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HUMAN RESOURCES

ARMED SERVICES VOCATIONAL APTITUDE BATTERY: VALIDATION FOR CIVILIAN OCCUPATIONS

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Terry R. Armstrong
Albert B. Chalupsky
Donald H. McLaughlin
Marie R. Dalldorf

American Institutes for Research
P.O. Box 1113
Palo Alto, California 94302

MANPOWER AND PERSONNEL DIVISION
Brooks Air Force Base, Texas 78235-5601

August 1988

Final Report for Period May 1985 - July 1988

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LABORATORY

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235-5601

88 9

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S) AFHRL-TR-88-20
6a. NAME OF PERFORMING ORGANIZATION American Institutes for Research 6b OFFICE SYMBOL *(If applicable)*	7a. NAME OF MONITORING ORGANIZATION Manpower and Personnel Division
6c. ADDRESS *(City, State, and ZIP Code)* P.O. Box 1113 Palo Alto, California 94302	7b. ADDRESS *(City, State, and ZIP Code)* Air Force Human Resources Laboratory Brooks Air Force Base, Texas 78235-5601
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Air Force Human Resources Laboratory 8b. OFFICE SYMBOL *(If applicable)* HQ AFHRL	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F33615-84-C-0067
8c. ADDRESS *(City, State, and ZIP Code)* Brooks Air Force Base, Texas 78235-5601	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO: 63704F PROJECT NO: 2922 TASK NO: 02 WORK UNIT ACCESSION NO: 01

11. TITLE *(Include Security Classification)*
Armed Services Vocational Aptitude Battery: Validation for Civilian Occupations

12. PERSONAL AUTHOR(S)
Armstrong, T.R.; Chalupsky, A.B.; McLaughlin, D.H.; Dalldorf, M.R.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT *(Year, Month, Day)*	15. PAGE COUNT
Final	FROM May 85 TO Jul 88	August 1988	110

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP
05	09	
05	08	

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
aptitude tests,
~~Armed Services Vocational Aptitude Battery (ASVAB)~~
civilian occupations,
occupational membership,
validation,
vocational counseling.

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

Form 14 of the Armed Services Vocational Aptitude Battery (ASVAB) is used in the Department of Defense high school testing program. Researchers have criticized the use of the ASVAB for career counseling in high schools because of a lack of validity data from studies of civilian occupations. To help counter the criticism, the American Institutes for Research undertook a project to validate ASVAB Form 14 on 12 common civilian occupations. ASVAB scores were obtained from 1,328 individuals across the nation who had been employed in one of the 12 occupations for at least 3 months. Holding a job, rather than job performance, was used as the criterion. Analyses focused on the extent to which skills measured by ASVAB vary among the 12 civilian occupations. There was a statistically significant variation in ASVAB profiles among occupations. The most salient dimension of variation was defined by high scores on Auto and Shop Information and low scores on the Verbal composite. The 12 occupations grouped into six clusters. About 30% of cases could be accurately placed in their occupations using ASVAB information, compared to a chance level of 12%. Because criterion performance data were not available, there is no evidence that skills characteristic of membership in the occupations are the same as skills required for successful careers in the occupations.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL Nancy J. Allin, Chief, STINFO Office	22b TELEPHONE *(Include Area Code)* (512) 536-3877 22c OFFICE SYMBOL AFHRL/TSR

DD Form 1473, JUN 86 *Previous editions are obsolete* SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

SUMMARY

The Armed Services Vocational Aptitude Battery (ASVAB) has been criticized as a high school vocational counseling tool since most validity data are based on criteria specific to military occupations. This project validated Form 14 of the ASVAB on civilian occupations to help overcome this criticism and encourage wider use of the ASVAB in high schools. When the Office of Management and Budget refused to allow the collection of performance criterion data from employers, the study was redesigned to use holding a job, rather than job performance, as the criterion.

The ASVAB was administered to employees across the nation who had been holding a job in one of 12 different occupations that do not require a four year college degree. Usable scores were obtained from 1,328 individuals. Analyses of these data were supplemented by existing data from the Youth Cohort in the National Longitudinal Studies of Labor Market Experience and by examining validity data from military occupations that are highly similar to some of the 12 civilian occupations.

The results were generally positive. The ASVAB was able to detect differences among the types of individuals who were members of different occupations. Four significant dimensions of between occupation variation were identified, distinguishing six clusters among the 12 occupations. Auto and Shop Information (AS) played the most important role in occupational differentiation in this study; in six of the occupations, for example, it provided the highest mean subtest standard score; and it exhibited the most significant between-occupation variance. The difference between AS and Verbal scores was the most salient dimension of variation, both between genders and between occupations controlling for gender.

Other analyses yielded information on the interaction of gender, skills, and occupations and on the relations between age and ASVAB scores. Clemans' lambda was used to estimate the validity with which ASVAB skills predict occupational membership.

PREFACE

This study was completed by the American Institutes for Research under contract with the Air Force Human Resources Laboratory, Brooks Air Force Base, Texas.

The authors express their appreciation to the following AIR staff for their many contributions during the instrument development and data collection and analysis phases: Ms. Judith Appleby, Ms. Parisa Ashrafi, Mr. Harley Baker, Ms. Peggie Campeau, Ms. Susanne Horvath, Ms. Reiling Lee, Ms. Dorothy Reller, Dr. Robert Rossi, and Dr. Lauress Wise. Appreciation is also extended to Ms. Carrie Davis for her valuable assistance throughout all phases of the project, especially during the preparation of the data collection instruments and project reports.

A special debt of gratitude is owed to the following AFHRL staff:

Major John R. Welsh, Jr., for his guidance throughout the project;

Dr. Thomas W. Watson for his valuable support and advice since he assumed the role of Laboratory Contract Monitor for this project;

Mr. James M. Wilbourn, Dr. Darrell D. Hartke, and 1Lt Christopher T. Sorrentino, the previous AFHRL contract monitors; and

Dr. William E. Alley, Dr. Malcolm James Ree, and Dr. Lonnie D. Valentine, Jr. for their thorough review and comments on the draft manuscript.

The authors also express their appreciation to Mr. Richard Wood, Chief, Examination Services Division of the U.S. Office of Personnel Management and to the leaders in the OPM regional and area offices. Through their willingness to publicize the ASVAB civilian validation study, OPM part-time testers were alerted to the study and were able to provide valuable assistance during their off duty time.

Finally, a sincere thank you is expressed to all the industry and public agency employers and employees and union members who participated in the study. A particular thank you is extended to Mr. Reese Hammond, Director of Education and Training, International Union of Operating Engineers, AFL/CIO, for encouraging the local unions that took part in this study.

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I. PURPOSE OF VALIDATING ASVAB-14 ON CIVILIAN OCCUPATIONS

The Armed Services Vocational Aptitude Battery (ASVAB) is a multiple aptitude test battery developed by the Air Force Human Resources Laboratory (AFHRL) for the Department of Defense (DoD). It is used by all of the military services to help determine the qualifications of candidates for enlistment and to help place them in occupations. Since 1968, DoD has administered the ASVAB free of charge to interested 10th, 11th, and 12th grade students and to students in postsecondary schools. Annually, over 1.3 million students in approximately 14,000 schools participate in this program (U. S. Department of Defense, 1984). Schools use ASVAB test results to provide educational and career counseling for students. In exchange, the military is allowed to use the information in recruiting for a limited period of time.

The current version of the ASVAB used in secondary and postsecondary schools, Form 14 (ASVAB-14), consists of 10 subtests and takes about 3 hours to administer. Introduced in the 1984-1985 school year, it is an improved replacement for the previous version, Form 5. Despite its potential as an effective tool for career guidance and counseling for civilian occupations, many schools have adopted an arms-length attitude toward use of the battery. One strong reason for this is that the available validity information is primarily related to those forms of the battery reserved for use by the military and to criteria specific to military occupations. Weiss (1978) and Cronbach (1979) called attention to this problem as it pertained to Form 5 of the ASVAB. Weiss expressed his concern about Form 5 by stating, "The major technical deficiency of the ASVAB, however, is a very serious lack of validity data." And Cronbach, writing about the same form, noted that existing data provided only hints regarding validity for choice of civilian occupational field.

Most recently, Jensen (1985) noted that ASVAB-14 "may be regarded, from a psychometric standpoint, as an exemplar of the state of the art for norm-referenced, group-administered, paper-and-pencil tests of mental abilities"; and that "the total 'package' offered by DoD is attractive, impressive, and probably unmatched by any commercially available test" (p. 32). He went on to state, however, that the test battery could be considerably enhanced as a tool for vocational counseling in high schools by providing more complete information on the level and range of scores typical of persons successful in different civilian occupations.

Questions of validity are paramount in the evaluation of the utility or value of a test. In considering the use of ASVAB for civilian vocational counseling in the schools, the question arises: Can predictions from military validity studies be generalized to civilian occupations?

In April 1981, pursuant to the Federal Advisory Committee Act of 1972, DoD established the Defense Advisory Committee on Military Personnel Testing, composed of eminent scholars with strong backgrounds in psychometrics, industrial and organizational psychology, and counseling. The three Congressionally mandated responsibilities of this group are:

1. to review the procedures used in the development and calibration of enlistment tests to ensure the accuracy of scores;

2. to examine relevant validation studies to ensure that the tests have utility in predicting success in technical training and on the job; and

3. to review ongoing testing research in support of the enlistment process and recommend improvements to make the testing program more responsive to the needs of DoD and the Services.

Among other findings and recommendations, in its June 1983 Biennial Report, the Defense Advisory Committee on Military Personnel Testing made the following recommendation:

> There is clearly a need for evidence of ASVAB validity for civilian occupations, in order to support guidance uses of the ASVAB in the High School Testing Program. High quality studies with a small number of occupations are preferable to crude surveys of many occupations, and should be initiated as soon as possible (p. 5).

If more schools were interested in encouraging students to take the ASVAB, or were less negative toward its administration, the interests of the country would be served better. A greater number of students would take the battery, resulting in a more complete inventory of potentially available talent. This inventory could support a variety of national goals. The approach recommended by the Defense Advisory Committee on Military Personnel Testing to validate the ASVAB directly against civilian jobs should, if properly implemented, contribute significantly to making the battery more useful to students, their counselors, and their educational institutions.

In 1985, AFHRL awarded a contract to the American Institutes for Research (AIR) to conduct a civilian occupational validation of ASVAB-14. The primary objectives of the study were (a) to collect and analyze data relevant to the validity of ASVAB Form 14 for samples of employees in common civilian jobs to increase its usefulness for students, their counselors, and their schools, and (b) to respond to the recommendations of the Congressionally mandated Defense Advisory Committee on Military Personnel Testing. The remainder of this report discusses the major activities of this initial ASVAB civilian validation study.

II. DEVELOPING THE SAMPLING DESIGN PLAN

Overview

Phase 1 of the validation study focused on the development of the sampling design plan. This plan consisted of three major segments: selection of occupations, selection of employers, and selection of employees. The occupations were selected during the first 6 weeks of the project; the procedures used are described below. Following this description, the plans developed for selecting employers are described. The recruiting of employers and employees is covered in Section V.

Selection of Occupations

Selection of the 12 occupations was carried out in two steps. First, a pool of occupations was determined based on a set of specific requirements. Then the 12 best candidates were selected from this pool, based on a set of guidelines.

Step 1. Establishing a Pool of Occupations

The first step was to establish a list of all civilian occupations that met each of four primary criteria and at least one of three other secondary criteria. These criteria and the sources consulted to establish them were as follows.

Primary criteria (all four must be satisfied)

1. The occupation does not require a 4-year college degree nor more than 4 years of formal training.

Sources: (a) U.S. Department of Labor, Bureau of Labor Statistics. (1984b). Occupational outlook handbook (1984-85 ed.). Washington, DC.

(b) U.S. Department of Labor, Bureau of Labor Statistics. (1979). Exploring careers, Bulletin 2001. Washington, DC.

2. More than 150,000 individuals nationwide are employed in the occupation.

Sources: (a) U.S. Department of Labor, Bureau of Labor Statistics. (1984b). Occupational outlook handbook (1984-85 ed.). Washington, DC.

(b) U.S. Department of Labor, Bureau of Labor Statistics. (1984c). The job outlook in brief, Washington, DC.

3. The jobs represent each of the following first digit code categories of occupations from the Dictionary of Occupational Titles (DOT):

0/1	Professional, technical, and managerial
2	Clerical and sales (at least two occupations)
3	Service (at least two occupations)
6	Machine trades
7	Bench work
8	Structural work (at least two occupations)
9	Miscellaneous

Source: U.S. Department of Labor, Employment and Training Administration. (1977). Dictionary of occupational titles (4th ed.). Washington, DC.

4. The occupation is not military-related.

This requirement was interpreted connotatively; that is, to rule out occupations that are predominantly "military" in character in the labor force (for example, police officer, prison guard). This did not preclude civilian occupations that have counterparts in the military occupational classification system, if these occupations otherwise meet the criteria for inclusion in the study. Military occupational categories do, in fact, cover the vast majority of occupations customarily considered to be civilian (such as truck driver, administrative clerk, or mechanic).

Secondary criteria (at least one of the three must be satisfied)

1. There is evidence that the job has average or better than average potential for growth and good employment prospects.

Source: U.S. Department of Labor, Bureau of Labor Statistics. (1984b). Occupational outlook handbook (1984-85 ed.). Washington, DC.

2. There is evidence that the ASVAB is likely to be a good predictor for the occupation, on the basis of known ASVAB validities for people employed in similar jobs in the Army, based on research findings from Project A (described in Section VI).

Sources: (a) McLaughlin, D. H., Rossmeissl, P. G., Wise, L. L., Brandt, D. A., & Wang. M. M. (1984). Validation of current and alternative Armed Services Vocational Aptitude Battery (ASVAB) area composites (Technical Report 651). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

(b) U.S. Department of Defense, Military Enlistment Processing Command. (1978). Military-civilian occupational sourcebook (2nd ed.). Fort Sheridan, IL.

The selection of occupations for which the ASVAB is most likely to be valid was appropriate for this study because the stated purpose of the study was to determine the potential value of the ASVAB for use in counseling for civilian occupations. Within its present scope, the study could not cover the full range of civilian occupations; thus, to include occupations for which there is existing evidence of lack of validity would be questionable.

3. There is evidence that high school students today consider the job attractive and desirable.

Sources: (a) San Mateo County, California, Office of Education, Regional Occupational Program. (1983). Top ten career choices by district. Unpublished memorandum. (This report presented the results of the 1982-1983 Career Planning Inventory that was administered to 10,000 students in six high school districts. The report showed the top 10 career choices by district.)

(b) Personal interviews and correspondence from previous AIR projects.

(c) Campbell, A., Converse, P. E., & Rodgers, W. L. (1976). The quality of American life. New York: Sage Foundation.

(d) National Society for the Study of Education. (1975). In R. J. Havighurst & P. H. Dreyer (Eds.). Youth (Part I). Chicago: University of Chicago Press.

A list of 74 jobs was developed, based on these criteria. That list is shown in Appendix A, by DOT occupational category.

Step 2. Selection of Occupations from the Pool

Primary criterion #3 provided the major structure for the selection of 12 occupations from the list of 74. That is, each occupational category was considered separately, and a rationale was developed for selection of the best one or two occupations from that category. Because criterion #3 specified only 10 of the 12 occupations, "next best" alternatives were noted for each of the categories, insofar as possible; and the selection of the final two occupations was made from this set.

The following guidelines were used to select among alternatives for each category. Select jobs:

1. that have the most incumbent employees.

2. with greatest growth potential.

3. where incumbents are likely to be centrally employed--that is, large numbers are likely to work for a single company.

4. where employees are likely to be available for testing at the employment site and employers are likely to cooperate.

5. at least two of which are female dominated. [Source: U.S. Department of Labor, Bureau of Labor Statistics. (1984a). Employment and earnings. Washington, DC]

6. where most incumbents have a high school education and are likely to be English-speaking, to ensure the appropriateness of using the ASVAB.

7. for which reasonably well-defined job descriptions are recognized and/or criteria for the job are available on which to begin to develop rating scales.

8. that are as different as possible from one another on face value.

When no Army ASVAB validity data are available for jobs with military counterparts, select jobs that tend to have the following characteristics typical of jobs with high ASVAB validities:

1. requires learning a large number of operational procedures.
2. requires knowledge of mathematics.
3. requires keeping data organized.
4. requires ability to find patterns.
5. does not consist mainly of social or interpersonal interactions.

These characteristics were derived from an examination of validities for 92 Army military occupational specialties (MOSs) and a comparison with descriptions of the tasks in these MOSs.

The 12 jobs that were selected for inclusion in the project are:

DOT code	Occupation
079.374-014	Licensed Practical Nurse
003.161-014 & -018	Electronics Technician (includes semiconductor development)
203.362-022	Word Processing Machine Operator
210.382. & 216.482	Bookkeeper (clerical) and Accounting Clerk (clerical)
213.362	Computer Operator

DOT Code	Occupation
373.364	Firefighter
332.271	Cosmetologist
625.281	Diesel Mechanic
726.261-010	Electronics Assembler (developmental)
726.684-018	Electronics Assembler (electronics)
850, 853, & 859	Operating Engineer (Construction Machinery Operator--excavating, grading, dredging, and paving)
821.261	Line Installer & Cable Splicer (electrical and telephone line installer-maintainer-repairer)
913.463	Bus Driver

The rationale for their selection is included in Appendix A. Other likely candidate occupations that were considered are also listed in Appendix A, along with the reasons for their rejection.

Selection of Employers

Difficulties were anticipated in getting employers to agree to allow their employees to be tested for approximately 3.5 hours (plus the additional demands associated with obtaining performance ratings and other criterion data). Thus, two levels of criteria for employer selection were established: (a) meets minimum selection standards, and (b) has preferred characteristics.

The original minimum qualifications for individual employer participation in the validation study were (a) that the business or governmental agency have 20 or more employees aged 17 through 25 with at least 3 months' service in one or more of the selected jobs, (b) that these employees indicate their willingness to take the tests with a reasonable degree of enthusiasm, and (c) that the supervisors indicate their willingness to devote the necessary time to completing the performance rating scales. As will be discussed in Sections IV and V, these criteria had to be relaxed considerably because of the problems that resulted from the forms clearance process conducted by the Office of Management and Budget.

All other "criteria" for individual employer selection were thought of as guidelines rather than rigid standards. On the other hand, the total sample of employers for each of the 12 jobs together was designed to meet the following minimum standards:

1. A total of at least 10 employers will participate in the study.

2. Each job shall be represented by two or more employers.

3. The entire sample of employers will not be located in a single State but rather, will be spread across the country.

III. DEVELOPING CRITERION MEASURES

A key part of any validation study is the selection or development of criterion measures against which to regress the predictors. As the main criterion measures, scales were developed to rate job performance and plans were made to supplement the rating data with other routine performance data in the employers' files. Behaviorally anchored rating scales (BARS) were developed to rate performance on each of the 12 jobs studied, in order to provide:

1. a consistent way to measure performance across employers and across jobs, and

2. descriptions of behavior as part of each scale, to encourage consistency across raters.

Smith and Kendall (1963) developed rating scales with behavioral anchors to overcome some of the problems with graphic scales. The central problem is that graphic scales do not establish an adequate metric for raters to use and often result in distributions of ratings that are skewed or clustered in the middle of the scale. Smith and Kendall argued that, by using short, verbal descriptions of actual behavior to illustrate points on a scale (the anchors), raters will produce more objective and consistent ratings.

A six-step process was followed to create behaviorally anchored rating scales in the tradition of Smith and Kendall. First, descriptions of performance dimensions were developed for each of the 12 jobs being studied.

Next, employers were recruited in the San Francisco Bay Area to help develop and refine the scales. Third, interviews were conducted with job supervisors at employer sites to refine the performance dimensions and obtain descriptions of employee behavior. Fourth, preliminary scales were constructed, including descriptions of behavior as anchors for each scale. Finally, the scales were field tested and refined accordingly. Each of these steps is discussed in the remainder of this section.

Developing Performance Dimensions

The scale development process began with the staff collecting descriptions of the performance dimensions for each of the 12 jobs. Descriptions of job duties or tasks were collected from the Dictionary of Occupational Titles (U.S. Department of Labor, 1977, 1986) and the Occupational Outlook Handbook (U.S. Department of Labor, 1984b). Also, the research literature and the results of other projects conducted by AIR were reviewed to find task analyses and other descriptions of the 12 jobs. Then project staff members contacted companies in the San Francisco Bay Area and obtained job descriptions from them.

Once several descriptions for each job had been collected and analyzed, common elements in the descriptions were identified and a list of 10 to 15 specific dimensions was created for each job. The list for each job contained the candidate job dimensions for which rating scales would be developed.

Project staff members also prepared descriptions of generalized dimensions that were common to all jobs. The goal was to identify common elements of job knowledge, motivation, and overall job performance that could provide the basis for three scales for use across all 12 jobs. These three scales would be in addition to those specific to each job. The general descriptions for job knowledge, motivation, and overall job performance were analyzed and characteristics that were candidates for key performance dimensions were identified.

Recruiting Employers

Existing files on employers in the San Francisco Bay Area were used to identify those who might agree to participate in the development of the performance rating scales for use in the main validation study to be conducted nationally. The staff also began a new search for local employers that employed workers in the 12 jobs under study. Several employers were selected for each job and managers were contacted to request that they participate in the project. Arrangements were made to travel to each site to meet with supervisors of employees who were working in any of the 12 jobs. Project staff members met with supervisors at a minimum of four sites for each job.

Conducting Interviews

Meetings with supervisors lasted an average of 2 hours each. First, supervisors were asked to read the appropriate list of characteristics that were candidates for job dimensions and rate how much each dimension contributes to successful performance. Supervisors were also asked to indicate any of the job dimensions that were not performed by their employees and to suggest other dimensions that were more important than the ones listed.

Next, a modification of the Critical Incident Technique (Flanagan, 1954) was used to collect descriptions of behavior to anchor the scales. Supervisors were asked to describe examples of superior, average, and poor performance they had actually observed for each of the potential job dimensions, including the dimensions for the three generalized scales (job knowledge, motivation, and overall job performance). Project staff recorded these descriptions verbatim. For each dimension, an average of six descriptions of behavior were collected for each of the three levels of performance.

Constructing Scales

The importance ratings of the potential job dimensions that were obtained from supervisors were the raw materials from which the rating scales were developed. Average importance scores were calculated for each of the job dimensions. From five to eight of the highest rated dimensions for each of the 12 jobs were picked to describe job-specific performance, in addition to the generalized dimensions of job knowledge, motivation, and overall job performance required by the contract. For each dimension, a title, a short description of the dimension, and a seven-point metric were created.

Creating Behavioral Anchors

Project staff members used the descriptions of superior, average, and poor behavior that were obtained from supervisors to construct three behavioral anchors for each scale. To the extent possible, the actual words of the supervisors were used since these were more likely to be understood by raters using the scales. All the examples obtained for a particular anchor point for a particular scale were examined and edited to create a set of short statements to serve as the anchors for the first, fourth, and seventh points on each of the seven-point scales.

Evaluating and Refining the Scales

The five to eight job-specific scales were then combined with the three generalized scales to create a set of scales for each of the 12 jobs. The scales were assembled into booklets for each job and then field tested with supervisors in the San Francisco Bay Area. Project staff members field tested the booklets at an average of eight companies for each of the 12 occupations. The supervisors in the field test were asked to rate three employees each: first, to think of the best employee they had ever supervised and to fill out a set of scales for that person; next, to think of the poorest employee supervised and fill out a set of scales; and finally, to think of an average employee supervised and fill out a third set of scales. After they completed their ratings, the supervisors were asked to suggest ways to improve any aspects of the scales.

Ratings were collected on approximately 24 different employees per job. The mean and standard deviation of the ratings on each scale were examined to see how close the mean was to the midpoint of the scale and to determine whether there was wide variability in the ratings. The data that were obtained in the field test indicated that the careful work in preparing the scales did indeed pay off. The means were sufficiently close to four--the midpoint of the scales--and the standard deviations were high enough to instill confidence that these scales would provide satisfactory criterion data. Finally, the staff did some editing of the scales and the wording of the behavioral anchors based on comments received from the supervisors in the field test.

IV. FORMS CLEARANCE AND ITS IMPACT ON THE STUDY DESIGN

Because the performance rating scales and the two other data collection instruments were planned for administration to more than nine individuals, it was necessary to obtain approval of the forms and the data collection plan from the Office of Management and Budget (OMB). This was required by the Paperwork Reduction Act of 1980 and 5 CFR 1320. A draft forms clearance package was prepared and submitted to the project monitor at AFHRL in August 1985.

In early October, additional supporting materials were submitted to AFHRL. Shortly thereafter, the clearance package was forwarded to the Office of the Assistant Secretary of Defense (OASD), and submitted to OMB by that office on December 26, 1985.

Original plans were to begin testing in January. When the forms were not cleared by mid-February, a report was submitted to the contract monitor documenting that approximately 350 participants would likely be lost if data collection could not begin in March. In mid-March, further estimates of losses due to the delay in OMB clearance were submitted to AFHRL. In mid-April 1986, it was learned that OMB had refused to grant forms clearance. In a brief explanation of its decision not to approve the information collection, OMB noted that "the value of assessing how well the Armed Services Vocational Aptitude Battery (ASVAB) predicts success in civilian occupations does not justify the burden imposed by this information collection." This ruling was unexpected in view of the fact that the Defense Advisory Committee on Military Personnel Testing had, in 1983, emphasized the importance of timely validation of the ASVAB against civilian occupational criteria to support the use of the test battery for high school guidance purposes. Further, OASD had assessed the proposed procedures as being "clearly in conformance with professional standards for validity studies while demonstrating extreme sensitivity to the need to protect the privacy of the study's participating employers and employees."

Denial of permission to administer the data collection forms nationwide impacted on all aspects of the project, including the number of companies and employees agreeing to participate, and the project schedule. Because it was no longer possible to collect performance data on employees, it was necessary to develop a completely different approach. Accordingly, during April and May of 1986, project activity focused on identifying and evaluating a variety of different validation approaches that would not require OMB clearance. In late May 1986, five alternative approaches were submitted to the AFHRL project monitor, and one of these approaches was selected as the basis for redirecting the validation effort.

The revised statement of work eliminated all use of the rating scales. Instead, it directed that: (a) estimates be made of the validity of ASVAB profiles for differentiating the characteristics of civilians who are members of different occupational groups, and (b) the validity coefficients obtained from studies on military job performance be used to estimate ASVAB validity for civilian occupations where appropriate matches between civilian and military jobs can be found. The revision directed other changes in the project as well, including reducing the number of employees to be tested in each job and extending the project completion date, in recognition of the major losses in the number of participating employers.

V. PREPARING TO COLLECT VALIDATION DATA

This chapter presents the major activities carried out to obtain the participation of employers, employees, and test administrators and to prepare for actual test administration. Four major activity areas are described:

1. developing procedures for recruiting employers and employees,

2. recruiting employers and employees,

3. ensuring confidentiality of participating employees, and

4. arranging test sessions.

Developing Procedures for Recruiting Employers and Employees

Employer Incentives

Before the actual recruiting began, considerable time was devoted to developing incentives to encourage employer participation in the project. It was anticipated that employers would be reluctant to release their employees for approximately 3-1/2 hours to take the ASVAB and fill out a background questionnaire, and to make supervisors available to provide performance ratings.

The incentive materials developed for employers explained the overall benefits of the ASVAB civilian validation, including:

1. providing useful data for better counseling and guidance on career opportunities for high school students;

2. improving national defense by increasing the number of young men and women who take the ASVAB, resulting in a more complete inventory of potentially available talent for military recruiting;

3. improving the employer's capacity to identify qualified job applicants for employment through a better understanding of the importance of various aptitudes for job success; and

4. enhancing the cooperation between government and civilian organizations in matters of mutual concern.

Specifically, the employer incentives included:

1. a copy of the Behaviorally Anchored Rating Scales (BARS) developed for this study for each occupation in which employees were provided--employers could use the information on the scales for personnel reviews and appraisals, or to develop inventories of the proficiency of their employees;

2. a profile of ASVAB mean scores for each occupation that best described the typical members of each occupation for which employees were provided, along with interpretive information--this information would indicate what abilities most of the people within the occupation had compared to those in other occupations;

3. a certificate of appreciation as official recognition from the Federal Government for their help in the research effort--this certificate would be suitable for framing and would be signed by a high ranking representative of the Department of Defense;

4. an average profile of the employer's employees, by occupation, compared with the rest of the study sample in the same occupation (only when 50 employees or more in one occupation from the employer had participated)--this would help the employer answer the question of how the abilities of their workers were different from those of people in similar situations at other organizations; and

5. special analyses that focused on the relationship between the ASVAB aptitudes and existing job performance measures, if the employer provided such data on at least 50 employees. This information would enable the employer to estimate which ability test scores of potential job applicants might predict job performance in a particular organization. For example, if arithmetic reasoning is important, information on an applicant's ability in this area would be useful for the employer to obtain.

Employee Incentives

The materials that were prepared to assist employers in communicating with their employees stressed three major incentives:

1. confidential test results, sent to their home address, along with interpretive information;

2. a certificate of appreciation from the Federal Government; and

3. the knowledge that their participation in this research would help tomorrow's high school students improve their career planning.

Recruiting Employers and Employees

One of the crucial and most difficult aspects of the validation was recruiting employers that met the criteria established.

Nationwide Campaign

The recruiting efforts were primarily directed toward large organizations across the nation (businesses, governmental agencies, and defense industries). The series of activities carried out are described below.

Press release. The project staff developed a press release for government newsletters or newsletters of associations that had some ties to active, reserve, or retired military personnel, such as the Air Force Association, the Reserve Officers Association, and the National Security Industrial Association.

Letters of support. As a way of showing employers the importance of this project, support letters were requested from key government representatives. These letters were used as part of the packet of materials sent to defense contractors, and later to other companies that were invited to participate.

Mass mailings. The first major mailing to recruit employers was directed toward Fortune 500 companies and Fortune 500 service organizations. These included leading insurance companies, public utilities, telephone companies, transportation companies, and diversified service companies throughout the United States.

Association letters. Letters were also sent to over 50 employer associations and organizations of government employees (local, county, and state) asking them to publish a press release in their trade associations' newsletters or journals. Of these, 28 newsletters or journals eventually carried information on the ASVAB civilian validation study.

Project presentations. The Project Director made special appeals for cooperation to attendees at several professional meetings in California. In addition, the Associate Project Director spoke to the National Joint Apprenticeship and Training Committee for Operating Engineers. After considerable interaction, The International Union of Operating Engineers (IUOE) agreed to assist the project by making initial contacts with the IUOE apprenticeship programs across the country.

Special recruitment efforts. Several times throughout the recruitment process, special efforts were made to locate employers in special target areas where the projected counts were much lower than desired. These concentrated efforts, consisting primarily of specially tailored letters to key persons in a wide range of employers, included state departments of agriculture and consumer affairs, state forestry agencies, fire departments, and tour bus companies.

Due to the small number of licensed practical (or vocational) nurses (LPNs) and cosmetologists that could be tested at any given time, permission was granted by AFHRL to test advanced LPN students who were performing their clinical duties under supervision as part of their clinical experience. Permission was also granted to test advanced cosmetology students who were gaining job experience under close supervision.

Activities to Enhance the Chances for a Greater Employer Response

In order to encourage a positive response to the letter inviting them to participate, a follow-up telephone call was made to a majority of the employers. Some of the initial employers that had responded negatively to the letter were also followed up by telephone to find out why and to get suggestions of others that might be contacted in their area.

Because of the long delay due to OMB's review and the need to redirect the project, a number of employer sites that had initially agreed to participate were lost. This required project staff to develop even more leads for new kinds or sources of employers to contact. Some of the efforts included sending out an updated news release for trade and technical publications, distributing handouts at the American Vocational Association (AVA) convention, submitting an article to the AVA newsletter, and recontacting previously tested sites for possible future testing or referrals of other companies and organizations.

Installation of 800 telephone line. To make it easier for out-of-state employers to call, a toll-free 800 telephone number was installed. This telephone line also allowed site coordinators and test administrators who had questions regarding the testing to call at no charge to them. An answering machine was also installed on the 800 line for calls that came in after hours or on weekends.

Employer data base. Thousands of contacts were made throughout the employer recruitment phase. To expedite the logistics involved in contacting employers (e.g., telephone follow-up, establishing test dates, and preparing the letters that were required), a computerized data base was developed. Once an employer had agreed to participate, the contact person was sent incentive material information to help recruit employee volunteers. Tracking the status of each prospective testing site was greatly facilitated by this computerized data base.

Ensuring Confidentiality of Participating Employees

In accordance with the provisions of the Privacy Act of 1974, procedures to protect the privacy of the participants and the confidentiality of their data were an important aspect of this project. Staff members were sensitive to this issue and took all necessary measures to ensure that such safeguards were implemented. The privacy protection procedures were designed such that they would facilitate the merging of data from several sources and would enable individual employees to receive their test results if they wished them.

The procedures included developing a 10-digit unique ID number (not the Social Security number) for each employee tested. This ID number was recorded on the ASVAB answer sheet, on a site roster, and on a label put on a consent form. The first three digits of this number referred to the testing site, the next two digits referred to the occupation that was being tested at that site, and the last five digits were random numbers that had been computer-generated. The combination of these three sections of the unique 10-digit number allowed project staff to locate a specific individual within any of the 12 occupations at any site.

The two-part label that was put at the bottom of the consent form had the ID number vertically printed on both parts of the form. The right side of the label was larger and allowed space for the employee to print in his or her name, if the project did not already have it, and home address if individual test results were desired. A confidential roster linking the names of tested employees with their assigned ID numbers was maintained by site.

Arranging Testing Sessions

A series of internal control procedures was developed along with forms for use in making testing arrangements. These included procedures for printing labels with unique ID numbers and quality control procedures for preparing, processing, and shipping materials to the test administrators.

Locating Test Administrators

Early in the project, the U.S. Office of Personnel Management (OPM) was contacted and permission was received to contact OPM coordinators in each of the 10 regions to request help with the administration of the ASVAB. Through the regional coordinators, it was possible to locate part-time OPM employees who were experienced testers and who were interested in assisting the project. The OPM testers administer the ASVAB routinely as part of the enlistment qualification process. It was agreed that testing on the project would not interfere with any commitments between the testers and OPM.

Excellent cooperation was received from the regional coordinators as well as from area managers throughout the entire testing effort. As a result, nearly all of the testing was done by OPM test administrators working on their own time and paid out of project funds. The advantage of having OPM test administrators was that they were already thoroughly familiar with the administration procedures and with the security procedures for the ASVAB, and they were located throughout the United States.

Preparing and Shipping Test Material

The preparation of the test materials for shipment included a number of steps. The process started with the creation of labels with the unique ID number. A packing list was created that identified all materials being sent to the administrator. Also developed was a roster that listed by serial number all the test booklets being sent to a test site. This roster served two major purposes. It served as a vehicle for test administrators to inventory test booklets before and after testing, and as a cross-check document for use by project staff to compare against the log of materials checked out.

Individual test packages. The staff put together test packages consisting of the ASVAB test booklet and answer sheet, plus scratch paper. The answer sheet was precoded with the unique ID number, the test version, and the test booklet number. A consent form and a two-part label with the ID number and name, if available, were attached to the outside of an envelope containing test materials. The ASVAB booklet number was then written on the outside of the envelope for ease in returning the completed test materials to the appropriate envelope.

VI. COLLECTING VALIDATION DATA

Administering ASVAB Form 14a

A pilot test of the procedures was conducted in January 1986 to work out any logistical problems and administration concerns. Administration of the

ASVAB began in March 1986 while awaiting OMB clearance of the performance rating scales and the two other instruments. If these tests had not been administered then, a very high percentage of participants would have been lost. However, upon hearing of OMB's refusal to grant clearance for the questionnaires and performance rating forms, it was decided in April 1986 to stop testing to allow time for the development of alternative procedures that did not require OMB clearance. These procedures were approved by AFHRL and are reflected in the remainder of this report. Testing was resumed in August 1986 and completed in May 1987.

Of the over 3,000 companies and organizations that were contacted from the beginning of the employer recruiting efforts, about 370 had initially expressed interest in cooperating. By April 1986, about 80 employers had agreed to arrange for testing about 2,850 employees. However, because of the numerous delays and the uncertainty of OMB forms clearance, staff were forced to cancel testing at 25 of the sites that were committed to participating. This resulted in an estimated loss of over 700 employees in seven of the 12 occupations. In total, testing was conducted at 80 sites, for a total of 1,330 employees across the 12 occupations. Employers in Washington, DC and in the following 27 states participated: Arizona, Arkansas, California, Colorado, Florida, Georgia, Hawaii, Idaho, Illinois, Kansas, Louisiana, Maryland, Minnesota, Missouri, Montana, North Carolina, New Jersey, Nevada, New York, Ohio, Pennsylvania, Tennessee, Texas, Utah, Virginia, Washington, and West Virginia.

Obtaining Criterion Data

As noted in Section IV, it was necessary to substitute other types of criterion data for the performance rating scales and questionnaires originally planned. Three types of data were obtained:

1. occupational group membership information;

2. data on the youth cohort of the National Longitudinal Survey of Labor Market experience (Center for Human Resource Research, 1986);

3. information from studies of military occupations.

Occupational Group Membership

The primary criterion used in this study was occupational group membership; i.e., being employed in one of the 12 occupations selected for this study and having at least 3 months experience in that job with the current employer. Data on occupational group membership formed the basis for the data analysis, as discussed in Section VII.

Youth Cohort Data from the National Longitudinal Survey of Labor Market Experience

In 1980, a parallel form of the ASVAB Form 14 (Form 8a) was normed by administering it to a nationally representative sample of young men and women, ages 16 to 23. The sample was the Youth Cohort of the National Longitudinal Survey of Labor Market Experience (Center for Human Resource Research, 1986). The norming study--titled "The Profile of American Youth"--provided 33 variables, including individual ASVAB raw scores, scale scores, and standard errors for each of the 10 ASVAB subtests, along with sampling weight. In addition, a wide range of data on employment status and characteristics of current and former jobs were collected in the Youth Cohort each year from 1979 through 1986. In 1979, the first year of the Youth Cohort study, information on occupation was collected using both Census and the Dictionary of Occupational Titles (DOT) occupational codes (U. S. Department of Labor, 1977). Each year thereafter, occupation information was collected using U.S. Census codes only (U.S. Department of Commerce, 1982).

Descriptions of occupations used by the Census were compared to those used from the DOT to select the 12 occupations in the present study. There were close matches between the two sets of descriptions for six of the 12 occupations; for the remaining six, the Census occupations were broader and included tasks not in the DOT descriptions.

Selected data from the Youth Cohort study will be discussed in Section VII and compared with the data from this study.

Locating Validity Data from Studies of Military Occupations

In order to provide additional estimates of ASVAB validity for civilian occupations, a search was conducted for validation studies involving military occupations matching any of the 12 civilian occupations included in the current study. Military occupations were found that matched these civilian occupations by searching the Military Career Guide (U.S. Department of Defense, undated). The Guide was produced by the Department of Defense for use by civilians in career counseling. It is based on a project that developed crosswalks between military and civilian occupational information (Wright & Treichel, undated). That project had civilian occupational analysts use job analytic criteria specified by the U.S. Department of Labor to compare the standardized definitions for civilian occupations contained in the DOT with definitions that each military service has developed for its occupations. The analysts matched about 1,000 DOT occupational descriptions with over 3,000 military occupations.

The search of the DOT Code Index in the Military Career Guide located good matches for eight occupations (Bookkeeper/Accounting Clerk, Bus Driver, Computer Operator, Diesel Mechanic, Firefighter, Licensed Practical Nurse, Line Installer/Cable Splicer, and Operating Engineer), marginal matches for two additional occupations (Electronics Technician and Word Processing Machine Operator), and no matches for two occupations (Cosmetologist and Electronics Assembler). The number of matches between occupational titles in the Military Career Guide and the 12 civilian occupations encouraged us to look further for validity data from studies of military occupations.

A search of the Crosscode Data Base was requested from the Defense Manpower Data Center (DMDC) in the Department of Defense. This data base contains the results of the 1,000 DOT matches found by the crosscode project. The search revealed several Military Occupational Specialties (MOSs) in the U.S. Army and several U.S. Air Force Specialties (AFSs) that matched some of the 12 civilian occupations included in this validation study.

Information was also obtained about selected AFSs and validity data that were available from AFHRL. A major source of information was Air Force

Regulation 39-1 (1982, 1983, 1985, 1986), which contains descriptions of duties and qualifications of the AFSs. Task analyses from the Occupational Research Data Base (ORDB) were also examined. Several good matches to the civilian occupations in this study were found. However, the project staff could not locate validity data for the ASVAB-14 that were based on job performance data. Uncorrected correlation coefficients for ASVAB Forms 8, 9, and 10 and technical training grades for 70 courses are available (Wilbourn, Valentine, & Ree, 1984). While the ASVAB-14 is a scrambled version of the ASVAB Form 9, the data reported by Wilbourn et al. are based on different composites than are used for the ASVAB-14.

The American Institutes for Research is a member of a consortium that is currently conducting Project A for the U.S. Army Research Institute. That project involves examining and redesigning the selection and classification system that is used by the U.S. Army to assign enlistees to MOSs. As part of Project A, extensive validity studies of the ASVAB have been conducted over a range of MOSs (McLaughlin et al., 1984). Data collected from existing Army sources for over 60,000 soldiers were analyzed. In addition, detailed analyses of the tasks required by selected MOSs were carried out, special measures of performance on those tasks were created, and additional validity studies were conducted. The validity data and task descriptions were available for use on the present project.

Potential matches to nine of the civilian occupations were found among the MOSs that were examined in Project A. A total of 15 MOSs with validity data from Project A appeared to match one of the nine civilian occupations. Since the task descriptions for the 15 MOSs prepared during Project A were available, project staff used them to examine the match to the civilian occupations more closely. Checklists were prepared for each of the nine occupations, listing the tasks performed in the potentially matched MOSs. For each occupation, the staff selected a set of supervisors of employees who took the ASVAB during the present project. These supervisors were sent the appropriate checklists and asked to indicate whether or not their employees usually do the tasks listed for each MOS that potentially matched the occupation. Ratings were obtained for all of the 15 MOSs for which validity data were available from Project A and for which a match was expected as indicated by the analyses of the Military Career Guide. Ratings were provided by supervisors from an average of nine companies for the nine civilian occupations that appeared to have military counterparts. The validity data from these matching MOSs will be presented in the next section.

VII. ANALYZING THE VALIDITY DATA

Data Editing

The process of examining the quality of the ASVAB data began at the time employees were taking the test battery. The test administrators kept a log of the conditions under which testing occurred and of the actions of the examinees. These logs noted any special circumstances during testing and any answer sheets that should be examined separately.

As a group of employees completed the ASVAB and turned in their test booklets and answer sheets, the test administrators visually scanned the answer sheets to make sure all three pages were intact and there were no extraneous marks. Once the answer sheets were received at AIR, they were logged in and every page was checked again. Any extraneous marks were cleaned up and any light responses were darkened to prepare for machine scoring. The cleaned answer sheets were sent in batches to the Air Force Human Resources Laboratory to be machine scored. All the scoring procedures were pilot tested with a set of six answer sheets.

When each data tape and the scored answer sheets were returned, each record was printed out and examined for completeness. Project staff also spot-checked a few answer sheets in each batch by hand scoring them and comparing the results to the machine scoring on the data tape. As a further quality check, all records were aggregated by occupation and seven ASVAB composite scores were printed out for each record. Every score for the seven composites that are normally reported for the ASVAB 14 that was below the 10th percentile was flagged. The staff then examined the original answer sheets and the logs from the test administrators to determine if there were extraneous reasons for these low scores.

The project staff began analyzing ASVAB scores by creating several descriptive statistics. They examined the statistics for missing or outlying values and checked the original answer sheets for records with apparent problems. In many cases where there were problems with demographic data, it was possible to determine correct values since employees wrote in their answers for these questions and also darkened answer spaces on the ASVAB answer sheets. For example, tenure on the job and birthdate were used to create a value for age at which an employee started working. All cases were examined where the value was below 20 to determine if there were any problems in tenure coding or birthdate coding on the original answer sheet. Of the total 1,330 answer sheets, only two were eliminated because of unsolvable problems, resulting in 1,328 usable answer sheets.

Data Analysis

The data analysis addressed eight questions aimed at clarifying the relations between the ASVAB and civilian occupations. Of primary concern was the estimation of the amount of information provided by the ASVAB on the differential likelihood of successful pursuit of different careers. Because the available data base excluded criterion data on which to compute predictive validities, the eight questions only indirectly address the problem of estimating validity. Nevertheless, their answers shed some light on the ASVAB as a counseling tool and provide support for the use of ASVAB in career counseling.

Each of the eight questions is discussed below, along with results related to each one. The major objective of the individual questions is to address the overall question of validity of the ASVAB subtests and composites for identifying promising occupations for young people. However, in order to provide the proper context for interpreting the data, results are first presented concerning the composition of the study sample. The demographic variations among occupations in the sample could have substantial implications for outcomes.

Question 1. Are there gender differences among occupations?

For the sample of 12 occupations, no attempt was made to balance the gender and race distributions, but rather, to represent the natural variation in the work force. In order to understand the extent to which occupational variations might be confounded with gender and race variations, the differences in frequencies were examined.

As shown in Table 1, there were extreme variations in the relative frequency of men and women in the 12 occupations. The chi square statistic for this table was very significant (732.6, df = 11, p<001); and the contingency coefficient[1] was .60. The samples from four of the occupations were primarily women: bookkeeper/accounting clerk, cosmetologist, licensed practical nurse, and word processing machine operator; and the samples from five

Table 1. **Frequencies and Percentages by Gender for Each Occupation and Overall**

	Male		Female		Total
Occupation	N	Row %	N	Row %	N
Bookeeper/Accounting Clerk	10	13.3	65	86.7	75
Bus Driver	36	53.7	31	46.3	67
Computer Operator	41	44.6	51	55.4	92
Cosmetologist	8	7.2	103	92.8	111
Diesel Mechanic	119	98.3	2	1.7	121
Electronics Assembler	24	42.9	32	57.1	56
Electronics Technician	23	88.5	3	11.5	26
Firefighter	316	92.1	27	7.9	343
Licensed Practical Nurse	13	14.9	74	85.1	87
Line Installer/Cable Splicer	41	93.2	3	6.8	44
Operating Engineer	136	80.5	33	19.5	169
Word Processing Machine Operator	6	4.4	131	95.6	137

[1]The contingency coefficient, as given by Hays (1963), page 606, is equal to the square root of the ratio of the chi-square statistic to the sum of the sample size plus the chi-square statistic.

other occupations were primarily men: diesel mechanic, electronics technician, firefighter, operating engineer, and line installer/cable splicer. Only three of the occupations exhibited balance: bus driver, electronics assembler, and computer operator.

The implications for this study are that attempts will need to be made to separate differences between males and females from differences among occupations. Otherwise, apparent differences among occupations may merely reflect the gender proportions of the samples in these occupations. It should be noted that there is no evidence that the imbalances observed are related to any bias in the sample selection process; the same imbalances exist in the populations for these occupations.

The balance between men and women in the sample was compared with estimates of the balance in the work force as a whole for the 12 occupations studied. The sample was compared to data derived by the Bureau of Labor Statistics from the 1980 population survey (U.S. Department of Labor, 1982). It was found that the balance in the sample was within 5 percentage points of that for the total work force for eight occupations: bookkeeper/accounting clerk, bus driver, cosmetologist, diesel mechanic, electronics assembler, electronics technician, line installer/cable splicer, and word processing machine operator. The sample was within 10 percentage points for two additional occupations: computer operator and firefighter. There were about 12% fewer females in the sample of licensed practical nurses than in the general work force, while there were 19% more females in the sample for operating engineers. The last finding may be due to the fact that the sample of operating engineers was drawn from apprentice training programs.

<u>Question 2</u>. <u>Are there racial differences among occupations?</u>

Similarly, racial differences among occupations must be examined. Fortunately, as can be seen in Table 2, there were no dramatic interactions between race or ethnic group and occupation. While the chi square statistic for this table was very significant (145.0, with $df = 55$, $p < .001$), the contingency coefficient was only .31. Moreover, in every occupation, the White sample is the majority, and the Black and Hispanic samples are next in size, with few in the remaining categories. On this basis, it appears appropriate to ignore variation in racial or ethnic groups. Analyses were carried out both with and without taking race into account, but because results of the two analyses were essentially the same, only the results ignoring race are presented.

Table 2. Frequencies and Percentages by Race and Ethnic Group for Each Occupation and Overall

	White		Black		Hispanic		Asian		American Indian		Other		Total
Occupation	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %	N	Row %	N
Bookkeeper/Accounting Clerk	57	77.0	10	13.5	1	1.4	4	5.4			2	2.7	74
Bus Driver	49	75.4	6	9.2	5	7.7	2	3.1	1	1.5	2	3.1	65
Computer Operator	59	64.8	9	9.9	19	20.9	1	1.1	1	1.1	2	2.2	91
Cosmetologist	99	89.2	7	6.3	4	3.6			1	0.9			111
Diesel Mechanic	101	85.6	12	10.2	2	1.7	3	2.5					118
Electronics Assembler	39	69.6	11	19.6	4	7.1			1	1.8	1	1.8	56
Electronics Technician	19	76.0	2	8.0			3	12.0			1	4.0	25
Firefighter	247	72.4	38	11.1	37	10.9	2	0.6	8	2.3	9	2.6	341
Licensed Practical Nurse	57	65.5	9	10.3	12	13.8	6	6.9	1	1.1	2	2.3	87
Line Installer/Cable Splicer	35	79.5	2	4.5	6	13.6	1	2.3					44
Operating Engineer	119	71.3	20	12.0	5	3.0	7	4.2	6	3.6	10	6.0	167
Word Processing Machine Operator	83	61.0	34	25.0	12	8.8	4	2.9	1	0.7	2	1.5	136
Total	964	73.3	160	12.2	107	8.1	33	2.5	20	1.5	31	2.4	1315[a]

[a]Thirteen observations are missing because racial or ethnic group membership was unknown.

Question 3. How do ASVAB scores for this sample compare with norms?

This sample consists of 1,328 individuals actively pursuing careers in various occupations not requiring college education, and it can be expected to differ from the population used to create norms for the ASVAB. It will be of some value to document the differences observed between this sample and the norms, both to provide the basis for applying these results to high school counseling and to provide new, albeit incomplete, information on the effects of career development on ASVAB scores. The means and standard deviations are given in Table 3 for the subtest standard scores and in Table 4 for the DoD Student Testing Composite standard scores. The tables show the values for both this study (civilian validation) and for the normative population (longitudinal survey). The ASVAB was normed in 1980 with the Youth Cohort of the National Longitudinal Surveys (Center for Human Resource Research, 1986). The longitudinal survey values in Tables 3 and 4 are based on a subset of the Youth Cohort study; those who, in 1985, were holding one of the 12 occupations selected for the present project. Of 11,914 individuals who took the ASVAB in 1980 in the norming study, 508 were identified who were in occupations (coded according to 1970 U.S. Census codes) that roughly corresponded to those included in the civilian validation study in 1985. The means for the civilian validation were above the normative standard score mean of 50 in every case but one. The highest mean was for the Auto and Shop Information subtest. The meaning of this result is ambiguous, however, because it is impossible to determine from the study data whether:

1. some members of the sample had learned the information required on the ASVAB as a result of experience in their careers or in life in general,

or

2. the employers who participated tended to attract or select individuals with particular ability profiles with greater frequency than such individuals occur in the normative population, or that these particular kinds of employees tended to volunteer for the testing.

The means and standard deviations of ASVAB subtest scores for the 12 individual occupations in the civilian validation are presented in the first 12 tables in Appendix B. It is clear from these tables that individuals in certain occupations exhibited different kinds of ASVAB score profiles from those in other occupations. For example, diesel mechanics scored very high on the Auto and Shop Information subtest, while electronics technicians scored very high on the Electronics Information subtest. Again, it is not possible to separate the explanation of learning on the job from that of employment selectivity for these skills.

Table 3. **Aggregrate Statistics for ASVAB Subtest Standard Scores**

Subtest	Civilian validation (n = 1328) Mean	SD	Min	Max	Longitudinal survey (n = 508) Mean	SD	Min[b]	Max
General Science	53.38	8.73	20	68	48.39	8.83	18	68
Arithmetic Reasoning	53.80	8.55	30	66	49.07	9.35	26	66
Word Knowledge	53.96	7.36	20	61	49.08	9.22	16	61
Paragraph Comprehension	51.20	8.38	20	62	50.12	9.55	17	62
Numerical Operations	52.05	8.43	20	62	47.80	9.07	16	62
Coding Speed	51.79	8.28	22	72	49.65	9.41	22	72
Auto and Shop Information	56.28	10.23	24	69	48.11	9.53	24	69
Mathematics Knowledge	49.96	8.63	29	68	49.58	8.93	29	68
Mechanical Comprehension	52.44	10.20	24	70	48.61	9.35	24	70
Electronics Information	53.93	10.03	23	70	47.90	9.20	23	70
Verbal[a]	53.22	7.46	20	62	49.33	9.11	15	62

[a]Verbal (VE) is a composite of the Word Knowledge (WK) and Paragraph Comprehension (PC) subtests. VE is commonly used in reporting ASVAB results and in constructing composites such as the Armed Forces Qualification Test (AFQT).

[b]ASVAB standard scores are truncated at 20 for operational uses. The full range of scores was used in this research study.

Table 4. **Aggregrate Statistics for DoD Student Testing Composite Standard Scores**

Composite	Civilian validation (n = 1328) Mean	SD	Min[a]	Max	Longitudinal survey (n = 508) Mean	SD	Min[a]	Max
Academic Ability	53.86	7.86	25	65	49.20	9.11	18	65
Verbal	53.11	7.98	20	65	49.15	8.98	14	64
Math	51.99	8.37	31	68	49.31	8.97	26	68
Mechanical and Crafts	54.70	9.53	23	71	48.22	9.07	21	70
Business and Clerical	51.97	7.54	19	70	49.43	8.92	20	67
Electronics and Electrical	53.15	8.35	28	70	48.61	8.66	21	68
Health, Social, and Technology	53.60	8.36	23	68	48.89	8.98	19	67

[a]ASVAB standard scores are truncated at 20 for operational uses. The full range of scores was used in this research study.

To clarify these results, the outcomes of the ASVAB civilian validation were compared to the results of the original norming study of American youth. The 508 individuals in the 12 occupations in the Youth Cohort were entering the labor force in the early 1980s, only slightly more recently than the participants in the civilian validation study. The major difference is the age at which the ASVAB was taken; in the civilian validation, the individuals were generally somewhat older and established in occupations, whereas in the Youth Cohort, the individuals were generally in school or recently out of school when they took the test. Thus, a comparison of results between these two studies can shed some light on the question of whether the differences in ASVAB profiles among occupations are a function of selectivity or experience. If we assume that both samples represent the outcomes of similar selection processes because they are in the same occupations, differences in the results might reasonably be attributed to experience. Of course, any such conclusion must be very tentative, because of the differences in sample selection.

The ASVAB subtest means and standard deviations for the Youth Cohort (longitudinal study) are given in Tables B-13 through B-24 in Appendix B. Overall, the means for the civilian validation were generally higher than those for the Youth Cohort Study, but there are clear differences among the occupations in terms of ASVAB score profiles measured 5 years earlier, according to the norming study. For example, in the Youth Cohort study, diesel mechanics scored high on Auto and Shop Information and electronics technicians scored high on Electronics Information; however, these differences were even more pronounced in the civilian validation study.

Of some interest is the finding of generally higher scores in the older civilian validation study sample (as compared to the Youth Cohort subsample in these same occupations) on Word Knowledge, Auto and Shop, and Electronics Information, and fewer higher scores and even some lower scores in Math Knowledge and Paragraph Comprehension. It would appear that Word Knowledge, Auto and Shop, and Electronics Information measure knowledge that adults generally acquire incrementally after leaving school, whereas Math Knowledge and Paragraph Comprehension measure abilities that are at their peak at about the end of high school. In this latter regard, it should be noted that the set of occupations in the present study was selected so as not to require college education. As can be seen from Table 4, the pattern for the DoD Student Testing Composites is similar to the pattern for the ASVAB subtests shown in Table 3. In every area, the average civilian validation participants' scores were higher than the normative values for the youth who entered the same range of occupations.

Examination of the standard deviations (Table 3) and correlations (Table 5) for the subtest standard scores for the civilian validation suggests that the sample is representative of people early in their careers. The standard deviations are less than the Youth Cohort population values of 10, and in comparison with the analyses from the Army Research Institute's Project A (McLaughlin et al., 1984), the standard deviations observed here are generally midway between the standard deviations for all Army applicants and the standard deviations for enlisted personnel who remain in the Army long enough to take the Skill Qualification Test (SQT). The SQT is used to assess individual qualifications for promotion and to evaluate the overall effectiveness of Army training programs. The intercorrelations among subtest standard scores from the sample are generally lower than those from the ASVAB norming population but not as low as the Army sample used for the initial validation studies in Project A. The general result can be characterized as the effect of a process that raises mean levels, reduces variances, and therefore reduces intercorrelations.

Table 6 presents correlations among subtests based on the Youth Cohort Study subsample. Tables 7 and 8 present the correlations of the DoD Student Testing Composite Standard Scores for both the civilian validation and the Youth Cohort Studies, for comparison. The correlations among composites are somewhat higher than would be the correlations of seven separate tests, because the same subtests entered into several different composites. The correlations between pairs of composites thus include some correlation of error components of subtests common to the composites. Tables B-25 through B-36 and B-37 through B-48 in Appendix B provide composite information corresponding to the subtest information in Tables B-1 through B-12 for the civilian validation and Tables B-13 through B-24 for the longitudinal study of the

Table 5. **Intercorrelations Among ASVAB Subtest Standard Scores (n = 1328)**

Subtest	AR	WK	PC	NO	CS	AS	MK	MC	EI	VE
General Science (GS)	.62	.74	.67	.38	.25	.57	.54	.58	.58	.76
Arithmetic Reasoning (AR)		.61	.61	.53	.39	.47	.73	.57	.49	.65
Word Knowledge (WK)			.73	.44	.35	.45	.49	.43	.47	.97
Paragraph Comprehension (PC)				.49	.40	.44	.54	.50	.46	.87
Numerical Operations (NO)					.65	.14	.49	.26	.20	.49
Coding Speed (CS)						.05	.39	.17	.11	.39
Auto and Shop Information (AS)							.41	.75	.79	.47
Mathematics Knowledge (MK)								.56	.45	.54
Mechanical Comprehension (MC)									.71	.48
Electronics Information (EI)										.50
Verbal (VE)[a]										

[a]Verbal (VE) = WK + PC.

Table 6. **Intercorrelations Among ASVAB Subtest Standard Scores, Youth Cohort, National Longitudinal Survey, 1985 (n = 508)**

Subtest	AR	WK	PC	NO	CS	AS	MK	MC	EI	VE
General Science (GS)	.67	.79	.66	.43	.40	.61	.64	.64	.72	.79
Arithmetic Reasoning (AR)		.64	.60	.53	.45	.51	.77	.64	.58	.66
Word Knowledge (WK)			.78	.52	.50	.53	.65	.53	.65	.98
Paragraph Comprehension (PC)				.54	.57	.40	.60	.44	.52	.89
Numerical Operations (NO)					.68	.25	.58	.32	.33	.56
Coding Speed (CS)						.18	.49	.27	.29	.55
Auto and Shop Information (AS)							.39	.75	.76	.51
Mathematics Knowledge (MK)								.55	.52	.66
Mechanical Comprehension (MC)									.71	.53
Electronics Information (EI)										.64
Verbal (VE)[a]										

[a]Verbal (VE) = WK + PC.

Table 7. **Intercorrelations Among DoD Student Testing Composite Standard Scores**

Composite	VA	MA	MC	BC	EE	HS
Academic Ability (AA)	.89	.88	.74	.85	.88	.93
Verbal (VA)[a]		.68	.68	.79	.83	.85
Math (MA)			.72	.84	.90	.86
Mechanical and Crafts (MC)				.60	.89	.90
Business and Clerical (BC)					.80	.79
Electronics and Electrical (EE)						.92
Health, Social, and Technology (HS)						

[a]The Verbal DoD Student Testing Composite is different than the Verbal (VE) operational ASVAB composite.

Table 8. **Intercorrelations Among DoD Student Testing Composite Standard Scores, Youth Cohort, National Longitudinal Survey, 1985**

Composite	VA	MA	MC	BC	EE	HS
Academic Ability (AA)	.92	.90	.80	.89	.92	.96
Verbal (VA)[a]		.74	.73	.88	.86	.88
Math (MA)			.76	.84	.92	.88
Mechanical and Crafts (MC)				.66	.90	.91
Business and Clerical (BC)					.84	.84
Electronics and Electrical (EE)						.94
Health, Social, and Technology (HS)						

[a]The Verbal DoD Student Testing Composite is different than the Verbal (VE) operational ASVAB composite.

Youth Cohort. The same relationships generally hold for the composites as for the subtests, although the variations among occupations are not as great.

As further descriptive information, the means and standard deviations of the ASVAB standard subtest scores and the DoD Student Testing composites by gender are presented in Appendix C.

Question 4. Are ASVAB scores correlated with age and job tenure?

Two possible explanations for variations in the distributions of ASVAB scores are: (a) change as a function of age, and (b) change as a function of job tenure. To provide a basis for assessing the potential strength of these effects, data were collected on age and job tenure. The sample frequency distributions on age and job tenure are shown in Tables 9 and 10. Table 11 presents the correlations of age and job tenure with subtest standard scores, and Table 12 presents the correlations of age and job tenure with the DoD Student Testing composite scores.

As shown in Table 9, over half of the sample was in their twenties, and nearly 90% of the sample was under 40. Nevertheless, there is sufficient variation in age to estimate the relation of age to ASVAB scores. Similarly, as shown in Table 10, there was substantial variation across occupations in the number of years completed in the occupation. About 25% of the sample had been working in its occupation for less than 1 year, and 80% had fewer than 10 years' job tenure.

Employee recruitment for participation was targeted on employees 35 years old or younger. However, in some cases, a large group with older members was tested in order to get the younger participants. As shown in Tables 9 and 10, efforts to recruit younger employees in the first few years of tenure in their occupations were generally successful. Older employees were included in the analyses to examine the effects of age and job tenure.

The patterns of correlations among age and ASVAB scores and among tenure and ASVAB scores are, of course, similar. Generally, age is positively correlated with scores on scales (Auto and Shop Information, Electronics

Table 9. **Frequencies by Age Group for Each Occupation and Overall**

Occupation	Age group 18-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-68	Total
Bookkeeper/Accounting Clerk	9	26	12	10	5	2	5	3	2	74
Bus Driver	3	13	19	16	6	5	2	2	1	67
Computer Operator	18	34	14	9	4	2	2			83
Cosmetologist	47	24	13	12	11	3	1			111
Diesel Mechanic	24	19	31	16	11	7	11	1	1	121
Electronics Assembler	11	13	10	5	9	1	4	2	1	56
Electronics Technician	3	9	7	3	2	1	1			26
Firefighter	117	134	54	25	4	6	1		1	342
Licensed Practical Nurse	14	24	26	8	7	4		1	2	86
Line Installer/Cable Splicer		16	11	15	2					44
Operating Engineer	45	62	41	13	6			1		168
Word Processing Machine Operator	40	30	23	16	9	5	4	5	5	137
Total	331	404	261	148	76	36	31	15	13	1315[a]
Percent of 1315	25	31	20	11	6	3	2	1	1	

[a]Thirteen observations are missing because age was unknown.

Table 10. **Frequencies for Job Tenure for Each Occupation and Overall**

Occupation	Years in the occupation <1	1	2	3	4	5-9	10-14	15-19	20-24	25-49	Total
Bookkeeper/Accounting Clerk	5	12	8	5	6	24	10	2	3		75
Bus Driver	4	8	12	4	2	21	9	4	1		65
Computer Operator	8	8	18	15	10	19	5	7	1	1	92
Cosmetologist	27	19	10	7	4	26	9	2	3	3	110
Diesel Mechanic	5	7	5	8	8	25	32	15	6	9	120
Electronics Assembler		7	1	1	1	20	7	4	7	8	56
Electronics Technician	1	2	2	4		10	3	3		1	26
Firefighter	146	39	22	4	12	34	18	8	7		290
Licensed Practical Nurse	40	4	1	9	7	12	8	3		1	85
Line Installer/Cable Splicer			5	1		22	9	5	2		44
Operating Engineer	44	24	35	12	10	8	7	1			141
Word Processing Machine Operator	23	15	20	15	5	33	10	7	2	5	135
Total	303	145	139	85	65	254	127	61	32	28	1239[a]
Percent of 1239	24	12	11	7	5	21	10	5	3	2	

[a]Eighty-nine observations are missing because tenure was unknown.

Table 11. **Correlations of ASVAB Subtest Standard Scores with Age and Job Tenure**

Subtest	Age	Job Tenure
General Science	0.13	0.08
Arithmetic Reasoning	0.06	0.03
Word Knowledge	0.20	0.10
Paragraph Comprehension	0.01	-0.02
Numerical Operations	-0.18	-0.17
Coding Speed	-0.16	-0.13
Auto and Shop Information	0.11	0.12
Mathematics Knowledge	-0.07	-0.07
Mechanical Comprehension	-0.03	0.04
Electronics Information	0.16	0.16
Verbal[a]	0.15	0.07

[a]Verbal = Word Knowledge + Paragraph Comprehension

Table 12. **Correlations of DoD Student Testing Composite Standard Scores with Age and Job Tenure**

Composite	Age	Job Tenure
Academic Ability	0.11	0.05
Verbal[a]	0.12	0.06
Math	-0.01	-0.02
Mechanical and Crafts	0.09	0.11
Business and Clerical	-0.04	-0.06
Electronics and Electrical	0.09	0.06
Health, Social, and Technology	0.06	0.05

[a]The Verbal DoD Student Testing Composite is different than the Verbal (VE) operational ASVAB composite.

Information, and General Science) that include items of knowledge frequently acquired by a percentage of adults after leaving school and negatively correlated with speeded tests (Coding Speed and Numerical Operations).

As shown in Table 3, the ASVAB scores for this sample were generally higher than those for the normative population, especially those later pursuing careers in occupations such as the 12 included in the present study. An attempt was made to assess whether this increase was due to tenure in the occupation when controlling for differences in ages, by estimating regression coefficients for the model:

$$\text{ASVAB score}_i = b_A \text{ age}_i + b_G \text{ gender}_i + b_{O_i} \text{ occupation}_i + b_{T_i} (\text{tenure}_i - \text{average tenure in occupation}_i).$$

This model, which included 26 predictors, was fit for the data base of 1,328 participants. The results were stable, in the sense that the maximum condition index[2] was less than 6, certainly within the acceptable range.

Of course, the regression equation models the relations among measures in the study; it does not model causality. Therefore, a significantly negative regression weight for tenure in an occupation would not imply that experience in the occupation acted to reduce skills measured by the ASVAB; it might merely indicate that the sample of older members in the occupation were subject to different rules of selectivity than the younger members. Selection to enter the occupation may have been less stringent when the more tenured members joined, or the more tenured members may be those who failed to earn promotions out of the occupation. The different selectivity rules might also be related to the practical sample selection procedures of the study.

For four of the occupations, a significant number of training or apprenticeship program participants were included in the sample: cosmetologists,

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[2]The maximum condition index is given by the ratio of the maximum to the minimum eigenvalue of the matrix of predictors. Belsley, Kuh, and Welsch (1980, p. 104) discuss its use in the evaluation of the stability of regression estimates.

licensed practical nurses, firefighters, and operating engineers. However, for other occupations, there were no obvious sampling factors that might affect the tenure-skill relations. With these cautions, measures of the tenure-skill relations are given in Tables 13 and 14, for ASVAB Subtest Standard scores and DoD Student Testing Composites, respectively. The measures reported are the Students' t values for testing the hypothesis that the corresponding regression weight is zero. Although there are many plausible relations in Tables 13 and 14, there are also puzzling patterns, such as the negative t values for computer operators. No clear result of this test of tenure-skill relations emerges.

<u>Question 5</u>. <u>Is there significant ASVAB variation among occupations, once gender is controlled?</u>

The first major question concerning the differential validity of the ASVAB is whether the variation in ASVAB scores among occupations is significantly greater than the variation within occupations. It is important to establish the statistical significance of differences prior to exploring the patterns of differences descriptively. Differences among occupations might be due to (a) differential selectivity in entry to the occupations, (b) differential training on the job that affected skills differently in different occupations, or (c) differential sampling and data collection methods for this study. Every attempt was made to minimize the third factor, but no direct separation of the first two factors was possible.

A multivariate analysis of variance was performed in order to test whether the descriptive differences one might derive from discriminant analyses would be statistically significant. The model tested whether variation in ASVAB subtest scores could be accounted for on the basis of gender, and within gender, on the basis of occupation. Overall, Wilks' criterion (Jones, 1966) yielded $\underline{F}(198,10862) = 4.76$ for the prediction of subtests by occupations within gender, and $\underline{F}(9,1296) = 30.89$ for the prediction of subtests by gender; both values were significant beyond the .0001 level. (Wilks' criterion is a multivariate analog of the univariate $\underline{F}$ test in the analysis of variance. A significant Wilks' criterion indicates significant mean Table differences among groups.) In fact, the first four

Table 13. **Students' t Values for Contribution of Tenure in Each Occupation to ASVAB Subtest Standard Scores**

Occupation	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	VE
Bookkeeper/Accounting Clerk	-0.879	-0.450	-0.048	-0.160	-0.467	0.271	0.283	-1.673	-0.772	-0.686	-0.054
Bus Driver	0.737	0.696	0.295	0.489	-1.431	-0.626	1.236	-0.875	0.399	1.969	0.375
Computer Operator	-2.165	-2.234	-2.809	-2.781	-1.980	-2.085	-2.212	-3.115	-2.211	-0.489	-2.950
Cosmetologist	0.321	-0.529	0.873	0.140	-0.572	-2.601	2.554	-0.089	-0.041	0.380	0.667
Diesel Mechanic	-1.160	-1.804	-2.910	-3.150	-1.403	-0.549	-2.069	-1.270	-0.787	-1.864	-3.133
Electronics Assembler	1.020	1.170	1.913	0.623	2.349	0.742	-0.080	0.373	1.140	0.083	1.539
Electronics Technician	-0.440	-0.854	-0.393	-1.035	-0.613	-0.318	1.345	-1.368	0.927	-0.717	-0.668
Firefighter	2.315	2.046	2.595	2.305	2.055	2.538	3.333	0.385	2.999	3.458	2.708
Licensed Practical Nurse	-0.778	-0.452	0.832	0.822	-1.465	-0.283	1.713	0.173	0.540	0.589	0.904
Line Installer/Cable Splicer	1.870	0.388	0.416	-0.534	-0.731	1.175	-1.036	-0.723	-0.893	-1.640	0.095
Operating Engineer	0.523	0.707	-0.516	-0.773	-0.369	0.102	0.013	0.192	1.268	0.547	-0.685
Word Processing Machine Operator	0.053	-0.454	0.799	0.154	-1.610	-0.660	-0.011	0.026	1.329	-0.256	0.580

Table 14. **Students' t Values for Contribution of Tenure in Each Occupation to DoD Student Testing Composite Standard Scores**

Occupation	Acad	Verb	Math	Mech	Bus	Elect	Health
Bookkeeper/Accounting Clerk	-0.302	-0.424	-1.091	-0.524	-0.687	-1.069	-0.544
Bus Driver	0.620	0.602	-0.096	1.260	-0.525	0.777	0.489
Computer Operator	-2.792	-2.839	-2.862	-2.113	-3.428	-2.496	-2.790
Cosmetologist	0.029	0.424	-0.293	0.653	-0.896	0.080	-0.040
Diesel Mechanic	-2.681	-2.604	-1.673	-1.965	-2.019	-1.847	-2.163
Electronics Assembler	1.445	1.307	0.824	0.732	1.090	0.869	1.455
Electronics Technician	-0.883	-0.693	-1.178	0.148	-1.081	-1.019	-0.178
Firefighter	2.513	2.666	1.327	3.507	2.246	2.454	2.972
Licensed Practical Nurse	0.214	0.234	-0.106	0.659	0.300	-0.199	0.277
Line Installer/Cable Splicer	0.228	0.698	-0.134	-0.945	0.196	0.061	-0.233
Operating Engineer	0.058	-0.250	0.473	0.789	-0.160	0.646	0.564
Word Processing Machine Operator	-0.008	0.348	-0.161	0.182	-0.099	-0.186	0.501

Table 15. **Characteristic Vectors for Occupation Within Gender and for Gender Based on Multivariate Analysis of Variance of ASVAB Subtest Standard Scores**

Characteristic Root	%	GS	AR	NO	CS	AS	MK	MC	EI	VE
					Characteristic Vectors of Weights for Discriminating Among Occupations, Controlling for Gender					
0.3819	49.62	-12.71	4.62	-2.53	-9.65	34.80	-14.11	-10.81	11.42	-24.21
0.1218	15.83	-14.63	6.07	-4.47	12.75	-3.81	20.90	-8.77	35.94	-10.86
0.0899	11.69	14.96	-3.48	-2.06	4.06	14.46	-1.63	19.65	-21.69	10.92
0.0773	10.05	-23.29	4.49	7.45	25.00	28.65	-10.34	-8.43	-18.17	6.01
0.0333	4.33	-18.89	30.23	-19.16	10.60	-29.36	-27.38	25.48	4.57	16.53
0.0291	3.79	-4.49	-20.24	-6.88	6.55	0.93	28.49	25.52	-16.99	-20.61
0.0178	2.32	8.35	-24.98	28.55	1.52	-16.49	-15.86	19.75	18.33	-10.46
0.0146	1.90	15.34	-21.76	-32.70	32.30	-1.98	1.76	-6.90	8.15	5.43
0.0036	0.47	-40.81	-28.84	2.66	-11.05	0.82	14.57	5.64	5.26	57.17
					Characteristic Vectors of Weights for Discriminating Between Genders					
0.2145	100.00	2.57	-2.51	4.47	-12.05	27.01	4.18	14.13	16.96	-31.84

characteristic vectors for occupation discrimination, as shown in Table 15, were statistically significant on successive application of Wilks' criterion. That is, there are four independent ways in which ASVAB variation among occupations is greater than ASVAB variation within occupations. In addition, univariate analyses of variance found significant occupational variation on all subtest standard scores and significant gender variation on all subtest standard scores but the Verbal (VE) composite and the Numerical Operations (NO) subtest.

The characteristic vectors based on ASVAB subtests are given in Table 15 for occupations and for gender. These characteristic vectors are frequently referred to as discriminant functions. A comparison of the first characteristic vector for occupations with the single characteristic vector for gender indicated that both are quite similar. In both cases, the most discriminating contrast would appear to be the combination of high scores on Auto and Shop Information and low scores on the Verbal composite (VE). However, four of the subtests change signs between the two contrasts: Mathematics Knowledge (MK), General Science (GS), Numerical Operations (NO), and Arithmetic Reasoning (AR). Among occupations, the first three of these four scales varied similarly to the Verbal measure, while AR was similar to AS. That is, occupations employing people with verbal skills tended also to be occupations employing people with math skills and science knowledge. Between genders, however, math skills and science knowledge, like auto and shop knowledge, characterized males. That is, men were characterized as higher on math skills as well as auto and shop, mechanical comprehension, and electronics information, while women were characterized as higher on verbal skills, as well as coding speed. The role of AR, it should be noted, is minor and is probably highly dependent on its intercorrelations with other subtests.

To a certain extent, the similarity of the gender and occupational characteristic vectors may be a function of the specific occupations included in the study. Generally, however, one would expect that if, in our society, occupations were structured to minimize gender identification, the discriminant function for gender would bear little resemblance to the discriminant function for occupations within gender. From the present study, it appears that the sampled occupations involve skill clusters that are gender specific to a high degree. To determine the source of this gender specificity of job skill clusters would require additional investigation.

To corroborate the nature of the variation among occupations, a multivariate analysis of variance was also carried out, comparing occupations within both gender and ethnic groupings. The ethnic grouping was four valued: White, Black, Hispanic, and Other/Missing. Although there was a significant ethnic main effect, the results concerning occupational variation were essentially the same as for the primary analysis. Again, the most discriminating contrast appeared to be Verbal (VE) minus Auto and Shop Information (AS).

The same multivariate analyses were performed for the DoD Student Testing ASVAB Composite Scores, and occupations were compared within gender variation. The results are similar to those from the ASVAB subtest scores. The characteristic vectors are given in Table 16.

Table 16. **Characteristic Vectors for Occupation Within Gender and for Gender Based on Multivariate Analysis of Variance of DoD Student Testing Composite Standard Scores**

Characteristic Root	%	Acad	Verbal	Math	Mech	Bus	Elec	Health
	Characteristic Vectors of Weights for Discriminating Among Occupations, Controlling for Gender							
0.3800	53.07	0.21	-9.77	-23.19	-112.90	24.87	62.35	-57.01
0.1097	15.32	25.77	-46.40	-20.92	34.97	49.63	31.32	-41.36
0.0919	12.85	-87.73	76.97	49.60	-3.39	-37.20	-32.94	59.41
0.0647	9.04	-22.59	-32.24	-34.29	-68.40	-40.21	157.87	25.98
0.0330	4.61	-136.30	78.31	114.56	42.49	6.43	-93.14	-11.57
0.0222	3.10	7.21	75.18	23.16	67.75	16.25	-40.89	-135.60
0.0143	2.00	-35.83	-68.35	-125.50	-65.90	51.68	119.66	112.47
	Characteristic Vectors of Weights for Discriminating Between Genders							
0.2069	100.00	47.31	-12.26	-23.52	-75.72	23.38	3.56	17.35

Question 6. What is the configuration of distances among occupations, in terms of ASVAB scores?

Given the demonstrated statistical significance, it is appropriate to carry out discriminant analyses to describe the distances among the occupations in terms of differences in mean levels of ASVAB standardized subtest scores. First, the matrix of Mahalanobis distances (i.e., mean differences in standard deviation units) was examined to identify clusters of nearby occupations. These distances are shown in Tables 17 and 18 for ASVAB subtest standard scores and in Tables 19 and 20 for DoD Student Testing Composite scores. Results are presented both before and after removing gender effects in order to assess the extent to which the skill patterns of the occupations are related to the variation in gender proportions. Tables 17 and 19 show the overall Mahalanobis distances, and Tables 18 and 20 show the distances with mean gender differences removed. The gender differences were removed by subtracting overall gender means from all scores as the first step in the analysis.

Table 17. **Squared Mahalanobis Distances Among Occupations, Discriminant Analysis Using ASVAB Subtest Standard Scores**

Distance	CO	WPMO	CL	LPN	BD	FF	ET	EA	LI/CS	OE	DM
Bookkeeper/Accounting Clerk (BK/AC)	0.38	0.76	1.22	1.58	2.30	2.96	6.68	3.24	4.69	5.77	8.64
Computer Operator (CO)		0.79	0.90	1.28	1.38	2.10	5.12	1.79	3.54	4.15	6.71
Word Processing Machine Operator (WPMO)			0.47	1.30	3.70	5.00	8.77	4.06	7.08	7.96	11.64
Cosmetologist (CL)				0.57	2.84	3.98	8.90	3.14	6.79	6.55	10.20
Licensed Practical Nurse (LPN)					2.15	3.14	7.91	2.73	5.48	5.88	9.03
Bus Driver (BD)						0.48	4.04	0.60	1.35	1.13	2.60
Firefighter (FF)							3.35	1.44	1.01	1.13	2.13
Electronics Technician (ET)								3.73	2.31	5.13	4.36
Electronics Assembler (EA)									2.29	1.82	3.02
Line Installer/Cable Splicer (LI/CS)										1.51	1.53
Operating Engineer (OE)											0.87
Diesel Mechanic (DM)											

Table 18. **Squared Mahalanobis Distances Among Occupations, Discriminant Analysis Using ASVAB Subtest Standard Scores After Removing the Mean Gender Differences**

Distance	CO	WPMO	CL	LPN	BD	FF	ET	EA	LI/CS	OE	DM
Bookkeeper/Accounting Clerk (BK/AC)	0.54	0.60	1.15	1.58	0.93	0.55	2.93	2.23	0.73	1.83	2.00
Computer Operator (CO)		0.07	0.54	1.32	1.17	0.47	3.10	2.13	1.09	2.08	2.58
Word Processing Machine Operator (WPMO)			0.44	1.13	1.04	0.40	2.93	2.02	0.85	1.96	2.42
Cosmetologist (CL)				0.50	0.69	0.22	3.86	1.50	1.44	1.35	1.97
Licensed Practical Nurse (LPN)					0.71	0.51	4.02	1.69	1.35	1.82	2.27
Bus Driver (BD)						0.69	3.48	0.67	0.75	0.46	0.63
Firefighter (FF)							3.74	1.95	1.07	1.57	2.09
Electronics Technician (ET)								3.02	2.37	5.14	3.98
Electronics Assembler (EA)									1.69	1.00	0.68
Line Installer/Cable Splicer (LI/CS)										1.63	1.42
Operating Engineer (OE)											0.53
Diesel Mechanic (DM)											

Table 19. Squared Mahalanobis Distances Among Occupations, Discriminant Analysis Using DoD Student Testing Composite Standard Scores

Distance	CO	WPMO	CL	LPN	BD	FF	ET	EA	LI/CS	OE	DM
Bookkeeper/Accounting Clerk (BK/AC)	0.32	0.57	1.08	1.65	2.19	2.90	3.07	4.65	5.46	5.96	8.74
Computer Operator (CO)		0.72	0.84	1.26	1.21	2.02	1.53	3.51	3.85	4.55	6.84
Word Processing Machine Operator (WPMO)			0.41	1.24	3.35	4.71	3.78	6.91	7.32	8.36	11.59
Cosmetologist (CL)				0.53	2.57	3.84	2.78	6.67	6.20	8.35	10.18
Licensed Practical Nurse (LPN)					2.14	3.16	2.60	5.62	5.87	7.43	9.29
Bus Driver (BD)						0.43	0.40	1.37	1.01	3.53	2.68
Firefighter (FF)							1.05	1.03	1.15	2.65	2.10
Electronics Technician (ET)								2.12	1.13	3.43	2.97
Electronics Assembler (EA)									1.32	1.92	1.65
Line Installer/Cable Splicer (LI/CS)										4.08	0.67
Operating Engineer (OE)											4.10
Diesel Mechanic (DM)											

Table 20. Squared Mahalanobis Distances Among Occupations, Discriminant Analysis Using DoD Student Testing Composite Standard Scores After Removing the Mean Gender Differences

Distance	CO	WPMO	CL	LPN	BD	FF	ET	EA	LI/CS	OE	DM
Bookkeeper/Accounting Clerk (BK/AC)	0.47	0.43	1.04	1.67	0.87	0.54	2.00	0.72	1.68	2.17	1.95
Computer Operator (CO)		0.05	0.49	1.25	0.97	0.41	1.85	1.09	1.83	2.53	2.62
Word Processing Machine Operator (WPMO)			0.40	1.08	0.82	0.29	1.74	0.85	1.61	2.63	2.37
Cosmetologist (CL)				0.47	0.53	0.18	1.13	1.44	1.23	3.36	1.88
Licensed Practical Nurse (LPN)					0.72	0.50	1.50	1.47	1.93	3.45	2.32
Bus Driver (BD)						0.60	0.47	0.71	0.38	2.87	0.58
Firefighter (FF)							1.61	1.10	1.56	3.01	2.05
Electronics Technician (ET)								1.58	0.43	2.78	0.57
Electronics Assembler (EA)									1.41	2.00	1.54
Line Installer/Cable Splicer (LI/CS)										4.09	0.28
Operating Engineer (OE)											3.70
Diesel Mechanic (DM)											

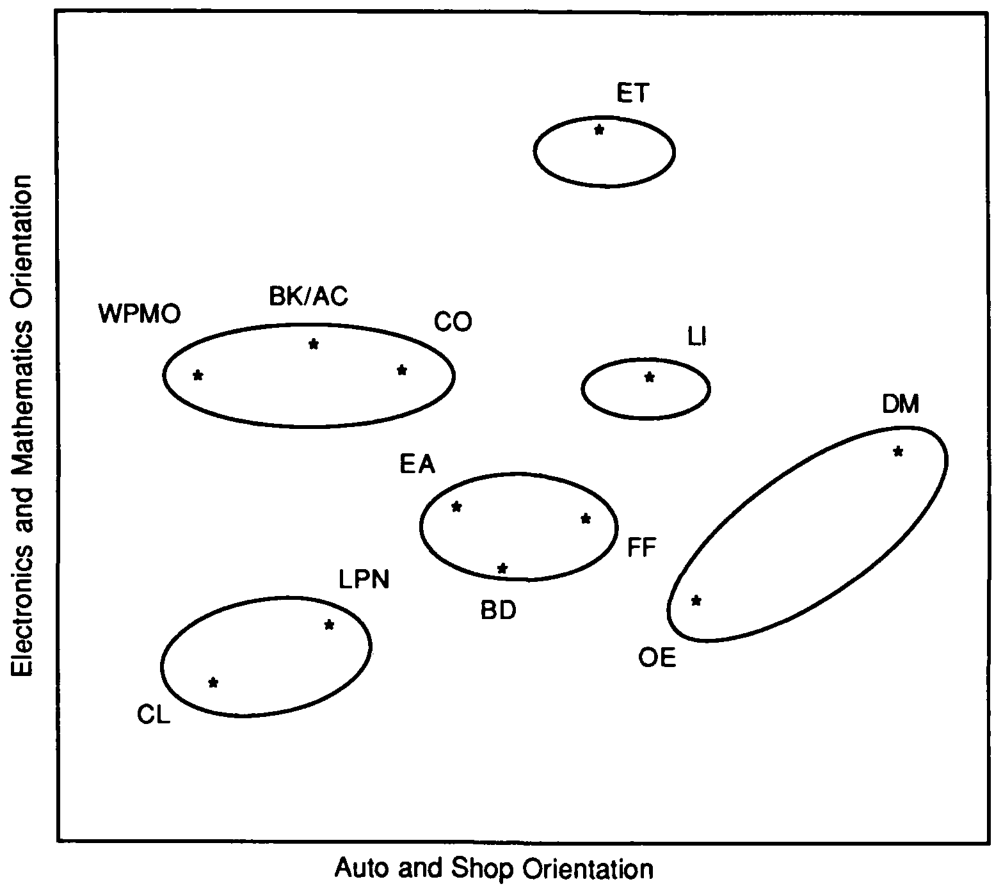
Overall, there appeared to be six clusters of occupations, in terms of ASVAB subtest scores:

1. word processing machine operator, computer operator, and bookkeeper/accounting clerk;
2. cosmetologist and licensed practical nurse;
3. firefighter, bus driver, and electronics assembler;
4. diesel mechanic and operating engineer;
5. line installer/cable splicer; and
6. electronics technician.

The Mahalanobis distances among these six clusters were not uniform, however. For example, electronics technicians differed far more from the average than others did in terms of ASVAB subtest profiles. The skill profiles for occupations in cluster 1 were not very different from those for occupations in cluster 2, and those for occupations in cluster 3 were not very different from those for cluster 4.

Some of the differences among occupations may be due to the variation in the relative numbers of men and women in the occupations, although the causal relation would not be clear, in any case. In order to eliminate this source of difference, the distances were recomputed using scores from which the gender means had been subtracted. When the means by gender were removed, there were a few interesting changes in the clusters. The most noticeable change was the increase in profile similarity of firefighters to cosmetologists and nurses, as well as to the cluster of word processing machine operators, computer operators, and bookkeeper/accounting clerks.

The locations of the occupational samples, in the space of ASVAB skills, are summarized in Figure 1. Each occupation is located according to its mean value on each of the first two occupational characteristic vectors, from Table 15. The diesel mechanics and operating engineers, for example, scored very high on the Auto and Shop Information subtest, and the electronics technicians scored very high on the Electronics Information subtest. Therefore, the diesel mechanics and operating engineers are located to the right in Figure 1 and the electronics technicians are located near the top. The occupational clusters indicated in Figure 1 are based on the Mahalanobis distances shown in Table 17. Because the results summarized in Figure 1 are sensitive to sampling variation, extreme caution should be exercised in generalizing to entire occupations.



Note: The size of the ovals reflects the Mahalanobis distances among the occupations. It does not reflect either the raw differences in means or the variances, considered separately.

Legend

BK/AC	- Bookkeeper/Accounting Clerk	ET	- Electronics Technician
BD	- Bus Driver	FF	- Firefighter
CO	- Computer Operator	LPN	- Licensed Practical Nurse
CL	- Cosmetologist	LI/CA	- Line Installer/Cable Splicer
DM	- Diesel Mechanic	OE	- Operating Engineer
EA	- Electronics Assembler	WPMO	- Word Processing Machine Operator

Figure 1. **Mean Locations of Occupational Samples, Based on First Two Characteristic Vectors of ASVAB Subtests.**

Question 7. How successfully can occupational membership in this study be identified by using ASVAB scores?

Statistical significance and Mahalanobis distances provide abstract measures of the statistical discriminability of occupations in terms of the ASVAB subtest scores of job incumbents, but they do not provide a concrete measure for comparison with other data sets. In order to describe the magnitude of the differences in ASVAB subtest scores for people in different occupations, one can estimate the proportion of individuals who would be accurately classified, using multiple linear discriminant functions. The percentages correctly classified depend on the base rates, and in order to render the accuracy independent of the particular samples available for the study, one must assume a uniform base rate. Then, the guess for each case is the occupation with the smallest Mahalanobis distance from that case. The overall chance level of successful classification on an independent sample would be approximately one divided by the number of categories, in this case 1 divided by 12, or 8.3%, if the ASVAB had no predictive value. The chance level of successful classification is slightly higher when the assignments are made on the same data set used to construct the discriminant functions. However, the likelihood of successful classification for any particular occupation could be much smaller than chance. A random simulation yielded a chance level of 12% for this data set.

The percentages of correct classifications based on the subtest discriminant function are shown in Table 21. The classifications in the first column include gender variation in ASVAB scores while those in the second column are based only on within-gender variation in scores. That is, percentages in the second column are based on analyses of ASVAB scores from which overall gender means have been subtracted. The overall percentages of correct classifications are 30%, retaining gender differences, and 22%, eliminating gender information. The percentages of correct classifications range from 9% (bus driver) to 77% (electronics technician) with a median of 31% when the gender variation is included. Excluding gender variation, the percentages are reduced and range from 4% (bus driver) to 73% (electronics technician) with a median of 25%. The complete tables of classification percentages are presented in Appendix D.

Table 21. **Percentages of Correct Classifications Based on the Subtest Discriminant Function**

Occupation	Including gender variation	Within-gender variation only
Bookeeper/Accounting Clerk	37.3	26.6
Bus Driver	8.9	4.4
Computer Operator	10.8	22.8
Cosmetologist	26.1	17.1
Diesel Mechanic	47.9	32.2
Electronics Assembler	28.5	33.9
Electronics Technician	76.9	73.0
Firefighter	25.9	13.4
Licensed Practical Nurse	33.3	31.0
Line Installer/Cable Splicer	38.6	34.0
Operating Engineer	29.5	31.3
Word Processing Machine Operator	37.2	12.4

Overall, there appears to be successful discrimination in excess of chance, along with a great deal of overlap. Some occupations (such as bus driver) employed individuals with a wide range of skill profiles, while others (such as electronics technician) were tightly centered around a characteristic profile. The broad spread of computer operator profiles is of some note, suggesting that, like bus drivers, computer operators are not differentiated from the general population by skills measured by the ASVAB.

Question 8. How valid are predictions of occupations based on ASVAB?

The original intent of the study was to estimate the validity of ASVAB scores for predicting success in selected civilian occupations. Because data on job performance ratings were not available, the only criterion that could be used for validation was whether the individuals show evidence that they are able to pursue a career in the particular occupation- that is, whether they were in the occupation on the date of testing. Thus, validity is in a sense related to discriminability, and the validity estimates for any occupation computed in this way are dependent on the selection of other occupations for inclusion in the study. To the extent that the occupations do not span the range of career fields, validities may be underestimated; but to the extent that the study oversampled unusual occupations, validities may be overestimated.

As discussed in Section II, the criteria for selecting occupations included the number of individuals working in the occupation nationwide. This should have ruled out unusual occupations. On the other hand, although occupations were included from seven of the first-digit code categories from the Dictionary of Occupational Titles, only 12 occupations were represented in the analyses, which is certainly a limited sampling of the full range of career fields.

A series of linear regressions was used to estimate validities for predicting membership in the occupations whereby the dichotomous outcome of membership in each occupation versus the other occupations was predicted using ASVAB scores. The resulting values of R^2 provide the basis for estimating validity; however, their maximum values are severely limited by the fact that the dichotomous outcome is highly disproportionate. One solution is to transform the correlation (that is, the square root of R^2) to a biserial correlation, by dividing by the maximum possible value of the correlation, given the skewness and the assuming the predictors to be normally distributed. However, the normality assumption is important for this transformation, and several of the biserial correlations thus computed were greater than 1.0. Therefore, Clemans' lambda (Clemans, 1958), which substitutes the empirical distribution of the predictors for the normality assumption, was computed. These values are shown in Tables 22 and 23. The values shown in Table 22 are based on regressions using the entire ASVAB, for the total sample and for males and females separately, and as a comparison, for the Youth Cohort sample. The validity estimates (Clemans' lambda) in Table 22 are for the best linear combination of subtests and of composites.

Table 22. **Validity Coefficients for ASVAB: Clemans' λ for Best Linear Combinations**

Occupation	Subtests: Civilian Validation	Subtests: Youth Cohort	Composites: Civilian Validation	Composites: Youth Cohort	Civilian Validation Subtests: Male	Civilian Validation Subtests: Female	Civilian Validation Composites: Male	Civilian Validation Composites: Female
Bookkeeper/Accounting Clerk	.50	.53	.51	.52	.43[a]	.41	.45[a]	.41
Bus Driver	.17	.30	.13	.28	.18	.42	.18	.40
Computer Operator	.35	.36	.35	.38	.43	.28	.41	.27
Cosmetologist	.57	.34	.57	.33	.52[a]	.32	.52[a]	.30
Diesel Mechanic	.73	.58	.73	.58	.62	.61[a]	.62	.63[a]
Electronics Assembler	.30	.56	.25	.55	.49	.53	.47	.49
Electronics Technician	.74	.62	.71	.60	.72	.87[a]	.69	.84[a]
Firefighter	.42	.36[a]	.41	.26[a]	.51	.43	.52	.42
Licensed Practical Nurse	.53	.50	.54	.44	.41[a]	.49	.42[a]	.49
Line Installer/Cable Splicer	.57	.54[a]	.57	.46[a]	.42	.81[a]	.43	.76[a]
Operating Engineer	.56	.62	.52	.57	.52	.62	.47	.62
Word Processing Machine Operator	.67	.53	.66	.50	.49[a]	.44	.47[a]	.40

[a]Based on a sample of fewer than 20.

Table 23. **Validity Coefficients for ASVAB: Clemans' λ for Individual Subtests and Composities**

Occupation	Subtests: GS	AR	NO	CS	AS	MK	MC	EI	VE	Composites: Acad	Verb	Math	Mech	Bus	Elec	Health
Bookkeeper/Accounting Clerk		.20	.32	.36		.16			.30	.25	.15	.18		.33	.03	.06
Bus Driver	.01				.10			.05	.04	.00	.01		.02			
Computer Operator		.05	.21	.21		.03				.02		.04		.11		
Cosmetologist			.02	.02												
Diesel Mechanic	.04	.10			.68		.48	.49		.01		.02	.51		.17	.22
Electronics Assembler																
Electronics Technician	.28	.58	.39	.08	.39	.58	.45	.71	.23	.44	.26	.59	.56	.38	.60	.47
Firefighter	.27	.17	.09		.33	.20	.35	.19	.17	.18	.24	.19	.31	.15	.24	.28
Licensed Practical Nurse	.10								.15		.13					
Line Installer/Cable Splicer	.38	.30	.19	.12	.62	.18	.38	.57	.40	.35	.41	.23	.50	.25	.39	.38
Operating Engineer					.42		.10	.15					.14			
Word Processing Machine Operator			.26	.31					.00					.11		

[a]Based on a sample of fewer than 20.

Clemans' lambda is computed as follows. Suppose that a predicted likelihood of person j being in occupation i, p_{ij} is available (e.g., based on linear regression). Let $\bar{p}_{i.}$ be the average of these, and let $\bar{p}_{ii}$ be the average for the n_i people actually in occupation i. Finally, let $\bar{P}_{i*}$ be the average of the n_i largest of the p_{ij}'s. Then, for occupation i,

$$\lambda_i = (\bar{p}_{ii} - p_{i.})/(\bar{p}_{i*} - \bar{p}_{i.}).$$

Clemans' lambda is similar to a standard validity coefficient in the sense that it ranges from 0 to 1.0 as the strength of prediction increases from the extreme of no differential prediction to the extreme in which the predicted likelihoods for all actual members of the group are higher than for all other cases. When the distributions are actually normal, this statistic is identical to the traditional biserial correlation coefficient.

Values of Clemans' lambda for the individual subtests and composites are shown in Table 23. Only positive relations are included in Table 23. In other cases, membership in an occupation was characterized by a lower value on the ASVAB measure, relative to the other occupations.

To provide an indication of the confidence intervals of Clemans' lambda, one can, for example, perform balanced repeated replications of analyses based on half samples. The cost of these analyses dictates their cautious use, however. For the present data set, estimates of standard deviations for λ_i for each occupation for one composite, Mechanical and Crafts, were obtained as a representative example. The standard deviations of $\lambda_{i,MECH}$ ranged from .02 to .05, with the exception that for electronics assemblers the standard deviation of $\lambda_{i,MECH}$ was .08. Thus, except for electronics assemblers, the figures in the MECH column of Table 23 are likely to be within .10 of population values for the population from which the sample was drawn.

The results indicate that the ASVAB is a reasonably valid discriminator of incumbents in these different occupations. For the total civilian validation sample, the occupations whose incumbents are most identifiable by the ASVAB were the diesel mechanics and the electronics technicians, and only the bus drivers were virtually indistinguishable from the overall average of these 12 occupations. However, the samples for two occupations, cosmetologists and electronics assemblers, were characterized only by lower scores than the other occupations. Separate analyses were performed for the subsample of men only and of women only in order to remove the component of validity inherited from the differences in mean ASVAB scores between males and females. In some cases, in Table 22, fewer than 20 cases were available; thus the corresponding estimates should be interpreted only with great caution.

Generally, the patterns for the males matched the overall pattern, with a somewhat lower overall level because the predictive power of the ASVAB based on gender variation was removed. The pattern for women showed greater variation in the discriminability of occupations. For example, in comparing cosmetologists and computer operators to the other occupations, the discriminability was poorer for females than for males; however, the discriminability was better for females than for males when comparing bus drivers, line installers, and electronics technicians to the other occupations. Although these results might not be used directly by counselors, they appear to confirm the unique characteristics of females who are employed in so-called "nontraditional" occupations.

Validity Data from Military Studies

Because it was not possible to collect measures of job performance and compute validities for the ASVAB based on those measures, project staff looked for validity data for military occupations that match the nine potentially comparable civilian occupations included in the study, as discussed in the previous section. These matches were assessed by having a small sample of supervisors indicate whether or not their employees usually do the critical or frequent tasks in a potentially matching Military Occupational Speciality (MOS) in the U.S. Army. The MOS validities were computed from Project A based primarily on criteria from Skill Qualification Tests (L. L. Wise, personal communication, 1987).

Table 24 shows the best matches (based on task similarity) that were found between 9 of the 12 civilian occupations and corresponding military occupations. The column labeled "Percent of Supervisors Matching" indicates the percentage of supervisors who indicated that their civilian employees normally do the majority of the tasks in the corresponding Army MOS. The higher percentages indicate a closer match. The closeness of the matches and the very high validities from Project A suggest that the ASVAB can predict performance on civilian jobs as well as discriminate among civilian job incumbents as the present validation study shows.

Table 24. Validity from Military Occupations Studied in Project A

Civilian Occupation	Corresponding military occupation (Army MOS)	Percent of supervisors matching	Project A validity[a]	N
Bookeeper/Accounting Clerk	Accounting Specialist (73D)	50	.70	72
Bus Driver	Motor Transport Operator (64C)	100	.59	14,917
Computer Operator	Computer/Machine Operator (74D)	86	.64	545
Diesel Mechanic	Heavy-Wheel Vehicle Mechanic (63S)	100	.74	941
Firefighter	Firefighter (51M)	100	.72	72
Licensed Practical Nurse	Medical Specialist (91A)	86	.73	392
Line Installer/Cable Splicer	Wire Systems Installer (36C)	67	.51	2,907
Operating Engineer	Heavy Construction Equipment Operator (62E)	100	.64	233
Word Processing Machine Operator	Administrative Specialist (71L)	55	.64	9,509

[a]Based on the relationship between ASVAB subtest scores and Skill Qualification Test (SQT) scores (except for Medical Specialist where the criterion was a composite of hands-on and job knowledge tests). No weighting of subtests nor corrections for restriction of range were performed when computing the validities.

Summary of Data Analyses

A variety of analyses were carried out on a data base of 1,328 individuals who took ASVAB Form 14 while holding jobs in one of the 12 occupations. The primary purpose was to estimate the extent to which skills measured by ASVAB vary among civilian occupations. The major results are summarized as follows:

1. There was a statistically significant variation in ASVAB profiles among occupations. Four independent characteristic vectors were each statistically significant, indicating that variation among occupations in ASVAB skills occurred along four different dimensions. These results are based on analyses in which gender variations among occupations were controlled.

2. The most salient dimension of variation, both between genders and among occupations controlling for gender, was defined by high scores on Auto and Shop Information (AS) and low scores on the Verbal (VE) composite (Word Knowledge + Paragraph Comprehension).

3. Auto and Shop Information (AS) was the highest mean standard subtest score for samples in 6 of the 12 occupations: bus driver, diesel mechanic, operating engineer, firefighter, line installer/cable splicer, and electronics assembler. Coding Speed (CS) or Numerical Operations (NO) was highest for four occupations: bookkeeper/accounting clerk, computer operator, word processing machine operator, and cosmetologist. General Science (GS) was the highest score for licensed practical nurse; and Electronics Information (EI) was the highest score for electronics technician.

4. The Mahalanobis distances among occupations suggested six clusters of occupations:

a. bookkeeper/accounting clerk, word processing machine operator, and computer operator

b. bus driver, firefighter, and electronics assembler

c. cosmetologist and licensed practical nurse

d. diesel mechanic and operating engineer

e. electronics technician

f. line installer/cable splicer

5. Roughly 30% of cases could be accurately placed in their occupation using ASVAB information, compared to a chance level of 12%. If gender means were first subtracted from all scores, the accuracy rate was reduced to 22%.

6. Clemans' lambda was used to estimate validity of ASVAB profiles for "predicting" occupational membership, adjusting for the highly disproportionate distribution of the dichotomous outcome. The most significant positive relationships for DoD Student Testing Composites were:

a.	for bookkeeper/accounting clerk:	Business and Clerical; Academic
b.	for diesel mechanic:	Mechanical and Crafts
c.	for electronics technician:	all composites (Electronics highest)
d.	for firefighter:	Mechanical and Crafts; Health, Social, and Technology
e.	for line installer/cable splicer:	all composites (Mechanical and Crafts highest)

7. Of the 12 occupations, the populations of 4 were predominantly female, and the populations of 5 were predominantly male. Only computer operator, bus driver, and electronics assembler were roughly balanced. Ethnic group imbalances among occupations were much less severe.

8. In an equation that included occupational membership, relative length of job tenure, and gender, the relationship of age to ASVAB scores was estimated. For subtests, there were significant positive relationships between age and General Science (GS), Word Knowledge (WK), Auto and Shop Information (AS), and Electronics Information (EI) and significant negative relationships between age and the speeded subtests Numerical Operations and Coding Speed.

9. Information on tenure effects on ASVAB skills in different occupations could not be separated from potential artifacts of sampling and of cohort variation. For example, a negative relation to tenure might occur because selection to enter the occupation may have been less stringent when the more tenured members joined, or the more tenured members may be those who failed to earn promotions out of the occupation.

10. For 9 of the 12 occupations involved in this study, matches were found with Army occupations under study in Project A by the Army Research Institute in the Behavioral and Social Sciences. ASVAB composite validities for predicting training outcome and skill qualification test scores were presented for these occupations and range from .51 to .74.

Finally, a note of caution must be expressed. Although the results of the civilian ASVAB validation study demonstrate a wide variety of significant, strong relationships between ASVAB scores and membership in occupations, use of the specific results in a counseling context cannot be recommended at this time. Because criterion performance rating data were not available as planned, no evidence has been presented that skills characteristic of membership in an occupation (i.e., membership in one of the 12 sampled occupations) are the same as skills required for successful careers in the occupation. Further research based on actual criteria of job success appears warranted.

REFERENCES

Air Force Regulation 39-1. (Jan. 1982, Sept. 1982, Mar. 1983, Mar. 1985, Sept. 1985, Mar. 1986). Airman classification. Washington, DC: Department of the Air Force.

Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). Regression diagnostics: Identifying influential data and sources of collinearity. New York: John Wiley & Sons.

Campbell, A., Converse, P.E., & Rodgers, W.L. (1976). The quality of American life. New York: Sage Foundation.

Center for Human Resource Research. (1986). The National Longitudinal Surveys handbook. Columbus, OH: The Ohio State University.

Clemans, W. V. (1958). An index of item-criterion relationships. Educational and Psychological Measurement, 18, 167-172.

Cronbach, L. J. (1979). The Armed Services Vocational Aptitude Battery - A test battery in transition. Personnel and Guidance Journal, 57, 232-237.

Federal Advisory Committee Act. (1972). Public Law 92-463.

Flanagan, J. C. (1954). The critical incident technique. Psychological Bulletin, 51(4), 327-358.

Hays, W. L. (1963). Statistics for psychologists. New York, NY: Holt, Rinehart and Winston.

Jensen, A.R. (1985). Armed Services Vocational Aptitude Battery. Measurement and Evaluation in Counseling and Development, 18, 32-37.

Jones, L. V. (1966). Analysis of variance in its multivariate developments. In R. B. Cattell (Ed.), Handbook of multivariate experimental psychology. Chicago: Rand McNally & Company.

McLaughlin, D. H., Rossmeissl, P. G., Wise, L. L., Brandt, D. A., & Wang, M. M. (1984). Validation of current and alternative Armed Services Vocational Aptitude Battery (ASVAB) area composites. (Technical Report No. 651). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

National Society for the Study of Education. (1975). In R.J. Havighurst & P.H. Dreyer (Eds.). Youth (Part I). Chicago: University of Chicago Press.

Office of the Assistant Secretary of Defense. (1983). Biennial report of the Defense Advisory Committee on Military Personnel Testing. Washington, DC: Department of Defense.

Paperwork Reduction Act of 1980. Title 44 U.S.C., Chapter 35.

San Mateo County California, Office of Education, Regional Occupation Program Program. (1983). Top ten career choices by district. Unpublished memorandum.

Smith, P. C., & Kendall, L. M. (1963). Retranslation of expectations: An approach to the construction of unambiguous anchors for rating scales. Journal of Applied Psychology, 47, 149-155.

U.S. Department of Commerce. (1982). 1980 Census of Population, Classified index of industries and occupations (Report PHC80-R4). Washington, DC.

U.S. Department of Defense. (undated). Military career guide. Washington, DC.

REFERENCES (continued)

U.S. Department of Defense. (1984). Counselor's manual for the Armed Services Vocational Aptitude Battery Form 14. North Chicago, IL: U.S. Military Entrance Processing Command.

U.S. Department of Defense, Military Enlistment Command. (1978). Military-civilian occupational sourcebook (2nd ed.). Fort Sheridan, IL.

U.S. Department of Labor, Bureau of Labor Statistics. (1979). Exploring careers (Bulletin 2001). Washington, DC.

U.S. Department of Labor, Bureau of Labor Statistics. (1982). Labor force statistics derived from the current population survey: A databook. Vol. I. Washington, DC.

U.S. Department of Labor, Bureau of Labor Statistics. (1984a). Employment and earnings. Washington, DC.

U.S. Department of Labor, Bureau of Labor Statistics. (1984b). Occupational outlook handbook (1984-85 ed.). Washington, DC.

U.S. Department of Labor, Bureau of Labor Statistics. (1984c). The job outlook in brief. Washington, DC.

U.S. Department of Labor, Employment and Training Administration. (1977). Dictionary of occupational titles (4th ed.). Washington, DC.

U.S. Department of Labor, Employment and Training Administration. (1986). Dictionary of occupational titles (4th ed. supplement). Washington, DC.

Weiss, D.J. (1978). Multi-aptitude batteries: ASVAB review [483]. In O. K. Buros (Ed.), The eighth mental measurements yearbook. Highland Park, NJ: The Gryphon Press.

REFERENCES (concluded)

Wilbourn, J. M., Valentine, L. D., Jr., & Ree, M. J. (1984). Relationships of the Armed Services Vocational Aptitude Battery (ASVAB) Forms 8, 9, and 10 to Air Force technical school final grades (AFHRL-TP-84-8, AD-A144 213). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Wright, C. J., & Treichel, J. M. (undated). Crosscoding military and civilian occupational classification systems. Unpublished technical paper. Bethesda, MD: Booz, Allen, & Hamilton.

APPENDIX A:

JOBS CONSIDERED FOR ASVAB VALIDATION (BY DOT CODE)

DOT Code 0/1 Professional, Technical, and Managerial

	DOT Code	Job
1.	078	Clinical laboratory technician
2.	079	Licensed practical nurse
3.	003	Electronics technician
4.	007	Drafter
5.	162	Buyer: wholesale and retail
6.	166/169	Personnel and labor relations specialist
7.	079	Dental assistant
8.	076	Physical therapy assistant
9.	197	Merchant marine; ship engineer, pilot, mate
10.	193	Broadcast technician

A total of 10 occupations in this category were considered. Although only one was required, both licensed practical nurse and electronics technician stood out as most appropriate in comparison with the others, and because they are substantially different from each other, they were both tentatively selected subject to consideration of the other categories. The following Code 0/1 jobs were rejected because, in comparison to the selected occupations, the occupation as a category is broken into too many subspecializations and is not readily defined: clinical laboratory technician and drafter. Insufficient numbers of incumbent employees or improbability of locating centralized employment sites were the reasons for eliminating dental assistant, physical therapy assistant, and broadcast technician. Wholesale and retail buyer occupations were eliminated because, while numerous, there was less evidence of likelihood of high ASVAB validities.

Rationale for Jobs Selected

079.374-014. Licensed Practical Nurse

- Over 500,000 incumbents
- Good growth potential
- Moderately high Army ASVAB validity (.58)
- Large groups at centralized employment sites
- Good possibility of cooperation from employers (e.g., government hospitals, large profit and nonprofit hospitals and clinics)
- Performance criteria probably available at least on state-by-state basis for licensing purposes.

003.161-014 & -018. Electronics Technician (Includes Semiconductor Development)

- Over 300,000, including electrical technicians
- Much better than average growth potential
- Moderately high Army ASVAB validities for similar jobs (.53, .50)
- Good possibility of large concentrations employed at one site
- Good possibility of employer cooperation (defense contractors)
- Job performance data from previous AIR project

DOT Code 2. Clerical and Sales

	DOT Code	Job
11.	201, 202, 203	Secretary, stenographer, typist
12.	203.362	Word processing machine operator
13.	210 and 216	Bookkeeper/accounting clerk
14.	211.462	Bank teller
15.	211.462	Cashier
16.	213.382	Computer operator
17.	237	Receptionist
18.	260-290	Retail sales trade worker
19.	260-279	Wholesale sales trade worker
20.	222	Stock clerk
21.	219	Administrative clerk
22.	250.257	Insurance agent
23.	250.357	Real estate sales agent
24.	230	Mail carrier
25.	243	Postal clerk
26.	219,249	Teacher aide
27.	235	Telephone operator

A total of 17 occupations in this category were considered. The first two selected were word processing machine operator and bookkeeper/accounting clerk, and the occupation of computer operator was considered to be the best of the "next best" alternatives in the various categories and so was included. The following Code 2 jobs were considered because of the large numbers employed in these areas, but rejected because of the probable difficulty in locating employees who could be released for testing: postal clerk, mail carrier, stock clerk, cashier and bank teller. Eliminated as unlikely to be well predicted by ASVAB were: teacher aide, insurance and real estate sales agents, retail sales clerk, and receptionist.

Rationale for Jobs Selected

203.362-022. Word Processing Machine Operator

- Over one million employed in all secretarial occupations
- Good prospects for growth
- Likely to have high ASVAB validity because requires knowledge of detailed procedures
- Job performance criteria available from AIR's Vocational Competency Measures (VCM) project
- Large numbers centrally employed
- Probability of good employer cooperation and availability for testing

210.382. and 216.482 Bookkeeper (Clerical) and Accounting Clerk (Clerical)

- Over one million incumbents (bookkeepers and accounting clerks)
- High ASVAB validity (.68) in military jobs
- Large numbers likely to be concentrated at one employment site
- Considerable high school student career interest

213.362. Computer Operator

- Over 260,000 employed
- Average growth potential
- Very high Army ASVAB validity (.74)
- VCM job performance criteria available
- Considerable high school student career interest

DOT Code 3. Service Occupations

	DOT Code	Job
28.	311	Waiter/waitress
29.	311	Fast food counter attendant
30.	313	Cook/chef
31.	312	Bartender
32.	355	Nursing aide/orderly
33.	382	Custodian/janitor
34.	332	Cosmetologist
35.	373	Firefighter

Cosmetologist and firefighter were selected from this category. The following Code 3 jobs were rejected despite the large numbers employed in them because they frequently employ individuals with less than a high school education and/or with little mastery of English, and also because they are considered low prestige jobs by most high school students: custodian/ janitor, fast food counter attendant, and waiter/waitress. Cook/chef was eliminated because working conditions are not likely to permit time for testing. Bartender was eliminated because of possible objections from school personnel and because it is a socially oriented occupation, likely to be poorly predicted by ASVAB. Nursing aide/orderly was rejected because of its similarity to licensed practical nurse, a Code 0/1 selection.

Rationale for Jobs Selected

332.271. Cosmetologist

- Over 500,000 incumbents
- Average growth potential
- Among top 10 high school career choices
- Good possibility of available performance criteria (through licensing bureau)
- Possibility of testing at training sites with realistic job conditions

373.364. Firefighter

- Over 250,000 incumbents
- Good possibility of locating cooperative employers
- Good opportunities for testing at work site
- Attractive to high school students

DOT Code 4. Agricultural. Fishery, Forestry, and Related Occupations

	DOT Code	Job
36.	406-408	Gardener/Groundskeeper
37.	452, 459	Forestry technician

No jobs selected from this code.

DOT Code 5. Processing Occupations

	DOT Code	Job
38.	518	Foundry worker/molder/core maker
39.	542, 553, 559, 563, 572, 573	Boiler tender/furnace operator

No jobs selected from this code.

DOT Code 6. Machine Trades

	DOT Code	Job
40.	600	Machinist/layout marker
41.	602-606	Machine tool operator
42.	620	Automobile mechanic
43.	625	Diesel mechanic
44.	630	Industrial machine repairer
45.	621	Aircraft mechanic/airframe and power plant mechanic
46.	637	Air conditioning, refrigeration and heating mechanic
47.	601	Tool and die maker
48.	6... (various depending upon industry)	Blue-collar worker supervisor

Machine tool operator and related machining occupations were among the Code 6 jobs not selected because the occupations tend to be so specialized as to have no widely accepted definition. Automobile mechanic was rejected in favor of diesel mechanic because of lower ASVAB validities for related military occupations and because auto mechanics are less likely to be found in centralized employment situations. This problem was also true for air conditioning, refrigeration, and heating mechanic, an occupation that was also determined to have poor growth potential.

Rationale for Job Selected

625.281. Diesel Mechanic

- About 175,000 incumbents
- Average growth possibilities
- Higher Army ASVAB validity than for auto mechanics (.55)

- Better possibility of locating large numbers of centrally employed incumbents than for auto mechanics
- Vehicle mechanic is a top career choice of high school students

DOT Code 7. Bench Work Occupations

	DOT Code	Job
49.	726	Electronics assembler
50.	713, 716	Optical laboratory technician; lens grinder
51.	760	Bench carpenter
52.	785, 786, 787, 789	Sewing machinery operator
53.	723	Appliance installer-repairer
54.	720	Radio/TV service technician

We selected electronics assembler from this category. Another Code 7 benchwork occupation employing very large numbers was sewing machinery operator, however, this occupation was rejected because a high school education is frequently not required and because satisfactory employment testing conditions were not likely to be met. Appliance installer-repairer was rejected because of the very large downturn in number employed in the past five years.

Rationale for Job Selected

726.261-010 and 726.684-018. Electronics Assembler (Developmental and General)

- Over 400,000 employed (including electrical and electronic machinery and equipment assembly)
- Average growth potential
- Likely to be centrally employed
- Good possibility of cooperative employers (defense industry)

DOT Code 8. Structural Word Occupations

	DOT Code	Job
55.	810	Welder/flamecutter
56.	820	Electrician
57.	840	Painter
58.	850, 853, 859	Operating engineer (construction machinery operator)
59.	860	Carpenter
60.	862	Plumber/pipefitter
61.	869	Construction laborer
62.	822	Telephone/telegraph equipment installer-repairer
63.	821	Line installer/cable splicer
64.	828	Computer service technician
65.	829	Automobile body repairer

We selected operating engineer and line installer/cable splicer from this category. The following Code 8 jobs were eliminated because of probable difficulty of locating centrally employed individuals who would be available for testing at the work site: welder/flamecutter, electrician, painter, carpenter, plumber/pipefitter, and construction laborer. Computer service technician was rejected because of the relatively small numbers of job incumbents.

Rationale for Jobs Selected

850, 853, and 859. Operating Engineer (Construction Machinery Operator--Excavating, Grading, Dredging, and Paving)

- Over 200,000 incumbents (excluding self employed)
- Excellent growth potential
- High Army ASVAB validity (.60)
- Trade union (Operating Engineers) favorably disposed to testing and establishing criteria

821.261. Line Installer & Cable Splicer (Electrical and Telephone Line Installer-Maintainer-Repairer)

- 195,000 incumbents (line installer/cable splicer- electrical and telephone)
- Average growth potential
- Moderate ASVAB validities for military counterparts (.29 to .58)
- Excellent possibility of centralized employment
- Good possibility of cooperative employers

DOT Code 9. Miscellaneous Occupations

	DOT Code	Job
66.	921	Industrial truck operator
67.	903-905	Truck driver - long distance
68.	913.463	Bus driver
69.	921.633	Heavy construction equipment operator (hoisting, conveying)
70.	950	Stationary engineer
71.	950, 952	Water treatment technician
72.	955	Wastewater treatment technician
73.	971	Photographer
74.	900-906	Local truck driver

We selected bus driver from this category. The following Code 9 jobs were not selected because of the small likelihood that sufficiently large groups of testable employees could be located at one employment site: local and long distance truck driver, water treatment technician, wastewater treatment technician, and photographer. Heavy construction equipment operator was eliminated because of the similarity of the job to operating engineer, selected for Category 8.

Rationale for Job Selected

913.463. Bus Driver

- Over 450,000 incumbents (including school bus, city bus, etc.)
- Excellent likelihood of centralized employment
- Municipal employers likely to be disposed toward testing

APPENDIX B:

STANDARD SCORE STATISTICS FOR INDIVIDUAL OCCUPATIONS

Table B-1. Statistics for ASVAB Subtest Standard Scores for Bookkeeper/Accounting Clerk (n = 75)

Subtest	Mean	SD	Min	Max
General Science	53.41	7.40	32	68
Arithmetic Reasoning	56.28	7.07	38	66
Word Knowledge	56.76	5.46	38	61
Paragraph Comprehension	52.80	6.76	32	62
Numerical Operations	55.27	6.25	40	62
Coding Speed	57.48	7.34	38	71
Auto and Shop Information	52.81	8.35	33	67
Math Knowledge	52.71	7.47	38	68
Mechanical Comprehension	49.48	6.80	33	67
Electronics Information	50.84	7.34	34	65
Verbal Comprehension	55.77	5.60	39	62

Table B-2. Statistics for ASVAB Subtest Standard Scores for Bus Driver (n = 67)

Subtest	Mean	SD	Min	Max
General Science	53.52	8.56	24	66
Arithmetic Reasoning	53.48	9.27	35	66
Word Knowledge	54.69	6.73	33	61
Paragraph Comprehension	50.85	9.06	23	62
Numerical Operations	50.54	8.83	27	62
Coding Speed	49.96	7.64	31	69
Auto and Shop Information	57.72	8.39	39	69
Math Knowledge	49.18	9.21	35	68
Mechanical Comprehension	52.34	9.94	31	68
Electronics Information	55.06	9.08	32	70
Verbal Comprehension	53.66	7.17	30	62

Table B-3. Statistics for ASVAB Subtest Standard Scores for Cosmetologist
(n = 111)

Subtest	Mean	SD	Min	Max
General Science	49.84	7.18	36	66
Arithmetic Reasoning	50.14	8.68	30	66
Word Knowledge	52.35	6.20	35	61
Paragraph Comprehension	49.30	7.65	20	62
Numerical Operations	52.00	8.00	20	62
Coding Speed	51.78	7.37	22	67
Auto and Shop Information	46.06	8.48	24	66
Math Knowledge	46.03	7.73	29	65
Mechanical Comprehension	44.15	8.25	24	67
Electronics Information	43.77	9.84	23	65
Verbal Comprehension	51.51	6.13	34	62

Table B-4. Statistics for ASVAB Subtest Standard Scores for Diesel Mechanic
(n = 121)

Subtest	Mean	SD	Min	Max
General Science	53.64	10.06	20	63
Arithmetic Reasoning	55.00	8.20	32	66
Word Knowledge	52.59	8.64	20	61
Paragraph Comprehension	51.21	9.[illegible]7	20	62
Numerical Operations	48.93	9.3[illegible]	22	62
Coding Speed	48.65	7.49	26	62
Auto and Shop Information	65.03	6.35	35	69
Math Knowledge	49.38	8.22	33	6[illegible]
Mechanical Comprehension	59.93	7.80	27	70
Electronics Information	61.50	7.40	32	70
Verbal Comprehension	52.20	8.60	20	62

Table B-5. Statistics for ASVAB Subtest Standard Scores for Electronics Assembler (n = 56)

Subtest	Mean	SD	Min	Max
General Science	49.75	10.75	20	66
Arithmetic Reasoning	50.79	9.31	34	66
Word Knowledge	50.43	8.83	21	61
Paragraph Comprehension	47.96	8.88	26	62
Numerical Operations	46.75	8.82	27	62
Coding Speed	47.64	6.73	31	67
Auto and Shop Information	54.18	10.17	35	69
Math Knowledge	47.54	9.42	30	68
Mechanical Comprehension	49.70	9.64	31	68
Electronics Information	53.79	9.98	25	70
Verbal Comprehension	49.70	8.53	23	62

Table B-6. Statistics for ASVAB Subtest Standard Scores for Electronics Technician (n = 26)

Subtest	Mean	SD	Min	Max
General Science	57.54	8.60	40	68
Arithmetic Reasoning	60.92	5.81	46	66
Word Knowledge	55.81	7.29	41	61
Paragraph Comprehension	53.58	8.53	32	62
Numerical Operations	56.00	6.25	37	62
Coding Speed	53.38	7.04	39	68
Auto and Shop Information	61.38	7.44	44	69
Math Knowledge	60.50	8.43	40	68
Mechanical Comprehension	60.15	7.81	42	70
Electronics Information	65.42	4.27	56	70
Verbal Comprehension	55.27	7.37	38	62

Table B-7. Statistics for ASVAB Subtest Standard Scores for Firefighter
(n = 343)

Subtest	Mean	SD	Min	Max
General Science	56.04	8.86	24	68
Arithmetic Reasoning	55.47	8.51	31	66
Word Knowledge	54.81	7.62	20	61
Paragraph Comprehension	52.97	8.24	20	62
Numerical Operations	52.82	8.94	20	62
Coding Speed	51.75	8.38	22	72
Auto and Shop Information	59.92	8.35	24	69
Math Knowledge	52.35	8.81	29	68
Mechanical Comprehension	56.80	9.28	24	70
Electronics Information	56.11	9.31	23	70
Verbal Comprehension	54.39	7.79	20	62

Table B-8. Statistics for ASVAB Subtest Standard Scores for Operating Engineer
(n = 169)

Subtest	Mean	SD	Min	Max
General Science	51.75	8.29	20	68
Arithmetic Reasoning	51.90	8.73	31	66
Word Knowledge	52.17	7.46	25	61
Paragraph Comprehension	47.94	8.92	23	62
Numerical Operations	49.91	8.38	22	62
Coding Speed	48.73	7.25	32	71
Auto and Shop Information	61.53	7.00	35	69
Math Knowledge	46.97	7.63	32	68
Mechanical Comprehension	54.08	8.80	31	68
Electronics Information	56.30	7.72	32	70
Verbal Comprehension	50.88	7.69	24	62

Table B-9. Statistics for ASVAB Subtest Standard Scores for Line Installer/Cable Splicer (n = 44)

Subtest	Mean	SD	Min	Max
General Science	58.68	6.32	36	68
Arithmetic Reasoning	57.50	6.26	40	66
Word Knowledge	57.34	3.88	42	61
Paragraph Comprehension	54.77	4.63	41	62
Numerical Operations	53.98	5.29	40	62
Coding Speed	54.00	6.69	36	68
Auto and Shop Information	64.20	3.51	55	69
Math Knowledge	53.09	6.72	41	66
Mechanical Comprehension	58.82	6.25	46	70
Electronics Information	63.20	4.66	53	70
Verbal Comprehension	56.75	3.58	44	62

Table B-10. Statistics for ASVAB Subtest Standard Scores for Computer Operator (n = 92)

Subtest	Mean	SD	Min	Max
General Science	51.78	7.45	28	66
Arithmetic Reasoning	54.39	7.30	34	66
Word Knowledge	53.96	6.36	35	61
Paragraph Comprehension	50.95	7.96	26	62
Numerical Operations	54.18	7.28	31	62
Coding Speed	55.03	7.60	30	72
Auto and Shop Information	52.03	9.15	31	67
Math Knowledge	50.65	8.02	35	68
Mechanical Comprehension	48.83	8.33	31	65
Electronics Information	51.52	8.47	27	70
Verbal Comprehension	53.10	6.58	32	62

<u>Table B-11.</u> Statistics for ASVAB Subtest Standard Scores for Licensed Practical Nurse (n = 87)

Subtest	Mean	SD	Min	Max
General Science	54.78	6.49	38	68
Arithmetic Reasoning	51.93	8.45	34	66
Word Knowledge	54.74	7.04	20	61
Paragraph Comprehension	52.07	8.17	20	62
Numerical Operations	50.97	7.97	20	62
Coding Speed	49.70	9.46	22	69
Auto and Shop Information	49.55	9.34	24	69
Math Knowledge	48.21	8.39	29	68
Mechanical Comprehension	47.06	10.53	24	70
Electronics Information	48.87	9.73	23	70
Verbal Comprehension	54.07	7.09	20	62

<u>Table B-12.</u> Statistics for ASVAB Subtest Standard Scores for Word Processing Machine Operator (n = 137)

Subtest	Mean	SD	Min	Max
General Science	50.44	7.83	28	68
Arithmetic Reasoning	52.16	7.55	35	66
Word Knowledge	54.19	6.78	28	61
Paragraph Comprehension	50.99	7.30	32	62
Numerical Operations	54.65	6.34	34	62
Coding Speed	56.08	7.55	35	72
Auto and Shop Information	46.93	7.84	24	67
Math Knowledge	48.90	7.11	29	66
Mechanical Comprehension	44.75	7.84	24	67
Electronics Information	47.92	7.75	23	68
Verbal Comprehension	53.33	6.61	28	62

Table B-13. Statistics for ASVAB Subtest Standard Scores for Bookkeeper/Accounting Clerk (Longitudinal Study) (n = 93)

Subtest	Mean	SD	Min	Max
General Science	48.59	7.33	28	64
Arithmetic Reasoning	50.25	8.96	32	66
Word Knowledge	51.44	7.49	26	61
Paragraph Comprehension	52.71	6.94	29	62
Numerical Operations	51.74	7.93	26	62
Coding Speed	54.27	8.57	33	72
Auto and Shop Information	44.73	6.53	30	60
Math Knowledge	52.06	9.13	30	68
Mechanical Comprehension	46.93	9.53	29	68
Electronics Information	47.44	7.03	27	65
Verbal Comprehension	51.84	7.03	30	61

Table B-14. Statistics for ASVAB Subtest Standard Scores for Bus Driver (Longitudinal Study) (n = 20)

Subtest	Mean	SD	Min	Max
General Science	45.31	9.08	32	66
Arithmetic Reasoning	49.03	11.05	35	66
Word Knowledge	44.23	12.55	20	60
Paragraph Comprehension	47.09	11.67	23	62
Numerical Operations	45.86	7.47	30	61
Coding Speed	48.26	7.62	27	65
Auto and Shop Information	42.28	7.43	31	67
Math Knowledge	47.83	10.31	33	66
Mechanical Comprehension	45.59	10.54	29	67
Electronics Information	44.41	7.05	30	60
Verbal Comprehension	44.76	12.71	20	61

Table B-15. Statistics for ASVAB Subtest Standard Scores for Cosmetologist (Longitudinal Study) (n = 51)

Subtest	Mean	SD	Min	Max
General Science	45.58	6.86	18	62
Arithmetic Reasoning	45.73	8.81	31	66
Word Knowledge	47.47	8.00	28	61
Paragraph Comprehension	48.31	10.76	20	62
Numerical Operations	47.12	9.07	24	62
Coding Speed	49.89	9.02	30	64
Auto and Shop Information	43.80	6.33	30	58
Math Knowledge	46.98	7.65	30	65
Mechanical Comprehension	45.46	7.76	33	67
Electronics Information	44.19	8.72	30	68
Verbal Comprehension	47.66	8.30	27	62

Table B-16. Statistics for ASVAB Subtest Standard Scores for Diesel Mechanic (Longitudinal Study) (n = 27)

Subtest	Mean	SD	Min	Max
General Science	52.97	9.76	24	66
Arithmetic Reasoning	52.11	10.94	32	65
Word Knowledge	50.25	8.99	25	61
Paragraph Comprehension	50.45	9.13	23	62
Numerical Operations	49.13	9.18	28	62
Coding Speed	48.66	8.71	28	64
Auto and Shop Information	60.27	10.12	31	69
Math Knowledge	49.26	8.86	37	68
Mechanical Comprehension	56.61	9.43	37	70
Electronics Information	55.74	8.68	30	68
Verbal Comprehension	50.37	8.85	25	61

Table B-17. Statistics for ASVAB Subtest Standard Scores for Electronics Assembler (Longitudinal Study) (n = 100)

Subtest	Mean	SD	Min	Max
General Science	45.72	9.63	18	68
Arithmetic Reasoning	45.42	8.48	26	65
Word Knowledge	44.82	10.33	16	60
Paragraph Comprehension	45.27	11.38	17	62
Numerical Operations	42.96	8.39	16	59
Coding Speed	44.30	9.19	22	64
Auto and Shop Information	50.55	10.46	24	67
Math Knowledge	44.69	7.05	29	65
Mechanical Comprehension	49.80	9.26	24	68
Electronics Information	47.91	10.36	23	70
Verbal Comprehension	44.75	10.33	15	61

Table B-18. Statistics for ASVAB Subtest Standard Scores for Electronics Technician (Longitudinal Study) (n = 20)

Subtest	Mean	SD	Min	Max
General Science	56.45	7.74	36	68
Arithmetic Reasoning	53.24	6.67	36	62
Word Knowledge	53.34	5.95	39	60
Paragraph Comprehension	54.75	6.25	35	62
Numerical Operations	46.08	7.25	33	61
Coding Speed	50.05	6.78	35	69
Auto and Shop Information	57.67	7.90	39	67
Math Knowledge	54.84	5.95	37	68
Mechanical Comprehension	55.73	8.64	33	65
Electronics Information	55.66	8.39	42	68
Verbal Comprehension	53.79	4.69	43	59

Table B-19. Statistics for ASVAB Subtest Standard Scores for Firefighter (Longitudinal Study) (n = 8)

Subtest	Mean	SD	Min	Max
General Science	52.86	8.15	34	58
Arithmetic Reasoning	53.34	9.43	35	64
Word Knowledge	53.70	7.63	30	60
Paragraph Comprehension	54.78	8.05	26	59
Numerical Operations	44.10	7.32	34	54
Coding Speed	46.92	5.06	34	54
Auto and Shop Information	51.50	6.43	35	64
Math Knowledge	55.30	7.42	41	65
Mechanical Comprehension	54.07	6.38	42	63
Electronics Information	53.51	8.20	30	65
Verbal Comprehension	53.87	7.79	28	59

Table B-20. Statistics for ASVAB Subtest Standard Scores for Operating Engineer (Longitudinal Study) (n = 22)

Subtest	Mean	SD	Min	Max
General Science	46.23	11.62	24	64
Arithmetic Reasoning	46.23	11.14	28	66
Word Knowledge	44.21	13.58	19	59
Paragraph Comprehension	43.94	11.95	26	62
Numerical Operations	42.60	12.08	24	56
Coding Speed	41.02	8.45	25	53
Auto and Shop Information	53.28	11.18	35	69
Math Knowledge	47.08	8.68	35	66
Mechanical Comprehension	50.30	11.25	33	70
Electronics Information	50.13	11.78	32	65
Verbal Comprehension	43.77	13.27	20	59

Table B-21. Statistics for ASVAB Subtest Standard Scores for Line Installer/Cable Splicer (Longitudinal Study) (n = 14)

Subtest	Mean	SD	Min	Max
General Science	50.70	7.64	26	60
Arithmetic Reasoning	50.82	9.01	38	65
Word Knowledge	48.54	6.36	28	57
Paragraph Comprehension	45.94	7.67	35	59
Numerical Operations	41.87	9.63	28	62
Coding Speed	46.31	6.70	30	59
Auto and Shop Information	57.37	7.27	39	66
Math Knowledge	48.35	6.41	35	60
Mechanical Comprehension	54.70	5.91	40	68
Electronics Information	51.78	7.11	39	63
Verbal Comprehension	47.64	6.45	31	55

Table B-22. Statistics for ASVAB Subtest Standard Scores for Computer Operator (Longitudinal Study) (n = 75)

Subtest	Mean	SD	Min	Max
General Science	50.81	8.40	24	68
Arithmetic Reasoning	51.11	8.33	34	66
Word Knowledge	51.59	7.44	21	61
Paragraph Comprehension	53.02	6.69	23	62
Numerical Operations	48.60	7.06	29	62
Coding Speed	49.72	7.47	25	67
Auto and Shop Information	47.98	8.12	30	66
Math Knowledge	51.98	9.08	33	68
Mechanical Comprehension	47.77	7.61	25	67
Electronics Information	47.50	8.35	27	65
Verbal Comprehension	52.03	7.08	20	62

Table B-23. Statistics for ASVAB Subtest Standard Scores for Licensed Practical Nurse (Longitudinal Study) (n = 25)

Subtest	Mean	SD	Min	Max
General Science	50.13	7.20	24	60
Arithmetic Reasoning	52.40	8.93	36	66
Word Knowledge	53.55	7.26	20	60
Paragraph Comprehension	53.49	6.60	23	62
Numerical Operations	50.90	9.46	18	62
Coding Speed	50.47	9.36	25	64
Auto and Shop Information	43.57	4.65	31	53
Math Knowledge	53.34	7.54	35	66
Mechanical Comprehension	47.45	7.63	31	59
Electronics Information	47.47	5.77	30	58
Verbal Comprehension	53.56	6.91	24	59

Table B-24. Statistics for ASVAB Subtest Standard Scores for Word Processing Machine Operator (Longitudinal Study) (n = 53)

Subtest	Mean	SD	Min	Max
General Science	46.06	7.05	30	62
Arithmetic Reasoning	48.62	8.60	34	65
Word Knowledge	48.40	7.73	26	61
Paragraph Comprehension	51.71	7.[illegible]	20	62
Numerical Operations	51.27	7.87	31	62
Coding Speed	55.08	8.80	28	72
Auto and Shop Information	42.94	5.96	30	58
Math Knowledge	50.09	8.82	33	66
Mechanical Comprehension	44.90	7.55	33	63
Electronics Information	43.73	9.18	27	68
Verbal Comprehension	4[illegible].43	7.57	23	61

Table B-25. Statistics for ASVAB Composite Standard Scores for Bookkeeper/Accounting Clerk (n = 75)

Composite	Mean	SD	Min	Max
Academic Ability	56.59	5.78	42	65
Verbal	54.73	6.38	38	63
Math	54.73	6.73	41	67
Mechanical and Crafts	52.71	6.58	36	67
Business and Clerical	56.24	5.54	37	67
Electronics and Electrical	53.75	6.39	35	66
Health, Social and Technology	54.44	5.81	41	64

Table B-26. Statistics for ASVAB Composite Standard Scores for Bus Driver (n = 67)

Composite	Mean	SD	Min	Max
Academic Ability	53.91	8.14	32	65
Verbal	53.30	8.02	25	64
Math	51.43	9.16	36	67
Mechanical and Crafts	55.27	9.15	35	70
Business and Clerical	51.12	7.63	30	67
Electronics and Electrical	53.19	8.77	33	68
Health, Social and Technology	53.64	8.86	30	67

Table B-27. Statistics for ASVAB Composite Standard Scores for Cosmetologist (n = 111)

Composite	Mean	SD	Min	Max
Academic Ability	50.96	7.16	35	64
Verbal	50.59	6.41	35	64
Math	47.98	7.44	33	66
Mechanical and Crafts	45.47	7.39	27	64
Business and Clerical	49.77	6.27	26	64
Electronics and Electrical	47.14	7.07	31	65
Health, Social and Technology	48.41	6.78	35	66

Table B-28. Statistics for ASVAB Composite Standard Scores for Diesel Mechanic
(n = 121)

Composite	Mean	SD	Min	Max
Academic Ability	53.94	8.18	26	65
Verbal	52.70	9.18	20	65
Math	52.35	8.08	34	67
Mechanical and Crafts	61.92	7.40	30	71
Business and Clerical	50.08	7.77	23	64
Electronics and Electrical	55.53	7.89	30	68
Health, Social and Technology	56.45	8.24	24	67

Table B-29. Statistics for ASVAB Composite Standard Scores for Electronics Assembler
(n = 56)

Composite	Mean	SD	Min	Max
Academic Ability	50.32	9.12	27	65
Verbal	49.34	9.31	22	63
Math	49.09	9.23	31	67
Mechanical and Crafts	52.43	10.11	35	70
Business and Clerical	48.02	7.65	25	62
Electronics and Electrical	50.57	10.04	30	69
Health, Social and Technology	50.07	9.33	29	67

Table B-30. Statistics for ASVAB Composite Standard Scores for Electronics Technician
(n = 26)

Composite	Mean	SD	Min	Max
Academic Ability	58.73	5.89	41	65
Verbal	56.12	7.91	38	65
Math	61.15	7.06	43	68
Mechanical and Crafts	63.65	5.[illegible]	51	71
Business and Clerical	57.54	6.51	40	69
Electronics and Electrical	62.62	6.05	47	70
Health, Social and Technology	60.08	6.26	47	68

Table B-31. Statistics for ASVAB Composite Standard Scores for Firefighter
(n = 343)

Composite	Mean	SD	Min	Max
Academic Ability	55.39	8.19	26	65
Verbal	55.04	8.28	24	65
Math	54.10	8.58	33	68
Mechanical and Crafts	58.09	8.77	27	71
Business and Clerical	53.33	8.11	19	69
Electronics and Electrical	55.65	8.59	28	70
Health, Social and Technology	56.33	8.65	27	68

Table B-32. Statistics for ASVAB Composite Standard Scores for Operating Engineer
(n = 169)

Composite	Mean	SD	Min	Max
Academic Ability	51.56	8.12	28	65
Verbal	50.67	7.99	24	63
Math	49.46	8.01	33	68
Mechanical and Crafts	56.81	7.51	32	71
Business and Clerical	48.75	6.97	26	66
Electronics and Electrical	51.98	7.34	30	70
Health, Social and Technology	52.58	8.05	28	67

Table B-33. Statistics for ASVAB Composite Standard Scores for Line Installer/Cable Splicer
(n = 44)

Composite	Mean	SD	Min	Max
Academic Ability	57.80	4.65	47	65
Verbal	57.52	4.41	42	65
Math	55.48	6.29	43	66
Mechanical and Crafts	62.52	4.22	55	71
Business and Clerical	55.45	4.84	47	64
Electronics and Electrical	59.20	4.66	52	68
Health, Social and Technology	58.77	4.59	50	67

Table B-34. Statistics for ASVAB Composite Standard Scores for Computer Operator (n = 92)

Composite	Mean	SD	Min	Max
Academic Ability	54.08	6.62	32	65
Verbal	52.43	7.03	32	63
Math	52.66	7.30	34	67
Mechanical and Crafts	51.90	7.48	33	65
Business and Clerical	53.42	6.62	31	70
Electronics and Electrical	52.45	6.83	35	66
Health, Social and Technology	52.39	6.43	33	66

Table B-35. Statistics for ASVAB Composite Standard Scores for Licensed Practical Nurse (n = 87)

Composite	Mean	SD	Min	Max
Academic Ability	53.33	7.56	25	65
Verbal	54.18	6.81	28	65
Math	50.09	7.99	31	68
Mechanical and Crafts	49.20	9.38	23	71
Business and Clerical	50.80	7.73	19	65
Electronics and Electrical	51.09	7.87	32	70
Health, Social and Technology	51.21	8.37	23	67

Table B-36. Statistics for ASVAB Composite Standard Scores for Word Processing Machine Operator (n = 137)

Composite	Mean	SD	Min	Max
Academic Ability	53.02	6.75	31	65
Verbal	52.03	7.03	28	64
Math	50.58	6.99	36	67
Mechanical and Crafts	47.64	7.07	29	66
Business and Clerical	53.28	5.88	38	68
Electronics and Electrical	49.84	6.74	33	69
Health, Social and Technology	50.10	6.79	33	65

Table B-37. Statistics for ASVAB Composite Standard Scores for Bookkeeper/Accounting Clerk (Longitudinal Study) (n = 93)

Composite	Mean	SD	Min	Max
Academic Ability	51.18	7.82	33	65
Verbal	50.99	6.89	32	61
Math	51.23	8.81	33	68
Mechanical and Crafts	46.97	7.65	30	65
Business and Clerical	53.14	7.60	36	67
Electronics and Electrical	49.58	7.56	35	67
Health, Social and Technology	49.69	8.24	30	67

Table B-38. Statistics for ASVAB Composite Standard Scores for Bus Driver (Longitudinal Study) (n = 20)

Composite	Mean	SD	Min	Max
Academic Ability	46.45	12.19	27	62
Verbal	45.09	10.72	25	59
Math	48.42	10.51	35	66
Mechanical and Crafts	44.58	8.89	32	63
Business and Clerical	46.56	9.96	27	64
Electronics and Electrical	46.26	9.10	33	64
Health, Social and Technology	45.96	12.04	26	64

Table B-39. Statistics for ASVAB Composite Standard Scores for Cosmetologist (Longitudinal Study) (n = 51)

Composite	Mean	SD	Min	Max
Academic Ability	46.51	7.89	29	65
Verbal	46.93	8.03	25	62
Math	46.18	7.75	35	65
Mechanical and Crafts	44.09	7.58	32	65
Business and Clerical	47.81	8.23	29	64
Electronics and Electrical	45.11	7.36	32	64
Health, Social and Technology	45.81	7.83	31	65

Table B-40. Statistics for ASVAB Composite Standard Scores for Diesel Mechanic (Longitudinal Study) (n = 27)

Composite	Mean	SD	Min	Max
Academic Ability	51.39	9.79	29	65
Verbal	51.43	9.53	25	62
Math	50.73	9.80	35	68
Mechanical and Crafts	57.07	9.69	35	70
Business and Clerical	49.33	8.84	29	65
Electronics and Electrical	52.91	9.25	34	67
Health, Social and Technology	53.47	9.98	31	67

Table B-41. Statistics for ASVAB Composite Standard Scores for Electronics Assembler (Longitudinal Study) (n = 100)

Composite	Mean	SD	Min	Max
Academic Ability	44.77	9.25	18	62
Verbal	44.89	10.32	14	61
Math	44.90	7.57	26	64
Mechanical and Crafts	48.23	9.77	21	67
Business and Clerical	43.67	8.51	20	59
Electronics and Electrical	45.47	8.79	21	66
Health, Social and Technology	46.20	9.28	19	64

Table B-42. Statistics for ASVAB Composite Standard Scores for Electronics Technician (Longitudinal Study) (n = 20)

Composite	Mean	SD	Min	Max
Academic Ability	53.70	5.54	41	61
Verbal	55.15	5.58	40	63
Math	54.09	6.06	40	66
Mechanical and Crafts	56.45	7.16	44	65
Business and Clerical	53.36	5.59	41	61
Electronics and Electrical	55.75	6.62	43	64
Health, Social and Technology	54.90	5.90	42	62

Table B-43. Statistics for ASVAB Composite Standard Scores for Firefighter (Longitudinal Study) (n = 8)

Composite	Mean	SD	Min	Max
Academic Ability	54.00	8.36	30	62
Verbal	53.90	8.19	28	59
Math	54.50	8.59	37	65
Mechanical and Crafts	53.34	7.71	33	64
Business and Clerical	52.58	5.95	32	57
Electronics and Electrical	54.21	8.07	33	63
Health, Social and Technology	54.32	8.06	33	63

Table B-44. Statistics for ASVAB Composite Standard Scores for Operating Engineer (Longitudinal Study) (n = 22)

Composite	Mean	SD	Min	Max
Academic Ability	44.68	12.76	22	62
Verbal	44.39	13.00	21	62
Math	46.46	10.08	32	67
Mechanical and Crafts	50.10	12.31	31	69
Business and Clerical	42.97	10.69	25	60
Electronics and Electrical	47.13	11.41	28	66
Health, Social and Technology	46.26	12.67	25	65

Table B-45. Statistics for ASVAB Composite Standard Scores for Line Installer/Cable Splicer (Longitudinal Study) (n = 14)

Composite	Mean	SD	Min	Max
Academic Ability	49.44	7.93	35	60
Verbal	48.21	6.91	31	56
Math	49.49	7.39	39	63
Mechanical and Crafts	54.14	6.99	41	63
Business and Clerical	47.08	6.61	33	56
Electronics and Electrical	50.58	7.23	39	59
Health, Social and Technology	51.18	7.14	37	59

<u>Table B-46.</u> Statistics for ASVAB Composite Standard Scores for Computer Operator (Longitudinal Study) (n = 75)

Composite	Mean	SD	Min	Max
Academic Ability	51.75	7.47	25	65
Verbal	52.06	7.31	20	64
Math	51.66	8.57	33	68
Mechanical and Crafts	48.41	7.57	29	66
Business and Clerical	51.52	7.15	22	65
Electronics and Electrical	50.36	7.96	28	68
Health, Social and Technology	50.35	7.26	24	64

<u>Table B-47.</u> Statistics for ASVAB Composite Standard Scores for Licensed Practical Nurse (Longitudinal Study) (n = 25)

Composite	Mean	SD	Min	Max
Academic Ability	53.38	7.36	30	64
Verbal	52.57	6.78	25	58
Math	53.07	7.90	36	66
Mechanical and Crafts	47.40	6.25	34	57
Business and Clerical	52.82	8.21	26	63
Electronics and Electrical	50.98	6.98	32	60
Health, Social and Technology	51.30	7.44	31	62

<u>Table B-48.</u> Statistics for ASVAB Composite Standard Scores for Word Processing Machine Operator (Longitudinal Study) (n = 53)

Composite	Mean	SD	Min	Max
Academic Ability	49.06	8.27	27	64
Verbal	48.64	7.10	23	62
Math	49.35	8.81	33	66
Mechanical and Crafts	44.36	7.36	33	61
Business and Clerical	51.73	8.46	25	66
Electronics and Electrical	46.77	8.15	31	63
Health, Social and Technology	47.37	7.84	28	65

APPENDIX C:

STANDARD SCORE STATISTICS FOR MALES AND FEMALES

Table C-1. Statistics for ASVAB Subtest Standard Scores for Males Only (n = 773)

Subtest	Mean	SD	Min	Max
General Science	55.12	9.02	20	68
Arithmetic Reasoning	55.24	8.41	31	66
Word Knowledge	54.09	7.55	20	61
Paragraph Comprehension	51.66	8.67	20	62
Numerical Operations	51.75	8.65	20	62
Coding Speed	50.58	7.95	22	72
Auto and Shop Information	61.81	7.46	[illegible]	[illegible]
Math Knowledge	51.48	8.79	29	68
Mechanical Comprehension	57.24	8.65	24	70
Electronics Information	58.57	8.38	23	70
Verbal Comprehension	53.45	7.75	20	62

Table C-2. Statistics for ASVAB Subtest Standard Scores for Females Only (n = 555)

Subtest	Mean	SD	Min	Max
General Science	50.95	7.70	24	68
Arithmetic Reasoning	51.80	8.35	30	66
Word Knowledge	53.78	7.10	20	61
Paragraph Comprehension	50.56	7.91	20	62
Numerical Operations	52.48	8.09	20	62
Coding Speed	53.48	8.45	22	72
Auto and Shop Information	48.59	8.44	24	67
Math Knowledge	47.85	7.94	29	68
Mechanical Comprehension	45.75	8.25	24	68
Electronics Information	47.46	8.44	23	68
Verbal Comprehension	52.91	7.04	20	62

Table C-3. Statistics for ASVAB Composite Standard Scores for Males Only (n = 773)

Composite	Mean	SD	Min	Max
Academic Ability	54.75	8.00	26	65
Verbal	53.96	8.34	22	65
Math	53.54	8.46	31	68
Mechanical and Crafts	59.40	7.81	28	71
Business and Clerical	52.18	7.84	19	70
Electronics and Electrical	55.80	8.07	29	70
Health, Social and Technology	56.05	8.14	27	68

Table C-4. Statistics for ASVAB Composite Standard Scores for Females Only (n = 555)

Composite	Mean	SD	Min	Max
Academic Ability	52.61	7.48	25	65
Verbal	51.93	7.29	20	64
Math	49.83	7.75	31	67
Mechanical and Crafts	48.15	7.67	23	69
Business and Clerical	51.69	7.11	19	69
Electronics and Electrical	49.46	7.27	28	69
Health, Social and Technology	50.19	7.43	23	67

APPENDIX D:

PERCENTAGES OF CORRECT AND INCORRECT CLASSIFICATIONS BASED ON THE SUBTEST DISCRIMINANT FUNCTION

Table D-1. *Classification Summary for the Discriminant Analysis Using ASVAB Subtest Standard Scores*

	Best profile match													
	BK/AC		CO		WPMO		CL		LPN		BD		FF	
Actual occupation	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Bookeeper/Accounting Clerk (BK/AC)	28	37.3	5	6.6	10	13.3	8	10.6	2	2.6	6	8.0	5	6.6
Computer Operator (CO)	16	17.3	10	10.8	17	18.4	8	8.6	8	8.6	2	2.1	9	9.7
Word Processing Machine Operator (WPMO)	22	16.0	7	5.1	51	37.2	24	17.5	19	13.8	3	2.1	1	0.7
Cosmetologist (CL)	13	11.7	4	3.6	27	24.3	29	26.1	19	17.1	4	3.6	4	3.6
Licensed Practical Nurse (LPN)	10	11.4	1	1.1	14	16.0	12	13.7	29	33.3	7	8.0	4	4.5
Bus Driver (BD)	5	7.4	1	1.4	3	4.4	5	7.4	7	10.4	6	8.9	4	5.9
Firefighter (FF)	15	4.3	12	3.4	5	1.4	9	2.6	17	4.9	14	4.0	89	25.9
Electronics Technician (ET)					1	3.8								
Electronics Assembler (EA)	2	3.5	1	1.7	7	12.5	2	3.5	4	7.1	2	3.5		
Line Installer/Cable Splicer (LI/CS)	3	6.8	1	2.2							1	2.2	6	13.6
Operating Engineer (OE)	3	1.7	3	1.7	4	2.3	4	2.3	5	2.9	13	7.6	14	8.2
Diesel Mechanic (DM)							1	0.8					1	0.8
Total	117	8.8	45	3.3	139	10.4	102	7.6	110	8.2	58	4.3	137	10.3

Table D-1. (Concluded)

Actual occupation	Best profile match											
	ET		EA		LI/CS		OE		DM		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Bookeeper/Accounting Clerk (BK/AC)	3	4.0	4	5.3	4	5.3					75	100.0
Computer Operator (CO)	5	5.4	5	5.4	8	8.6	1	1.0	3	3.2	92	100.0
Word Processing Machine Operator (WPMO)	4	2.9	5	3.6	1	0.7					137	100.0
Cosmetologist (CL)	1	0.9	6	5.4	1	0.9	3	2.7			111	100.0
Licensed Practical Nurse (LPN)	4	4.5	4	4.5	1	1.1	1	1.1			87	100.0
Bus Driver (BD)	6	8.9	11	16.4	7	10.4	6	8.9	6	8.9	67	100.0
Firefighter (FF)	37	10.7	26	7.5	61	17.7	35	10.2	23	6.7	343	100.0
Electronics Technician (ET)	20	76.9	1	3.8	1	3.8	1	3.8	2	7.6	26	100.0
Electronics Assembler (EA)	8	14.2	16	28.5	5	8.9	4	7.1	5	8.9	56	100.0
Line Installer/Cable Splicer (LI/CS)	8	18.1			17	38.6	2	4.5	6	13.6	44	100.0
Operating Engineer (OE)	5	2.9	11	6.5	12	7.1	50	29.5	45	26.6	169	100.0
Diesel Mechanic (DM)	11	9.0	6	4.9	27	22.3	17	14.0	58	47.9	121	100.0
Total	112	8.4	95	7.1	145	10.9	120	9.0	148	11.1	1328	100.0

Table D-2. **Classification Summary for the Discriminant Analysis Using ASVAB Subtest Standard Scores after Removing the Mean Sex Differences**

	Best profile match													
	BK/AC		CO		WPMO		CL		LPN		BD		FF	
Actual occupation	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Bookeeper/Accounting Clerk (BK/AC)	20	26.6	7	9.3	3	4.0	5	6.6	3	4.0	4	5.3	5	6.6
Computer Operator (CO)	15	16.3	21	22.8	4	4.3	7	7.6	10	10.8			8	8.6
Word Processing Machine Operator (WPMO)	12	8.7	19	13.8	17	12.4	13	9.4	15	10.9			11	8.0
Cosmetologist (CL)	10	9.0	13	11.7	12	10.8	19	17.1	11	9.9	1	0.9	8	7.2
Licensed Practical Nurse (LPN)	5	5.7	6	6.8	4	4.5	4	4.5	27	31.0	4	4.5	7	8.0
Bus Driver (BD)	7	10.4	3	4.4	4	5.9	2	2.9	7	10.4	3	4.4	3	4.4
Firefighter (FF)	55	16.0	23	6.7	11	3.2	31	9.0	41	11.9	7	2.0	46	13.4
Electronics Technician (ET)									2	7.6				
Electronics Assembler (EA)	3	5.3	4	7.1	1	1.7	1	1.7	2	3.5	2	3.5		
Line Installer/Cable Splicer (LI/CS)	4	9.0	3	6.8	2	4.5			6	13.6	1	2.2	1	2.2
Operating Engineer (OE)	14	8.2	4	2.3	5	2.9	11	6.5	11	6.5	7	4.1	3	1.7
Diesel Mechanic (DM)	8	6.6	1	0.8			1	0.8	8	6.6	4	3.3		
Total	153	11.5	104	7.8	63	4.7	94	7.0	143	10.7	33	2.4	92	6.9

Table D-2. (Concluded)

Actual occupation	ET N	ET %	EA N	EA %	LI/CS N	LI/CS %	OE N	OE %	DM N	DM %	Total N	Total %
Bookkeeper/Accounting Clerk (BK/AC)	10	13.3	2	2.6	9	12.0	2	2.6	5	6.6	75	100.0
Computer Operator (CO)	6	6.5	6	6.5	6	6.5	2	2.1	7	7.6	92	100.0
Word Processing Machine Operator (WPMO)	13	9.4	7	5.1	15	10.9	8	5.8	7	5.1	137	100.0
Cosmetologist (CL)	7	6.3	9	8.1	1	0.9	15	13.5	5	4.5	111	100.0
Licensed Practical Nurse (LPN)	8	9.1	6	6.8	6	6.8	7	8.0	3	3.4	87	100.0
Bus Driver (BD)	6	8.9	9	13.4	4	5.9	11	16.4	8	11.9	67	100.0
Firefighter (FF)	30	8.7	18	5.2	39	11.3	25	7.2	17	4.9	343	100.0
Electronics Technician (ET)	19	73.0	1	3.8	2	7.6	1	3.8	1	3.8	26	100.0
Electronics Assembler (EA)	7	12.5	19	33.9	4	7.1	5	8.9	8	14.2	56	100.0
Line Installer/Cable Splicer (LI/CS)	6	13.6	3	6.8	15	34.0	2	4.5	1	2.2	44	100.0
Opera...g Engineer (OE)	6	3.5	19	11.2	4	2.3	53	31.3	32	18.9	169	100.0
Diesel Mechanic (DM)	13	10.7	16	13.2	17	14.0	14	11.5	39	32.2	121	100.0
Total	131	9.8	115	8.6	122	9.1	145	10.9	133	10.0	1328	100.0

Column groups are headed "Best profile match".

* U. S. GOVERNMENT PRINTING OFFICE: 1988 - 561048 80039