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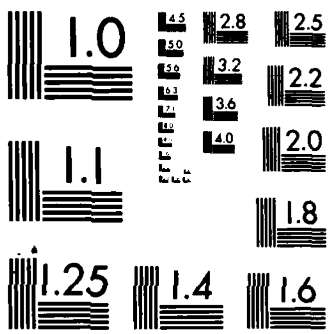

CNR 102 / February 1985

(2)

VALIDITY OF THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY FORMS 8, 9, AND 10 WITH APPLICATIONS TO FORMS 11, 12, 13, AND 14

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The Armed Services Vocational Aptitude Battery (ASVAB) was validated against training grades in 34 Marine Corps occupational specialties. Four aptitude composites for assigning Marine recruits to occupational specialties were developed and evaluated. The high predictive validity of the ASVAB supports its continued use for selecting recruits and assigning them to occupational specialties.

The fairness of the aptitude composites as predictors of performance was evaluated for racial/ethnic minorities and females.

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From: Commandant of the Marine Corps
To: Distribution List

Subj: CNR 102, "VALIDITY OF THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY FORMS 8, 9, AND 10 WITH APPLICATIONS TO FORMS 11, 12, 13 and 14"

1. The objectives of this study were:

a. Validation of ASVAB 8/9/10 scores as a predictor of performance in Marine Corps occupational specialty training courses.

b. Development and evaluation of aptitude composites for ASVAB 11/12/13.

c. Evaluation of the aptitude composites used for the Student Testing Program.

d. Evaluation of Marine Corps aptitude composites for fairness as concerns racial/ethnic minorities and females.

e. Evaluation of the appropriateness of currently established minimum aptitude composite scores for assignment of Marine recruits to occupational specialties.

2. This Headquarters has reviewed the study and found that the objectives were accomplished.

3. The results of the study are concurred in and the study is approved for publication.

4. A copy of this letter will be affixed inside the front cover of each copy of the subject study prior to its distribution.

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CNR 102 / February 1985

VALIDITY OF THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY FORMS 8, 9, AND 10 WITH APPLICATIONS TO FORMS 11, 12, 13, AND 14

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ABSTRACT

The Armed Services Vocational Aptitude Battery (ASVAB) was validated against training grades in 34 Marine Corps occupational specialties. Four aptitude composites for assigning Marine recruits to occupational specialties were developed and evaluated. The high predictive validity of the ASVAB supports its continued use for selecting recruits and assigning them to occupational specialties.

The fairness of the aptitude composites as predictors of performance was evaluated for racial/ethnic minorities and females.

EXECUTIVE SUMMARY

The Armed Services Vocational Aptitude Battery (ASVAB) is used by all military services to select recruits and assign them to occupational specialties. Forms 8, 9, and 10 of the ASVAB (ASVAB 8/9/10) were introduced on 1 October 1980. Forms 11, 12, and 13 (ASVAB 11/12/13) were introduced 1 October 1984.

The objectives of this research effort were to accomplish the following:

- Validate ASVAB 8/9/10 as a predictor of performance in Marine Corps occupational specialty training courses
- Develop and evaluate aptitude composites for ASVAB 11/12/13
- Evaluate the aptitude composites for the Student Testing Program, in which form 14, with the same content as ASVAB 8/9/10, is administered to students in high schools and postsecondary training institutions
- Evaluate the fairness of the ASVAB for racial/ethnic minorities and females
- Evaluate the appropriateness of minimum prerequisite aptitude composite scores for assigning recruits to occupational specialties.

PROCEDURES

The Marine Corps provided grades for students in occupational training courses for classes that started during 1981 and 1982. These grades served as the criterion measure of performance. The Marine Corps also provided ASVAB scores and background information (racial/ethnic group, level of education, and gender) for the students.

The analysis involved determining the validity of the ASVAB as a predictor of training grades across the spectrum of Marine Corps occupational specialties. The fairness of the ASVAB was evaluated for females and racial/ethnic minorities. The appropriateness of qualifying aptitude composite scores for assigning recruits to occupational specialties was evaluated by examining the failure rates in the training courses to determine whether they are excessive (larger than 10 percent).

RESULTS

The analysis is based on 26,325 Marine students grouped into 34 training courses. The results show that the ASVAB subtests are valid predictors of performance in Marine Corps training courses. Four aptitude composites for ASVAB 11/12/13 were developed in this analysis. The mean predictive validity of these composites and the subtests in each are shown in table I. The advantages of the four new composites are as follows:

- The validity of the Clerical composite was improved; the mean validity for clerical specialties increased from .60 to .65.

- The number of aptitude composites was reduced from six to four, which simplifies the system for assigning Marine recruits to occupational specialties.

- The composites are identical to those used in the Student Testing Program, which means that high-school and postsecondary students (and their counselors and parents) can readily know the Marine Corps specialties for which they qualify.

The Clerical composite was improved by adding more math content. The Mechanical Maintenance and Electronics Repair composites were left unchanged. The General Technical composite was improved by adding technical content (Mechanical Comprehension). The Combat and Field Artillery composites were replaced on 1 October 1984 by the General Technical composite. The new General Technical composite is as valid as or more valid than those replaced.

The aptitude composites do not systematically discriminate for or against racial/ethnic minorities (see table II). An exception is the infantry courses taught at Camp Lejeune, where whites performed better than expected compared to racial/ethnic minorities with the same aptitude composite scores. In the majority of courses, high-school graduates did better than expected compared to nongraduates with the same aptitude scores. In occupations traditionally entered by females (notably administrative clerk and food service), females did better than expected compared to males with the

TABLE I

MEAN VALIDITY[a] AND DEFINITIONS OF MARINE CORPS APTITUDE COMPOSITES FOR USE WITH ASVAB 11/12/13

PART A: Validity

	Aptitude composite			
Occupational cluster	MM	CL	EL	GT
Mechanical Maintenance	.64	.57	.63	.63
Clerical	.52	.65	.61	.61
Electronics Repair	.63	.63	.69	.67
General Technical	.63	.67	.69	.69
Combat	.46	.45	.49	.49
Field Artillery	.61	.60	.62	.62

PART B: Definition

	Symbol	Subtests[b]			
Mechanical Maintenance	MM	AR	AS	MC	EI
Clerical	CL	VE	MK	CS	
Electronics Repair	EL	GS	AR	MK	EI
General Technical	GT	VE	AR	MC	

a. Correlations are population-wide estimates.

b. VE = Verbal
GS = General Science
AR = Arithmetic Reasoning
MK = Math Knowledge
AS = Auto/Shop Information
MC = Mechanical Comprehension
EI = Electronics Information
CS = Coding Speed.

TABLE II

FAIRNESS OF THE ASVAB FOR MINORITIES

		Number of significant differences[a]					
		Racial/ethnic		Education level		Gender	
Occupational cluster	Number of samples	Minorities	Whites	Graduates	Nongraduates	Females	Males
Mechanical Maintenance	9	1	2	6	0	2[b]	1[b]
Clerical	7	0	1	5	0	2	0
Electronics Repair	3	1	0	3	0	0	0
General Technical	4	0	1	2	0	2	0
Combat[c]	8	0	4[d]	1	0	–	–
Field Artillery[c]	3	0	1	2	0	–	–

a. Number of courses for which the group has a significantly higher predicted performance, at the 5-percent level of statistical significance.

b. Seven of nine courses contained females.

c. No females were assigned to these specialties.

d. All four courses were taught at Camp Lejeune; the courses taught at Camp Pendleton had no differences.

for doing well on a subtest when, in fact, that subtest is positively related to training grades.

A second constraint is that no composite should contain more than four or five subtests. Aptitude composites are sometimes computed by hand, and adding too many numbers leads to errors. Personnel in the examining stations can handle four or five subtests in a composite reasonably well. In general, the maximum validity ordinarily is attained with three to five subtests; adding additional tests would only increase the computational burden and add little to predictive validity.

A third constraint is that the subtests in each composite should be unit weighted. Regression weights are difficult to use in hand computations. More importantly, unit weights generalize better than regression weights from sample to sample.

Grouping the Specialties

The purpose of grouping occupational specialties is to establish an efficient and effective basis for assigning recruits. Aptitude composites and clusters of specialties have meaning only in relation to each other. The specialties in a cluster tend to require similar aptitudes, and specialties in different clusters require different patterns of aptitudes. To the extent that occupational clusters differ in their aptitude requirements, people can be classified as having a higher aptitude for one cluster than for others.

The procedures for clustering specialties involve computing regression equations of training grades on the four factor composites: verbal, mathematical, technical, and speed. The factor analysis of ASVAB 8/9/10 is described in appendix A. Population estimates of the validity coefficients were used to compute the regression equations. Samples with similar patterns of regression weights were clustered together, provided they were known through other analyses to have similar job requirements.

The regression equations were cross validated by separate analyses of people tested with ASVAB 8/9/10 and ASVAB 5/6/7. The first requirement for clustering is that the pattern of regression weights should be stable for each sample. If the patterns could not be cross validated, then any clustering would lack stability.

separately, the two sets of cases were combined to obtain the maximum sample size.

Defining Aptitude Composites

The stepwise least-squares regression procedure was used to select the most valid set of subtests for each sample. The stepwise regression procedure selects the subtests in order of their highest unique validity. The estimated population validity coefficients were used in the test selection. Although the full regression equations were computed for each course, only the subtests that resulted in an increase of at least .005 to the correlation coefficients were considered for inclusion in the composites.

The theory of differential classification was followed when defining the composites, and the predictive validity of each composite was maximized [3]. By maximizing the predictive validity of each composite for the corresponding cluster of specialties (absolute validity), there was also a tendency to maximize the differences in predicted performance between clusters of specialties (differential validity).

The correlation among the aptitude composites has no direct bearing on the differential validity of the ASVAB. The statistics that govern differential validity are the predictive validity of the ASVAB (the higher the absolute validity, the greater the differential validity or classification efficiency) and the intercorrelation of the predicted performance scores (the higher the intercorrelation of predicted performance scores, the lower the differential validity). The intercorrelation of predicted performance scores is based on the full regression equations, which include all ASVAB subtests and not just those in each aptitude composite. The formula for classification efficiency (CE) developed by Brogden [3] is: $CE = R\sqrt{1-r}$, where R is the mean predictive validity of the aptitude composites and r is the mean intercorrelation among the predicted performance scores, when all subtests enter into the regression equations. The aptitude composites that were developed are a satisfactory compromise between theoretical maximum differential validity and constraints from the operational testing program.

One constraint in the operational testing program is that subtests with negative weights should not be used to select and classify recruits. A negative weight means that the person is penalized in that composite for doing well on the negatively weighted subtest. As a rule, examinees should not be penalized

Training course grades were collected from all Marine Corps schools. The worksheet shown in appendix B was used to collect the grades. An attempt to collect grades for Marines trained by the other services was also made. The Navy trains Marines in aviation specialties; the Air Force trains Marines in specialized courses, such as photography; and the Army trains Marines in a variety of specialties, including armor crewman, military police, and field artillery. Relatively few of the Marines trained by the Army were included in the analysis because the grades were unavailable for administrative reasons or the grades did not reflect different levels of performance.

SAMPLES

The larger courses, which had 150 or more students with a final grade and a complete set of ASVAB 8/9/10 scores, were analyzed separately. The smaller courses that had similar job requirements and similar distributions of ASVAB scores were combined. Before combining courses, the final grades in each course were standardized to have a mean of 50 and a standard deviation of 10. In some cases, a larger course was pooled with smaller ones when there were not enough cases to pool the smaller courses only and the job requirements and ASVAB score distributions were similar. This pooling of courses increased the number of samples with enough cases for meaningful analysis. The courses that were pooled are shown in appendix B.

STATISTICAL ANALYSIS

The first step in the statistical analysis was to compute the correlation between the ASVAB subtests and the grades for each sample. The second step was to compute estimates of the validity coefficients in the full population of potential recruits. The estimation procedure, called "correction for restriction in range," essentially extends the regression of grades on ASVAB scores from the sample statistics to the regression values that would be obtained in the full population of potential recruits [2]. The multivariate model was used; it corrects for the effects of selecting students for each sample on all ASVAB subtests simultaneously. The procedure for estimating population values is described more fully in appendix C.

Three analyses were conducted for each sample. The primary one included students tested with ASVAB 8/9/10. A cross validation was conducted on students tested with ASVAB 5/6/7. In addition to being analyzed either in formal training courses or in on-the-job training, or some combination. The academic composites are designed to measure potential for further education in high schools or postsecondary training programs, such as 2-year colleges.

CRITERION MEASURE

Final grades of trainees in Marine Corps occupational training courses were used as the criterion measure to determine the predictive validity of the ASVAB. The level of performance of the trainees was indicated by final grades in the training courses. In most Marine Corps courses, training grades are reported as percentage scores in which normally the passing score is 70 and the maximum score is 100. The Marine Corps training courses, the courses included in this analysis, and the grades assigned to academic failures and academic recycles are listed in appendix B.

Approximately 7 percent of the students did not complete their training course on schedule. Students who failed academically – that is, those who did not graduate from the course because of academic deficiencies – were assigned a grade one standard deviation below the minimum passing score. The standard deviation of course grades was computed using the grades of all students who passed the course on schedule (called regular passers). Students recycled for academic reasons to later classes and who subsequently graduated were assigned the minimum passing score regardless of their final grade awarded by the school. If recycled students later failed the course, they were counted as academic failures.

Students who failed or were recycled for nonacademic reasons, such as medical or disciplinary, were deleted from the sample unless they subsequently received an academic grade. If they passed the course, they were treated as regular passers and their final grade was included in the analysis. If they became academic failures or academic recyles, they were treated as such. The nonacademic failures or recycles who did not have final grades were deleted from the analysis because it was assumed that their status in the course was not related to either their performance or aptitude.

DATA COLLECTION

ASVAB scores were obtained from automated Marine Corps files. Students for whom subtest scores were missing were deleted from the analysis.

TABLE 2

SUBTESTS CONTAINED IN ASVAB 14 COMPOSITES

	ASVAB 14 subtest[a]			
Composite	Verbal	Math	Technical	Speed
Occupational				
Mechanical and Crafts		AR	AS MC EI	
Business and Clerical	WK PC	MK		CS
Electronics and Electrical	GS	AR MK	EI	
Health, Social, and Technology	WK PC	AR	MC	
Academic				
Academic Ability	WK PC	AR		
Verbal	GS WK PC			
Math		AR MK		

a. See table 1 for full titles of subtests.

The academic composites (Verbal, Math, and Academic Ability, which is a combination of verbal and math subtests) are similar to those used in many civilian educational test batteries. The *occupational composites* are designed to measure potential for succeeding in four groupings of occupations that are common to the military services and the civilian economy. The following types of occupations are associated with the occupational composites:

- Mechanical and Crafts – automobile mechanic, carpenter, aviation mechanic
- Business and Clerical – office secretary, bookkeeper, inventory control
- Electronics and Electrical – TV-radio repair, computer repair, electrical equipment repair
- Health, Social, and Technology – laboratory technician, police officer, computer operator.

The occupational composites and their military counterparts are designed to predict success in occupations that require postsecondary vocational

TABLE 1 (Continued)

Subtest	Symbol	Subtest in version 8/9/10	Subtest in version 5/6/7	Description
Other subtests				
Space Perception	SP	No	Yes[a]	Identify three-dimensional figures obtained from folding flat patterns
Attention to Detail	AD	No	Yes	A speed test to count the number of Cs in a series of Os
General Information	GI	No	Yes	Knowledge of sports, history, automobiles
Classification Inventory	ACI	No	Yes	Interest in mechanical, electronics, clerical, and outdoor activities

a. Used to define the Armed Forces Qualification Test (AFQT).
b. Combined to form the Verbal (VE) score.
c. Separate subtests in ASVAB 5/6/7.

TABLE 1

SUBTESTS CONTAINED IN THE ASVAB

Subtest	Symbol	Subtest in version: 8/9/10	Subtest in version: 5/6/7	Description
Verbal factor				
Word Knowledge	WK	Yes[a,b]	Yes[a]	Knowledge of the meaning of words
Paragraph Comprehension	PC	Yes[a,b]	No	Understanding the meaning of paragraphs
General Science	GS	Yes	Yes	Knowledge of physical and biological sciences
Mathematical factor				
Arithmetic Reasoning	AR	Yes[a]	Yes[a]	Word problems that emphasize reasoning
Math Knowledge	MK	Yes	Yes	Knowledge of algebra, geometry, and fractions
Technical factor				
Auto/Shop Information[c]	AS	Yes	Yes	Knowledge of automobiles and use of shop tools
Mechanical Comprehension	MC	Yes	Yes	Understanding mechanical principles
Electronics Information	EI	Yes	Yes	Knowledge of electronics
Speed factor				
Numerical Operations	NO	Yes[a]	Yes	A speed test of simple arithmetic
Coding Speed	CS	Yes	No	A speed test of matching words and numbers

CHAPTER 1

ANALYSIS OF THE ASVAB

INTRODUCTION

As a selection and classification instrument, the Armed Services Vocational Aptitude Battery (ASVAB) is designed to predict performance in military occupational specialties. As a multiple aptitude battery, it measures four constructs or factors: verbal, mathematical, technical, and speed. Forms 8, 9, and 10 of the ASVAB (ASVAB 8/9/10) were introduced 1 October 1980 to replace the previous versions, forms 5, 6, and 7 (ASVAB 5/6/7). ASVAB 8/9/10 contains ten subtests, which are grouped by these four factors in table 1.

The ASVAB subtests are combined to form the Armed Forces Qualification Test (AFQT) and aptitude composites. These scores are used to help select recruits and assign them to occupational specialties. The AFQT is also used to track historically the mental aptitudes of recruits and to help determine qualification for special enlistment programs, such as bonuses.

Each aptitude composite is used to help determine qualification of recruits for a cluster of occupations in which similar aptitudes are required. Each service defines its own aptitude composites, in terms of the subtests, and determines the set of composites that meets its needs for assigning recruits to specialties. A more detailed description of the ASVAB aptitude composites is given in appendix A.

The scores for ASVAB 5/6/7 are also used in this analysis, and therefore the subtests for ASVAB 5/6/7 are also shown in table 1. Sims and Hiatt [1] conducted a joint factor analysis of ASVAB 8/9/10 and ASVAB 5/6/7 and found a similar factor structure in the two versions. Forms 11, 12, and 13 of the ASVAB (ASVAB 11/12/13) were introduced 1 October 1984 and are parallel to ASVAB 8/9/10.

The ASVAB is widely used throughout the nation's high schools and postsecondary institutions for vocational guidance and occupational exploration. The Department of Defense provides free ASVAB testing to schools in return for access to the students' test scores and other information, such as occupational and educational plans. A new version of the ASVAB, form 14, which is parallel to ASVAB 8/9/10, was introduced in school year 1984-1985. The subtests of ASVAB 14 are combined to form academic and occupational composites (see table 2).

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- The current practice of setting prerequisite scores ten points higher for nongraduates of high school should be retained.

- Further research should be conducted to evaluate the differences in performance of males and females in traditional female occupations.

- Numerical grades in occupational training courses, rather than simple pass/fail grades, should be obtained under standardized testing conditions and retained for use as criterion measures in future research studies to validate standards for selecting recruits and assigning them to occupational specialties.

probably would not reduce any excessive number of failures (that is, over 10 percent) in the training courses.

FINDINGS

This analysis produced the following findings:

- The ASVAB is a valid predictor of performance in occupational training courses, ana it can continue to be used in making personnel decisions about selecting recruits and assigning them to occupational specialties.
- Four aptitude composites are adequate for assigning recruits to the range of Marine Corps occupational specialties.
- The ASVAB aptitude composites do not systematically discriminate against or in favor of racial/ethnic minorities or females in nontraditional female occupations. In traditional female occupations, however, they may discriminate against females.
- The prerequisite score levels for assigning recruits tc Marine Corps occupational specialties are satisfactory.

RECOMMENDATIONS

The following recommendations are made:

- The Marine Corps should replace the six aptitude composites used for ASVAB 8/9/10 with the four composites developed in this study.
- Occupational specialties that currently have the Combat or Field Artillery composites as the prerequisite should use the General Technical composite instead. The alignment between aptitude composite and occupational specialties for the other three composites (Mechanical Maintenance, Clerical, Electronics Repair) should remain as it is.
- The current prerequisite score levels should be retained.

same scores; but in occupations traditionally entered by males (mechanical and electronics maintenance), there were no systematic and statistically significant differences between males and females.

The meaning of the validity coefficients for the four new aptitude composites is shown in table III as the chances of a person doing well – that is, the probability of a person being a satisfactory performer in occupational specialties that differ in how difficult they are to learn. The procedures for computing the chances of a person doing well and for grouping occupational specialties by how difficult they are to learn are described in the main text. These chances of doing well in occupations are especially useful in the Student Testing Program to help students in occupational exploration and decision-making.

TABLE III

CHANCES OF PEOPLE DOING WELL[a] IN OCCUPATIONAL SPECIALTIES OF VARYING DIFFICULTY

Occupational composite percentile score	Difficulty of occupation[b]		
	Easy	Moderate	Difficult
Below average (5 to 30)	Good (.5 to .80)	Fair (.25 to .60)	Low (.10 to .35)
Average (30 to 70)	High (.80 to .95)	Good (.60 to .85)	Fair (.35 to .65)
Above average (70 to 99)	High (.95 +)	High (.85 +)	Good (.65 +)

a. Defined as the probability of a person having a predicted performance score at or above the minimum level of satisfactory performance.
b. Defined as difficulty of learning, not difficulty due to physical requirements or stress.

Evaluation of the minimum prerequisite aptitude composite scores supports the appropriateness of the current score levels. No changes to the prerequisite scores are warranted, because raising the prerequisite scores

Factor composites rather than subtests were used in the regression analysis because these weights are more stable. The subtests in each factor composite are highly intercorrelated. The high intercorrelation, or collinearity, results in fluctuation of the regression weights from sample to sample, even though the pattern of validity coefficients is similar. This phenomenon is sometimes referred to as "bouncing betas." The factor composites have relatively low intercorrelation, and the regression weights should be more meaningful.

Any change to the existing Marine Corps system for assigning recruits to occupational specialties should be a demonstrable improvement – either the differential validity should be higher or the new system should be simpler. The Marine Corps aptitude composites used with ASVAB 8/9/10 and the associated occupational clusters are shown in table 3.

TABLE 3

MARINE CORPS APTITUDE COMPOSITES AND OCCUPATIONAL CLUSTERS FOR ASVAB 8/9/10

		Subtest[a]			
Aptitude composite	Symbol	Verbal	Math	Technical	Speed
Mechanical Maintenance	MM		AR	AS MC EI	
Clerical	CL	VE			NO CS
Electronics Repair	EL	GS	AR MK	EI	
General Technical	GT	VE	AR		
Combat	CO	VE		AS	NO
Field Artillery	FA	VE	AR	AS	

Occupational cluster	Examples of specialties
Mechanical Maintenance	Automotive mechanic, aircraft mechanic
Clerical	Administrative clerk, supply, finance
Electronics Repair	Radio repair, avionics, radar repair
General Technical	Food service, military police, intelligence
Combat	Infantry
Field Artillery	Fire control, assault amphibian crew, tank crew

a. GS = General Science; VE = Word Knowledge + Paragraph Comprehension; AR = Arithmetic Reasoning; MK = Math Knowledge; AS = Auto/Shop Information; MC = Mechanical Comprehension; EI = Electronics Information; NO = Numerical Operations; CS = Coding Speed.

Effects of Social Groupings on ASVAB Validity

The effects of three social groupings on ASVAB validity were evaluated: racial/ethnic group (whites versus blacks and others), educational level (high-school graduate and higher versus nongraduates), and gender. The statistical procedures for evaluating the effects of the social groups are presented in chapter 2.

EVALUATING QUALIFYING APTITUDE COMPOSITE PREREQUISITE SCORES

The Marine Corps provided failure rates in training courses for fiscal year 1983. Failure rates were also obtained for fiscal year 1980 [4]. The Marine Corps policy is to keep the failure rate in each course at 10 percent or less. Historically, some of the more difficult courses, notably the Basic Electronics Course (BEC), have had failure rates above 10 percent. The BEC failure rate in 1982 was 25 percent, even though the prerequisite EL score was 115, which means that only about the top quarter of the current population of male youth would be qualified for assignment to the course. With such a high qualifying standard, further increasing the prerequisite score would greatly reduce the number of Marine recruits who would qualify but have relatively little impact on the failure rate. All courses were evaluated in a similar manner – by examining the failure rates, current prerequisite scores, and expected effects of raising the prerequisite scores.

CHAPTER 2

RESULTS OF THE ANALYSIS

The results of the analysis are presented in four main sections. In the first section, validity data are presented that support the continued use of the ASVAB for selecting and assigning Marine recruits. The second section presents the four aptitude composites and associated clusters of occupational specialties that were developed in this analysis. The third section presents evidence on fairness of the ASVAB for racial/ethnic minorities and for females. In the fourth section, the appropriateness of the prerequisite qualifying scores is examined.

PREDICTIVE VALIDITY OF ASVAB 8/9/10

The predictive validity of ASVAB 8/9/10 is based on the 34 samples included in the analysis (table 4). The number of cases in the samples tested with ASVAB 8/9/10 ranged from 153 (electrical equipment repair) to 2,508 (infantry rifleman). Table 4 also contains the number of cases tested with ASVAB 5/6/7 and the ASVAB 8/9/10 aptitude composite prerequisite scores. The full set of samples for which training grades were reported is shown in appendix B. Many of the smaller courses were pooled to provide enough cases to include in the analysis. The pooled samples are also shown in appendix B. Samples were pooled if they had similar job requirements and similar distributions of ASVAB scores. Prior to pooling, the grades for each entry-level training course were standardized to have a mean of 50 and a standard deviation of 10. The standardization is necessary because the metrics of training grades tend to be arbitrary; pooling the grades as reported by the training schools would introduce error and lead to erroneous results.

The mean validity coefficients of the ASVAB subtests are shown in table 5. The validity coefficients are the mean values for the specialties in each cluster. The validity for each sample is shown in appendix C. The sample values are shown in part A of table 5; these values are distorted because the students had been selected in part on the basis of their ASVAB scores. These effects on the validity coefficients were removed by applying the statistical correction for restriction in range (explained in appendix C). The corrected values, called population estimates, are shown in part B of table 5. These validity coefficients are comparable to those in an earlier validation study using ASVAB 5/6/7 to predict grades in Marine Corps training courses [4].

TABLE 4

SAMPLES OF OCCUPATIONAL SPECIALTIES IN THE ANALYSIS

Title	Code	Prerequisite score[a]	Number of cases[b] 8/9/10	Number of cases[b] 5/6/7
Engineer equipment operator	1345	MM90	452	245
Combat engineer	1371	MM90	189	179
Automotive mechanic	3521	MM90	459	415
Aircraft mechanic	6011	MM100	521	484
Helicopter mechanic	6111	MM100	357	120
Tracked vehicle repair[c]	13/21	MM90/100	376	353
Aircraft maintenance[c]	60xx	MM100	399	506
Electrical equipment repair[c]	11/60	MM100/EL90	153	216
Airfield services[c]	70xx	MM90	230	187
Administrative clerk (LJ)[d]	0151	CL100	640	391
Administrative clerk (P)	0151	CL100	640	387
Communication center	2542	CL110	334	184
Supply stock control	3043	CL110	665	363
Intelligence/operations[c]	02/70	CL100/GT100	157	99
Supply[c]	30/60	CL80/90/100	583	412
Finance/accounting[c]	34xx	CL110/GT110	277	99
Field radio operator	2531	EL90	903	361
Basic electronics[e]	2800	EL115	412	559
Basic electronics[e]	5900	EL110	744	1,124
Ammunition storage	2311	GT90	164	143
Logistics[c]	04xx	GT100	188	94
Food services[c]	33xx	GT90	613	210
Aviation ordnance[e]	65xx	GT100	381	104
Rifleman (LJ)	0311	CO80	2,508	934
Rifleman (P)	0311	CO80	1,269	179
Machine gunner (LJ)	0331	CO80	511	322
Machine gunner (P)	0331	CO80	179	26
Mortarman (LJ)	0341	CO80	502	385
Mortarman (P)	0341	CO80	209	35
Assaultman (LJ)	0351	CO80	510	364
Assaultman (P)	0351	CO80	224	34

TABLE 4 (Continued)

Title	Code	Prerequisite score[a]	Number of cases[b] 8/9/10	5/6/7
Fire control	0844	FA110	208	150
Amphibian crew	1833	FA90	302	-
Antiair[c]	72xx	FA90/GT100	219	183

a. ASVAB 8/9/10 aptitude composite qualifying score: MM = Mechanical Maintenance; CL = Clerical; EL = Electronics Repair; GT = General Technical; CO = Combat; FA = Field Artillery.

b. Cases tested with ASVAB 8/9/10 or ASVAB 5/6/7.

c. Pooled sample; specialties are listed in appendix B.

d. Samples marked LJ were taught at Camp Lejeune; samples marked P were taught at Camp Pendleton.

e. This is a prerequisite course for follow-on specialty training courses.

TABLE 5

MEAN VALIDITY OF ASVAB 8/9/10 SUBTESTS

Occupational cluster	ASVAB 8/9/10 subtest[a] VE	GS	AR	MK	AS	MC	EI	NO	CS	Number of samples
Part A. Sample Validity Coefficients[b]										
Mechanical Maintenance	22	22	22	22	33	29	28	6	9	9
Clerical	26	21	33	38	11	19	15	17	22	7
Electronics Repair	20	24	26	33	15	23	20	13	10	3
General Technical	28	29	32	34	20	27	22	9	12	4
Combat	22	24	24	26	21	25	20	10	10	8
Field Artillery	21	28	36	34	32	30	26	20	27	3
Part B. Estimated Population Validity Coefficients[b]										
Mechanical Maintenance	56	57	57	53	55	56	58	42	37	9
Clerical	59	52	59	61	32	44	45	51	49	7
Electronics Repair	58	61	64	64	45	55	56	48	40	3
General Technical	63	62	65	63	46	55	55	51	46	4
Combat	43	44	45	44	35	41	40	35	30	8
Field Artillery	54	55	59	55	50	53	52	48	46	3

a. VE = Verbal, sum of Word Knowledge and Paragraph Comprehension
GS = General Science
AR = Arithmetic Reasoning
MK = Math Knowledge
AS = Auto/Shop Information
MC = Mechanical Comprehension
EI = Electronics Information
NO = Numerical Operations
CS = Coding Speed

b. Decimals omitted.

All of the validity coefficients are positive, which indicates that all ASVAB subtests have predictive validity for all Marine Corps occupational training courses. This result is hardly surprising, because the ASVAB subtests are included in the battery on the basis of their validity and reliability.

To be useful for selection and assignment purposes, the validity coefficients should have two properties: First, they should have high absolute validity, which the estimated population values do have (they range from .30 to .65); second, they should have differential validity, which means that the profiles of validity coefficients for the subtests should be different. The profiles do show some differences, with the most notable being for AS, NO, and CS between the Mechanical Maintenance and Clerical clusters.

The estimated population coefficients are:

	Subtest		
Cluster	AS	NO	CS
Mechanical	.55	.42	.37
Clerical	.32	.51	.49

The differences for the other subtests and occupational clusters are smaller.

The mean validity coefficients of the Marine Corps ASVAB 8/9/10 aptitude composites and the AFQT are shown in table 6. The validity coefficient of each aptitude composite for the associated occupational cluster is underlined. If the definition of the aptitude composites is optimal, the underlined coefficient should be the highest value in each row. Only the Electronics Repair cluster is most predictable by the associated aptitude composite. All other clusters are as predictable or more predictable by other aptitude composites or by the AFQT. The absolute values of the validity coefficients are satisfactory, but the differential validity of the aptitude composites needs to be improved.

The analysis that led to an improved set of aptitude composites is described in the next section.

TABLE 6

MEAN VALIDITY OF ASVAB 8/9/10 APTITUDE COMPOSITES AND AFQT

Occupational cluster	Symbol	AFQT[b]	ASVAB 8/9/10 composite[a] MM	CL	EL	GT	CO	FA
Mechanical Maintenance	MM	59	<u>64</u>	51	63	60	63	65
Clerical	CL	64	52	<u>60</u>	61	63	58	59
Electronics Repair	EL	65	63	56	<u>69</u>	66	63	65
General Technical	GT	68	63	61	69	<u>69</u>	66	68
Combat	CO	47	46	42	49	47	<u>47</u>	48
Field Artillery	FA	61	61	57	62	60	62	<u>63</u>

a. Used from 1 October 1980 to 1 October 1984 (decimals omitted).
b. Armed Forces Qualification Test.

APTITUDE COMPOSITES AND OCCUPATIONAL CLUSTERS FOR ASVAB 11/12/13

The first step in developing new aptitude composites and the associated occupational clusters for ASVAB 11/12/13 was to compute regression equations for each sample:

$$grade = a + b_1 Verbal + b_2 Math + b_3 Tech + b_4 Speed + error$$

where

a = constant

b_i = regression weight for factor i .

The subtests in each factor are:

Verbal – General Science and Verbal (Word Knowledge and Paragraph Comprehension)

Mathematical – Arithmetic Reasoning and Math Knowledge

Technical – Auto/Shop Information, Mechanical Comprehension, and Electronics Information

Speed – Numerical Operations and Coding Speed.

The factor loadings and intercorrelation of the factors are shown in appendix A. As discussed in chapter 1, the regression weights for factor composites are more stable than for the individual subtests. Separate regression equations were computed for recruits tested with ASVAB 8/9/10 and ASVAB 5/6/7.

The regression weights for the factor composites in each sample are shown in table 7. The results may be characterized as follows:

- The mathematical factor composite has a high weight for all samples, and the weights are stable between the ASVAB 8/9/10 and ASVAB 5/6/7 subsamples. All aptitude composites should contain at least one math subtest.

- The technical factor composite has high, stable weights for the Mechanical Maintenance, Field Artillery, and Electronics Repair occupational clusters. It has a very low weight (essentially zero) for the Clerical specialties. Technical subtests should not be included in the Clerical aptitude composite.

- The speed factor composite has high stable weights for the Clerical specialties and generally high stable weights for the Field Artillery specialties. The speed composite tends to have low weights for the Mechanical Maintenance specialties.

- The verbal factor composite has high stable weights for the General Technical specialties and for most Clerical specialties. It has a low weight for many Mechanical Maintenance specialties.

An issue directly related to the definition of the aptitude composites, in terms of the subtests in each, is the clustering of the occupational specialties. Although the regression equations for some specialties deviate from others in the same cluster, no consistent pattern emerged that warranted a reshuffling of the specialties. The ASVAB 8/9/10 verbal factor composite has high weights in three specialties from the Mechanical Maintenance cluster dealing with aircraft (aircraft mechanic, aircraft maintenance, and airfield services). Two

TABLE 7

REGRESSION WEIGHTS[a] OF FACTOR COMPOSITES

Sample: Title	Code	ASVAB 8/9/10[b] Verbal	Math	Technical	Speed	ASVAB 5/6/7[c] Verbal	Math	Technical	Speed	Multiple correlation[a] 8/9/10	5/6/7
Mechanical Maintenance											
Engineer equipment operator	1345	.05	.10	.14	.10	−.02	.18	.15	.00	.33	.43
Combat engineer	1371	.02	.19	.16	.05	.06	.21	.20	.03	.51	.65
Automotive mechanic	3521	−.02	.07	.27	.06	.03	.14	.22	.05	.55	.61
Aircraft mechanic	6011	.14	.10	.12	.03	.26	.20	.04	.14	.38	.47
Helicopter mechanic	6111	.06	.13	.14	.15	.03	.24	.10	−.23	.35	.48
Tracked vehicle repair	13/21	.00	.10	.22	.09	−.04	.08	.26	.07	.44	.47
Aircraft maintenance	60xx	.13	.11	.17	−.01	−.02	.22	.19	.04	.44	.49
Electrical equipment repair	11/60	−.08	.22	.22	.17	.05	.12	.20	.05	.47	.45
Airfield services	70xx	.09	.02	.12	−.01	.14	.06	.23	.21	.31	.52
Mean		.04	.11	.17	.07	.05	.16	.17	.04		
Clerical											
Administrative clerk, LJ[d]	0151	.19	.25	−.07	.07	.20	.23	−.05	.18	.38	.53
Administrative clerk, P[d]	0151	.01	.15	.03	.11	.04	.17	.00	.18	.30	.38
Communications	2542	.11	.17	.02	.06	.10	.11	.04	.18	.38	.36
Supply control	3043	.10	.29	.01	.20	.07	.41	.02	.04	.59	.58
Intelligence/operations	02/70	.10	.17	.04	.17	.03	.03	.07	.24	.45	.29
Supply	30/60	.05	.25	−.03	.21	.03	.20	.06	.26	.37	.46
Finance/accounting	34xx	.19	.43	−.05	.00	.13	.41	.02	.16	.54	.65
Mean		.09	.24	−.01	.12	.09	.22	.02	.18		

TABLE 7 (Continued)

Sample		ASVAB 8/9/10[b]				ASVAB 5/6/7[c]				Multiple correlation[a]	
Title	Code	Verbal	Math	Technical	Speed	Verbal	Math	Technical	Speed	8/9/10	5/6/7
Electronics Repair											
Radio operator	2531	.07	.10	.04	.12	.12	.10	.13	.12	.24	.45
Basic electronics	2800	.21	.34	.11	.08	-.01	.32	.13	.13	.55	.51
Basic electricity and electronics	5900	.11	.34	.09	.06	-.05	.09	.24	.31	.46	.41
Mean		.13	.26	.08	.09	.02	.17	.17	.19		
General Technical											
Ammunition storage	2311	.16	.25	.06	.05	.10	.15	.12	-.01	.46	.52
Logistics	04xx	.14	.15	-.02	-.02	.07	.25	.09	.31	.38	.43
Food services	33xx	.12	.09	.14	.22	.13	.26	.08	.14	.46	.59
Aviation ordnance	65xx	.06	.30	.13	.08	.42	.22	.07	.01	.51	.55
Mean		.13	.19	.08	.08	.18	.22	.09	.06		
Combat[d]											
Rifleman, LJ	0311	.08	.15	.09	.04	.16	.12	.04	.08	.44	.45
Rifleman, P	0311	.07	.11	.03	.07	.04	.22	.07	-.06	.27	.38
Machine gunner, LJ	0331	.08	.11	.09	.02	.11	.15	.06	.01	.39	.37
Machine gunner, P	0331	.09	.09	.09	.10	–	–	–	–	.31	–
Mortarman, LJ	0341	.10	.09	.10	.15	.22	.16	.06	-.01	.41	.55
Mortarman, P	0341	.00	.11	.03	.08	–	–	–	–	.18	–
Assaultman, LJ	0351	.11	.10	.09	.04	.17	.09	.14	.16	.43	.47
Assaultman, P	0351	.02	.12	.07	.04	–	–	–	–	.25	–
Mean		.07	.11	.07	.07	.14	.15	.07	.02		

TABLE 7 (Continued)

Sample		ASVAB 8/9/10[b]				ASVAB 5/6/7[c]				Multiple correlation[a]	
Title	Code	Verbal	Math	Technical	Speed	Verbal	Math	Technical	Speed	8/9/10	5/6/7
Field Artillery											
Fire control	0844	−.13	.21	.13	.27	−.05	.36	.11	.07	.51	.60
Amphibious crew	1833	.14	.11	.14	.23	–	–	–	–	.52	–
Anti-air	72xx	.06	.13	.13	−.12	−.00	.20	.24	.06	.48	.51
Mean		.02	.15	.13	.13	−.03	.28	.17	.06		

a. Sample values.

b. ASVAB 8/9/10 factor composites: Verbal = Verbal score + General Science; Math = Arithmetic Reasoning + Math Knowledge; Technical = Auto/Shop Information + Mechanical Comprehension + Electronics Information; Speed = Numerical Operations + Coding Speed.

c. ASVAB 5/6/7 factor composites: Verbal = Word Knowlege + General Science; Math = Arithmetic Reasoning + Math Knowledge; Technical = Automotive Information + Mechanical Comprehension + Electronics Information; Speed = Numerical Operations.

d. Samples marked LJ were taught at Camp Lejeune; samples marked P were taught at Camp Pendleton.

of the three weights for the ASVAB 5/6/7 verbal factor also are high. However, the helicopter mechanic specialty has low weights for the verbal factor, as does the electrical equipment repair pooled sample, which includes an aircraft specialty.

In the Combat cluster, the instability of the verbal factor weight is even more apparent. Each combat specialty is taught at two locations – Camp Lejeune and Camp Pendleton. For the Camp Lejeune samples (marked with an LJ in table 7), the verbal composite tends to have a larger weight than when the same specialty is taught at Camp Pendleton (marked with a P). A similar result is obtained for the administrative clerk course, also taught at Camps Lejeune and Pendleton. The differences in the regression equations for courses taught at Camps Lejeune and Pendleton probably reflect different instructional procedures.

The different regression equations for the aircraft specialties may reflect different job requirements, or they may simply reflect different instructional strategies. If a separate cluster of aircraft specialties, as distinct from helicopter and ground vehicle maintenance specialties, were to be established, a more thorough content analysis of job requirements and training strategies would be required. If instructional strategy accounts for differences in regression equations, as appears to be the case between Camp Lejeune and Camp Pendleton, then the issue of the proper criterion measure for validating the selection and assignment of recruits requires a thorough analysis (see chapter 4).

The clusters of specialties as shown in table 7 were used in the analysis to define new aptitude composites for ASVAB 11/12/13; that is, combinations of subtests were found that best predicted the specialties in each cluster as a whole.

As a starting point to identify the subtests in each composite, the mean regression weights for the factor composites (table 8) suggest the following general definitions:

Mechanical Maintenance	(MM)	–	Math + Technical
Clerical	(CL)	–	Verbal + Math + Speed
Electronics Repair	(EL)	–	Verbal + Math and perhaps Technical

General Technical	(GT)	–	Verbal + Math and perhaps Technical and Speed
Combat	(CO)	–	Verbal + Math + Technical
Field Artillery	(FA)	–	Math + Technical + Speed.

TABLE 8

ASVAB 8/9/10 MEAN REGRESSION WEIGHTS

Occupational cluster	Verbal	Math	Technical	Speed
Mechanical Maintenance	.05	.11	.17	.05
Clerical	.12	.23	–.01	.12
Electronics Repair	.13	.26	.08	.07
General Technical	.13	.19	.08	.08
Combat	.07	.11	.07	.04
Field Artillery	.03	.14	.13	.14

The MM, CL, and EL composites have rather distinct content. These three composites and associated occupational clusters have been used by all military services since the inception of selection and classification test batteries. The only question about them is the exact subtests to use in each composite.

The other three composites and occupational clusters (GT, CO, and FA) have a less stable history. The GT cluster has long served as a repository for diverse specialties that do not fit into the other clusters. The aptitude requirements for the combat arms specialties of infantry, armor, and field artillery are hard to conceptualize and even more difficult to validate in a realistic combat environment. No solution has been devised that satisfies rational considerations about known job requirements and good measurement practice for assigning recruits to the combat arms specialties. Thus, considerable judgment is required to define the aptitude composites for the General Technical, Combat, and Field Artillery clusters.

Clerical = 4.848 + .943X

General Technical = 0.270 + 1.006X,

where X is the sum of subtest standard scores for the ASVAB 5/6/7 composites as defined earlier on the World War II scale.

The multiple correlation coefficients for the full and restricted models are shown in table 12. The significance of the difference between the two multiple correlation coefficients for each course is also shown. The two correlation coefficients usually are not significantly different, which means that the interaction terms do not significantly increase the accuracy of prediction. For four courses, the interaction terms are significant at the 1-percent level, and for two courses they are significant at the 5-percent level. No consistent pattern of significant interaction terms appeared, and in further analyses only the restricted model was used.

The absence of consistent interaction effects implies that equal changes in the aptitude composite scores are related to the same average amount of change in predicted performance. The next question is whether the intercepts are equal for the categories of each social group or whether one category has a different level of predicted performance. The regression weights in the restricted model are direct indicators of the difference in predicted performance for the two categories of each social group.

In table 13 the regression weights are presented (sample values, not corrected for restriction in range) for the aptitude composites and the social groups. The validity coefficients (uncorrected for restriction in range) are also shown for the aptitude composite score by itself and the multiple correlation for the aptitude composite score plus the social groups. The difference between the validity coefficients for the composite by itself and the multiple correlation shows the effect of the groups on predictive validity. For most courses, the difference in validity is .02 or less, but it does range up to .06 (for the airfield services and logistics samples).

The rules for interpreting the regression weights in table 13 are as follows:

- Weights without an asterisk are not statistically significant; those with a double asterisk are significant at the 1-percent level of confidence; and those with a single asterisk, at the 5-percent level of confidence.

The statistics used in the linear model are the values obtained for each sample rather than the population estimates. One reason for using these values is that the statistical significance of the regression weights is important in interpreting the results, and the significance of the weights estimated for the population cannot be computed. Another reason is that population estimates for the dichotomous variable do not make sense. The variance of the dichotomous dummy variables is a direct function of the proportions in each category; the statistical correction for restriction in range would change the proportions, but not necessarily make them more accurate estimates of the population values. The population estimates for the dummy variables could in fact be in greater error than the sample values.

In this analysis to evaluate the effects of social groups on ASVAB validity, the data for ASVAB 8/9/10 and ASVAB 5/6/7 were combined. Because ASVAB 5/6/7 did not contain the same subtests as ASVAB 8/9/10, adjustments were required when using the ASVAB 5/6/7 subtests to estimate the ASVAB 11/12/13 composites. The ASVAB 11/12/13 composites along with their approximations from the ASVAB 5/6/7 subtests are defined as follows:

Composite	ASVAB 11/12/13	ASVAB 5/6/7
MM	AR + AS + MC + EI	AR + AI + MC + EI
CL	VE + MK + CS	WK + MK + NO
EL	GS + AR + MK + EI	GS + AR + MK + EI
GT	VE + AR + MC	WK + AR + MC

Automotive Information (AI) was used instead of AS in MM; Word Knowledge (WK), instead of VE in CL and GT; and Numerical Operations (NO), instead of CS in CL.

Also, because the ASVAB 8/9/10 scores were on the 1980 score scale and the ASVAB 5/6/7 scores on the World War II score scale, the ASVAB 5/6/7 scores had to be equated to the ASVAB 8/9/10 scores. The equating was accomplished by a linear transformation of the ASVAB 5/6/7 scores. The formulas to transform the ASVAB 5/6/7 sums of subtest standard scores from the World War II scale to the 1980 scale are as follows:

Mechanical Maintenance = 5.313 + 1.013X

Electronics Repair = 2.810 + .986X

The second equation computed for each sample has the interaction terms deleted. This equation is called the restricted model. In this analysis it includes the following terms:

$$Y = b_0 + b_1 R + b_2 E + b_3 G + b_4 C + e,$$

where the terms are defined as above.

The statistical significance of the interaction effects is tested with the following F ratio [4]:

$$F = \frac{(R^2_{full} - R^2_{restricted})/df_1}{(1 - R^2_{full})/df_2},$$

where

R^2_{full} = squared multiple correlation for full model

$R^2_{restricted}$ = squared multiple correlation for restricted model

df_1 = degrees of freedom for numerator, defined as the number of independent terms in the full model minus the number of terms in the restricted model

df_2 = degrees of freedom for denominator, defined as the sample size minus the number of terms in the full model.

If the multiple correlation coefficients are not significantly different, the interaction terms can be dropped. The slope for predicting grades from the aptitude composites then is safely assumed to be equal for all subgroups. The interpretation of equal slopes is that a given change of composite scores results in the same amount of change in the predicted training grades for all subgroups. The desired outcome is that the interaction effects not be significant. If the interaction effects are not significant, the regression weights for the social groupings have direct meaning. They portray the difference in predicted grades for the two levels of each grouping. The statistical significance of these regression weights is routinely computed as part of the analysis.

Regression Analysis

The statistical procedures for evaluating the effects of social groupings on ASVAB validity involve computing regression equations that include aptitude composites and the social groupings. Dummy variables were established for the social groupings: 1 was assigned to whites and 0 to blacks and other minorities; 1 to graduates and 0 to nongraduates; and 1 to males and 0 to females.

Two regression equations were computed for each sample. The first equation was to determine whether the interaction between aptitude composites and grouping is significant. The interaction terms are obtained by multiplying the aptitude composite scores and the dummy variables. The regression equation, including all the interaction terms, is called the full model [6]. The full model is:

$$Y = b_0 + b_1R + b_2E + b_3G + b_4C + b_5R \times C + b_6E \times C + b_7G \times C + e,$$

where

Y	=	training course grade
b_0	=	regression constant
b_i	=	regression weight for variable i
R	=	racial/ethnic grouping (1 for whites, 0 for others)
E	=	educational level (1 for graduates, 0 for nongraduates)
G	=	gender (1 for males, 0 for females)
C	=	aptitude composite associated with the sample
R × C, E × C, and G × C	=	interaction terms between social grouping and aptitude composite
e	=	residual error.

groupings with the same ASVAB scores perform equally well. The rationale for this procedure follows directly from the way tests are used by the military services. Personnel decisions about qualification for enlistment and assignment to occupational specialties are made about individuals. The validity of the decisions depends on the degree of relationship between individuals' test scores and their subsequent performance in training courses. The relationship is not perfect, and individuals deviate from the regression line. These errors in prediction are assumed to be random, reflecting unique characteristics of individuals rather than systematic differences between social groupings. If the errors in prediction are systematically related to membership in a group, such as nongraduates of high school, then the scores have a different meaning for that group and the test is not equitable.

The question of bias against racial minorities has been extensively evaluated by the military services. The consistent finding is that the ASVAB and predecessor selection and classification tests are not biased against blacks. There is less evidence for ethnic groups because there are too few in most samples to analyze as a separate subgroup. In this analysis, blacks, Hispanics, and other minorities were grouped and contrasted with whites.

Educational level has been a major consideration by all services in setting enlistment standards, with standards for nongraduates set substantially higher than for graduates. In addition, the Marine Corps has set the prerequisite score for assigning nongraduates to an occupational specialty at a level ten points higher than for graduates. A consistent finding is that the predicted performance of nongraduates tends to be lower than that for graduates with the same aptitude scores. The additional ten points, equal to one-half of a standard deviation on the aptitude composites, tends to equalize predicted performance at the minimum qualifying level between the two groups.

Research efforts on bias against or in favor of females compared to males have yet to establish a consistent body of findings. There is some indication in the military services that the performance of females is underpredicted in occupations that traditionally have contained many females, notably clerical and food service occupations. For occupations that traditionally contain few females, such as mechanical and electronics maintenance, the evidence has been too sparse to note trends. The findings from this analysis will help clarify questions about fairness for females. A larger joint-service effort is also under way to examine the fairness of the ASVAB for females.

CL for the associated occupational clusters:

Cluster	Validity MM	Validity CL
Mechanical Maintenance	.64	.57
Clerical	.52	.65

These differences in validity imply that the composites are reasonably accurate in distinguishing clerks from mechanics. Thus, the assignment of recruits with high CL scores to clerical specialties does not significantly affect the number of recruits qualified for mechanical specialties. However, because the validity profiles for the other two occupational clusters (EL, GT) are similar, recruits with high predicted performance in one cluster also tend to have high predicted performance in the other cluster. Assignment to one cluster will have an effect on the assignments to the other. From the point of view of differential classification and assignment, larger differences in the validity profiles would be desirable, but these are the differences found in this set of data and in other sets of similar data.

The four ASVAB 11/12/13 composites and occupational clusters are a simplification over the six ASVAB 8/9/10 composites and clusters. The subtests in each are reasonable in terms of manifest relationship to job requirements, and similar composites and clusters have a long history of serving military personnel managers.

EFFECTS OF SOCIAL GROUPINGS ON ASVAB VALIDITY

Background

An assumption underlying the use of the ASVAB for personnel decisions is that the scores have essentially the same meaning in terms of predicted performance for all people; that is, test scores are not biased in favor of or against any social grouping. In the 1960s, widespread social concern arose about the fairness of aptitude tests for racial minorities. The concern then grew to include ethnic minorities. Currently social concern about the fairness of tests for females is growing.

The procedure used by military services to examine the question of fairness is to determine whether minority and majority members of social

TABLE 11

DEFINITION AND MEAN VALIDITY OF THE MARINE CORPS APTITUDE COMPOSITES FOR ASVAB 11/12/13

Part A: Definition

		ASVAB 11/12/13 subtest[a]							
Aptitude composite	Symbol	Verbal		Math		Technical			Speed
Mechanical Maintenance	MM			AR		AS	MC	EI	
Clerical	CL		VE		MK				CS
Electronics Repair	EL	GS		AR	MK			EI	
General Technical	GT		VE	AR			MC		

Part B: Mean validity

	Aptitude composite			
Occupational cluster	MM	CL	EL	GT[b]
Mechanical Maintenance	.64	.57	.63	.63
Clerical	.52	.65	.61	.61
Electronics Repair	.63	.63	.69	.67
General Technical	.54	.54	.57	.57

a. See text for titles of subtests.

b. Mean for the merged ASVAB 8/9/10 Combat, Field Artillery, and General Technical clusters.

As already noted, the job requirements for these three clusters hardly justify two mathematics tests in the composite, or, for that matter, the need for formal courses in high-school mathematics, which MK tends to reflect. That leaves AR in the composite.

A verbal test (VE or GS) is indicated by the regression analysis for the General Technical and Combat clusters. Infantry (Combat) specialties do not appear to require a background of training in the biological and physical sciences (GS), but Word Knowledge and Paragraph Comprehension (VE) are defensible aptitude requirements. VE then is appropriate for the General Technical and Combat clusters.

A technical test appeared in all three occupational clusters. In a study to predict job performance as measured by hands-on performance tests for infantry riflemen, the MC subtest had the highest validity (.52) [5]. In the present analysis, a combination of VE + AR + MC had a validity coefficient of .54, which is equal to the combination of VE + AR + AS. MC involves spatial perception, which on a rational basis is related to job requirements in the Combat and Field Artillery clusters. For the General Technical occupational cluster, the mean validity of VE + AR + MC is .69 versus .68 for VE + AR + AS. Therefore, the use of VE + AR + MC for the General Technical cluster has both rational and empirical justification.

The Field Artillery cluster proved troublesome to fit into the set of aptitude composites. Empirically, a separate composite could be justified (AR + MK + AS + CS). This combination of subtests also is rationally related to the job requirement for Field Artillery specialties. The projected number of students in training courses with FA as the prerequisite was only 900 in FY 1981 (table B-1); such a small number hardly warrants a separate composite. Hence, the ASVAB 11/12/13 GT is defined as VE + AR + MC, and it is to be used for assigning recruits to the General Technical, Combat, and Field Artillery specialties.

The definition and mean validity of the four aptitude composites developed in this analysis are shown in table 11. The validity of each composite for each sample is shown in appendix C. The absolute magnitude of the validity coefficients is satisfactory – the ASVAB is an effective instrument for selecting Marine recruits. But the differential validity of the composites is modest. The largest differences in validity coefficients are between MM and

The occupational composites are similar or identical to those found in this analysis of Marine Corps training courses (table 10):

Composite	Subtests							
Mechanical and Crafts			AR		AS	MC	EI	
Mechanical Maintenance (table 10)		VE	AR		AS		EI	
Business and Clerical		VE		MK				CS
Clerical (table 10)		VE		MK				CS
Electronics and Electrical	GS		AR	MK			EI	
Electronics Repair (table 10)	GS		AR	MK			EI	
Health, Social, and Technology		VE	AR			MC		
General Technical (table 10)		VE	AR	MK	AS			

The Business and Clerical composite is identical to Clerical (CL), and the Electronics and Electrical composite identical to Electronics Repair (EL). The Mechanical and Crafts composite is identical to the Marine Corps Mechanical Maintenance (MM) composite that was used with ASVAB 8/9/10. By deleting VE and adding *MC to MM in table 10, the Marine Corps MM composite for* ASVAB 11/12/13 would be the same as the high-school equivalent and as MM for ASVAB 8/9/10. The loss in predictive validity for the unit-weighted MM composite with MC replacing VE is .01, from .66 to .65. In the interest of consistency with the high-school Mechanical and Crafts composite and the Marine Corps ASVAB 8/9/10 MM, the Marine Corps ASVAB 11/12/13 MM composite could be defined as AR + AS + MC + EI.

Defining GT, CO, and FA

On both rational and empirical bases, the General Technical (GT) cluster for ASVAB 11/12/13 is defined as VE + AR + MC, which is identical to the Health, Social, and Technology composite for ASVAB 14. The Combat (CO) and Field Artillery (FA) clusters are merged with the GT cluster, and the CO and FA composites are deleted. The process of arriving at this outcome is explained below.

obtained from table 10 is identical to the EL used with ASVAB 8/9/10: GS + AR + MK + EI. The definition of MM is reasonable (VE + AR + AS + EI), but it differs somewhat from the MM used with ASVAB 8/9/10 (AR + AS + EI + MC).

The other three clusters did not result in aptitude composites that are rationally satisfactory. Both AR and MK had large beta weights for all three clusters; but the job requirements, for rifleman and cook, for example, hardly warrant such a heavy emphasis on mathematics. Other considerations, in addition to the analytical results, are needed to define the aptitude composites for the General Technical, Combat, and Field Artillery clusters.

ASVAB 14 Composites

One important consideration in defining the Marine Corps aptitude composites is consistency with the composites used in the High School Testing Program. Form 14 of the ASVAB (ASVAB 14) is administered to about one million high-school and postsecondary students each year. Many of the ASVAB 14 examinees are interested in joining a military service. If the aptitude composite scores reported to high-school students were the same as the Marine Corps composites, then recruiting for the Marine Corps may be enhanced; high-school counselors could advise students about the Marine Corps specialties for which they qualify, and the students could discuss their qualifications with friends and parents. The ASVAB 14 composites are:

Composite	Subtests
Occupational	
Mechanical and Crafts	AR + AS + MC + EI
Business and Clerical	VE + MK + CS
Electronics and Electrical	GS + AR + MK + EI
Health, Social, and Technology	VE + AR + MC
Academic	
Academic Ability	VE + AR
Verbal	VE + GS
Math	AR + MK

TABLE 10

STEPWISE REGRESSION FOR ASVAB 8/9/10 MEAN VALIDITY VECTORS

Occupational cluster	Number of courses	Verbal		Math		Technical			Speed		Multiple correlation	
		GS	VE	AR	MK	AS	MC	EI	NO	CS	Subtest	Maximum
Mechanical Maintenance	9		.19	.22		.24		.12			.66	.67
Clerical	7		.26		.35					.16	.67	.67
Electronics Repair	3	.18		.19	.28			.13			.70	.70
General Technical	4		.26	.20	.23	.12					.71	.71
Combat	8	.15		.14	.18	.11					.49	.50
Field Artillery	3			.20	.15	.28				.21	.67	.67

TABLE 9 (Continued)

Sample		Beta weight[b]										Multiple correlation[c]	
		Verbal			Math		Technical			Speed			
Title	Code	GS	WK	PC	AR	MK	AS	MC	EI	NO	CS	Selected subtests	Maximum
General Technical													
Ammunition storage	2311		.26		.24	.15		.15				.71	.72
Logistics	02xx	.18		.21		.30					.14	.70	.72
Food services	33xx	.22			.18		.24			.22		.70	.71
Aviation ordnance	65xx			.15	.18	.37	.23					.78	.78
Combat[d]													
Rifleman, LJ	0311	.11		.13	.30		.16					.60	.61
Rifleman, P	0311			.16	.10			.09				.44	.45
Machine gunner, LJ	0331		.19		.16	.15	.20					.59	.60
Machine gunner, P	0331	.12				.24	.22					.48	.50
Mortarman, LJ	0341		.19		.21		.20			.18		.63	.64
Mortarman, P	0341			.08	.19						.16	.37	.38
Assaultman, LJ	0351		.31			.17		.12	.16			.66	.67
Assaultman, P	0351					.17		.22				.34	.41
Field Artillery													
Fire control	0844				.37		.16			.17	.17	.70	.71
Amphibian crew	1833				.21		.21			.21		.74	.75
Anti-air	72xx					.21	.36				.21	.60	.61

a. See table 5 for titles of subtests.

b. Beta weights are estimated population values.

c. Multiple correlation is based on only the selected set of subtests (with beta weights shown) and on all subtests in the battery (maximum).

d Samples marked LJ were taught at Camp Lejeune; samples marked P were taught at Camp Pendleton.

TABLE 9

STEPWISE REGRESSION FOR ASVAB 8/9/10 SUBTESTS[a]

Sample		Beta weight[b]										Multiple correlation[c]	
		Verbal			Math		Technical			Speed			
Title	Code	GS	WK	PC	AR	MK	AS	MC	EI	NO	CS	Selected subtests	Maximum
Mechanical Maintenance													
Engineer equipment operator	1345	.13			.19		.29			.12		.59	.59
Combat engineer	1371			.18	.20	.16	.34					.72	.73
Automotive mechanic	3521					.20	.42		.23			.73	.74
Aircraft mechanic	6011		.32			.19		.12	.17			.69	.70
Helicopter mechanic	6111			.15	.19				.31	.13		.65	.66
Tracked vehicle repair	13/21			.22	.23		.27	.16				.74	.74
Aircraft maintenance	60xx	.10		.28		.18	.34					.73	.74
Electrical equipment repair	60/11				.21	.22	.21		.22			.73	.75
Airfield services	70xx	.10	.12				.26				.14	.50	.51
Clerical													
Administrative clerk, LJ[d]	0151		.31			.30					.14	.65	.66
Administrative clerk, P[d]	0151		.12			.23	.10				.18	.51	.52
Communications	2542		.14			.31			.11		.10	.56	.57
Supply stock control	3043			.21	.26	.26				.18		.80	.81
Intelligence/operations	02/70			.21		.30		.12			.19	.68	.69
Supply	30/60			.19		.35					.24	.65	.66
Finance/accounting	34xx		.20		.26	.33					.15	.81	.82
Electronics Repair													
Radio operator	2531					.23			.20	.14		.48	.48
Basic electronics	2800	.28			.21	.30		.16				.84	.84
Basic electricity and electronics	5900				.13	.43	.22					.67	.67

Regression Equations for Samples

A stepwise regression analysis was performed for each sample (as shown in table 9):

$$grade = a + b_i Subtest_i + error,$$

where

a = constant

b_i = regression weight for each ASVAB subtest.

The ASVAB 8/9/10 subtests in table 9 are grouped by factor composite. The Word Knowledge (WK) and Paragraph Comprehension (PC) subtests were kept separate when computing these regression equations. The intent was to determine whether PC added unique validity above that from WK. Because PC had large beta weights, its validity is not completely dominated by WK, and in subsequent analyses it is combined with WK to form the verbal (VE) score. The VE score is used in subsequent analyses.

The results for the individual subtests generally support those for the factor composites. The definition of the Clerical composite for ASVAB 11/12/13 is clearcut from table 9: VE (WK + PC) + MK + CS. The question arises, however, as to whether a separate composite containing both AR and MK should be used for the supply stock control and finance/accounting specialties. Because the gain in predictive validity by adding AR would be small (a maximum of .02), these specialties were retained in the Clerical cluster.

No clear pattern of subtest beta weights emerged for the other clusters. The regression weights of subtests for individual courses tend to fluctuate because of sampling variability; therefore, greater stability in the regression weights is likely to be found by analyzing the vector of mean validity coefficients. The vector of mean validity coefficients (population estimates) was computed, and a stepwise regression analysis for each cluster (table 10) was performed. The results are reasonable for most clusters. The definition of CL is confirmed: VE + MK + CS. The definition of EL for ASVAB 11/12/13

TABLE 12

DIFFERENCE BETWEEN FULL AND RESTRICTED LINEAR MODELS

Sample		Correlation[a]		
Title	Code	Full	Restricted	F value of difference[b]
Mechanical Maintenance				
Engineer equipment operator	1345	.35	.34	1.05
Combat engineer	1371	.60	.60	.71
Automotive mechanic	3521	.62	.61	2.31
Aircraft mechanic	6011	.40	.40	.64
Helicopter mechanic	6111	.29	.29	.16
Tracked vehicle repair	13/21	.54	.54	.74
Aircraft maintenance	60xx	.44	.44	1.29
Electrical equipment repair	60/11	.44	.42	1.78
Airfield services	70xx	.47	.46	1.39
Clerical				
Administrative clerk	0151	.48	.48	.92
Administrative clerk	0151	.36	.35	2.57
Communications	2542	.37	.37	.88
Supply stock control	3043	.55	.55	.82
Intelligence operations	02/70	.42	.42	.17
Supply	30/60	.42	.42	.53
Finance/accounting	34xx	.52	.52	.70
Electronics Repair				
Radio operator	2531	.37	.36	3.71*
Basic electronics	2800	.49	.48	1.98
Basic electricity and electronics	5900	.46	.45	4.05**
General Technical				
Ammunition storage	2311	.53	.53	.55
Logistics	04xx	.39	.33	4.73**
Food service	33xx	.48	.48	.45
Aviation ordnance	65xx	.45	.44	2.12
Combat				
Rifleman	0311	.40	.40	6.95**
Rifleman	0311	.30	.30	1.23
Machine gunner	0331	.36	.34	5.39**
Machine gunner	0331	.30	.30	.23

TABLE 12 (Continued)

Sample		Correlation[a]		
Title	Code	Full	Restricted	F value of difference[b]
Mortarman	0341	.44	.44	.25
Mortarman	0341	.24	.21	1.97
Assaultman	0351	.39	.38	3.64*
Assaultman	0351	.29	.28	.57
Field Artillery				
Fire control	0844	.50	.50	.60
Amphibian crew	1823	.46	.45	.56
Anti-air	72xx	.47	.45	2.65

a. Multiple correlation for the sample is uncorrected for restriction in range; the full model includes interaction terms; the restricted model includes only linear terms.

b. F ratios significant at the 1-percent level are shown by **; those significant at the 5-percent level are shown by *.

TABLE 13

EFFECTS OF SOCIAL GROUPINGS ON VALIDITY OF APTITUDE COMPOSITES

Sample		Regression weight[a]				Validity[b]	
Title	Code	Composite[c]	Race	Education	Gender	Composite	Multiple
Mechanical Maintenance							
Engineer equipment operator	1345	.24**[d]	1.46	2.17*	1.18	.33	.34
Combat engineer	1371	.38**	2.38*	2.58**	–	.58	.60
Automotive mechanic	3521	.40**	1.29	5.09**	1.88	.58	.61
Aircraft mechanic	6011	.36**	– 3.21**	2.40**	– 3.90*	.38	.40
Helicopter mechanic	6111	.25**	– 2.21	.97	–	.28	.29
Tracked vehicle repair	13/21	.41**	– .07	3.33**	– 7.88**	.50	.54
Aircraft maintenance	60xx	.36**	– .69	2.74**	– .99	.43	.44
Electrical equipment repair	60/11	.36**	– 1.22	– .01	– .95	.42	.42
Airfield services	70xx	.25**	4.82**	1.78	7.60**	.40	.46
Clerical							
Administration	0151	.31**	.41	2.16*	– 3.27**	.44	.48
Administration	0151	.25**	1.38*	2.47**	– 2.77*	.32	.35
Communications center	2542	.29**	– .46	.98*	– 1.92	.36	.37
Supply stock control	3043	.45**	1.33	2.29*	– .60	.54	.55
Intelligence/operations	02/70	.38**	– 2.90	.14	– 1.68	.40	.42
Supply	30/60	.36**	– .01	3.50**	– 1.83	.40	.42
Finance and accounting	34xx	.50**	– .54	.34	– .44	.52	.52
Electronics Repair							
Radio operator	2531	.28**	.66	3.39**	– .47	.32	.36
Basic electronics	2800	.48**	– .50	3.32**	– 1.40	.47	.48
Basic electricity and electronics	5900	.52**	– 1.12**	2.39**	– .77	.45	.45

TABLE 13 (Continued)

Sample		Regression weight[a]				Validity[b]	
Title	Code	Composite[c]	Race	Education	Gender	Composite	Multiple
General Technical							
Ammunition storage	2311	.38**	−.13	6.37**	−1.39	.48	.53
Logistics	04xx	.25**	1.99	2.89	−2.89*	.27	.33
Food service	33xx	.32**	3.19**	1.28	−4.41**	.43	.48
Aviation ordnance	65xx	.48**	−1.11	3.71**	.90	.43	.44
Combat							
Rifleman	0311	.26**	1.77**	−.28	–	.39	.40
Rifleman	0311	.26**	−.18	2.57**	–	.27	.30
Machine gunner	0331	.23**	2.08*	−.04	–	.33	.34
Machine gunner	0331	.21**	1.24	2.64	–	.27	.30
Mortarman	0341	.30**	2.23*	−.58	–	.43	.44
Mortarman	0341	.15*	.91	2.21	–	.18	.21
Assaultman	0351	.25**	3.15**	.65	–	.36	.38
Assaultman	0351	.25**	−1.07	1.52	–	.27	.28
Field Artillery							
Fire control	0844	.35**	.45	3.26**	–	.48	.50
Amphibian crew	1833	.34**	1.34	3.18**	–	.42	.45
Anti-air	72xx	.32**	3.56**	−.45	–	.43	.45

a. Regression coefficients are shown for appropriate aptitude composite and subgroups (whites versus blacks and others; high school graduates versus nongraduates; males versus females); sample values are used.
b. Validity coefficients are shown for aptitude composite score by itself and multiple correlation for aptitude composite score plus subgroups. These are uncorrected for restriction in range.
c. The appropriate composite was used for each occupational group.
d. Regression weights significant at the 1-percent level are shown by **; those significant at the 5-percent level are shown by *.

- A negative weight for race means that blacks and other minorities have a higher predicted course grade; a positive weight means that whites have a higher predicted course grade.

- A negative weight for education means that nongraduates have a higher predicted grade; a positive weight, that high-school graduates are higher.

- A negative weight for gender means that females have a higher predicted grade; a positive weight, males.

- The weights show the unique effect of each variable; for example, if the weight for gender is significant, the difference holds, regardless of mean differences between the sexes in aptitude or educational level.

- The weights for the aptitude composites cannot be compared directly to those for the groups because they are on different scales. To find how many composite score points are equivalent to the effect of a group, divide the group weight by the composite weight, and compare this number to the composite standard deviation of 20.

The larger the difference between the validity of the composite by itself and multiple correlation including the groups, the greater the effect of the groups on predictive validity. For example, the first occupational cluster is Mechanical Maintenance, and the first sample is engineer equipment operator, an occupation involving the operation of heavy construction equipment. Appendix B presents the frequencies for each subgroup and the means and standard deviations of the appropriate aptitude composite and course grade for all samples in the study. This sample contained 697 cases. The number of whites in the engineer equipment operator sample was 568, and the number of blacks and other minorities was 129; there were 571 high-school graduates and 126 nongraduates; 24 females and 673 males. The regression weight of the Mechanical Maintenance composite for the engineer equipment operator sample was .24, significant at the 1-percent level of confidence. The weight of .24 means that each point increase on the composite equals a .24-point increase in predicted course grade. For this sample, educational level had a significant effect on predictive validity, with the predicted performance of graduates 2.17 points higher than for nongraduates. Under the "validity" column, the validity (uncorrected for restriction in range) of the Mechanical Maintenance composite for engineer equipment operator by itself was .33; the multiple correlation of the composite plus the subgroups was .34.

The appropriate aptitude composite was significantly related to grades in every course. The aptitude composites have predictive validity regardless of racial/ethnic grouping, educational level, and gender.

For racial/ethnic grouping, no consistent differences emerged. For most courses, the regression weight was not significant.

For education, the tendency is that graduates have higher predicted scores than nongraduates, especially in the more technical samples (Mechanical Maintenance, Clerical, and Electronics Repair). Graduates outperformed nongraduates in 19 of the 34 courses. These results are consistent with previous research findings.

Effects of Gender

For gender, the general tendency was for females to do better than expected compared to males with the same ASVAB scores. In the Clerical and General Technical occupational clusters, the predicted performance of females was higher than for males in every sample except one, with 4 of the 11 differences statistically significant. In the Mechanical Maintenance and Electronics Repair clusters, however, there was no consistent pattern of statistically significant differences in predicted performance between males and females. The number of females in most courses was small, and therefore only large differences would have statistical significance.

The samples with similar job requirements and similar distributions of ASVAB scores were pooled to increase the number of females in each sample (table 14). The sample sizes, means, and standard deviations for the pooled samples are given in appendix B. The results for the pooled samples confirm the pattern for the individual samples:

- Females do significantly better than males with the same ASVAB scores in the Administration, Supply, and Communications pooled sample and in the Food Services and Logistics pooled sample.

- Predicted performance of females and males is not significantly different in the Mechanical Maintenance and Electronics Repair

TABLE 14

EFFECTS OF SOCIAL GROUPINGS IN POOLED SAMPLES

Pooled sample	Multiple correlation		F ratio	Regression weight[a]			
	Full	Restricted		Composite	Race	Education	Gender
Mechanical Maintenance Mechanics, Operators, and Services 1245, 3521, 6011, 13/21, 70xx	.46	.46	1.18	.35**	.35	2.99**	−.29
Repair and Ordnance 60xx, 11/60, 65xx	.41	.41	1.63	.34**	−.92	2.21**	−1.10
Clerical Administration, Supply, Communications 0151, 0151, 2542, 30/60	.35	.35	1.42	.29**	1.28**	2.82**	−2.21**
Supply Stock Control and Finance 3043, 34xx	.54	.54	1.27	.46*	.77	1.77	−.48
Electronics Repair Basic Electronics 2800, 5900	.48	.48	2.47	.45**	−.70	2.09**	−.57
General Technical Food Services and Logistics 33xx, 04xx	.44	.44	.41	.31**	2.89**	1.56*	−3.94**

a. Regression weights significant at the 1-percent level are shown by **; those significant at the 5-percent level are shown by *.

occupational clusters, although the regression weights are negative.

- Predicted performance of females and males in the more technical clerical samples (Supply Stock Control and Finance) is not significantly different.

The trend in these data is that males and females have about the same predicted performance in traditionally male occupations, but in traditionally female occupations females outperform males.

As a final check on the fairness of the ASVAB for females, regression equations were computed in the pooled samples for the people tested with ASVAB 8/9/10 (table 15). In the Electronics Repair sample a large number of people were tested with ASVAB 5/6/7, and regression equations were also computed for them.

The pattern of regression weights tends to be similar for females and males in each sample. Because of the small number of females, few of the regression weights for them are statistically significant, but generally the appropriate subtests have the larger weights. Aside from the underprediction for females in some occupations, there is no reason to question the usefulness of the ASVAB for making personnel decisions about females.

APPROPRIATENESS OF QUALIFYING APTITUDE COMPOSITE SCORES

Traditional Marine Corps policy is to maintain the failure rate in occupational training courses at 10 percent or less. Exceptions occur in specialties that are more difficult to learn, such as electronics repair and weather observation. Prerequisite aptitude composite scores are adjusted to maintain the desired failure rates, with two exceptions: qualifying scores above 110 are used judiciously because relatively few recruits normally score above that range (only about one-third of the 18- to 23-year-old youth population score above 110); qualifying scores below 80 are rarely if ever used (less than one-fourth of the youth population scores below 80). Even though specialties that are easy to learn, such as infantry, have failure rates below 10 percent, the minimum prerequisite score is still set at 80. The reason is that all Marine Corps specialties require minimum basic literary skills, and a score of 80 helps ensure that the people possess these skills. In 1981, the

TABLE 15

REGRESSION WEIGHTS FOR FEMALES AND MALES IN POOLED SAMPLES

Pooled sample	Number of cases	Regression weight for ASVAB 8/9/10 subtest[a] GS	VE	AR	MK	AS	MC	EI	NO	CS	Multiple correlation
Mechanical Maintenance											
Mechanics, Operators, and Service											
Females	98	1.13*[b]	−.25	−.05	.04	.74*	.27	−.04	−.06	.00	.50
Males	1,940	−.03	.15**	.10	.20**	.49**	.18**	.30**	.03	.04*	.41
Repair and Ordnance											
Females	56	−.58	.00	−.28	.56	.88	−.33	.16	.21	−.13	.38
Males	817	.12	.07	.14	.47**	.60**	.15	.15	.01	.08**	.46
Clerical											
Administration, Communications, and Supply											
Females	463	−.16	.33**	.22	.46**	.12	−.02	.02	.00	.06*	.40
Males	1,734	.06	.07	.12	.43**	.03	.10	.11	.02	.09**	.34
Supply Control and Finance											
Females	217	.06	.40**	.57**	.51**	.10	−.19	.26	−.02	.17**	.59
Males	725	.16	.12	.39**	.60**	.19*	−.07	−.05	.08	.08**	.60
General Technical											
Food Service and Logistics											
Females	124	.11	.30	.46	.03	.35	.28	.15	−.02	.10	.39
Males	677	.34**	−.02	.09	.23**	.45**	.27**	.06	.15**	−.01	.51
Electronics Repair											
Basic Electronics											
Females	61	.24	.23	.11	.17	.00	−.14	.00	.03	.03	.20
Males	1,094	.36**	.03	.33**	.66**	.15*	.22**	.29**	.05	.02	.53

TABLE 15 (Continued)

Pooled sample	Number of cases	Regression weight for ASVAB 8/9/10 subtest[a] GS	WK	AR	MK	MC	EI	NO	SP	Multiple correlation
Basic Electronics[c]										
Females	99	−.13	.12	.62*	.72*	.23	.37	.00	.45*	.52
Males	1,584	.21**	−.02	.29**	.86**	.16*	.41**	.05	.07	.49

a. See table 5 for titles of subtests.

b. Regression weights significant at the 1-percent level are shown by **; those significant at the .5-percent level are shown by *.

c. These were tested with ASVAB 5/6/7; subtest titles are given in table 1.

Marine Corps did raise the prerequisite EL score for the basic electronics course from 110 to 115 because of the high failure rate (24.9 percent in 1980). A further increase to 120 would reduce the proportion of youth qualified for the course from about 25 percent to about 20 percent. Such a high prerequisite score would require strong empirical justification that the failure rate would be reduced and that an adequate number of recruits would be available for assignment to the basic electronics course.

The failure rates in Marine Corps training courses in 1980, 1981-82, and 1983 are shown in table 16. The percentages for 1980 are from [4], and those for 1983 were provided by Headquarters, Marine Corps. The percentages for 1981-82 were computed from the data collected for this study. The 1981-82 rates include only academic failures – students dropped from the course because of academic deficiencies that could not be corrected by recycling them through the course. The percentages for 1980 and 1983 include all failures, both academic and nonacademic.

Except for the basic electronics course, none of the failure rates for 1981-82, which include attrition only for academic reasons, exceed 10 percent. Many of the courses in the other years, 1980 and 1983, have attrition rates larger than 10 percent. These attrition rates include people dropped from the courses for nonacademic reasons, such as medical and disciplinary, which have little relation to aptitude and motivation. No adjustments to prerequisite aptitude composite scores are required to reduce failure rates for academic reasons. A possible exception could be the basic electronics course, but as discussed above, only the top quarter of the population is qualified under the existing standard. The recommendation from the analysis is that the qualifying standards for assigning Marine recruits to occupational specialties remain intact.

TABLE 16

FAILURE RATES IN MARINE CORPS TRAINING COURSES

Specialty			Percent failures[a]		
Title	Code	Aptitude score	1980	1983	1981-82
Mechanical Maintenance					
Plumbing specialist	1121	MM90	3.5	–	0
Refrigeration mechanic	1161	MM100	2.0	0.5	0
Engineer equipment mechanic	1341	MM90	4.7	0.6	0
Engineer equipment operator	1345	MM90	1.1	28.5	0.2
Combat engineer	1371	MM90	2.6	0.7	0
Assault amphibian repair	2142	MM100	15.4	1.0	3.1
Tracked vehicle repair	2145	MM100	1.6	1.3	0
Automotive mechanic	3521	MM90	3.9	13.2	2.5
Aviation mechanic	6011	MM100	8.0	10.0	5.1
Turboprop mechanic	6026	MM100	8.9	12.7	7.4
Aviation hydraulics	6051	MM100	6.0	2.2	0
Aircrew survival equipment	6060	MM100	4.3	4.3	0
Ground support hydraulics	6072	MM100	6.0	9.0	3.9
Ground support electrical	6077	MM100	4.0	21.0	1.9
Aviation safety mechanic	6081	MM100	5.0	5.0	0
Helicopter mechanic	6111	MM100	4.0	8.0	0.8
Aircraft recovery	7011	MM90	1.0	10.0	0
Aircraft firefighting	7051	MM90	3.0	1.8	0
Clerical[b]					
Administrative clerk, LJ	0151	CL100	3.5	4.3	2.5
Administrative clerk, P	0151	CL100	–	–	5.2
Communications center	2542	CL110	8.8	6.2	1.2
Supply stock control	3043	CL110	10.4	0.9	0.2
Packaging specialist	3052	CL80	–	0	0
Subsistence supply	3061	CL90	11.4	0	1.5
Aviation supply	3072	CL100	12.7	6.7	–
Financial records	3421	CL110	3.1	0.9	0
Travel	3431	CL100	4.7	4.7	–
Aviation administration	6046	CL100	–	3.6	0
Aviation operations	7041	CL100	13.4	5.3	–
Electronics Repair					
Electrician	1141	EL90	2.7	1.2	0
Equipment repair	1142	EL100	7.1	–	21.0
Field radio operator	2531	EL90	8.8	7.7	1.7
Basic electronics	2800	EL115	24.9[c]	21.9	15.0
Basic electricity and electronics	5900	EL110	18.0	–	–

TABLE 16 (Continued)

Specialty			Percent failures[a]		
Title	Code	Aptitude score	1980	1983	1981-82
General Technical					
Intelligence	0231	GT100	5.0	0	6.1
Amphibious embarkation	0431	GT100	21.0	5.3	4.6
Ammunition storage	2311	GT90	3.7	3.7	0
Baker	3311	GT90	4.9	3.0	1.8
Cook	3371	GT90	10.5	3.0	0.4
Accounting	3451	GT110	11.8	0.9	7.1
Photographer	4641	GT100	10.5	5.3	–
Military police	5811	GT100	16.9	0	1.2
Corrections specialist	5831	GT100	4.2	11.2	–
Aviation ordnance	65xx	GT100	12.0	3.0	0
Weather observer	6821	GT110	20.4	26.8	–
Hawk operator	7222	GT100	5.6	5.6	0.9
Combat[b]					
Rifleman, LJ	0311	CO80	5.2	–	1.1
Rifleman, P	0311	CO80	5.2	1.3	0
Machine gunner, LJ	0331	CO80	5.2	–	0.4
Machine gunner, P	0331	CO80	5.2	–	1.7
Mortarman, LJ	0341	CO80	5.2	–	0
Mortarman, P	0341	CO80	5.2	1.8	0.5
Assaultman, LJ	0351	CO80	5.2	–	0
Assaultman, P	0351	CO80	5.2	0.5	0.4
Field Artillery					
Fire control	0844	FA110	25.0	13.9	3.8
Amphibious crew	1833	FA90	–	1.0	0.3
Tank crew	1811	FA90	5.8	5.8	–
Redeye gunner	7212	FA90	6.1	6.1	0.9

a. Rates for 1980 and 1983 include academic and nonacademic failures; rates for 1981-82 include only academic failures.

b. Courses marked LJ were taught at Camp Lejeune; those marked P were taught at Camp Pendleton.

c. The prerequisite in 1980 was EL110.

CHAPTER 3

USING THE ASVAB-14 OCCUPATIONAL COMPOSITES TO ESTIMATE CHANCES OF PEOPLE DOING WELL IN CIVILIAN OCCUPATIONS

This chapter discusses how the experience of the military services in training recruits for their occupational specialties can be used to estimate the chances of people doing well in civilian occupations that have military counterparts. This information is especially useful in the vocational guidance and counseling of the approximately one million civilian students who take the ASVAB each year. The relationships between aptitude test scores and performance found for military occupational specialties are assumed to hold for similar civilian occupations. The job requirements tend to be similar in terms of equipment and job tasks. More thorough support for validity generalization from military to similar civilian occupations is included in the Counselor's Manual for ASVAB 14 [7].

The linear regression model is used in this analysis to estimate the chances of doing well in civilian occupations. Four pieces of information are required to compute the chances of doing well:

- Difficulty of learning the occupation – Difficulty is expressed in terms of the percentage of the population that could be trained to be satisfactory performers. For example, if 50 percent of the population could be trained to be satisfactory electronics technicians, then in a large representative sample of students, say 1,000, 500 would graduate from the course and 500 would fail. Such a precise definition of difficulty is theoretical. In practice, performance standards can be raised or lowered depending on the quality of the students and the need for workers in the occupation. Also, the training program may be more or less effective, which could affect the failure rate. For analytical purposes, however, a precise dividing line between satisfactory and unsatisfactory performance facilitates the computations. At the close of this chapter, some implications of the difficulty of occupations for interpreting the chances of doing well are discussed.

- Validity of aptitude scores – Validity is usually expressed as a correlation coefficient. Typically, the correlation between the did not differ systematically. If no other explanation for the difference in predicted performance can be found, such as preference for a type of work, then an adjustment to the prerequisite scores for females may be warranted in specialties that show a difference between females and males.

VALIDITY OF ASVAB SUBTESTS

All ASVAB 8/9/10 subtests have predictive validity for all Marine Corps specialties. This finding tends to be true for all services and for all versions of military selection and classification batteries.

One subtest, however, does not appear in the ASVAB 11/12/13 Marine Corps aptitude composites. This is Numerical Operations, one of the two speeded subtests in the battery. The other speeded subtest is Coding Speed, and it appears only in the Clerical composite.

The speeded tests were carefully scrutinized by the Joint-Service Selection and Classification Working Group in 1983 [9,10]. Scores on speeded tests are influenced by the following factors:

- Design of the answer sheet - Coding Speed and Numerical Operations scores in the 1980 Reference Population had to be adjusted because the answer sheet used with this sample was different from the answer sheet used by the military services.

- Retesting and practice – Scores on retests increase more for speeded tests than for tests that have generous time limits.

DIFFERENTIAL VALIDITY

The differential validity of the ASVAB is modest. One reason is that the subtests of ASVAB 8/9/10 are highly intercorrelated, which means they tend to be measures of general mental ability. To the extent that the subtests measure the same thing, differential validity is precluded even though the occupations may, in fact, have different aptitude requirements.

The Coding Speed and Auto/Shop subtests contribute primarily to differential validity. Coding Speed has relatively low absolute predictive validity (see appendix C), but it does have unique validity for Clerical specialties and no unique validity for Mechanical courses. The Auto/Shop

CHAPTER 4

DISCUSSION

BACKGROUND

The purpose of this research effort was to validate ASVAB 8/9/10 and to develop and evaluate aptitude composites for ASVAB 11/12/13, which is parallel to ASVAB 8/9/10. The criterion measure of performance was grades received by persons taking occupational training courses. The results were that the ASVAB is indeed a valid predictor of performance. The validity of the aptitude composites, corrected for restriction in range, is over .6, except for the Combat specialties, where it is .5.

Four aptitude composites were developed and evaluated for ASVAB 11/12/13. The Clerical composite was improved by replacing Numerical Operations, a speeded test of basic arithmetic operations, with Math Knowledge. The Mechanical Maintenance and Electronics Repair composites were not changed. The General Technical composite was improved by adding Mechanical Comprehension; the improved General Technical composite can replace the Combat and Field Artillery composites used with ASVAB 8/9/10. Except for combining the Combat and Field Artillery occupational clusters used with the General Technical cluster, no changes to prerequisite scores for assigning recruits to specialties were indicated from this analysis.

The aptitude composites for ASVAB 11/12/13 are free of bias against racial/ethnic minorities in terms of predicting performance in Marine Corps occupational training courses. These results are consistent with prior findings by the military services.

High-school graduates have higher predicted performance than non-graduates across the range of specialties. These results support the Marine Corps policy of requiring nongraduates to score 10 points higher than graduates to qualify for assignment to training courses.

Females were found to have higher predicted performance than males in occupations traditionally entered by females, notably administrative clerk and food services. In nontraditional female occupations, such as mechanical and electronics maintenance, the predicted performance of females and males

The conclusion again is that predictions of people's chances of doing well in an occupation can only be guidelines for making occupational decisions. To a large extent, such predictions merely reflect common sense. In some cases, though, these predictions may shed a ray of realism on the process of vocational guidance and career exploration. Tests are tools and test scores are information; knowledge about the people's chances of doing well in various occupations should enhance the usefulness of these scores in the decision-making process.

23-year-old population would be qualified. Similarly, the proportion of satisfactory performers in the population refers to all 18- through 23-year-old people. Although the failure rates in Marine Corps training courses include only the people who joined the service, the failure rates are referenced to the total population of 18- through 23-year-olds. The Taylor-Russell tables, used to calculate the chances of doing well, are based on values for the population as a whole.

Strictly speaking, the chances of people doing well in an occupation should be based on the percentile scores compared to the population of 18- through 23-year-old people. Most high-school students, however, are not yet members of this population. The average scores of 16- and 17-year-old students are lower than those of older people, and the occupational composite scores of high-school juniors and seniors are likely to improve with increased maturity and education. If high-school students are compared to the population of 18- through 23-year-old people, in general, their chances of doing well will be underestimated. If they are compared to their grade peers, there is no precise basis for computing their chances of doing well, but, in general, they will be overestimated. A safe statement is that, as a rule, the chances for high-school students doing well should fall between those obtained for the two sets of percentile scores (based on population of 18- through 23-year-old people and on grade peers).

Setting a dividing line between satisfactory and unsatisfactory performers is especially troublesome. For analytical purposes, a sharp distinction was assumed at three well-defined points (50, 70, and 85 percent satisfactory versus 50, 30, and 15 percent unsatisfactory, respectively). For analytical purposes, such a clean distinction can be assumed and then used in the computations. In the working world, however, such a dividing line is murky. In general, there is some agreement about what constitutes success and failure in an occupation, but for any individual person, many factors enter into success or failure.

In the civilian working world, classification decisions are not as well structured as in the military services. Different employers use different standards, and few employers have precisely defined qualifying standards that lead to objective yes-or-no personnel decisions. Precise statements about qualification therefore cannot be made about most civilian occupations. Instead, for civilian occupations, test scores can be translated into probabilistic statements about chances of people doing well.

with above-average occupational composite scores (percentile scores above 70) have at least 8.5 in 10 chances of doing well in easy and moderate occupations, and good chances (at least 6.5 in 10) in difficult occupations. Another way of interpreting the results is that almost everyone has a good chance (at least 5 out of 10) of doing well in easy occupations, but people with low scores are likely to fail in difficult occupations.

The labels in table 18 are probably as precise as they can be for high-school students' chances of doing well in civilian occupations. The numbers are estimates rather than precise probabilities.

CAUTIONS IN INTERPRETING THE CHANCES OF DOING WELL

The chances of doing well in an occupation are dependent on the population of people qualified for, trained for, and performing in the occupations. The three proportions of the population included in this analyses were the following:

- Proportion of the population qualified on the occupational composites (selection ratio)
- Proportion of the population that could be trained to be satisfactory performers (difficulty of learning the occupation)
- Proportion of the students failing the training course.

The definition of the population must be considered.[1] For the purposes of selecting, classifying, and training military recruits, the population is easy to define – it is all people ages 18 through 23 in the United States, including those working in the civilian economy, enrolled in educational and training institutions, not employed, and in the military. The ASVAB percentile scores used to select recruits and assign them to occupational specialties are based, therefore, on the population of 18- through 23-year-old people. Thus, when the qualification standard for assignment to an occupational training course is a percentile score of 50, it means that the top 50 percent of the 18- through

1. The predictive validity of the occupational composites was also a key variable; the chances of persons doing well in an occupation are relatively insensitive to changes in validity coefficients. Similar results to these estimates (validity of .6) would be obtained for validity coefficients of .5 or .7.

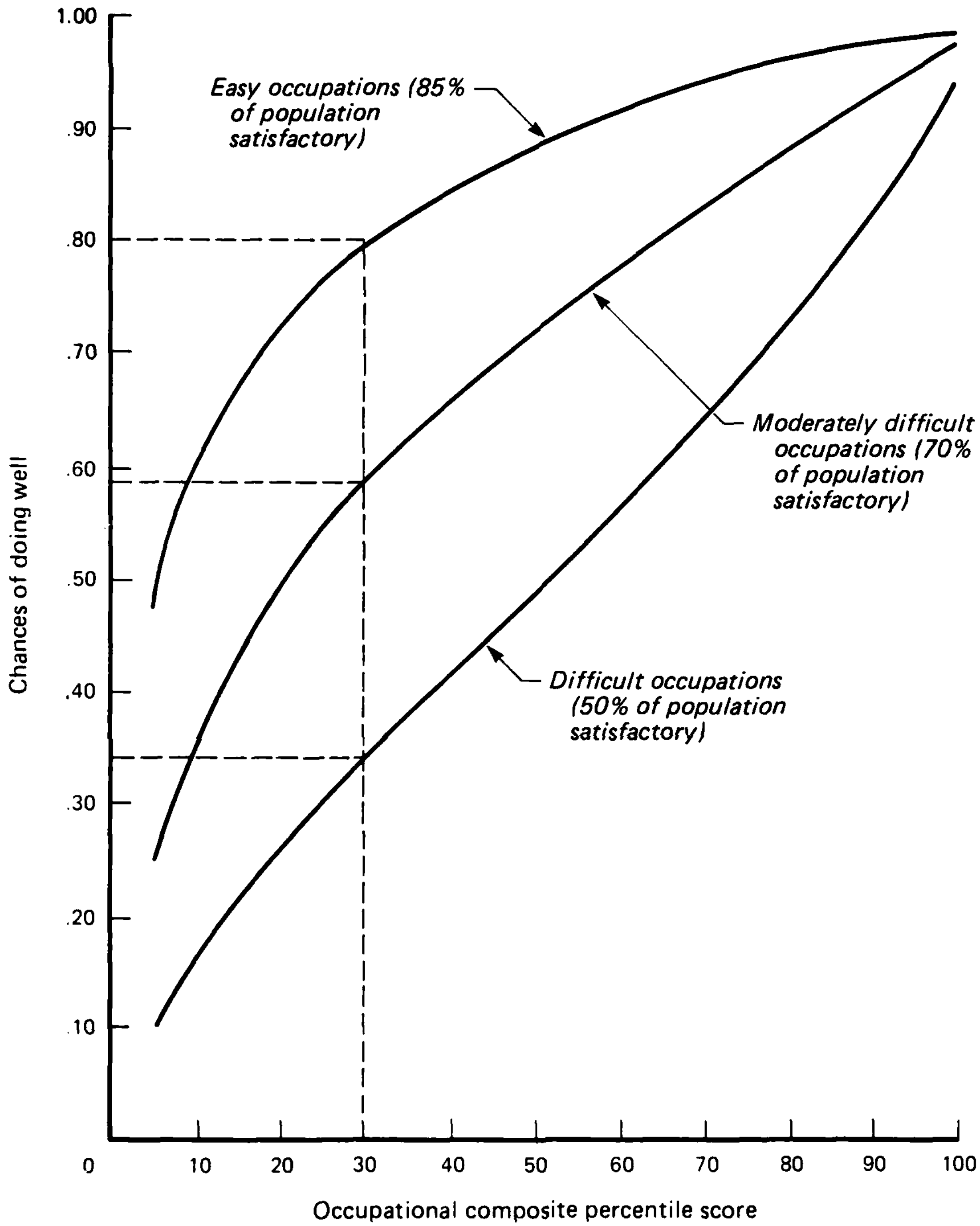

FIG. 3: CHANCES OF PEOPLE DOING WELL IN OCCUPATIONS AT THREE LEVELS OF DIFFICULTY

The chances of people doing well in the occupations at the three levels of difficulty are plotted in figure 3 and summarized in table 18. The procedure for reading the probability of a person performing at or above the minimum satisfactory level (chances of doing well) is illustrated in figure 3 for a percentile score of 30. For difficult occupations (50 percent of the population satisfactory), the probability of performing at or above the minimum satisfactory level is .35, or 3.5 chances in 10 of doing well. For moderately difficult occupations (70 percent of the population satisfactory), the probability of doing well is .58. For easy occupations (85 percent of the population satisfactory), the probability of doing well is .80.

TABLE 18

CHANCES OF PEOPLE DOING WELL[a] IN OCCUPATIONAL SPECIALTIES OF VARYING DIFFICULTY

Occupational composite percentile score	Difficulty of occupation[b]		
	Easy	Moderate	Difficult
Below average (5 to 30)	Good (.50 to .80)	Fair (.25 to .60)	Low (.10 to .35)
Average (30 to 70)	High (.80 to .95)	Good (.60 to .85)	Fair (.35 to .65)
Above average (70 to 99)	High (.95 +)	High (.85 +)	Good (.65 +)

a. Defined as probability of having a predicted performance score at or above the minimum level of satisfactory performance.
b. Difficulty of learning, not difficulty of physical requirements or stress.

As shown in figure 3 and table 18, people with below-average occupational composite scores (percentile scores of 30 or below) have at least 5 chances in 10 to do well (that is, to perform at or above the satisfactory level) in easy occupations. For moderately difficult occupations, people with below-average occupational composite scores have 2.5 to 6 chances out of 10 to do well. For difficult occupations, people with below-average occupational composite scores have only 3.5 or fewer chances out of 10 to do well. People

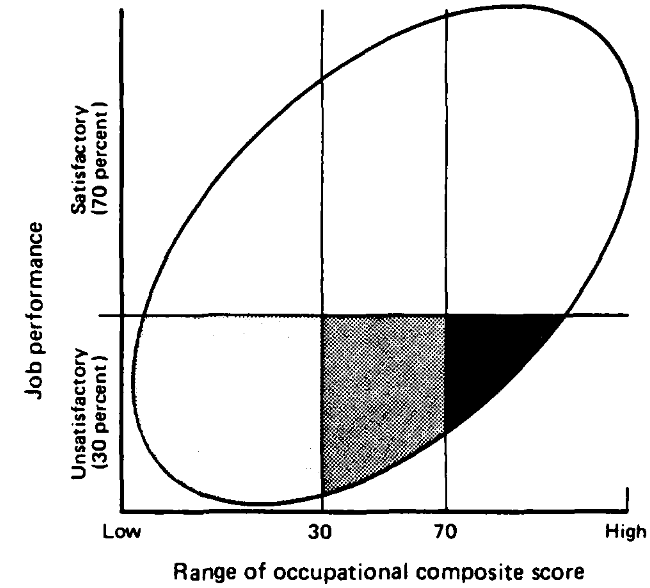

FIG. 2: GRAPHIC REPRESENTATION OF THE CHANCES OF PEOPLE DOING WELL IN OCCUPATIONS

In each interval of occupational composite scores in figure 2, the chances of doing well are computed as the ratio of the proportion above the dividing line (unshaded portion) divided by the total area in that interval (shaded plus unshaded portions).

The information needed for computing the chances of people doing well in occupations as related to their occupational composite percentile scores is the predictive validity of the occupational composites and the performance level that separates satisfactory from unsatisfactory performers at each difficulty level of the occupations. Based on their predictive validity for military specialties, the occupational composites are assumed to have a validity of .6 for civilian occupations. Separation of satisfactory from unsatisfactory levels of performance is straightforward. If 50 percent of the population is satisfactory, then 50 percent is unsatisfactory. Similarly, if 70 percent is satisfactory, 30 percent is unsatisfactory; if 85 percent is satisfactory, 15 percent is unsatisfactory. Assuming a normal bivariate relationship, computing the minimum satisfactory performance score and the percentage of the population that are satisfactory performers is routine. These computations are explained in appendix D.

for a moderately difficult occupation, 70 to 75 percent would be expected to graduate and 25 to 30 percent to fail. The 25 to 30 percent failure rate, however, is in excess of the maximum acceptable failure rate of 10 percent. The failure rate in the training course can be lowered to about 10 percent by restricting the student input to the top 50 percent on the occupational composite.

If the occupational composites had higher predictive validity, say .9, then the qualifying standard could be lowered and a 10 percent failure rate still be maintained. Setting qualifying standards to control failure rates is cost effective to the extent that the cost of training exceeds the cost of obtaining an adequate number of students.

COMPUTING THE CHANCES OF PEOPLE DOING WELL IN OCCUPATIONS

The schema developed for computing the chances of people doing well in occupations is shown in figure 2. The validity coefficient is assumed to be .6. In figure 2, three ranges of occupational composite scores are depicted on the horizontal axis: percentile scores less than 30 (below average); percentile scores of 30 to 70 (average); and percentile scores above 70 (above average). Level of job performance is shown on the vertical axis, with a line dividing satisfactory from unsatisfactory performance. The dividing line places approximately 70 percent of the population in the satisfactory category and 30 percent in the unsatisfactory category. If a normal distribution in job performance is assumed, this line falls one-half standard deviation below the mean. The dividing line corresponds to occupations that are moderately difficult to learn. As noted in the previous section, the percentage of the population that could be trained to satisfactorily perform occupations moderately difficult to learn was found to be 70 to 75 percent. In this section, this percentage is rounded down to approximately 70 percent for computational convenience.[1]

1. In a normal distribution, the area between the mean and one-half standard deviation below includes 19 percent of the distribution. Thus 31 percent of the population falls below this point and 69 percent above, which is rounded to 70 percent. Because the groupings of the occupational composite scores are not refined (only three intervals), the effects of using the rounded figure of 70 percent to compute the chances of doing well are minimal.

TABLE 17

EXAMPLES OF OCCUPATIONS SHOWN BY GROUP AND DIFFICULTY TO LEARN

	Occupational group			
Difficulty to learn	Mechanical and Crafts	Business and Clerical	Electronics and Electrical	Health, Social, and Technology
Easy (over 80 percent of population could be satisfactory performers)	Basic automobile mechanic Construction worker Driver Construction equipment operator Small arms repairer Metal body repairer	Basic transportation clerk Warehouse clerk	Basic electrician Radio operator Lineman	Basic food service Basic lithographic operator Offset-press operator
Moderate (75 percent of population could be satisfactory performers)	Machinist Aircraft maintenance Advanced automobile mechanic Advanced construction equipment repair Refigeration mechanic	Administration clerk Aviation supply	Electrical equipment repair	Surveyor Legal services clerk Travel clerk Graphics specialist
Difficult (50 percent of population could be satisfactory performers)	None	Financial records clerk Communications center operator Purchasing and contracting clerk	Electronics repair Computer repair Teletype repair Microwave repair Avionics repair	Computer programmer Computer operator Draftsman Auditing technician Accounting technician Air traffic controller

For occupations with 50 percent of the population qualified on the aptitude composites and failure rates in training courses of about 10 percent, between 70 and 75 percent of the population could be trained to perform satisfactorily. These types of occupations are called "moderately hard to learn."

For occupations with only 30 percent of the population qualified and a failure rate of 20 percent of the student input, 50 percent of the population could be trained to perform satisfactorily. These types of occupations are called "difficult to learn."

The information may be summarized as follows:

Qualifying standard	Failure rate	Percent of population that would be satisfactory performers	Difficulty of occupation to learn
70 percent (low)	Less than 10 percent	80 +	Easy
50 percent	About 10 percent	70–75	Moderate
30 percent (high)	*Above 10 percent*	*45–65*	*Difficult*

Examples of civilian occupations grouped by difficulty of learning and occupational cluster are shown in table 17.

The plots shown in figure 1 can be used to determine other levels of difficulty. The failure rates range from 10 percent to 50 percent of the student input. The selection ratio, or percent qualified on the aptitude composites, ranges from 10 percent (extremely high standards) to 90 (very low standards).

A word of clarification may be in order on the relationship between the percent of the population that could be trained to be satisfactory performers, called difficulty of the occupation, and the percent of the population qualified on the occupational composites. For moderately difficult occupations, 70 to 75 percent of the population could be trained to be satisfactory performers, but only 50 percent of the population is qualified on the occupational composite. The difference of 20 to 25 percent is a function of the maximum acceptable failure rate. If a large representative sample from the population were trained

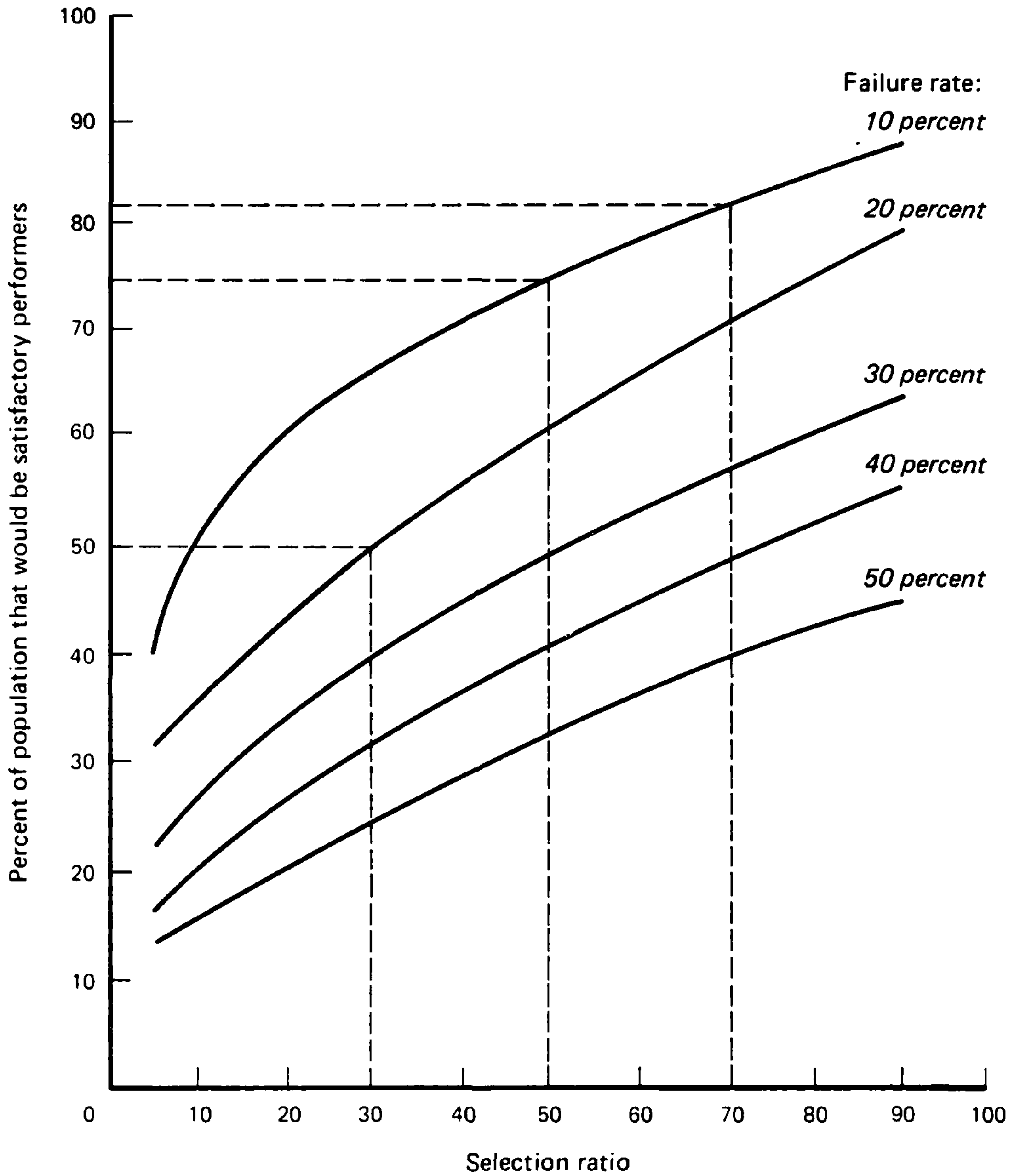

FIG. 1: PERCENT OF SATISFACTORY PERFORMERS IN THE POPULATION

keep the student failure rate to about 10 percent, tends to use similar qualifying scores.

As shown earlier in table 16, the student failure rates in courses with high qualifying standards (30 percent qualified) tend to range from 10 to 25 percent. The failure rates in training courses with moderate qualifying standards (50 percent qualified) tend to be about 10 percent, but some of them in 1983 were 12 or 13 percent. In courses with low qualifying standards (70 percent qualified) the failures typically are less than 10 percent.

A convenient set of tables, called the Taylor-Russell tables [8], can be used to compute the difficulty of the occupations from the predictive validity of the ASVAB occupational composites, qualifying standards for the occupational specialties (called the "selection ratio" in the Taylor-Russell tables), and maximum acceptable failure rate.[1]

In figure 1, information from the Taylor-Russell tables is presented that shows the relationship among these pieces of information for a validity coefficient of .6. The information portrayed in figure 1 is used to find the difficulty of occupations. For example, if 30 percent of the population were qualified for a training course on the aptitude composite and the failure rate for that group were 20 percent, then (as illustrated in figure 1) 50 percent of the entire population would be satisfactory performers. If in another course, 70 percent of the population were qualified on the aptitude composite (low standards) and the failure rate were 10 percent, then approximately 80 percent of the population would be satisfactory performers. These relationships are shown by dotted lines in figure 1.

For occupations with 70 percent qualified on the aptitude composites and failure rates in training courses of less than 10 percent, 80 percent or more of the population could learn how to perform satisfactorily. These types of occupations are called "easy to learn," although they may be physically demanding or even stressful.

1. Use of the Taylor-Russell tables to find the difficulty of occupations is backwards from their normal use. Normally, the difficulty of the occupations is assumed, the validity is known, and the task is to find a qualifying standard that is expected to result in an acceptable failure rate. Using the Taylor-Russell tables to estimate the difficulty of occupations is appropriate only if the other three variables are known independently. The fact that the military services have set qualifying standards based on empirical failure rates, rather than on the regression model explicitly, supports use of the Taylor-Russell tables for estimating the difficulty of occupations.

ASVAB and performance in entry-level training courses is about .6 in the full population of potential recruits. The interpretation of validity coefficients for personnel selection and classification is given in appendix A.

- Maximum acceptable failure rate – The Marine Corps and other services traditionally attempt to keep the failure rate in training courses at about 10 percent of the student input. This number is set by policy, and it generally reflects the cost of training versus the cost of recruiting. The value of 10 percent was not rigorously derived through analytical studies, nor is it rigorously adhered to. As shown earlier in table 16, failure rates fluctuate across time and across courses. It is a management tool and not a fixed standard.

- Percent of the population qualified on the aptitude tests – This value equals the qualifying standards on the ASVAB, either directly for percentile scores or through equivalent standard scores. The percent qualified is sometimes called the "selection ratio," or the ratio of qualified people to the total population.

The first analytical task is to compute how difficult the occupations are to learn, using the other three pieces of information. The experience of the military services in training recruits for their occupational specialties provides the other three pieces of information.

COMPUTING HOW DIFFICULT OCCUPATIONS ARE TO LEARN

The estimated population validity of the occupational composites for Marine Corps specialties, as was shown earlier in chapter 2, is approximately .6. The occupational composites are expected to have about the same predictive validity for similar civilian occupations.

Three levels of qualifying aptitude scores have long been used by the Marine Corps for occupational specialties that have civilian counterparts. These are aptitude composite scores of 90, 100, and 110, which correspond to approximately 70, 50, and 30 percent of the population qualified, respectively. These particular values are used because the Marine Corps experience is that with these qualifying standards, student failure rates in most training courses are held to about 10 percent. The Army, which has many occupational specialties similar to those in the Marine Corps and which also attempts to subtest also has relatively low absolute validity for most specialties. It does, however, have unique validity for the Mechanical Maintenance specialties and no unique validity for Clerical specialties. Much of the differential validity in the ASVAB is carried by the Coding Speed and Auto/Shop subtests.

The differential validity of the ASVAB could be increased by expanding the coverage of the battery. The content currently is limited to words, numbers, and static pictures, as is true for virtually all paper-and-pencil batteries administered to large groups. A promising means for expanding test content is computerized administration. With computers, movement in diagrams and information-processing strategies can be incorporated into test content. The new content would likely lower the intercorrelation of the subtests and perhaps increase differential validity.

THE CRITERION MEASURE

Another reason for the modest differential validity of the ASVAB lies in the criterion measure used to measure performance in the specialties. The training grades used in this analysis and in virtually all previous validation efforts by the military services may reflect a general learning ability as well as proficiency in job requirements. Traditionally, training grades have been based largely on paper-and-pencil, multiple-choice achievement tests. To the extent that these tests measure a general learning ability, the differential validity of the ASVAB is lowered.

Job performance tests are frequently mentioned as an improved criterion measure. Currently, a joint-service research effort is underway to validate the ASVAB and associated enlistment standards against job performance tests. Job performance tests are expensive to develop and administer. The full range of job requirements must be included in any analysis designed to evaluate the effectiveness of the ASVAB for making personnel assignments to occupational specialties. Because of the large expense in time and money, using performance tests for this purpose is not feasible. The Joint-Services Job Performance Measurement Working Group has decided, therefore, that a major purpose of the research effort is to find surrogate measures that reflect proficiency in job requirements and that are more economical.

The most reasonable alternative to large-scale job performance testing is the use of training grades. Training grades are routinely available for most recruits, and they cover the full range of job requirements. If they can be shown to be highly related to job performance, then they can be used confidently to validate the ASVAB and personnel assignment decisions.

The procedures used by the military services to train recruits are in a state of flux. All services have been restructuring their training using the Instructional Systems Development (ISD) model. The courses are being redesigned to increase their relevance to job requirements, but grades are becoming less useful as criterion measures of performance.

The relevance of a training course to job requirements should be increased by selecting appropriate course content. When following the ISD model, job requirements are systematically determined and incorporated into the training curriculum. Students are trained to perform the selected job tasks and then tested by performing the same set of tasks. Ideally, graduates from the training courses have demonstrated their competence on a set of job tasks to specified standards of performance.

From the point of view of training, the restructured courses thus accomplish the intended purpose of producing graduates with known capabilities. From the point of view of measurement, however, grades in the restructured courses have lost much of their meaning because the evaluation is not done under standard conditions. Students now have multiple opportunities to demonstrate that they have met the training standards. Some students pass the tests the first time, whereas others may take the same tests several times. Some students are in effect recycled, but the grading system does not reflect this fact. Also, much or most of the testing is done in the hands-on mode, and the test adminstrator has latitude in assigning scores. If the test administrator is also the instructor, the natural tendency is to be lenient in scoring. If training grades in the restructured courses are to serve as criterion measures for validating the ASVAB and qualifying standards, the measurement problems must be resolved.

Resolution of the criterion measure for validating ASVAB and personnel decisions lies outside the scope of this analysis. The joint-service groups concerned with selecting and classifying recruits and developing criterion measures have a continuing concern with obtaining adequate criterion measures.

FAIRNESS OF THE ASVAB

Social concern about the fairness of test scores for all members of our society has been growing since the 1960s. The initial concern was about fairness for racial/ethnic minorities. Research studies have consistently shown no systematic bias against or in favor of racial/ethnic minorities. Generally, the issue of fairness for racial/ethnic minorities in the aptitude-testing community has receded.

An emerging concern is fairness of aptitude tests for females. As job opportunities for females expand, there is a growing concern that tests may discriminate against females who seek employment in traditionally male occupations. No consistent body of evidence has yet emerged. The results of this analysis suggest that females are discriminated against in occupations traditionally entered by females, but not in the nontraditional ones. The issue is important, and it is being carefully studied in the military services.

The ASVAB has a long history of usefulness to personnel managers in making selection and classification decisions. The new forms of the ASVAB, the new Marine Corps aptitude composites, and the occupational composites for the Student Testing Program should further enhance the usefulness of the ASVAB in the future.

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APPENDIX A

ASVAB APTITUDE COMPOSITES

APPENDIX A

ASVAB APTITUDE COMPOSITES

The ASVAB subtests are combined into composites for purposes of selecting and classifying recruits. One composite is the Armed Forces Qualification Test (AFQT). The other composites are called aptitude composites by the Marine Corps, Army, and Navy, and called aptitude indices by the Air Force. All services use the AFQT for selecting recruits. Three aptitude composites were common to all services while ASVAB 8/9/10 was in use; in addition, all services have one or more unique composites. The definitions, in terms of subtests, of the AFQT and aptitude composites used with ASVAB 8/9/10, except those for the Navy, are shown in table A-1.

The AFQT is defined as the sum of the subtest raw scores (Arithmetic Reasoning, Verbal, and one-half of the Numerical Operations raw scores). The Numerical Operations raw score is divided by one-half to reduce the standard deviation to about the same level as the other two subtests, thereby giving the three subtests about the same weight.

Before the aptitude composite scores are computed, the subtest raw scores are converted to standard scores with a mean of 50 and a standard deviation of 10. Because all subtests then have equal standard deviations, they are about equally weighted in each composite. If a service wants to assign extra weight to a subtest in a composite, it can do so by explicitly weighting the subtest. In the composites for ASVAB 8/9/10, the Air Force used a weight of 2 in the Mechanical composite; the Army and Marine Corps use only unit weights. If raw scores were added directly without converting to standard scores, then the subtests with the larger standard deviations would in effect have larger weights. Because subtests with the larger standard deviations do not necessarily have the higher unique validity, adding raw scores would tend to lower validity.

When computing aptitude composite scores, the Marine Corps and Army standardize the sum of subtest standard scores. In these services, aptitude composites have a mean of 100 and a standard deviation of 20. The Air Force converts the sum of subtest standard scores to percentile scores. Prerequisite aptitude composite scores used for assigning recruits to job training courses in these services are expressed as standard or percentile scores.

TABLE A-1

ASVAB 8/9/10 COMPOSITES[a]

Composite	Verbal		Math		Technical			Speed	
	Subtest[b]								
Common									
Armed Forces Qualification Test		VE	AR					NO/2	
Clerical/Administrative		VE						NO	CS
Electronics Repair	GS		AR	MK			EI		
General Technical		VE	AR						
Army (unique)									
Combat			AR		AS	MC			CS
Field Artillery			AR	MK		MC			CS
Mechanical Maintenance					AS	MC	EI	NO	
General Maintenance	GS			MK	AS		EI		
Surveillance/Communications		VE			AS			NO	CS
Operators/Food		VE			AS	MC		NO	
Skilled Technical	GS	VE		MK		MC			
Marine Corps (unique)									
Combat		VE			AS			NO	
Field Artillery		VE	AR		AS				
Mechanical Maintenance			AR		AS	MC	EI		
Air Force (unique)									
Mechanical	GS				2AS	MC			

a. Composites used at time of introduction on 1 October 1980.

b. Subtests are grouped by similar content: GS = General Science, VE = Verbal (sum of Word Knowledge and Paragraph Comprehension), AR = Arithmetic Reasoning, MK = Math Knowledge, AS = Auto/Shop Information, MC = Mechanical Comprehension, EI = Electronics Information, NO = Numerical Operations, CS = Coding Speed

The Navy adds the subtest standard scores and then expresses aptitude composite prerequisites in terms of the sums of subtest standard scores. The Navy does not have a common metric for aptitude composite scores.

The subtests in table A-1 are grouped according to their similar content. Numerous factor analyses have been performed, and the results are consistent. The results of a factor analysis of ASVAB 8A in the 1980 Reference Population [A-1] are shown in table A-2. The verbal factor is defined by General Science (GS) and Verbal (VE), the latter being the sum of Word Knowledge (WK) and Paragraph Comprehension (PC); the mathematical factor is defined by Arithmetic Reasoning (AR) and Math Knowledge (MK); the technical factor, by Auto/Shop Information (AS), Mechanical Comprehension (MC), and Elec'ronics Information (EI); and the speed factor by Numerical Operations (NO) and Coding Speed (CS).

TABLE A-2

ASVAB 8A COMMON FACTORS IN 1980 REFERENCE POPULATION[a]

ASVAB subtest	Verbal	Math	Technical	Speed
Part A: Factor Loadings				
General Science (GS)	.54	.21	.29	-.05
Word Knowledge (WK)	.95	-.02	.01	.03
Paragraph Comprehension (PC)	.68	.08	-.04	.16
Numerical Operations (NO)	-.03	.12	.03	.79
Coding Speed (CS)	.06	-.06	.00	.81
Arithmetic Reasoning (AR)	.07	.69	.15	.11
Math Knowledge (MK)	.08	.85	-.05	.06
Auto/Shop Information (AS)	.00	-.10	.94	.05
Mechanical Comprehension (MC)	-.03	.27	.68	.03
Electronics Information (EI)	.28	.10	.62	-.04
Part B: Factor Correlation Matrix				
	Verbal	Math	Technical	Speed
Verbal	1.00	.72	.62	.68
Math	.72	1.00	.58	.65
Technical	.62	.58	1.00	.31
Speed	.68	.65	.31	1.00

a. Source: [A-1].

The intercorrelations of Marine Corps aptitude composites for ASVAB 8/9/10, ASVAB 11/12/13, and AFQT are shown in table A-3. Because the definitions of Mechanical Maintenance (MM) and Electronics Repair (EL) are the same in both sets, their correlation with the other composites and with AFQT are also the same. The two Clerical (CL) scores have a correlation of .94, and the two General Technical (GT) scores, .96. The correlation of Combat (CO) and Field Artillery (FA) from ASVAB 8/9/10 with GT from ASVAB 11/12/13 is .90 and .96, respectively. This high correlation indicates that retaining the same levels of qualifying standards for CL and GT is warranted; but because the correlations are less than unity, some improvement in predictive validity is possible and has been achieved. The high correlation between CO and FA with GT from ASVAB 11/12/13 also supports using GT in lieu of CO and FA for assigning recruits to these specialties.

Research efforts are underway to develop new predictors that could be used to select and classify recruits. If these efforts reach fruition, the content of the ASVAB could be expanded and the overlap among the composites reduced.

VALIDITY OF APTITUDE COMPOSITES

The interpretation of validity coefficients in personnel selection and classification is straightforward. A perfectly valid test would have a validity coefficient of 1.0 and would yield the maximum possible gain in performance compared to random selection (validity coefficient of 0). A validity coefficient of .6 would result in 60 percent of the maximum possible gain.

For example, if 50 percent of the population could be trained to be satisfactory performers, then in a large random sample, 50 percent would be satisfactory and 50 percent failures. Most employers, including the military services, are loathe to tolerate such poor performance. They use selection and classification tests to simultaneously reduce the failure rate and increase the mean level of performance of their trainees.

Say an employer wants to obtain 500 satisfactory workers in an occupation where 50 percent of the population could be trained to be satisfactory performers. If the trainees were selected randomly or, as the equivalent, given a test that has zero validity, then 1,000 trainees would need

TABLE A-3

INTERCORRELATION OF MARINE CORPS APTITUDE COMPOSITES

	ASVAB 8/9/10						ASVAB 11/12/13				
	MM	CL	EL	GT	CO	FA	MM	CL	EL	GT	AFQT
MM	1.0	.62	.91	.83	.86	.94	1.0	.71	.91	.93	.79
CL	.62	1.0	.75	.84	.88	.77	.62	.94	.75	.78	.92
EL	.91	.75	1.0	.93	.86	.93	.91	.86	1.0	.94	.90
GT	.83	.84	.93	1.0	.89	.95	.83	.91	.93	.96	.98
CO	.86	.88	.86	.89	1.0	.94	.86	.86	.86	.90	.93
FA	.94	.77	.93	.95	.94	1.0	.94	.84	.93	.96	.92
MM	1.0	.62	.91	.83	.86	.94	1.0	.71	.91	.93	.79
CL	.71	.94	.86	.91	.86	.84	.71	1.0	.86	.86	.93
EL	.91	.75	1.0	.93	.86	.93	.91	.86	1.0	.94	.90
GT	.93	.78	.94	.96	.90	.96	.93	.86	.94	1.0	.93

to be selected. The number of failures would be 500, and the mean performance of the 1,000 trainees would be the population mean, say 100.

In the interest of reducing training costs, employers usually want to select people with higher probabilities of doing well in the occupation. Assuming performance scores are normally distributed from very high to marginally satisfactory, then the gain in mean performance level from using an aptitude test with known validity can be computed.

The maximum performance of a group of workers would be obtained by selecting the 500 graduates of the training course, assuming the training is perfectly valid. The mean performance of this group, all of whom are above the population mean and whose performance is normally distributed, is .8 of a standard deviation above the mean, or 116 on the Army and Marine Corps standard score scale.[1] If a representative group of trainees with aptitude scores above the mean were selected (their test scores were normally distributed and the test had validity of .6), then their mean performance would be .48 (.6 × .8) of a standard deviation above the mean, or 109.6 on the Army and Marine Corps standards score scale. This interpretation of validity coefficients was formulated by Brogden [A-2].

The failure rate in the group of 500 students with above-average aptitude scores would be 30 percent, as found from the Taylor-Russell tables [A-3]. Only 350 of the 500 would graduate as satisfactory performers. To obtain the required 500 graduates, still assuming 50 percent of the population could be satisfactory performers, and selecting the top half of the population, 715 students would need to be selected (only 70 percent of 715 would be expected to graduate). The failure rate could be lowered by raising the qualifying standard. If the top 30 percent on the aptitude test were selected, then the expected failure rate would be 20 percent, and only 625 students would need to be selected. However, finding 625 people with such high aptitude may be difficult or expensive, and then the employer would need to evaluate the cost of recruiting versus the cost of training. In the All-Volunteer Force era, the military services face this tradeoff in selecting and classifying recruits.

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1. In a normal distribution, the mean of a selected group is u/p, where u is the ordinate at point p, and p is the proportion of the population selected or qualified.

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APPENDIX B

MARINE CORPS JOB SPECIALTY TRAINING COURSES

APPENDIX B

MARINE CORPS JOB SPECIALTY TRAINING COURSES

The list of Marine Corps job specialty training courses to whicn enlisted recruits could be assigned in FY 1981 is shown in table B-1 (page B-3). The projected annual flow of enlisted recruits is also shown in table B-1.

The specialties for which training grades were provided by the training schools are listed in table B-2 (page B-7). For each course, the number of students is shown for whom training grades were provided as well as the number of usable cases. Cases were deleted if they could not be matched to the data tape with ASVAB scores or if they had missing ASVAB subtest scores. The aptitude composite prerequisite and the minimum qualifying score are listed for each course.

The final two columns of table B-2 list the training grades that were assigned to students who did not complete the course on schedule because of academic deficiencies. Students recycled for academic reasons and who subsequently passed the course were assigned the minimum passing scores. Students who failed for academic reasons were assigned a grade one standard deviation below the minimum passing score. The standard deviation of training grades was computed on the students who graduated from each course on schedule.

The specialties that were pooled are listed in table B-3 (page B-11). The pooled specialites have similar job requirements, even though some have different aptitude composite prerequisites, and they have similar ASVAB score distributions.

The worksheet and the instructions for its use in collecting training grades are shown in figures B-1 and B-2 (pages B-13 and B-14).

Table B-4 (page B-15) shows the mean aptitude composite scores and mean course grade for the social groupings in each sample. Standard deviations (sigma) are also shown. The samples include people tested with versions 8/9/10 or 5/6/7 of the ASVAB.

AD-A159 260 VALIDATION OF THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY FORMS 8 9 AN..(U) CENTER FOR NAVAL ANALYSES ALEXANDRIA VA MARINE CORPS OPERATIO.. M H MAIER ET AL. FEB 85 CNR-102 N00014-83-C-0725 2/2

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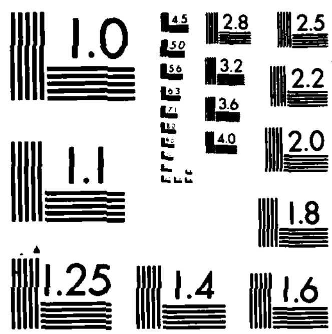
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3

Definitions for labels used in table B-4 are as follows:

Social Grouping

- The total sample is all students in the course, tested with versions 5/6/7 or 8/9/10 of the ASVAB, for whom complete data is available.
- "Black" includes students identified as black as well as other racial/ethnic groups, such as Hispanics and Orientals. White includes all students not identified as belonging to a racial/ethnic minority.
- "Nongraduate" includes all people not identified as high-school graduates. High-school graduates includes all who have at least a high-school education.

Grade

- Final grade in the occupational specialty training course.

The appropriate aptitude composite was used for each sample.

TABLE B-1

MARINE CORPS SPECIALTY TRAINING COURSES FOR ENLISTED RECRUITS IN FY 1981

Title	Course length	Code	Projected number of students (FY 1981)
Tracked vehicle repairman, tank	42 days	2145	117
Tracked vehicle repairman, self-propelled artillery	35 days	2144	46
Small arms repair	45 days	2111	266
Artillery repair	52 days	2131	65
Fire control instrument repair	98 days	2171	20
Metal body repair	63 days	3513	22
Quartermaster equipment repair	44 days	1173	34
Mechanists repair shop	105 days	2161	24
Law enforcement (MP)	58 days	5811	667
Law enforcement (correction specialist)	49 days	5831	166
Armor crewman	63 days	1811	333
Office machine repair	84 days	1182	20
Fabric repairman	84 days	1181	37
Laundry and bath specialist	35 days	1171	96
Engineer equipment operations	63 days	1345	430
Field artillery radar crewman	47 days	0842	31
Field artillery fire controlman	44 days	0844	346
Artillery ballistic meteorology	56 days	0847	27
Improved HAWK launch mechanical systems repair	231 days	5929	11
Ammunition storage	45 days	2311	315
IBM 360 computer operations	28 days	4034	148
IBM 360 COBOL programming	56 days	4063	50
Basic supply stock control	49 days	3043	691
Subsistance supply man	35 days	3061	175
Basic baker	49 days	3311	140
Basic food service	42 days	3371	605
Basic travel clerk	49 days	3431	34
Personnel financial records clerk	49 days	3421	215
Basic automotive mechanic	84 days	3521	869
Fiscal accounting	63 days	3451	49
Basic electrician	49 days	1141	132
Basic refrigeration mechanic	49 days	1161	67
Basic electrical equipment repairman	112 days	1142	302

TABLE B-1 (Continued)

Title	Course length	Code	Projected number of students (FY 1981)
Basic engineering equipment mechanic	77 days	1341	375
Basic combat engineer	42 days	1371	954
Basic metal worker	42 days	1316	76
Basic plumbing and water supply	52 days	1121	159
Rifleman[a]	35 days	0311	2,003
Antitank assaultman[a]	35 days	0351	361
Mortar man[a]	35 days	0341	423
Machine gunner[a]	35 days	0331	298
Airborne radio operator	184 days	7382	20
Unit dairy clerk[b]	23 days	0131	157
Administrative clerk[b]	20 days	0151	841
Personnel clerk[b]	23 days	0121	148
Repairman AN/TYQ-1	126 days	5962	16
Teletype repair	102 days	2818	95
Terminal equipment theory	56 days	282x	14
Ground radar technician	196 days	2881	12
Radar fundamentals		288x	96
Aviation fire control repair	68 days	5943	22
Aviation radar repair 'C'	81 days	5945	39
Repair AN/TYQ-2	128 days	5963	53
Communications centerman	68 days	2542	628
Field radio operator	42 days	2531	1,548
Ground radar repair	63 days	2881	31
Ground radio repair	147 days	2841	332
Basic electronics	91 days	2800	1,545
Aviation radio repair	98 days	5937	30
Air support operations operator	44 days	7242	52
Air control electronics operator	38 days	7234	82
High frequency communications control operator	33 days	2534	80
Personnel clerk[c]	23 days	0121	149
Assault amphibian repairman	39 days	2142	229
Unit diary clerk[c]	23 days	0131	149
Administrative clerk[c]	20 days	0151	779
Basic assault amphibian crewman	23 days	1833	523
Rifleman[c]	35 days	0311	4,068
Machine gunner[c]	35 days	0331	604
Mortarman[c]	35 days	0341	859
Antitank assaultman[c]	35 days	0351	732

TABLE B-1 (Continued)

Title	Course length	Code	Projected number of students (FY 1981)
Aviation support equipment technician, electrician class A	64 days	6071	105
Aviation fundamentals, aviation support equipment technician, electrical	14 days	6071	132
Aviation fundamentals, aviation support equipment technician, mechanical	14 days	6071	130
Aviation support equipment, technician mechanic class A	65 days	6071	105
Aviation fundamentals, aviation support equipment technician, hydraulics	14 days	6071	37
Aviation support equipment technician, hydraulics	67 days	6071	37
Aviation fundamentals, air controlman	14 days	7311	218
Air controlman class A1	96 days	7311	218
Aviation fundamentals, aviation structural mechanic, safety equipment	14 days	6051	131
Aviation structural mechanic, safety equipment class A1	47 days	6051	131
Aviation fundamentals, aviation structural mechanic, hydraulics	47 days	6051	233
Aviation structural mechanic, hydraulics	49 days	6051	233
Aviation fundamentals, aviation ordnance	12 days	65xx	370
Aviation ordnanceman class A1	64 days	65xx	370
Aviation fundamentals, basic helicopter	14 days	6111	488
Basic helicopter class A1	42 days	6111	488
Aviation fundamentals, aviation structural mechanic, metalsmith	5 days	6091	289
Aviation structural mechanic, metalsmith	61 days	6091	289

TABLE B-1 (Continued)

Title	Course length	Code	Projected number of students (FY 1981)
Aviation fundamentals, avionics technician non-Navy	12 days	6300	992
Avionics technician non-Navy	115 days	6300	1,120
Aircraft firefighting/rescue	33 days	7051	182
Aviation fundamentals, aviation machinists mate J	12 days	6011	55
Aviation fundamentals, aviation electrician	12 days	6331	505
Aviation electrician A1	75 days	6331	437
Basic electronics-electrician USMC other	30 days	5900/ 6300	252
Basic electronics/electrician, aviation electrician mate	35 days	5900/ 6300	505
Basic electronics/electrician, aviation support equipment technician, electrical	32 days	5900/ 6300	132
Basic electronics-electrician avionics non-Navy	38 days	6300	992
Aviation fundamentals, aviation machinist mate	15 days	6000	439
Aviation machinist mate class A1	45 days	6000	439
Aviation maintenance, administrative man class A	47 days	6046	90
Aviations operations, clerical	32 days	7041	120
Aviation supply clerk	67 days	3072	501

a. Camp Lejeune.
b. Parris Island, moved to Camp Lejeune in 1982.
c. Camp Pendleton.

TABLE B-2

TRAINING COURSES WITH GRADES REPORTED

Specialty		Number of cases with ASVAB 8/9/10 scores		Aptitude composite prerequisites		Grade assigned	
Title[a]	Code	Original	Final	Composite	Minimum score	Academic recycles	Academic failures
Personnel clerk	0121	49	47	CL	100	90	89
Unit dairy clerk	0131	65	62	CL	100	90	89
Administrative clerk (LJ)	0151	653	640	CL	100	75	70
Administrative clerk (P)	0151	664	640	CL	100	80	78
Intelligence specialist	0231	78	70	GT	100	70	64
Rifleman (LJ)	0311	2,587	2,508	CO	80	60	54
Rifleman (P)	0311	1,312	1,269	CO	80	60	54
Machine gunner (LJ)	0331	519	511	CO	80	70	62
Machine gunner (P)	0331	187	179	CO	80	70	62
Mortarman (LJ)	0341	517	502	CO	80	70	62
Mortarman (P)	0341	216	209	CO	80	70	62
Antitank assaultman	0351	524	510	CO	80	70	62
Antitank assaultman	0351	233	224	CO	80	70	62
Basic logistics	0400	77	76	GT	100	70	64
Unit embarkation clerk	0431	116	112	GT	100	35	32
Field artillery fire controlman	0844	218	208	FA	110	70	64
Plumbing and water supply specialist	1121	42	41	MM	90	80	75
Basic electrician	1141	79	77	EL	90	70	65
Basic electrical equipment repair specialist	1142	51	48	EL	100	70	65
Basic refrigeration mechanic	1161	32	32	MM	100	70	65

TABLE B-2 (Continued)

Specialty		Number of cases with ASVAB 8/9/10 scores		Aptitude composite prerequisites		Grade assigned	
Title[a]	Code	Original	Final	Composite	Minimum score	Academic recycles	Academic failures
Basic engineer equipment mechanic	1341	172	169	MM	90	70	65
Engineer equipment operator	1345	475	452	MM	90	70	66
Basic combat engineer	1371	202	189	MM	90	70	64
Assault amphibian crewman	1833	304	302	FA	90	75	71
Assault amphibian repairman	2142	66	63	MM	100	70	65
Tracked vehicle repairman, tank	2145	151	144	MM	100	70	65
Ammunition technician	2311	172	164	GT	90	80	77
Field radio operator	2531	972	903	EL	90	55	45
Communication center operator	2542	369	334	CL	110	40	28
Radio fundamentals	2800			EL	115	70	65
Radar fundamentals	2800	498	412	EL	115	70	64
Basic electronics	2800			EL	115	70	65
Basic supply stock clerk	3043	678	665	CL	110	70	63
Packaging specialist	3052	51	51	CL	80	70	63
Subsistence supply clerk	3061	68	66	CL	90	70	62
Aviation supply clerk	3072	423	381	CL	100	75	71
Basic baker	3311	113	109	GT	90	80	77
Cook, specialist	3371	533	504	GT	90	70	66
Personal financial records clerk	3421	234	233	CL	110	70	64

TABLE B-2 (Continued)

Specialty		Number of cases with ASVAB 8/9/10 scores		Aptitude composite prerequisites		Grade assigned	
Title[a]	Code	Original	Final	Composite	Minimum score	Academic recycles	Academic failures
Accounting technician	3451	44	44	GT	110	70	63
Travel clerk	3431	26	26	CL	100	70	65
Organizational automotive mechanic	3521	481	459	MM	90	70	64
Photographer	4641	28	28	GT	100	75	70
Military police[b]	5811	451	413	GT	100	260	225
Aviation mechanic	6011	559	521	MM	100	60	52
Turboprop prop mechanic	6026	60	54	MM	100	60	52
Aviation maintenance administration clerk	6046	87	85	CL	100	13	3
Aviations structural hydraulic mechanic	6051	39	37	MM	100	65	59
Basic electronics/ electrical	5900	–	744	EL	110	–	63
Aircrew survival equipment	6060	90	87	MM	100	75	71
Aviation maintenance ground support equipment mechanic/hydraulics	6072	139	130	MM	100	60	55
Aviation maintenance ground support equipment electrician	6077	115	105	MM	100	65	59
Aviation safety equipment mechanic	6081	92	91	MM	100	65	59
Helicopter mechanic	6111	360	357	MM	100	70	63
Basic aviation ordnance	65xx	406	381	GT	100	70	65

TABLE B-2 (Continued)

Specialty		Number of cases with ASVAB 8/9/10 scores		Aptitude composite prerequisites		Grade assigned	
Title[a]	Code	Original	Final	Composite	Minimum score	Academic recycles	Academic failures
Weather observer	6821	43	37	GT	110	75	70
Aircraft recovery specialist	7011	72	72	MM	90	65	58
Aviation operations specialist	7041	92	87	CL	100	75	71
Aircraft firefighting and rescue specialist	7051	161	158	MM	90	70	65
REDEYE gunner	7212	118	112	FA	90	70	69
HAWK missile system operator	7222	*109*	*107*	*GT*	*100*	*70*	65

a. LJ – Courses taught at Camp Lejeune; P – Courses taught at Camp Pendleton.
b. Specialty deleted because criterion measure was reported as time to complete training.

TABLE B-3

POOLED SPECIALTIES

Specialty: Title	Specialty: Code	Number of cases	ASVAB 8/9/10 subtest mean[a]: AR	AS	WK
Aircraft Maintenance (60xx)					
Ground support	6072	130	23	20	30
Safety equipment	6081	91	22	19	28
Aviation hydraulics	6051	37	22	20	29
Turboprop	6026	54	20	20	27
Aircraft survival	6060	87	21	19	28
Electrical Equipment Repair (11/60)					
Ground support	6077	105	24	20	31
Electrical equipment	1142	48	22	30	28
Tracked Vehicle Repair (13/21)					
Assault amphibian crew	2142	63	20	19	26
Tank repair	2145	144	19	19	25
Engineer equipment	1341	169	19	19	27
Airfield Services (70xx)					
Aircraft recovery	7011	72	21	18	28
Firefighting	7051	158	20	17	27
Supply (30/60)					
Packaging specialist	3052	51	19	15	26
Subsistence supply	3061	66	20	15	26
Aviation supply	3072	381	20	16	27
Aviation administration	6046	85	19	16	28
Intelligence/Operations (02/70)					
Intelligence specialist	0231	70	24	18	31
Aviation operations clerical	7041	87	20	16	27
Financial/Accounting (34xx)					
Financial records	3421	233	24	17	30
Accounting technician	3451	44	22	16	30

TABLE B-3 (Continued)

Specialty		Number of cases	ASVAB 8/9/10 subtest mean[a]		
Title	Code		AR	AS	WK
Food Service (33xx)					
Baker	3311	109	21	16	28
Cook	3371	504	31	16	28
Logistics (04xx)					
Logistics	0400	76	21	13	27
Embarkation assistant	0431	112	20	16	26
Antiair (72xx)					
Hawk missile operator	7222	107	21	18	28
Redeye gunner	7212	112	20	18	28

a. AR = Arithmetic Reasoning raw score
AS = Auto/Shop Information raw score
WK = Word Knowledge raw score

FIG. B-1: ASVAB 8/9/10 VALIDATION STUDY WORKSHEET

1. COURSE NO. 2. CLASS NO. 3. COURSE TITLE 4. MOS

5. NUMERICAL PERFORMANCE INDICATOR (NPI)

FCG	AMS	ANA	TC	Other

6. TYPE OF COURSE

FIXED LENGTH Lockstep	VARIABLE LENGTH Self-paced	Other

7. SSN	8. LAST NAME	9. STATUS	10. REASON*	11. NPI SCORE	7. SSN	8. LAST NAME	9. STATUS	10. REASON*	11. NPI SCORE
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		
		P F					P F		

12. SUBMITTED BY: ______________________ 13. DATE: ______________

14. AUTOVON NUMBER: ______________________

Local reproduction authorized.

Reason for failure:

A. Academic Failure – will recycle in same course.
B. Academic Failure – will NOT recycle in same course.
C. Nonacademic Failure – will recycle in same course.
D. Nonacademic Failure – will NOT recycle in same course.

APPENDIX C

VALIDITY OF ASVAB SUBTESTS AND MARINE CORPS APTITUDE COMPOSITES

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Social grouping: Black	White	Nonagraduate	Graduate	Female	Male
FIELD ARTILLERY (Continued)								
Anti-air	Mean							
7212, 7222	Grade	50.0	44.3	51.4	50.1	49.9	–	–
	GT	105.9	96.9	108.3	104.9	106.2	–	–
	Sigma							
	Grade	10.3	12.4	9.1	8.9	10.6	–	–
	GT	12.5	8.5	12.3	11.1	12.8	–	–
	Number of cases	402	82	320	77	325	–	–

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Black	White	Nongraduate	Graduate	Female	Male
			Social grouping					
COMBAT (Continued)								
Assaultman (Pendleton) 0351	Mean							
	Grade	50.0	49.3	50.3	49.6	50.3	–	–
	GT	100.2	93.6	102.4	102.4	98.9	–	–
	Sigma							
	Grade	10.0	10.8	9.7	9.0	10.5	–	–
	GT	11.7	10.4	11.4	10.3	12.3	–	–
	Number of cases	258	62	196	96	162	–	–
FIELD ARTILLERY								
Fire control 0844	Mean							
	Grade	49.9	45.4	51.0	47.3	50.6	–	–
	GT	108.3	96.5	111.2	108.2	108.4	–	–
	Sigma							
	Grade	10.0	11.1	9.3	10.4	9.8	–	–
	GT	13.4	12.2	12.1	10.6	14.0	–	–
	Number of cases	358	69	289	69	289	–	–
Amphibian crew (1833)	Mean							
	Grade	50.0	45.6	50.3	47.9	51.3	–	–
	GT	107.0	97.7	107.5	106.5	107.3	–	–
	Sigma							
	Grade	10.0	7.3	10.1	10.9	9.3	–	–
	GT	12.0	13.8	11.8	9.7	13.2	–	–
	Number of cases	302	15	287	112	190	–	–

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Social grouping: Black	White	Nongraduate	Graduate	Female	Male
COMBAT (Continued)								
Mortarman (Lejeune) 0341	Mean							
	Grade	50.0	44.8	51.0	50.5	49.8	–	–
	GT	105.4	94.3	107.6	105.9	105.3	–	–
	Sigma							
	Grade	10.0	10.2	9.6	8.9	10.3	–	–
	GT	13.4	11.2	12.7	11.1	14.1	–	–
	Number of cases	887	143	744	242	645	–	–
Mortarman (Pendleton) 0341	Mean							
	Grade	50.1	48.0	50.5	48.8	50.9	–	–
	GT	104.3	95.0	106.0	104.5	104.1	–	–
	Sigma							
	Grade	10.0	11.6	9.7	9.9	10.1	–	–
	GT	11.7	10.1	11.2	8.9	13.3	–	–
	Number of cases	244	39	205	99	145	–	–
Assaultman (Lejeune) (0351)	Mean							
	Grade	49.9	44.5	51.0	49.6	50.1	–	–
	GT	104.2	93.1	106.3	104.7	104.0	–	–
	Sigma							
	Grade	10.0	11.4	9.4	11.0	9.7	–	–
	GT	12.7	10.6	11.9	10.8	13.3	–	–
	Number of cases	874	140	734	231	643	–	–

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Black	White	Nongraduate	Graduate	Female	Male
			Social grouping					
COMBAT (Continued)								
Rifleman (Pendleton) 0311	Mean							
	Grade	50.1	48.5	50.5	48.8	50.8	–	–
	GT	103.7	94.8	105.9	104.4	103.4	–	–
	Sigma							
	Grade	9.9	10.2	9.8	11.1	9.2	–	–
	GT	12.7	10.3	12.3	10.1	13.8	–	–
	Number of cases	1,448	287	1,161	471	977	–	–
Machine gunner (Lejeune) 0331	Mean							
	Grade	50.0	46.2	51.1	50.6	49.7	–	–
	GT	101.2	91.6	103.9	103.6	100.3	–	–
	Sigma							
	Grade	10.0	10.8	9.4	9.5	10.1	–	–
	GT	12.9	11.0	12.0	11.3	13.3	–	–
	Number of cases	833	188	645	218	615	–	–
Machine gunner (Pendleton) 0331	Mean							
	Grade	50.0	47.5	50.7	48.9	50.9	–	–
	GT	102.6	104.3	95.1	104.6	101.5	–	–
	Sigma							
	Grade	10.0	11.2	9.6	10.4	9.8	–	–
	GT	12.5	10.1	12.3	10.7	13.6	–	–
	Number of cases	205	42	163	85	120	–	–

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Black	White	Nongraduate	Graduate	Female	Male
			Social grouping					
GENERAL TECHNICAL (Continued)								
Food service 3311, 3371	Mean							
	Grade	49.9	45.0	51.4	49.9	49.9	53.0	49.4
	GT	104.2	95.6	106.9	107.8	102.7	101.5	104.6
	Sigma							
	Grade	9.9	10.7	9.2	9.6	10.1	10.4	9.8
	GT	12.5	11.3	11.7	11.5	12.6	8.4	13.0
	Number of cases	823	194	629	247	576	111	712
Aviation ordnance 65xx	Mean							
	Grade	49.9	48.0	50.2	47.3	50.2	46.0	50.3
	GT	115.6	109.5	116.4	117.0	115.4	108.0	116.2
	Sigma							
	Grade	10.0	8.1	10.2	11.3	9.9	9.9	10.0
	GT	9.1	8.0	8.9	10.9	8.9	9.0	8.8
	Number of cases	485	58	427	48	437	38	447
COMBAT								
Rifleman (Lejeune) 0311	Mean							
	Grade	50.0	46.1	51.5	50.6	50.0	–	–
	GT	100.6	90.6	104.5	101.7	100.3	–	–
	Sigma							
	Grade	10.0	10.3	9.5	9.6	10.2	–	–
	GT	13.6	9.9	12.8	10.7	14.4	–	–
	Number of cases	3,442	958	2,484	828	2,614	–	–

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Social grouping: Black	White	Nongraduate	Graduate	Female	Male
ELECTRONICS REPAIR (Continued)								
Basic electricity and electronics 5900	Mean							
	Grade	50.0	49.1	50.1	48.4	50.1	49.8	50.0
	EL	118.1	114.4	118.5	119.2	118.0	115.9	118.2
	Sigma							
	Grade	10.0	10.6	9.9	12.0	9.8	8.1	10.1
	EL	8.8	8.2	8.8	9.3	8.8	7.4	8.9
	Number of cases	1,868	166	1,702	129	1,739	98	1,770
GENERAL TECHNICAL								
Ammunition storage 2311	Mean							
	Grade	50.0	46.9	51.0	43.8	50.8	52.3	49.8
	GT	102.1	93.2	105.2	100.9	102.3	102.9	102.1
	Sigma							
	Grade	9.9	9.8	9.8	12.0	9.4	7.5	10.1
	GT	12.6	10.6	11.8	13.7	12.5	8.9	12.8
	Number of cases	307	79	228	35	272	18	289
Logistics 04xx 0400, 0431	Mean							
	Grade	50.0	47.3	50.9	48.0	50.4	52.3	49.4
	GT	103.0	97.5	104.8	106.4	102.4	101.2	103.5
	Sigma							
	Grade	10.0	1.00	9.9	8.5	10.2	11.1	9.6
	GT	10.9	9.8	10.7	9.4	11.1	8.2	11.5
	Number of cases	282	67	215	45	237	57	225

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Social grouping: Black	White	Nongraduate	Graduate	Female	Male
CLERICAL (Continued)								
Financial accounting 3421, 3451	Mean							
	Grade	50.0	48.0	50.6	45.5	50.3	50.9	49.7
	CL	111.1	106.3	112.4	102.7	111.6	112.3	110.6
	Sigma							
	Grade	10.0	9.9	10.0	9.8	10.0	9.7	10.2
	CL	10.5	10.5	10.1	9.2	10.4	9.6	10.8
	Number of cases	376	84	292	22	354	106	270
ELECTRONICS REPAIR								
Field radio operator 2531	Mean							
	Grade	50.0	48.2	50.7	47.7	50.9	51.0	49.9
	EL	103.4	97.8	105.7	104.3	103.3	102.7	103.7
	Sigma							
	Grade	10.0	11.0	9.5	11.3	9.3	7.6	10.2
	EL	11.4	11.1	10.7	10.4	11.8	8.7	11.7
	Number of cases	1,264	339	925	349	915	128	1,136
Basic electronics 2800	Mean							
	Grade	50.0	46.9	50.6	48.0	50.2	51.3	49.9
	EL	117.4	109.7	118.9	119.9	117.2	116.9	117.4
	Sigma							
	Grade	10.0	9.8	9.9	9.8	10.0	9.7	10.0
	EL	10.2	11.2	9.2	9.0	10.2	8.2	10.3
	Number of cases	971	156	815	67	904	62	909

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Social grouping: Black	White	Nongraduate	Graduate	Female	Male
CLERICAL (Continued)								
Supply control 3043	Mean							
	Grade	50.0	46.2	50.8	43.9	50.3	52.0	49.6
	CL	111.0	105.1	112.3	102.7	111.5	114.2	110.4
	Sigma							
	Grade	10.0	10.9	9.5	10.8	9.8	9.3	10.0
	CL	11.6	13.4	10.8	10.8	11.5	9.6	11.9
	Number of cases	1,028	185	843	56	972	154	874
Intelligence operations 0231, 7041	Mean							
	Grade	50.0	50.1	50.0	47.7	50.3	51.6	49.6
	CL	107.3	101.6	108.6	103.1	107.7	108.2	107.1
	Sigma							
	Grade	10.1	9.4	10.2	8.3	10.2	10.2	10.0
	CL	11.3	9.8	11.3	10.9	11.3	7.7	12.0
	Number of cases	256	50	206	26	230	47	209
Supply 3052, 3061, 3072, 6046	Mean							
	Grade	50.0	48.9	50.4	47.2	50.5	54.9	49.5
	CL	100.7	97.5	102.0	101.7	100.6	108.6	100.0
	Sigma							
	Grade	9.9	10.1	9.9	10.3	9.8	9.4	9.9
	CL	10.6	10.9	10.3	8.9	10.9	9.7	10.5
	Number of cases	995	282	713	158	837	81	914

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Social grouping: Black	White	Nongraduate	Graduate	Female	Male
CLERICAL								
Administrative clerk (Lejeune) 0151	Mean							
	Grade	50.0	47.7	51.3	46.3	50.4	53.5	47.3
	CL	104.9	99.7	107.9	102.4	105.2	109.7	101.4
	Sigma							
	Grade	10.0	10.6	9.3	11.0	9.7	8.3	10.2
	CL	11.9	11.8	11.0	11.3	12.0	10.0	12.0
	Number of cases	1,031	374	657	104	927	438	593
Administrative clerk (Pendleton) 0151	Mean							
	Grade	49.9	47.5	50.8	47.8	50.4	54.5	49.6
	CL	105.1	99.7	107.2	105.1	105.1	110.8	104.7
	Sigma							
	Grade	10.0	12.1	8.8	11.8	9.4	2.6	10.2
	CL	11.8	11.0	11.4	10.2	12.1	10.6	11.8
	Number of cases	1,027	289	738	198	829	64	963
Communications center 2542	Mean							
	Grade	50.0	49.1	50.6	48.7	50.2	53.1	49.4
	CL	104.4	100.2	106.8	103.8	104.5	109.2	103.4
	Sigma							
	Grade	10.0	10.6	9.6	10.8	9.9	8.4	10.2
	CL	12.1	11.3	11.9	10.5	12.3	9.0	12.4
	Number of cases	518	194	324	76	442	85	433

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Black	White	Nongraduate	Graduate	Female	Male
			Social grouping					
MECHANICAL MAINTENANCE (Continued)								
Aircraft maintenance 6026, 6051, 6060, 6072, 6081	Mean							
	Grade	50.0	47.3	50.4	48.9	50.1	47.6	50.1
	MM	112.0	102.8	113.4	115.8	111.4	102.0	112.4
	Sigma							
	Grade	10.0	9.2	10.0	10.3	9.9	8.9	10.0
	MM	12.4	12.4	11.7	12.1	12.3	10.1	12.3
	Number of cases	905	122	783	125	780	40	865
Electrical equipment repair 1142, 6077	Mean							
	Grade	50.0	48.4	50.2	50.9	49.9	46.2	50.1
	MM	118.4	110.9	119.4	120.9	118.2	105.4	118.8
	Sigma							
	Grade	10.0	10.7	9.9	8.1	10.1	13.7	9.8
	MM	11.8	13.3	11.3	10.4	12.0	12.5	11.6
	Number of cases	369	40	329	36	333	11	358
Airfield services 7011, 7051	Mean							
	Grade	50.0	43.8	51.5	50.6	50.0	39.4	50.3
	MM	104.7	94.5	107.2	109.6	103.3	91.2	105.1
	Sigma							
	Grade	10.0	11.3	98.1	9.7	10.1	9.3	9.9
	MM	13.1	11.6	12.3	12.4	13.0	8.7	13.0
	Number of cases	417	83	334	92	325	12	405

TABLE B-4 (Continued)

Specialty	Statistic	Total sample	Social grouping: Black	White	Nongraduate	Graduate	Female	Male
MECHANICAL MAINTENANCE (Continued)								
Aircraft mechanic 6011	Mean							
	Grade	50.0	49.7	50.1	49.4	50.1	51.4	49.9
	MM	108.3	100.0	110.3	112.6	107.2	101.5	108.5
	Sigma							
	Grade	10.0	9.2	10.2	10.3	10.0	9.7	10.0
	MM	12.0	10.6	11.5	11.1	12.0	10.1	12.0
	Number of cases	1,005	187	818	219	786	25	980
Helicopter mechanic 6111	Mean							
	Grade	49.9	49.2	50.0	49.5	50.0	–	–
	MM	114.9	103.6	116.2	117.0	114.5	–	–
	Sigma							
	Grade	9.9	10.5	9.9	10.3	9.9	–	–
	MM	12.0	11.8	11.3	11.2	12.1	–	–
	Number of cases	477	50	427	67	410	–	–
Tracked vehicle repair 1341, 2142, 2145	Mean							
	Grade	50.0	45.8	51.0	48.8	50.4	56.7	49.8
	MM	106.7	95.7	109.4	110.5	105.6	102.6	106.8
	Sigma							
	Grade	10.0	9.7	9.8	10.4	9.8	4.8	10.0
	MM	12.9	11.0	11.9	11.0	13.3	9.9	13.0
	Number of cases	729	145	584	160	569	17	712

TABLE B-4

ASVAB APTITUDE MEAN COMPOSITE SCORES AND STANDARD DEVIATIONS BY SOCIAL GROUPINGS

			Social grouping					
Specialty	Statistic	Total sample	Black	White	Nongraduate	Graduate	Female	Male
MECHANICAL MAINTENANCE								
Engineer equipment operator 1345	Mean							
	Grade	50.0	46.3	50.8	49.1	50.2	46.7	50.1
	MM	107.5	96.7	109.9	111.0	106.7	96.3	107.9
	Sigma							
	Grade	10.1	9.9	9.9	9.0	10.3	10.0	10.0
	MM	13.2	11.0	12.5	9.8	13.8	10.0	13.2
	Number of cases	697	129	568	126	571	24	673
Combat engineer 1371	Mean							
	Grade	50.0	43.8	52.2	49.9	50.0	–	–
	MM	103.4	91.1	107.8	106.4	100.8	–	–
	Sigma							
	Grade	10.1	9.5	9.3	9.7	10.4	–	–
	MM	14.4	11.9	12.6	12.6	15.4	–	–
	Number of cases	368	97	271	171	197	–	–
Automotive mechanic 3521	Mean							
	Grade	50.0	44.6	51.6	47.0	50.6	45.9	50.3
	MM	107.4	95.8	110.7	110.3	106.8	99.2	107.9
	Sigma							
	Grade	10.0	10.2	9.4	10.7	9.8	10.0	10.0
	MM	14.3	12.6	13.0	13.1	14.5	11.8	14.3
	Number of cases	874	196	678	136	738	53	821

FIG. B-2: INSTRUCTIONS FOR COMPLETING ASVAB 8/9/10 VALIDATION STUDY WORKSHEET

The following information is requested on the worksheet:

Block 1: Record number of course.

Block 2: Record class number.

Block 3: Record course title.

Block 4: Record four digit MOS for which graduates qualify.

Block 5: Circle the NPI used in this course:

Final Course Grade = FCG
Average Module Score = AMS
Average Number of Attempts = ANA
Time to Completion = TC
Other = O

Block 6: Circle type of course.

Block 7: Record Social Security Number (SSN) (9 digits) for all Marine students.

Block 8: Record first five letters of last name.

Block 9: Circle "P" if the Marine student passed the course. Circle "F" if the Marine student did not pass the course. Report "P" or "F" for each Marine student in the class.

Block 10: If Block 9 marked "F", record the reason for "F" in Block 10 using code at bottom of worksheet.

A. Academic Failure — will recycle in same course.
B. Academic Failure — will NOT recycle in same course.
C. Nonacademic Failure — will recycle in same course.
D. Nonacademic Failure — will NOT recycle in same course.

Block 11: Enter the Marine student's NPI score.

Block 12: Person preparing worksheet.

Block 13: Date worksheet prepared.

Block 14: Autovon phone number of person preparing worksheet.

APPENDIX C

VALIDITY OF ASVAB SUBTESTS AND MARINE CORPS APTITUDE COMPOSITES

Table C-1 contains the observed validity coefficients of the ASVAB 8/9/10 subtests for each sample. The samples are grouped by occupational clusters. The mean validity coefficients for each cluster and the standard deviation of the validity coefficients in each cluster are also shown. To the extent that the specialties in a cluster have similar aptitude requirements, the standard deviations of the validity coefficients within a cluster tend to be smaller than the standard deviations for the total set of samples. The mean and standard deviation of the validity coefficients for all the samples are shown in the last two lines of the table.

The validity coefficients in table C-1 are difficult to interpret because they are affected to varying degrees by the procedures for assigning students to the training courses. The students in each sample were selected for that specialty in part because they had qualifying aptitude composite scores. Because the ranges of subtest scores in each sample are restricted by the selection of students, the coefficients cannot be compared to each other.

To be comparable, the coefficients need to be placed on a common basis, and preferably the common basis should have meaning in its own right. One procedure for placing the validity coefficients on a common metric is called "correction for restriction in range." The correction procedure estimates what the validity coefficients would be in a population of examinees who have not been selected on the basis of their test scores. The population used here to correct the validity coefficients is the 1980 youth population (composed of 18- through 23-year-old males and females), and hence "population estimates" of the validity coefficients are spoken of.

The population estimates of the validity coefficients for each sample are shown in table C-2. The population estimates are strikingly higher than the sample values. Another feature is that the profile of estimated population validity coefficients in each sample (table C-2) tend to be more similar than the profile of the sample values (table C-1). The population estimates can be compared to each other, and they are more accurate values than the sample values, in the sense that they are reasonably close to the values expected if people were randomly assigned to the specialties.

TABLE C-1

VALIDITY COEFFICIENTS FOR ASVAB 8/9/10 (SAMPLE VALUES)

Specialty: Title	Code	VE	GS	AR	MK	AS	MC	EI	NO	CS
Mechanical Maintenance										
Engineer Equipment Operator	1345	17	19	20	18	30	22	23	2	0
Combat Engineer	1371	27	35	38	30	46	36	30	21	15
Automotive Mechanic	3521	16	27	22	21	51	38	42	1	2
Aircraft Mechanic	6011	31	21	16	23	21	27	27	2	7
Helicopter Mechanic	6111	22	15	22	23	21	21	28	10	10
Tracked Vehicle Repair	13/21	27	23	23	12	35	33	26	6	12
Aircraft Maintenance	60xx	29	27	20	25	34	30	27	−1	11
Electrical Equipment Repair	11/60	11	14	32	34	26	33	28	19	10
Airfield Services	70xx	21	18	8	10	29	25	19	−6	8
Mean		22	22	22	22	33	29	28	6	9
Standard Deviation		7	7	9	8	10	6	6	9	5
Clerical										
Administrative Clerk	0151	26	13	27	30	2	6	3	12	21
Administrative Clerk	0151	18	12	24	26	15	16	10	14	18
Communications	2542	28	28	26	36	13	26	25	12	10
Supply Stock Control	3043	38	35	51	53	23	28	26	30	27
Intelligence/Operations	02/70	32	28	33	40	20	33	25	20	25
Supply	30/60	18	9	27	32	-2	11	5	20	26
Finance/Accounting	34xx	27	25	43	49	8	16	14	12	24
Mean		26	21	33	38	11	19	15	17	22
Standard Deviation		8	10	10	10	9	10	10	7	6
Electronics Repair										
Radio Operator	2531	14	14	13	20	10	13	15	11	7
Basic Electronics	2800	29	38	38	43	25	34	21	21	16
Basic Electronics/Electrical	5900	18	21	27	36	11	23	23	7	7
Mean		20	24	26	33	15	23	20	13	10
Standard Deviation		8	12	13	12	8	11	4	7	5
General Technical										
Amunition Storage	2311	34	30	39	35	18	31	20	4	11
Logistics	04xx	25	33	30	28	35	34	27	16	12
Food Service	33xx	30	26	22	32	−1	13	11	3	14
Aviation Ordnance	65xx	22	27	36	43	29	28	27	14	13
Mean		28	29	32	34	20	27	22	9	12
Standard Deviation		5	3	8	7	16	10	8	7	1

Subtest[a] columns: VE, GS, AR, MK, AS, MC, EI, NO, CS

TABLE C-1 (Continued)

Specialty		Subtest[a]								
Title	Code	VE	GS	AR	MK	AS	MC	EI	NO	CS
Combat										
Rifleman	0311	32	32	35	33	30	35	29	12	13
Rifleman	0311	19	19	21	23	10	20	15	10	11
Mortarman	0331	30	28	29	29	28	31	23	3	7
Mortarman	0331	18	25	17	24	28	21	13	9	-4
Machine Gunner	0341	30	30	31	30	28	28	25	17	16
Machine Gunner	0341	10	7	18	13	6	6	13	11	17
Assaultman	0351	37	28	31	32	24	30	33	11	15
Assaultman	0351	1	25	14	25	11	28	12	4	1
Mean		22	24	24	26	21	25	20	10	10
Standard Deviation		12	8	8	6	10	9	8	4	8
Field Artillery										
Fire Control	0844	15	13	44	38	26	30	24	34	34
Assault Amphibious Crewman	1833	33	43	36	37	32	30	37	24	22
Anti-Air	72xx	16	29	26	27	38	31	18	2	26
Mean		21	28	36	34	32	30	26	20	27
Standard Deviation		10	15	9	6	6	1	10	16	6
All Specialty Groups										
Mean		23	24	28	30	22	25	22	11	14
Standard Deviation		9	9	10	10	13	9	9	9	8

a. ASVAB subtest:
- GS = General Science
- AR = Arithmetic Reasoning
- WK = Word Knowledge
- PC = Paragraph Comprehension
- NO = Numerical Operations
- CS = Coding Speed
- AS = Auto/Shop Information
- MK = Math Knowledge
- MC = Mechanical Comprehension
- EI = Electronics Information
- VE = Verbal (WK + PC)

TABLE C-2

VALIDITY COEFFICIENTS FOR ASVAB 8/9/10 (POPULATION ESTIMATES)

Specialty		Subtest[a]								
Title	Code	VE	GS	AR	MK	AS	MC	EI	NO	CS
Mechanical Maintenance										
Engineer Equipment Operator	1345	48	50	50	46	50	48	50	39	30
Combat Engineer	1371	58	61	63	58	59	57	56	44	37
Automotive Mechanic	3521	51	59	55	51	68	62	66	38	30
Aircraft Mechanic	6011	64	59	58	57	50	55	59	44	41
Helicopter Mechanic	6111	58	54	57	55	48	51	57	47	39
Tracked Vehicle Repair	13/21	61	60	64	54	61	64	63	47	42
Aircraft Maintenance	60xx	64	63	60	57	59	60	61	42	43
Electrical Equipment Repair	11/60	54	60	65	61	58	63	65	48	37
Airfield Services	70xx	42	43	38	36	43	42	41	26	31
Mean		56	57	57	53	55	56	58	42	37
Standard Deviation		8	6	9	8	8	7	8	7	5
Clerical										
Administrative Clerk	0151	60	50	57	58	27	38	39	48	47
Administrative Clerk	0151	44	37	45	45	30	35	34	40	39
Communications	2542	49	46	49	53	26	41	43	41	38
Supply Stock Control	3043	70	63	74	73	43	53	55	64	57
Intelligence/Operations	02/70	61	55	59	61	36	48	49	53	51
Supply	30/60	55	48	56	59	25	39	40	53	52
Finance/Accounting	34xx	71	65	75	76	39	52	55	57	56
Mean		59	52	59	61	32	44	45	51	49
Standard Deviation		10	10	11	11	7	7	8	9	8
Electronics Repair										
Radio Operator	2531	41	41	42	43	30	35	39	36	29
Basic Electronics	2800	70	74	77	76	56	68	65	59	49
Basic Electronics/Electrical	5900	64	68	74	73	49	61	65	50	42
Mean		58	61	64	64	45	55	56	48	40
Standard Deviation		15	18	19	18	13	17	15	11	10
General Technical										
Ammunition Storage	2311	64	61	66	62	44	57	53	48	44
Logistics	04xx	60	62	61	57	55	58	57	53	43
Food Service	33xx	64	60	61	63	31	46	49	47	50
Aviation Ordnance	65xx	65	65	71	71	54	61	62	54	47
Mean		63	62	65	63	46	55	55	51	46
Standard Deviation		2	2	5	6	11	6	6	3	3

TABLE C-2 (Continued)

Specialty		Subtest[a]								
Title	Code	VE	GS	AR	MK	AS	MC	EI	NO	CS
Combat										
Rifleman	0311	53	52	55	52	44	51	49	40	33
Rifleman	0311	39	38	40	40	25	34	33	34	30
Mortarman	0331	53	51	53	50	45	50	48	39	33
Mortarman	0331	35	42	39	41	39	37	35	31	20
Machine Gunner	0341	57	55	56	52	46	50	51	48	41
Machine Gunner	0341	30	25	33	30	18	22	26	29	30
Assaultman	0351	62	56	57	55	46	53	56	45	40
Assaultman	0351	14	29	26	30	19	32	23	17	13
Mean		43	44	45	44	35	41	40	35	30
Standard Deviation		16	12	12	10	12	11	13	10	10
Field Artillery										
Fire Control	0844	53	50	65	59	44	53	49	57	51
Assault Amphibious Crewman	1833	64	67	65	60	56	59	63	55	48
Anti-Air	72xx	44	49	47	47	50	48	43	33	39
Mean		54	55	59	55	50	53	52	48	46
Standard Deviation		10	10	10	7	6	5	10	13	6
All Specialty Groups										
Mean		54	54	56	55	43	49	50	44	40
Standard Deviation		12	11	12	12	13	11	12	10	10

a. ASVAB subtest:
- GS = General Science
- AR = Arithmetic Reasoning
- WK = Word Knowledge
- PC = Paragraph Comprehension
- NO = Numerical Operations
- CS = Coding Speed
- AS = Auto/Shop Information
- MK = Math Knowledge
- MC = Mechanical Comprehension
- EI = Electronics Information
- VE = Verbal (WK + PC)

A review of the procedure to correct for restriction in range may help clarify what the corrected coefficients, or population estimates, mean. The multivariate procedure was used, which corrects for selection on all ASVAB subtests simultaneously.

The correction procedure requires that we know the population standard deviations and intercorrelation of the ASVAB subtests. The population values come from the 1980 youth population. These population values are shown in table C-3.

The multivariate correction procedure is based on the following two assumptions:

- The regression weights of training grades on the ASVAB subtests are identical in both the population and the selected groups (samples).

- The standard errors of estimate for predicting training grades are the same in the population and the selected groups.

A third assumption made is that the partial correlation among all variables not used explicitly to select people (called incidential selection variables) is equal in both the population and selected group. Because there is only one incidental variable (training grades), this assumption does not affect the results.

The correction for restriction in range in effect extends the multivariate regression plane to cover the full range of scores. If the assumptions are met, the population estimates are correct. In practice, of course, selection of students for a specialty is never based solely on ASVAB scores. The correction is therefore an approximation.

The estimated population coefficients were used to compute the validity of the aptitude composites (table C-4). The composites for ASVAB 8/9/10 (labeled "Old"), ASVAB 11/12/13 (labeled "New"), ASVAB 14 (labeled "Occupational" and "Academic"), and two additional factor composites (technical and speed) are shown. Verbal and mathematics composites are included under "Academic."

TABLE C-3

INTERCORRELATION[a] OF ASVAB-8 SUBTESTS FOR MALES AND FEMALES IN THE 1980 YOUTH POPULATION

	ASVAB subtest[b]											
	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	VE	Standard deviation
GS	–	72	80	69	52	45	64	69	70	76	80	5.01
AR	72	–	71	67	63	52	53	83	69	66	73	7.37
WK	80	71	–	80	62	55	53	67	60	68	98	7.71
PC	69	67	80	–	61	56	42	64	52	57	90	3.36
NO	52	63	62	61	–	70	31	62	41	42	64	10.80
CS	45	52	55	56	70	–	22	52	34	34	58	16.76
AS	64	53	53	42	31	22	–	41	74	75	52	5.55
MK	69	83	67	64	62	52	41	–	60	59	69	6.39
MC	70	69	60	52	41	34	74	60	–	74	60	5.35
EI	76	66	68	57	42	34	75	59	74	–	68	4.24
VE	80	73	98	90	64	58	52	69	60	68	–	10.59

a. Decimals omitted.

b. ASVAB subtest:

GS = General Science
AR = Arithmetic Reasoning
WK = Word Knowledge
PC = Paragraph Comprehension
NO = Numerical Operations
CS = Coding Speed
AS = Auto/Shop Information
MK = Math Knowledge
MC = Mechanical Comprehension
EI = Electronics Information
VE = Verbal (WK + PC)

TABLE C-4

VALIDITY OF ASVAB 8/9/10 COMPOSITES FOR MARINE CORPS OCCUPATIONAL TRAINING COURSES

Specialty			ASVAB 8/9/10 Composite[a]																		
			Old						New				Occupational				Academic			Factor	
Title	Code	AFQT	MM	CL	EL	GT	CO	FA	MM	CL	EL	GT	M&C	B&C	E&E	HS&T	AA	V	M	T	S
Mechanical Maintenance																					
Engineer Equipment Operator	1345	53	57	45	56	53	56	58	57	48	56	55	57	48	56	55	53	52	50	54	37
Combat Engineer	1371	64	68	53	67	65	67	71	68	60	67	67	68	60	67	67	65	63	63	63	44
Automotive Mechanic	3521	55	72	45	66	57	64	68	72	51	66	63	72	51	66	63	57	58	56	72	37
Aircraft Mechanic	6011	65	63	57	66	66	65	67	63	63	66	67	63	63	66	67	66	65	60	60	46
Helicopter Mechanic	6111	62	61	55	63	62	63	64	61	60	63	63	61	60	63	63	62	59	59	57	46
Tracked Vehicle Repair	13/21	66	72	58	68	67	70	72	72	62	68	71	72	62	68	71	67	64	62	69	48
Aircraft Maintenance	60xx	65	69	57	68	67	69	72	69	64	68	70	69	64	68	70	67	67	61	66	46
Electrical Equipment Repair	11/60	63	72	53	71	64	66	69	72	59	71	69	72	59	71	69	64	60	66	68	46
Airfield Services	70xx	42	47	38	45	43	46	48	47	43	45	46	47	43	45	46	43	45	39	46	31
Mean		59	64	51	63	60	63	65	64	57	63	63	64	57	63	63	60	59	57	62	42
Standard Deviation		8	9	7	8	8	7	8	9	7	8	8	9	7	8	8	8	7	8	8	6
Clerical																					
Administrative Clerk	0151	63	46	60	58	63	56	57	46	65	58	59	46	65	58	59	63	58	60	38	52
Administrative Clerk	0151	49	41	47	46	48	47	46	41	50	46	47	41	50	46	47	48	43	47	36	43
Communications	2542	53	45	49	54	52	48	48	45	54	54	52	45	54	54	52	52	50	53	40	43
Supply Stock Control	3043	78	64	73	75	77	73	73	64	78	75	74	64	78	75	74	77	70	76	55	65
Intelligence/Operations	02/70	66	55	63	63	65	62	61	55	68	63	64	55	68	63	64	65	61	63	49	57
Supply	30/60	62	46	61	57	60	55	53	46	65	57	56	46	65	57	56	60	54	60	38	57
Finance/Accounting	34xx	77	63	70	76	78	69	72	63	79	76	74	63	79	76	74	78	72	79	53	61
Mean		64	52	60	61	63	58	59	52	65	61	61	52	65	61	61	63	58	63	44	54
Standard Deviation		11	9	10	11	11	10	11	9	11	11	11	9	11	11	11	11	10	12	8	9

TABLE C-4 (Continued)

Specialty			ASVAB 8/9/10 Composite[a]																	
			Old						New				Occupational				Academic			Factor	
Title	Code	AFQT	MM	CL	EL	GT	CO	FA	MM	CL	EL	GT	M&C	B&C	E&E	HS&T	AA	V	M	T	S
Electronics Repair																					
Radio Operator	2531	45	42	41	47	44	44	44	41	44	47	44	42	44	47	44	44	43	44	38	36
Basic Electronics	2800	78	76	68	82	79	76	79	76	76	82	81	76	76	82	81	79	76	80	69	58
Basic Electronics/Electrical	5900	72	71	60	79	74	67	73	71	70	79	75	71	70	79	75	74	70	77	64	50
Mean		65	63	56	69	66	63	65	63	63	69	67	63	63	69	67	66	63	67	57	48
Standard Deviation		17	18	14	20	19	16	19	18	17	20	19	18	17	20	19	19	17	20	16	12
General Technical																					
Amunition Storage	231.1	69	63	60	68	70	65	68	63	67	68	71	63	67	68	71	70	66	67	56	50
Logistics	04xx	66	66	59	67	65	69	68	66	62	67	67	66	62	67	67	65	64	61	62	52
Food Service	33xx	67	54	62	66	67	59	61	54	68	66	64	54	68	66	64	67	65	65	46	53
Aviation Ordnance	65xx	72	71	64	76	73	71	74	71	71	76	74	71	71	76	74	73	69	74	65	55
Mean		68	63	61	69	69	66	68	63	67	69	69	63	67	69	69	69	66	67	57	52
Standard Deviation		3	7	2	5	4	5	5	7	4	5	4	7	4	5	4	4	2	5	8	2
Combat																					
Rifleman	0311	57	57	48	59	58	57	59	57	54	59	60	57	54	59	60	58	55	56	53	40
Rifleman	0311	43	38	40	42	43	40	41	38	43	42	43	38	43	42	43	43	41	42	33	35
Mortarman	0331	56	56	48	57	57	56	59	56	53	57	59	56	53	57	59	57	55	54	53	39
Mortarman	0331	40	43	33	45	40	43	44	43	37	45	42	43	37	45	42	40	41	42	41	27
Machine Gunner	0341	61	58	56	61	61	62	62	58	59	61	61	58	59	61	61	61	59	57	54	49
Machine Gunner	0341	34	28	34	32	34	32	31	28	35	32	32	28	35	32	32	34	29	33	24	32
Assaultman	0351	64	61	56	63	64	63	65	61	61	63	65	61	61	63	65	64	62	59	57	46
Assaultman	0351	21	29	17	30	22	21	23	29	22	30	27	29	22	30	27	22	23	29	27	17
Mean		47	46	42	49	47	47	48	46	45	49	49	46	45	49	49	47	46	46	43	36
Standard Deviation		15	14	13	13	15	15	15	14	13	13	14	14	13	13	14	15	14	12	13	10

TABLE C-4 (Continued)

Specialty			ASVAB 8/9/10 Composite[a]																		
			Old						New				Occupational				Academic			Factor	
Title	Code	AFQT	MM	CL	EL	GT	CO	FA	MM	CL	EL	GT	M&C	B&C	E&E	HS&T	AA	V	M	T	S
Fire Artillery																					
Fire Control	0844	65	60	62	63	63	64	63	60	64	63	64	60	64	63	64	63	54	65	54	58
Assault Amphibious																					
Crewman	1833	70	70	64	72	59	72	72	70	67	72	7	70	67	72	71	69	69	65	65	55
Anti-Air	72xx	47	54	44	52	49	52	55	54	50	52	52	54	50	52	52	49	49	49	51	39
Mean		61	61	57	62	60	62	63	61	60	62	62	61	60	62	62	60	57	60	57	51
Standard Deviation		12	8	11	10	11	10	9	8	9	10	9	8	9	10	9	11	10	9	7	10
All Specialty Groups																					
Mean		59	57	53	61	59	58	60	57	58	61	60	57	58	61	60	59	57	58	52	46
Standard Deviation		13	13	12	13	13	12	13	13	13	13	13	13	13	13	13	13	12	12	13	10

a. MM = Mechanical Maintenance
CL = Clerical
EL = Electronics Repair
GT = General Technical
CO = Combat
FA = Field Artillery
M&C = Mechanical and Crafts
B&C = Business and Clerical
E&E = Electronics and Electrical
HS&T = Health, Social, and Technology
AA = Academic Ability
V = Verbal
M = Math
T = Technical
S = Speed

APPENDIX D

COMPUTING THE PERCENT OF SATISFACTORY PERFORMERS IN INTERVALS OF OCCUPATIONAL COMPOSITE SCORES

APPENDIX D

COMPUTING THE PERCENT OF SATISFACTORY PERFORMERS IN INTERVALS OF OCCUPATIONAL COMPOSITE SCORES

Standard tables are available that show the proportion of a normal bivariate distribution in each cell, where the variables have been categorized by convenient intervals. Table D-1 shows the frequency in each cell when the variables (performance in the occupation and occupational composite score) are grouped by intervals of one-half standard deviation on each variable. Note that the frequencies are placed between the rows of the standard deviation units, which represent performance scores, and between the columns, which represent the occupational composite scores. The column totals show the sum of the cell frequencies in each one-half standard deviation interval. The column totals are cumulated and shown as percentile scores in the bottom row. The frequencies change as the correlation between the variables changes; the frequencies in table D-1 are for a correlation of .6.

The proportions of satisfactory and unsatisfactory performers need to be converted into standard deviation units away from the mean. The proportion of satisfactory performers turns out to be remarkably convenient. For difficult occupations, the dividing line is at the mean – 50 percent above (satisfactory) and 50 percent below (unsatisfactory). For moderate occupations, the dividing line is one-half of a standard deviation below the mean – about 70 percent is above this point (satisfactory) and about 30 percent below (unsatisfactory); for easy occupations, the dividing line is one standard deviation below the mean – about 85 percent above and 15 percent below this point.

The chances of doing well are simply the percentage of each column in table D-1 that falls above each dividing line between satisfactory and unsatisfactory performers. For example, the column for the interval between the mean and one-half standard above the mean contains .1915 of the total distribution. (The total distribution is 1.000.) The sum of the cell frequencies above the mean in this column is .1095, which is 57 percent of the total column. The interpretation is that 57 percent of the people who have occupational composite percentile scores of 50 to 70 (between the mean and one-half standard deviation above) would be satisfactory performers in occupations that are difficult to learn. For occupations moderately difficult to learn, the cell frequency for the interval one-half standard deviation below the mean (.0415) is also included; add .0415 to .1095 (the frequency above the mean) and divide by .1915. The percent is 79; 79 percent of the people who have occupational composite percentile scores of 50 to 70 would be satisfactory performers in moderately difficult occupations. For occupations easy to learn, also include .0256, from the cell one-half to one standard deviation below the mean, and divide by .1915. The result is that 92 percent of the people with occupational composite percentile scores between 50 and 70 would be satisfactory performers in easy occupations. Similar computations are performed for each column or percentile score interval of table D-1.

Because the intervals in table D-1 cover a range of percentile scores, the percentages in each column represent the midpoint of the interval.

TABLE D-1

CELL FREQUENCIES OF NORMAL BIVARIATE DISTRIBUTION[a]

Standard deviation units of performance scores	Standard deviation units of occupational composite scores									
		−2.0	−1.5	−1.0	−0.5	0	0.5	1.0	1.5	2.0
					.0001	.0003	.0008	.0013	.0015	.0022
2.5				.0002	.0006	.0017	.0032	.0040	.0035	.0023
2.0			.0002	.0010	.0032	.0068	.0101	.0104	.0073	.0050
1.5		.0002	.0012	.0043	.0109	.0188	.0224	.0184	.0104	.0053
1.0	.0002	.0010	.0043	.0127	.0256	.0356	.0340	.0224	.0101	.0040
0.5	.0007	.0032	.0109	.0256	.0415	.0463	.0356	.0188	.0068	.0020
0	.0020	.0068	.0188	.0356	.0463	.0415	.0256	.0109	.0032	.0007
−0.5	.0040	.0101	.0224	.0340	.0356	.0256	.0127	.0043	.0010	.0002
−1.0	.0053	.0104	.0184	.0224	.0188	.0109	.0043	.0012	.0002	
−1.5	.0050	.0073	.0104	.0101	.0068	.0032	.0010	.0002		
−2.0	.0033	.0035	.0040	.0032	.0017	.0006	.0002			
−2.5	.0022	.0015	.0013	.0008	.0003	.0001				
Column total	.0228	.0440	.0919	.1498	.1915	.1915	.1498	.0919	.0440	.0228
Percentile score interval	1–2	2–7	7–16	16–31	31–50	50–69	69–84	84–93	93–98	98–99

a. Frequencies are for a correlation coefficient of .6.

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