERIMENTAL AND OPERATIONAL TESTS ANALYZED FOR PREDICTION OF SUCCESS IN THE AUTOMOTIVE MAINTENANCE HELPER COURSE

Tests	VE	AR	PA	MA	ACS	ARC	SM	AI	ELI	Gen Adj	Clerks	Mech	Mech Sup	Clerks	Elctn	Mech	MK-I	Cat (Const)	Cat (Mech)
Verbal (VE)	--	.68	.55	.50	.50	.40	.60	.40	.40	.50	.47	.22	-.42	.33	.23	.10	.28	.61	.59
Arithmetic Reasoning (AR)		--	.60	.55	.50	.45	.60	.45	.46	.57	.32	.32	-.36	.25	.29	.17	.40	.63	.62
Pattern Analysis (PA)			--	.50	.50	.40	.50	.40	.40	.42	.36	.29	-.34	.14	.28	.19	.42	.53	.58
Mechanical Aptitude (MA)				--	.45	.35	.70	.60	.46	.55	.45	.35	-.32	.04	.40	.38	.60	.70	.74
Clerical Speed (ACS)					--	.45	.45	.25	.29	.40	.36	.16	-.38	.31	.14	.06	.23	.45	.40
Radio Code Apt. (ARC)						--	.30	.25	.35	.33	.28	.24	-.18	.29	.30	-.01	.22	.34	.36
Shop Mechanics (SM)							--	.65	.54	.48	.50	.44	-.29	-.05	.34	.47	.68	.84	.83
Automotive Information (AI)								--	.46	.44	.45	.60	-.22	-.21	.33	.72	.72	.68	.79
Electronics Information (ELI)									--	.39	.35	.38	-.23	.00	.50	.30	.61	.57	.59
General Adjustment										--	.73	.47	-.47	.22	.38	.32	.42	.56	.55
Clerks											--	.45	-.51	.22	.33	.35	.45	.55	.54
Mechanics												--	-.12	-.21	.32	.69	.57	.47	.56
Mechanics-Suppressor													--	-.17	-.12	-.07	-.16	-.33	-.30
Clerks (a priori ADAS key)														--	.18	-.40	-.23	-.02	-.09
Electronics															--	.29	.41	.35	.39
Mechanics (a priori ADAS key)																--	.66	.47	.61
Mechanical Knowledge, MK-1																	--	.43	.77
Craftsman Aptitude-Construction																		--	.86
Craftsman Aptitude-Mechanics																			--

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