

**TECHNICAL CLASSIFICATION AND ASSESSMENT CENTER
(TCAC) TESTS: VALIDITY FOR PREDICTING JOB
ACHIEVEMENT OF GENERAL DETAIL (GENDET) PERSONNEL**

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job history variables. Predictor validation was carried out using multiple regression with a double cross-validation paradigm. The TCAC tests added to the predictiveness of ASVAB and biographical variables for supervisors' marks, but all of the job history criteria were better predicted by combinations of ASVAB and biographical variables than by ASVAB, biographical, and TCAC variables. Because this and other research shows that job history variables are much better criteria of job performance than are supervisors' marks, further research with TCAC tests for selecting GENDETs is not warranted.

FOREWORD

The work reported herein was performed with funding from exploratory development work unit ZF55.521.030.01.01 (Prediction of Performance). This report is the fourth issued on the development and validation of a technical classification assessment center (TCAC) for evaluating general detail (GENDET) personnel. The first two (NPRDC TR 77-3 and TN 82-23) described initial development of the TCAC tests and their validation in a small pilot study. The third (NPRDC TR 83-25) described the development of an improved set of TCAC tests and their validation for a relatively large sample (N = 1,034), using supervisory evaluations of job performance as criteria.

Appreciation is extended to Dr. Eric (E. K.) Gunderson and to Mr. Mylan Miller, both of the Naval Health Research Center, for providing enlisted history data for personnel in the study.

The results of this research are intended for use by enlisted personnel detailers, fleet personnel concerned with assignment of GENDETs, personnel researchers, and cognizant officers in the military personnel and Navy recruiting commands.

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SUMMARY

Problem

The group of enlisted personnel who are assigned to general detail (GENDET) positions upon completion of recruit training have traditionally exhibited high first-term attrition and low incidence of promotion into skilled ratings. Many GENDETs receive training (strike) for skilled ratings; however, most of them fail to achieve rated status and, therefore, are not reenlisted. The use of an objective method of evaluating the performance capabilities of personnel for hands-on jobs could better identify GENDETs with potential for becoming rated. This would allow the assignment of personnel to striker positions appropriate to their abilities and would provide more cost-effective use of GENDETs.

Objective

The technical classification assessment center (TCAC) is a personnel selection and classification system designed to provide measurements of the performance capabilities of non-school-eligible enlisted personnel. The purpose of the research reported here was to compare the joint predictiveness of the TCAC tests with that of the Armed Services Vocational Aptitude Battery (ASVAB) tests and biographical measures available operationally in order to provide a definitive evaluation of the potential value of the TCAC technique for classification of GENDETs.

Approach

Performance and tenure information were collected on a sample of 991 GENDETs who had taken the TCAC battery administered in 1978 (Siegel, 1983). Predictor variables used were experimental performance test scores, biographical measures, and operational test scores. Criteria used were five job history variables and two supervisors' evaluation scores. Predictor validation was carried out using multiple regression with a double cross-validation paradigm, with predictor composites being selected on one subsample and cross-validated on another subsample. The stability of the regression coefficients was evaluated by comparing the average regression coefficients computed for the predictor selection subsample with those computed for the cross-validation subsample.

Findings

1. TCAC variables substantially added to the amount of variance in supervisors' marks that is predicted by operational variables. However, the predictive accuracy of the final composite for supervisors' marks is not great.
2. TCAC variables did not add to the predictiveness of operational variables for any of the five job history criteria.
3. Four of the five job history criteria had higher predictability than either of the supervisors' marks criteria. Two of these job history criteria--years to E-4 and attrition/nonattrition--had a predictability that was quite high ($r = .52$ and $.40$).
4. All of the job history criteria were better predicted by ASVAB plus biographical variables than by ASVAB variables alone or by ASVAB plus biographical plus TCAC variables.

5. The ASVAB tests did not have high validity for either job history or supervisory evaluation variables. In contrast, the biographical variables predicted a substantial portion of the variance for three of the five job history criteria. For these criteria, the biographical variables provided average increases in the absolute value of the cross-validated ASVAB coefficients of .24. (Absolute values of the maximum cross-validated coefficients for these criteria ranged from .21 to .52.)

Conclusions

Use of composites formed from ASVAB and biographical variables to select personnel for GENDET billets can increase the speed of advancement and decrease the attrition discharges of GENDETs.

Recommendations

1. Further research and evaluation of TCAC variables for operational use in GENDET classification is not warranted. However, the TCAC battery has acceptable psychometric characteristics and may have value for classifying personnel into particular technical ratings.

2. Research should be conducted to identify the combinations of ASVAB and biographical variables that are the most predictive of advancement variables (e.g., the percentage of a 4-year enlistment spent at E-4 and above and the highest pay grade achieved). The research analyses should identify the appropriate criteria to use for GENDET selection and should quantify the improvement in job performance characteristics to be expected from operational implementation of selector composites for GENDETs.

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INTRODUCTION

Background and Problem

Personnel who are not assigned to technical training in class "A" schools directly after boot camp are assigned to apprenticeship school. This school provides orientation and training in the basic knowledge and skills required for working as general detail (GENDET) personnel in seaman (SN), fireman (FN), and airman (AN) apprenticeship areas in the fleet. In these positions, personnel receive on-the-job training for specific ratings and perform necessary housekeeping chores for the commands. About 30 percent of incoming Navy enlisted personnel are assigned as GENDETs.

As a group, GENDETs have considerably poorer attrition and advancement characteristics than do personnel who receive training in class "A" schools. Cory (1982) hypothesized that the poorer enlistment outcome characteristics of GENDETs may be partly related to the fact that the procedures followed to select and assign them to Navy jobs are not as accurate as those followed for personnel who receive training in class "A" schools. Thus, it is believed that improvement in selection and assignment practices for GENDETs should improve their attrition and advancement characteristics.

Research at the Navy Personnel Research and Development Center (NAVPERS-RANDCEN) to improve the classification and assignment of GENDETs was begun in 1975. Siegel and Wiesen, in a small pilot study involving 140 personnel, investigated the feasibility of using a battery of experimental tests administered in a technical classification assessment center (TCAC) to select GENDET personnel for assignment to technical jobs.

Cory (1982) validated the predictor scores collected by Siegel and Wiesen. He found that TCAC scores added substantially to the predictiveness of the operational classification tests (Basic Test Battery) scores for supervisory evaluations, and recommended that further development and evaluation be conducted on them. Subsequently, Siegel (1983) administered a modified TCAC battery to 1,034 GENDET personnel and validated the test scores against supervisors' marks. Siegel found the TCAC battery to be somewhat more predictive than ASVAB tests, but the improvements associated with the TCAC tests were not great.

Recent research at NAVPERSRANDCEN has raised questions concerning the suitability of supervisors' marks as criteria of job performance. Results of the research (Cory, 1983; Vineberg & Joyner, 1982) support a conclusion that, for most jobs, supervisory marks are not adequate criteria for predictive validation of personnel selection variables. In contrast, they show that variables derived from the enlisted history of personnel (Cory, 1983) provide criteria with greater reliability, greater predictability, and greater face validity than do supervisors' marks. Therefore, because the advantage of the TCAC variables found by Siegel (1983) was not substantial and because of the weakness of supervisors' marks as criteria, it was decided to conduct an additional predictive validity study of the TCAC and the ASVAB tests, using job history variables as criteria. This additional comparison should make possible a more definitive evaluation of the usefulness of the TCAC tests for classifying GENDETs.

Purpose

The primary purpose of this research was to compare the joint predictiveness for job outcome and supervisory evaluation criteria of the TCAC tests with that of Armed

Services Vocational Aptitude Battery (ASVAB) tests and biographical measures available operationally. Of particular interest was the improvement in predictiveness that could be achieved by using TCAC tests to supplement the most predictive operational measures. These analyses, in conjunction with the previous analyses of the TCAC, will be used to formulate recommendations concerning the potential value of the TCAC technique for selection and classification of GENDETs in the Navy.

APPROACH

Sample

The Navy enlisted cohort history (NECH) tape, developed and maintained by the Naval Health Research Center, San Diego, contains complete information on the career histories of all enlisted personnel who have been on active duty since 1 January 1965. Thus, the records for the 1,034 personnel originally tested by Siegel (1983) were matched against the records in the June 1981 NECH tape update.

The 991 male personnel with matching records comprised the sample. On the average, they were 19.9 years of age and had 11 years of education. On 30 June 1981, 810 (82%) of the sample were on active duty status, 179 (18%) had been discharged, and 2 were deceased. For all sample members, scores measuring aspects of career history performance (such as highest pay grade, years to E-4, and rated/nonrated) were computed. Scores for the TCAC and ASVAB tests and years of education, together with scores on two supervisory evaluation criteria (supervisor's rating of overall performance (SRAT) and supervisor's rating of professional performance (SPROF)) were extracted from the TCAC data base used by Siegel and combined with the NECH records.¹ Supervisory evaluations were available for 425 personnel.

Predictors

Variables from the Operational Records

The predictor variables derived from operational records are shown in Table 1. They consisted of the 12 written tests in the ASVAB, Forms 6 & 7, together with three biographical variables--years of education, age at enlistment, and success chances of recruits entering the Navy (SCREEN)--which have been found to be predictive of job performance (Cory, 1983; Vineberg & Joyner, 1982). The last of these variables, SCREEN, is a multidimensional variable that was instituted operationally in October 1976 as an indicator of potential attrition characteristics of entering recruits. During the intervening years, SCREEN has been modified twice. The score for the second version of SCREEN, which was used operationally until October 1980, was used for the present study. The SCREEN score contained an intellectual component, based on the Armed Forces Qualification Test (AFQT) score, and personality and behavioral components, based on age, education, and marital status.

¹For further details on the construction and characteristics of the supervisory evaluation criteria, see Siegel (1983).

Table 1
Operational Predictors

Predictor Variable	Acronym	Description
<u>ASVAB Tests</u>		
General information	GI	A 15-item general knowledge test, primarily on sports, outdoor activities, automobile mechanics, and history.
Numerical operations	NO	A 50-item speeded mathematical test, requiring addition, subtraction, multiplication, and division.
Attention to detail	AD	A 30-item speeded test in which the examinee scans a line of Os that contain embedded Cs.
Word knowledge	WK	A 30-item vocabulary test.
Arithmetic reasoning	AR	A 20-item arithmetic test requiring examinees to solve word problems.
Space perception	SP	A 20-item pictorial test requiring examinees to select the three-dimensional figure that could be made from a flat pattern.
Mathematics knowledge	MK	A 20-item test requiring knowledge of algebra, geometry, fractions, decimals, and exponents.
Electronics information	EI	A 30-item test requiring knowledge of electrical and electronic components, principles, and symbols.
Mechanical comprehension	MC	A 20-item test about drawings illustrating mechanical principles.
General science	GS	A 20-item test measuring knowledge in the physical (N = 10) and biological (N = 10) sciences.
Shop information	SI	A 20-item test of examinee's knowledge about the use of shop tools and practices.
Automotive information	AI	A 20-item test on automobile parts, operations, or malfunctions.
<u>Biographical Measures</u>		
Years of education	YRED	Years of schooling completed.
Age at enlistment	AGEN	Years of age at enlistment.
Success chances of recruits entering the Navy	SCREEN	Composite of mental level, age, years of education, and marital status.

Experimental Predictors: The TCAC Tests

Scores for the TCAC tests were used as experimental predictors, which were intended to improve the predictive accuracy of the ASVAB, SCREEN, and biographical variables that were available operationally. Brief descriptions of the 10 assessment center tests and their 11 associated scores, as well as the scoring procedures for each, are presented in Table 2. For more detailed information, refer to Siegel (1983).

Table 2 shows that the TCAC battery consisted of 10 hands-on tests, which measure a variety of physical, psychomotor, and social skills and abilities. These tests, which were patterned to resemble tasks performed by GENDETs in their jobs, were demonstrated to and then required to be performed by the examinees.

Criteria

The seven criteria used for the study are shown and briefly described in Table 3. The first five criteria are job history variables extracted from the NECH tape. Three of these criteria (years to E-4, attrition/nonattrition discharge, and behavioral record) were scaled negatively (i.e., good scores are low, poor scores are high). Job history variables have been called surrogate measures of job performance because they do not measure job performance directly, as do supervisors' evaluations, but, rather, the consequences of job performance, such as promotion, rate of advancement, and behavioral record. The last two criteria in Table 3 are supervisors' marks collected by Siegel (1983).

Analysis

Appropriate Groupings

Siegel's (1983) analyses were carried out separately for SNs, FNs, and ANs. However, Cory (1983), in his predictive validity study with GENDETs, found that separate predictive composites for the SN, FN, and AN apprenticeship fields were no more accurate on cross-validation than was a single composite computed for the combined group. This indicated that no additional reliable predictability could be obtained by predicting for each rating separately. For this reason, analyses in the present study were conducted on undifferentiated groupings of SNs, FNs, and ANs.

Steps

Descriptive statistics for predictor and criterion variables were computed for the total sample. Then the sample was split approximately equally (N = 488 and 503) into Sample 1 and Sample 2 based on the last digits (1, 3, 5, 8, 0 and 2, 4, 6, 7, 9) of their social security numbers (SSNs). The two samples were used in a double cross-validation paradigm to carry out the predictive validity portion of the study. For this purpose, each sample was used for predictor selection and for cross-validation. Thus, Sample 1 was used for predictor selection for Sample 1 and cross-validation for Sample 2, and similarly for Sample 2.

Cross-validation provides a conservative estimate of the actual magnitude of predictor criterion coefficients by eliminating the capitalization on chance relationships that are unique for a sample but not characteristic of a population. Therefore, the predictor criterion coefficients in the study were cross-validated to eliminate this common source of overestimation of true predictive validity. It should be noted that the cross-validation sample does not completely represent the population values and usually provides a slight underestimate of the true predictor-criterion relationship.

Table 2
TCAC Tests

Test Name	Procedure	Task	Ability Tested	Scoring
Computation projection (CAP)	Technique for reading a simplified diagram of the positions, readings, and speeds of two ships demonstrated.	Extrapolate positions of the ships after 1 hour and evaluate their danger of collision. Use addition, subtraction, and measurement by ruler to solve problems.	1. Intercept course projection. 2. Arithmetic reasoning.	Sum of projection, collision identification, and course change direction scores.
Conceptual integration application (CIA)	Hypothetical electromechanical system and symptoms of series of malfunctions described.	Identify source of problems on the basis of symptoms.	1. Troubleshooting. 2. Logical reasoning.	Total right answers minus total wrong answers.
Tool and object nomenclature (TAO)	Navy tools or pieces of equipment (N=10) displayed and described.	Recall names and uses of equipment.	Learning and recall of verbal materials.	Total rights minus total wrongs.
Dual task (DT)	Cues presented on a control panel specify changes to be made in panel settings. Pipes with schematic diagrams for their assembly provided.	Fabricate a pipe assembly while monitoring the control panel, and changing panel settings when instructed.	1. Attentional time sharing. 2. Skill in fabricating pipe assemblies.	Sum of pipe assembly and alarm recognition scores.
Inspection/sort (SOR)	"Good" and "defective" items shown and practice given in the recognition of defects.	Within fixed time period, sort items by type, rejecting defective items.	1. Perceptual speed. 2. Coordination.	Sum of speed and number of correct classification scores.
Record keeping (RK)	Display of ships' speed and heading taught, logging values and "out of tolerance" conditions displayed.	Complete 20 written problems using the given data.	1. Short-term memory for numbers. 2. Logical reasoning.	Sum of heading, heading out of tolerance, speed out of tolerance, and time scores.
Social interaction (SI)	Tarpaulin and instructions for folding it properly presented to team candidates.	Work as a team to (1) develop a plan of approach to folding and (2) fold a tarpaulin.	Cooperation and leadership characteristics.	Algebraic sum of binary ratings (± 1) of cooperation, leadership, motivation, rulebreaking, shirking, and interference.
Precision and planning (PP)	Proper procedure presented for producing a clay model using an orthographic drawing.	Fabricate in clay an object depicted on an orthographic drawing.	1. Three-dimensional visualization. 2. Eye-hand coordination.	The sum of the scores on dimensions, surface, quality, and angles.
Relating diagrams to objects (ET)	Standard electronic components together with symbols representing them presented. Instructions for fabricating a simple electrical assembly given.	Construct an electrical assembly using a diagram.	1. Logical reasoning. 2. Short-term memory. 3. Eye-hand coordination.	The sum of the scores on five assembly tasks.
Level of aspiration (LOA)	Dart-throwing task explained and practice given.	Three trials throwing darts at a target, each preceded by candidate's estimate of his score.	Psychological characteristics: (1) need for achievement, (2) realism, (3) optimism, and (4) pessimism.	Algebraic sum of the ratings for need for achievement, realism, optimism, and pessimism.
Total score (TT)				Sum of the individual TCAC scores.

Table 3
Criteria

Criterion	Acronym	Content Characteristic	Number of Rating Categories
<u>Job History</u>			
Years to E-4	YRE4	A variable indicating the time in years that it took the man to achieve the E-4 pay grade (become rated).	
Attrition/non-attrition discharge	ATTR	A binary 0-1 variable indicating whether or not a discharged person received an attrition discharge. Persons receiving an attrition discharge were coded "1" and those receiving a nonattrition discharge were coded "0."	2
Highest pay grade	HIPG	Highest pay grade attained.	6
Behavioral record	BEHR	A variable indicating the man's overall behavioral record in the Navy. It was computed by adding his total number of unauthorized absences to twice his number of demotions and desertions.	
Binary rated/nonrated	BIRTD	A binary 0-1 variable indicating whether a man became rated (coded "1") or remained nonrated (coded "0").	2
<u>Supervisors' Rating</u>			
Supervisors' rating on special questionnaire	SRAT	Supervisor's global evaluation of job skills, collected by means of special questionnaire mailed out for the study.	7
Supervisors' rating of professional performance on NAVPERS 792	SPROF	Supervisor's evaluation of the man's professional performance, collected from his most recent NAVPERS 792.	9

Based on preliminary analysis, five job history criteria, years to E-4 (YRE4), attrition/nonattrition discharge (ATTR), highest pay grade (HIPG), behavioral record (BEHR), and binary rated/nonrated (BIRTD) were selected as most representative of the different job history characteristics of the personnel. These were combined with the two global supervisory marks, SRAT and SPROF, which served as the principal job performance criteria for Siegel. This set of seven job performance marks served as criteria for the predictive validation portion of the study. For each sample, zero-order validity coefficients were computed for the seven criteria for all ASVAB, TCAC, and biographical

predictors. Then, for each criterion, the predictors with statistically significant coefficients were used in multiple regression analyses.

The analyses were conducted using stepwise accretion. Shrunken multiple correlations were computed using a technique recommended by Thiel (1971). A hierarchical selection mode was employed in which the three sets of variables (ASVAB test scores, biographical variables, and TCAC test scores) were made available to the regression program one at a time. Within each set, the multiple regression program selected the most predictive variables, one at a time, in order of predictiveness; then, when predictive variables in the set were exhausted, moved to the next set.

The following restrictions were used for multiple regression computations:

1. Predictor sets were limited to those having zero-order validity coefficients significantly different from zero ($p < .05$).
2. No variable was selected for a composite unless it significantly increased ($p < .05$) the predictiveness of the composite.
3. No variable was selected for a composite unless at least 30 percent of its variance was independent of the variance of the set of previously selected predictors.

For each of the seven criteria, the scores of the predictors selected in the multiple regression runs on the predictor selection samples were converted to standard scores and then summed. This algorithm was used to be consistent with the practice of integer weighting of predictors used operationally for selection and classification. The resulting composites were correlated with criterion measures in the predictor selection samples to produce back-validation coefficients and with criterion measures in the cross-validation samples to produce cross-validation coefficients. Averages of the back-validation and cross-validation statistics were computed and compared.

RESULTS

Descriptive Statistics

Descriptive statistics concerning the predictor and criterion variables used for the study are shown in Table 4. Mean scores for most of the ASVAB tests were below 50, the average score for the total incoming recruit population. This is consistent with the fact that these personnel did not go to "A" schools and, for the most part, were not school-eligible. The fact that the sample was not full-range is shown by the standard deviations (SDs) for the ASVAB scores, which ranged from 6.89 to 8.69 (compared with SDs of approximately 10 for a full-range sample). Skewness and kurtosis measurements indicate that the ASVAB test scores and the total TCAC score (TT) were approximately normal in distribution. In contrast, some of the biographical measures and individual TCAC scores had distributions that were highly peaked or were skewed. The high kurtosis values for the YRED and AGEN variables indicate that the personnel in the sample predominantly had 11 and 12 years of education and were in the 18- to 19-year-age range.

TCAC test scores were predominantly negatively skewed by design. This provided tests that would discriminate most accurately in the bottom half of the distribution, where most GENDETs are located. For two of the TCAC tests, dual task (DT) and level of aspiration (LOA), the high kurtosis scores indicate that there was substantial bunching around the mean of the TCAC variables.

Table 4

Descriptive Statistics for Predictors
and Criteria

Variable	Mean	SD	Skewness	Kurtosis	N
Predictors					
ASVAB Test Scores:					
General information (GI)	47.84	7.50	.11	-.15	928
Numerical operations (NO)	47.32	7.00	.17	-.25	929
Attention to detail (AD)	49.55	8.69	.05	-.25	929
Word knowledge (WK)	48.27	6.89	.22	.12	928
Arithmetic reasoning (AR)	47.74	7.11	-.08	-.11	924
Space perception (SP)	52.47	7.67	-.18	.03	930
Mathematics knowledge (MK)	47.30	7.86	-.10	-.24	920
Electronic information (EI)	50.25	7.06	.01	-.16	924
Mechanical comprehension (MC)	48.15	7.76	.10	-.20	925
General science (GS)	47.04	7.79	.06	-.09	947
Shop information (SI)	49.64	7.01	.06	.04	926
Automotive information (AI)	50.16	8.26	-.19	-.26	926
Biographical Variables:					
Years of education (YRED)	11.66	1.07	-.12	4.82	990
Years of age at enlistment (AGEN)	19.90	2.53	1.82	3.96	990
Success chances of recruits entering the Navy (SCREEN)	78.95	5.98	-.27	-.04	941
TCAC Test Scores:					
Computation and projection (CAP)	32.70	7.16	-1.52	2.68	1034
Conceptual integration and application (CIA)	5.52	5.76	-.31	2.72	1034
Tool and object nomenclature (TAO)	4.44	5.14	-1.13	.94	1034
Dual task (DT)	19.49	5.88	5.73	90.03	1034
Inspection/sort (SOR)	74.47	14.92	-1.39	1.75	1034
Record keeping (RK)	15.19	4.47	-1.21	.87	1034
Social interaction (SI)	6.79	3.20	-.34	-.25	1034
Precision and planning (PP)	59.87	13.36	-2.40	8.18	425
Relating diagrams with objects (ET)	11.09	11.09	1.08	.44	426
Level of aspiration (LOA)	-.09	4.41	-11.74	251.80	1034
Total test score (TT)	249.47	46.50	-.53	-.14	424
Criteria					
Job History:					
Years to E-4 (YRE4)	2.11	.33	-1.76	5.98	293
Attrition/nonattrition discharge (ATTR)	1.92	.28	-3.03	7.26	179
Highest pay grade achieved (HIPG)	2.89	.93	-.29	-.74	991
Behavioral record (BEHR)	1.29	2.19	2.15	4.91	991
Binary rated/nonrated (BIRTD)	.30	.46	.90	-1.20	991
Global Supervisory Marks:					
Supervisor rating, special questionnaire (SRAT)	.64	.18	-.78	.63	405
Supervisor rating, professional performance on NAVPERS 792 (SPROF)	3.48	.34	-1.45	3.22	425

The criterion information indicates that (1) about 92 percent of the 179 personnel discharged had received attrition discharges,² (2) 30 percent of the sample had achieved pay grade E-4 after about 3 years of service,³ and (3) the average time required to become E-4 was about 2 years. On the average, the highest pay grade for personnel in the sample was slightly less than E-3. Supervisors' marks indicated that, on the average, the personnel were considered by their supervisors to be above the middle of the distribution of job performance of personnel in comparable positions.

Table 5 shows the highest ratings and pay grades achieved by the 991 personnel in the sample. During the 3 years that had elapsed since the tests were administered, 321 (32%) had advanced from GENDET status to become either rated or designated strikers. Of these, 293 (30%) had become rated. Seven ratings--boatswain's mate, machinist's mate, aviation boatswain's mate, mess management specialist, hull technician, engineman, and personnelman--contained 56 percent of the personnel in technical ratings.

Multiple Regression Computations

Shrunken multiple regression coefficients for Samples 1 and 2 for the seven criteria are shown in Table 6, which shows the following relationships:

1. Although ASVAB tests were found to be predictive for most criteria, no ASVAB test was consistently selected across criteria. Furthermore, particular ASVAB tests were not consistently selected for the same criterion from one sample to the other. The mechanical knowledge (MK) test was frequently selected for Sample 2, while the arithmetic reasoning (AR) test was the most frequently selected for Sample 1. These relationships appear to indicate that, although there is a cognitive component in most of the job performance criteria, the particular cognitive variable selected for the predictor composite depends primarily on variations in sample characteristics. These relationships appear to indicate that, although there is a cognitive component in most of the job performance criteria, the particular cognitive variable selected for the predictor composite depends primarily on variations in sample characteristics. These variations may result in part from variations in job characteristics of the ratings in the samples.

2. In contrast to the variation in the cognitive variables, both the age at enlistment (AGEN) and years of education (YRED) biographical variables were consistently selected for predictive composites across criteria and samples. Age was particularly important as a predictor for years to E-4 (YRE4) and attrition/nonattrition discharge (ATTR).

3. The most consistently selected TCAC variable was the tool and object test (TAO) score. This test was particularly important as a predictor for both supervisors' marks, the two criteria for which TCAC variables increased the predictiveness of the ASVAB plus biographical composite. The other TCAC variables selected for regression runs (conceptual integration and application (CIA), dual task (DT), and situational interaction (SI)) were apparently caused by chance variation: As shown in the Average Cross Validation column of Table 7, the increments they made to the predictiveness of the ASVAB plus biographical composite in the original sample did not hold up on cross-validation.

²Attrition discharges involved termination of enlistment for reasons such as disability, dependency, unsuitability or unfitness, in contrast to normal completion of enlistment (honorable discharge, expiration of enlistment, released inactive duty, fleet reserve).

³Since, as shown in Table 3, both ATTR and BIRTD were binary variables, the mean scores of these variables indicate the proportions of personnel who had received attrition discharges or who had achieved E-4 status.

Table 5

Description of Sample by Rating at Highest Pay Grade Achieved

Rating	Pay Grade					Subtotal
	E-1	E-2	E-3	E-4	E-5	
Rated or Designated Striker						
Boatswain's mate	--	--	--	60	3	63
Machinist's mate	--	--	2	26	--	28
Aviation boatswain's mate	--	--	2	22	--	24
Mess management specialist	--	--	3	16	--	19
Hull maintenance technician	--	--	3	14	--	17
Engineman	--	--	3	13	--	16
Personnelman	--	--	--	14	--	14
Yeoman	--	--	--	11	--	11
Ship's serviceman	--	--	--	11	--	11
Aviation machinist's mate	--	--	--	11	--	11
Disbursing clerk	--	--	--	8	--	8
Aviation ordnanceman	--	--	--	8	--	8
Machinery repairman	--	--	2	5	--	7
Boiler technician	--	2	3	2	--	7
Electrician's mate	--	--	--	7	--	7
Aviation structural mechanic	--	1	--	6	--	7
Quartermaster	--	--	2	4	--	6
Storekeeper	--	--	--	6	--	6
Electrician's mate	--	--	--	5	--	5
Aviation electrician's mate	--	--	--	5	--	5
Aviation storekeeper	--	--	--	5	--	5
Operations specialist	--	--	--	4	--	4
Gunner's mate	--	--	--	4	--	4
Hospital corpsman	--	--	3	1	--	4
Aviation electronics technician	--	--	--	2	1	3
Aviation maintenance administrationman	--	--	1	2	--	3
Electronics technician	--	--	--	1	1	2
Data processing technician	--	--	--	2	--	2
Illustrator draftsman	--	--	1	1	--	2
Aerographer's mate	--	--	--	2	--	2
Aviation support equipment technician	--	--	--	2	--	2
Torpedoman's mate	--	--	--	1	--	1
Radioman	--	--	--	1	--	1
Cryptologic technician	--	--	--	1	--	1
Postal clerk	--	--	--	1	--	1
Lithographer	--	--	--	--	1	1
Equipment operator	--	--	--	1	--	1
Air traffic controller	--	--	--	1	--	1
Aircrew survival equipmentman	--	--	--	1	--	1
Total	--	3	25	287	6	321
GENDET						
Seaman	43	156	194	--	--	393
Airman	16	48	76	--	--	140
Fireman	14	53	70	--	--	137
Total	73	257	340	--	--	670
Overall Total	73	260	365	287	6	991

Table 6

Shrunken Multiple Regression Coefficients of Operational and Experimental Predictors for Seven Criteria

Predictor Set	YRE4			ATTR			HIPG			BEHR			BIRTD			SRAT			SPROF		
	Final Shrunken R	Variable Selected	N	Final Shrunken R	Variable Selected	N	Final Shrunken R	Variable Selected	N	Final Shrunken R	Variable Selected	N	Final Shrunken R	Variable Selected	N	Final Shrunken R	Variable Selected	N	Final Shrunken R	Variable Selected	N
Sample 1 (N = 488)																					
ASVAB tests	.36	WK AR	135	.34	AR	71	.20	GI	449	.16	MK AR	449	.18	GI AD	449	.14	AR	186	NS	NS	197
ASVAB tests plus bio. variables	.50	AGEN WK AR YRED	135	.66	AGEN AR EI	71	.28	GI AGEN YRED	449	.33	YRED AGEN MK	449	.24	AGEN MC AD GI	449	.20	AR YRED	186	.21	YRED SI	197
ASVAB tests, bio variables, and TCAC variables	.53	AGEN WK AR YRED SI	135	.66	AGEN AR EI	71	.28	GI AGEN YRED	449	.34	YRED AGEN MC SI	449	.24	AGEN MC TAO GI	449	.22	TAO SOR	186	.23	YRED TAO	197
Sample 2 (N = 503)																					
ASVAB tests	.31	GI	134	NS	NS	85	.18	MK	465	NS	NS	465	.18	MK	465	.19	MK	197	.13	EI	205
ASVAB tests plus bio variables	.55	AGEN GI	134	.57	AGEN	85	.32	YRED MK	465	.23	YRED SCREEN	465	.28	YRED MK MC	465	.19	MK	197	.13	EI	205
ASVAB tests, bio variables, and TCAC variables	.59	AGEN GI SCREEN CIA	134	.57	AGEN	85	.32	YRED MK	465	.28	YRED SCREEN GI TAO	465	.30	YRED MK TAO DT	465	.27	TAO NO	197	.22	RK AGEN	205

Validity Coefficients of Predictor Composites

Back- and cross-validation coefficients for the two samples (Table 7) were computed by applying unit weights to the variables selected by stepwise multiple regression (Table 6). Three sets of coefficients are shown for each of the seven criteria. The first six columns present the back- and cross-validity coefficients for the samples and the difference scores between the coefficients for each sample; the last two contain the averages of the two cross-validation coefficients (considered to be the best measure of the predictive validity of the composites) and the averages of the two difference scores (considered a measure of stability of the coefficients across samples).

Table 7 shows the following relationships:

1. For all five job history marks (the first five criteria), the appropriate predictive composite to use was that formed from the ASVAB plus biographical variables rather than that formed from ASVAB scores alone or ASVAB plus biographical plus TCAC scores. For three of the job history criteria (YRE4, ATTR, and BEHR), the ASVAB plus biographic composite produced a higher average cross-validated coefficient than did the ASVAB plus biographical plus TCAC composite. For the remaining two job history variables (BIRTD and HIPG), the ASVAB plus biographical composite was as predictive as the ASVAB plus biographical plus TCAC composite. In contrast, for the two supervisors' marks, SRAT and SPROF, the ASVAB plus biographical plus TCAC composite was the most predictive of the three composites. These findings indicate that TCAC variables added reliably to the predictiveness of ASVAB and biographical variables for criteria based on supervisors' marks, but not for job history criteria.

The validity coefficients for supervisors' marks in this study are lower than those found by Siegel (1983), but they are consistent with Siegel's finding that TCAC variables add substantially to the amount of variance in supervisors' marks predicted by operational variables. Still, the predictive accuracy of the final composite for supervisors' marks, even with TCAC variables included, is not great.

2. Generally, the validity coefficients for job history criteria were higher than those for supervisors' marks. Four of the five job history marks (YRE4, ATTR, HIPG, and BEHR) had higher average cross-validation coefficients than did either of the supervisor's marks. Two of the job history measures--ATTR and YRE4--had large average cross-validation coefficients (.52 and -.40). These coefficients compare favorably with validity coefficients for job performance criteria found in other research (Cory, 1982, 1983; Vineberg & Joyner, 1982). YRE4 appears to be the most important of these two criteria. Because an average of 70 percent of first-term personnel will not continue in Navy service after their 4-year enlistment period (Cory, 1983), the amount of time that a person is able to serve at the E-4 or higher level is an important measure of his or her value to the Navy.

3. Coefficients for all five job history measures were more stable than were those for supervisors' marks. This finding is consistent with that of Cory's (1983) study of Navy enlisted personnel.

4. Generally, the ASVAB tests did not have high validity for either job history or supervisory evaluation variables. In fact, the validity coefficients for ASVAB tests for all job history measures except YRE4 were about the same magnitude as were those for the two supervisors' marks.

Table 7
Back- and Cross-validation Coefficients
for Seven Criteria

Criterion	Sample 1 (N = 488)			Sample 2 (N = 503)			Average	
	Back Val.	Cross Val.	Difference (BV - CV)	Back Val.	Cross Val.	Difference (BV - CV)	Cross Val.	Difference
1. <u>Years to E-4</u>								
ASVAB	-.36***	-.17*	-.19	-.32***	-.26**	-.06	-.23	-.13
ASVAB + Bio	-.50***	-.39***	-.11	-.51***	-.41***	-.10	-.40	-.11
ASVAB, Bio + TCAC	-.51***	-.31***	-.20	-.49***	-.45***	-.04	-.38	-.12
2. <u>Attrition/nonattrition discharge</u>								
ASVAB	-.35***	.04	-.39	-.10	-.18	.08	.07	-.16
ASVAB + Bio	-.55***	-.51***	-.04	-.57***	-.52***	-.05	.52	-.05
ASVAB, Bio + TCAC	-.55***	-.34**	-.21	-.57***	-.52***	-.05	.43	-.13
3. <u>Highest pay grade</u>								
ASVAB	.21***	.06	.15	.19***	.10*	.09	.08	.12
ASVAB + Bio	.26***	.23***	.03	.32***	.18***	.14	.21	.09
ASVAB, Bio + TCAC	.26***	.23***	.03	.32***	.18***	.14	.21	.09
4. <u>Behavioral record</u>								
ASVAB	-.03	-.02	-.01	-.06	-.12**	.06	-.07	-.03
ASVAB + Bio	-.29***	-.14***	.15	-.23***	-.27***	.04	-.21	-.06
ASVAB, Bio + TCAC	-.19***	-.10*	.09	-.23***	-.27***	.04	-.19	-.03
5. <u>Rated/nonrated</u>								
ASVAB	.16***	.11*	.05	.18***	.12**	.06	.12	.06
ASVAB + Bio	.22***	.15***	.07	.28***	.17***	.11	.16	.09
ASVAB, Bio + TCAC	.15***	.15***	.00	.23***	.16***	.07	.16	.04
6. <u>SRAT</u>								
ASVAB	.16*	.13*	.03	.20**	.00	.20	.07	.12
ASVAB + Bio	.22***	.12*	.05	.20**	.00	.20	.06	.13
ASVAB, Bio + TCAC	.23***	.15*	.08	.24***	.18**	.06	.17	.07
7. <u>SPROF</u>								
ASVAB	-	-	-	.14*	-.01	.15	-	-
ASVAB + Bio	.21**	.12*	.09	.14*	-.01	.15	.07	.12
ASVAB, Bio + TCAC	.25***	.21***	.04	.24***	.09	.15	.15	.10

"-" indicates that no predictors were significantly related to the criterion.

*p < .05.
**p < .01.
***p < .001.

5. In contrast, by subtracting, for each of the seven criteria, the average cross validation value for row 1 from that for row 2 and that for row 2 from that for row 3, it can be seen that biographical variables predicted the most variance for three of the five job history criteria (ATTR, HIPG, and BEHR). For these three criteria, biographical variables provided average increases in the absolute values of cross-validated ASVAB coefficients of .24.

DISCUSSION AND CONCLUSIONS

The major findings of this research for a recent peacetime all-volunteer services sample replicate those found for samples of GENDETs collected 10 to 15 years ago under wartime draft conditions (Cory, 1983). Both studies found predictabilities of supervisory marks ranging from .15 to .20, versus those for some job history variables in the .40s and .50s. This similarity in the findings for two large-scale studies carried out under widely different Navy manpower conditions provide further indication that these predictability values of supervisory marks and job history variables are reliable for Navy GENDETs.

The use of the TCAC variables as presently constituted for the classification of GENDETs does not appear warranted for the following reasons:

1. Of the seven criteria, TCAC variables only increase predictability for the two supervisors' marks. As has been found repeatedly (Cory, 1982, 1983; Vineberg, 1982), supervisors' evaluations of job performance are notoriously unstable criteria. Their accuracy is drastically lowered by halo effect and bias and they have been found to have low reliability over time (Cory, 1982; Siegel, 1983).

2. Job history variables are ultimate criteria in the sense that they measure elements of obvious value to the Navy, such as the length of time required to advance to E-4, achievement of rated status, etc. In contrast, supervisors' marks are only intermediate criteria.

For these reasons, if it is necessary to choose between the use of supervisory criteria and job history criteria for selection or classification purposes, job history criteria are to be preferred.

A predictive validity coefficient of .40, as is the case for YRE4, is substantial enough to be useful for personnel selection. Therefore, so long as there is a surplus of applicants for Navy GENDET billets, it should be possible to improve the job history characteristics of GENDETs by using selector composites to screen applicants, thus ensuring best selection. The results of this research, together with earlier work (Cory, 1983), indicate that the best variables for these selector composites are those presently being collected operationally--scores for the ASVAB subtests and biographical variables. Thus, it is desirable to undertake research to develop and evaluate selector composites for job history variables that measure attributes that are important to the Navy and that are very predictable (e.g., YRE4). Research for this purpose should be undertaken on a sample of 5,000 to 7,000 GENDETs because a sample of this size could produce regression equations of appropriate reliability for operational use.

RECOMMENDATIONS

1. Further research and evaluation of TCAC variables for operational use in GENDET classification is not warranted. However, as Siegel (1983) has pointed out, the TCAC battery has acceptable psychometric characteristics and may have value for classifying personnel into particular technical ratings.

2. Research should be conducted to identify the combinations of ASVAB and biographical variables that are the most predictive of advancement variables (e.g., the percentage of a 4-year enlistment spent at E-4 and above and the highest pay grade achieved). The research analyses should identify the appropriate criteria to use for GENDET selection and should quantify the improvement in job performance characteristics to be expected from operational implementation of selector composites for GENDETS.

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