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Career Counseling Validity of Discover's Job Cluster Scales for the Revised ASVAB Score Report

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ABSTRACT

Each year 1 million high school students complete the Armed Services Vocational Aptitude Battery (ASVAB) as part of the Department of Defense (DoD) Student Testing Program. Starting in the fall of 1992, students will be asked to use DoD's Occu-Find to find occupations that fit their "ASVAB Codes." Their ASVAB Codes will be based on the ASVAB Academic Ability Composite, which has been described by DoD as "a measure of student cognitive ability"--"a g loaded measure."

The purpose of this report is to provide evidence bearing on the career counseling validity of an alternative to the ASVAB code: DISCOVER's "ASVAB Job Cluster Scales" composed of 8 other ASVAB scores, plus ability self-estimates. The six scales provide scores for six job clusters similar to John Holland's occupational groups. Validity data based on 1,669 students attending 13 high schools in 9 states are presented. Multivariate statistical analyses showed that the ASVAB Job Cluster Scale scores of these students differ substantially across six career groups. Group membership predictions were about 50% more accurate for the six ASVAB Job Cluster Scales than for the 10 ASVAB Subtests. In addition, ASVAB Job Cluster Scale profiles for the 6 career groups and 19 more-specific groups were generally in accord with expectations. Study results supported the profile similarity model for interpreting ability scores (e.g., scores based on the ASVAB Job Cluster Scales) in career counseling.

ACKNOWLEDGEMENTS

This report, which provided the basis for a program presentation (Prediger & Swaney, 1992) at the 1992 National Convention of the American Association for Counseling and Development, is an update and extension of a report by Prediger (1987a). We are grateful to Richard Sawyer and Mike Valiga, ACT Research Division staff members, for helpful suggestions regarding the report.

Career Counseling Validity of DISCOVER's Job Cluster Scales for the Revised ASVAB Score Report

To enhance its value to career counselors and counselees, ACT's computer-based career planning system DISCOVER accepts and interprets scores from a number of tests and inventories administered off-line. One of these tests, the Armed Services Vocational Aptitude Battery (ASVAB), is administered each year to over 1,000,000 students in approximately 15,000 high schools (U.S. Department of Defense, 1992). The purpose of this report is to provide evidence bearing on the career counseling validity of ASVAB Job Cluster Scales, which were developed by American College Testing (ACT) for use in DISCOVER. The ASVAB Job Cluster Scales are based on eight ASVAB ability scores, plus self-estimates of abilities. This report is an update and extension of an ACT research report (Prediger, 1987a) that provided career counseling validity data for an earlier set of ASVAB Job Cluster Scales. (Also see Prediger, 1987b.)

Starting in the fall of 1992, students who participate in the Department of Defense (DoD) Student Testing Program will be asked to use an "ASVAB Code" based on general mental aptitude/ability (hereafter called ability) to find occupations they should consider. In addition, for the first time, the DoD will provide students with their scores for the 10 ASVAB Subtests. In light of these changes, the procedures used in DISCOVER to interpret ASVAB scores were reevaluated. The DoD's new approach to linking ASVAB scores to occupations was not adopted for use in DISCOVER, for reasons which follow.

Although students will receive scores for a total of 13 ASVAB ability measures, Exploring Careers: The ASVAB Workbook asks them to use only one measure, the "ASVAB Academic Ability Composite," in the standard search for occupational options.

Scores for this composite are converted to ASVAB Codes. Students are instructed to use their primary ASVAB Code to find occupations in ASVAB's "Occu-Find."

ASVAB's Academic Ability Composite has been described as "a measure of student cognitive ability"--"a g loaded measure" (Wall & Zytowski, 1991, pages not numbered). In the professional literature, "cognitive ability" and "g" have been variously known as "general cognitive ability," "general mental ability," "general intelligence," "intelligence," or "IQ"--e.g., see Gottfredson (1988, pp. 294-297).

According to Bock and Moore (1984), ASVAB national norm group data "reveal striking disparities between sociocultural and economic [racial/ethnic] groups" (p. 280). Because of these disparities, members of different racial/ethnic groups will tend to find different occupations when they use ASVAB Codes based on their Academic Ability Composite scores. Table 1 provides estimates of the percentages of Blacks, Whites, and Hispanics that will be referred to occupations in each of the five ASVAB Code groups. As described in Appendix A, these percentages are based on ASVAB national norm group data provided by the U.S. DoD (1982). Because of the potential effects of the racial/ethnic group disparities in ASVAB Code percentages, and because (in the ability domain) only general mental ability (g) is used in ASVAB's Occu-Find, ACT sought a different approach for linking ASVAB's ability scores to occupations.

This report describes how ACT used ASVAB Subtest scores, together with self-estimates of other work-relevant abilities, to develop new ASVAB Job Cluster Scales. In addition, the report provides career counseling validity data for the scales. These data are based on the ability self-estimates and ASVAB Subtest scores of the original sample of 1,109 high school

students (Prediger, 1987a) plus an additional sample of 560 students. The procedures for determining the validity of the new ASVAB Job Cluster Scales are identical to those used previously. Hence, readers who wish to compare the results reported here with previous results should consult the previous report (Prediger, 1987a). Because this 1992 report is an extension of the previous report, it repeats, verbatim, some of the background information in that report.

Overview of ASVAB Job Cluster Scales

ACT has developed six ASVAB Job Cluster Scales. Each corresponds to one of six ACT Job Clusters (ACT, 1988) which, in turn, parallel Holland's (1985) six occupational groups. Titles for the ASVAB Job Cluster Scales, ACT Job Clusters, and Holland's groups (in parentheses) are as follows: Business Contact (Enterprising), Business Operations (Conventional), Technical (Realistic), Science (Investigative), Arts (Artistic), and Social Service (Social). In the ACT Occupational Classification System (ACT, 1988), 23 job families (groups of similar occupations) are distributed over the six job clusters; 2 to 6 job families are assigned per cluster. Figure 1 lists job cluster titles, job family titles, and examples of occupations in each job family.

Rationale for Development of ASVAB Job Cluster Scales

Test Interpretation Models

Ability measures traditionally have been used in career (educational and occupational) counseling to identify career groups with ability profiles (patterns) similar to those of counselees. Groups so identified constitute career options counselees may wish to consider and explore. Thus, in career counseling, the "profile similarity model" for test interpretation

(e.g., see Cooley & Lohnes, 1968; Goldman, 1971; Prediger, 1974; Tiedeman, Rulon, & Bryan, 1951) is followed, rather than the "success prediction model" common to personnel psychology. Nevertheless, the ASVAB Code approach to career exploration is based on the success prediction model. Hence, the ASVAB Counselor's Manual states that "ASVAB [Code] validity is a matter of whether the test [ASVAB Code] . . . predicts performance [success] in various civilian and military occupations" (U.S. DoD, 1992, p. 20).

Problems with the exclusive use of general mental ability scores (e.g., the ASVAB Code) to predict occupational success were described by Prediger (1989), who showed that occupations differ on a wide range of abilities not subsumed by general mental ability. For the results of five additional studies, see Prediger (1987a) and Appendix C of this report.

Even if general mental ability were the only ability needed for occupational success, use of the success prediction model for career exploration and planning presents several practical, insurmountable problems (e.g., see Goldman, 1972; Prediger, 1987a). Unfortunately, measures of success are not available for the wide variety of occupations typically considered in career counseling. (See Thorndike (1982) for a discussion of the many shortcomings of success indicators and their general lack of availability.) Thus, career counselors must ask, "Do we know whether Test X predicts level of success for occupations such as insurance agent, machinist, actuary, commercial artist, elementary school teacher, chef, lawyer, farmer, and the thousands of other occupations relevant to career planning?". When success measures are available (i.e., for a limited number of occupations), will they be on a common scale? Unless they are, counselees can not compare their predicted levels of success for insurance agent, machinist, commercial artist, chef, etc..

If one cannot predict level of success on a comparable scale for a wide range of occupations, what about reporting probability of success? What is meant by "success" as an insurance agent, machinist, commercial artist, chef, etc.? If success is defined differently from occupation to occupation, asking counselees to compare probabilities of "success" appears to be problematic, at best.

Research has shown that test-performance correlations differ across occupations. These differences affect the standard deviations of success predictions from occupation to occupation. If correlations are low, success predictions in the average range will be provided to nearly everyone, regardless of test scores. Thus, the highest success predictions for some counselees will be for occupations for which tests have little validity. Counselors and counselees are likely to find it difficult to compare success predictions when test validity varies from occupation to occupation.

Finally, if general mental ability is given primary attention in career counseling--to the exclusion of other work-relevant abilities--how do counselees evaluate the resulting success predictions? Low levels of success in "high g" occupations will be predicted for most counselees. Their success predictions for "low g" occupations will be higher. Thus, many counselees may be encouraged to enter "low g" occupations by success predictions based on only one work-relevant ability.

In summary, a measure of general mental ability may be a cost-effective way to sort out applicants for Job X in Corporation Y or to assign military recruits to training programs. However, the success prediction model has little to offer when ability measures are used for career exploration--which, of course, involves the entire work world.

DISCOVER's Interpretation Procedure

Because of the problems with the success prediction model noted above, DISCOVER follows the profile similarity model in its interpretation of ASVAB scores. A counselee's ability profile (i.e., the three highest ASVAB Job Cluster Scales) is used to identify job families with similar ability profiles. Occupations in the job families to which counselees are referred are arranged according to typical level of education/preparation. Counselees are encouraged to consider their educational plans and resources as they explore occupations in a job family.

DISCOVER's procedure for the counseling use of ASVAB scores was developed for three primary reasons. First, there are psychometric and career counseling problems associated with the success prediction model and the ASVAB Code, as noted above. Second, DISCOVER links ability profiles to 23 job families and 500 occupations spanning the work world. Many of these occupations are not covered by the 200 ococupations included in ASVAB's Occu-Find.

Third, DISCOVER uses measures of 15 work-relevant abilities, to guide career exploration rather than only one (academic) ability. Many of the 15 abilities are seldom assessed by paper-and-pencil tests (e.g., sales, leadership, organizational, and creative/artistic abilities). Prediger (1992a) summarized 25 years of research leading to the identification of the 15 abilities and to their assignment to ACT's job clusters and Holland's (1985) occupational groups. In DISCOVER, self-estimates of abilities are linked to occupations through the job cluster scales; four abilities are assigned to each job cluster (see Table 2). A student's ability self-estimates are informed by her/his test scores (e.g., ASVAB Subtest scores) when scores are available. Prediger (1992b) discussed conditions related to the

accuracy of ability self-estimates.

Summary of Related Validity Studies

If DISCOVER's use of the profile similarity model for ASVAB interpretation is justified, persons pursuing diverse occupations should score differently on ability measures--the ASVAB Job Cluster Scales, in particular. That is, ability patterns (mean scores) for diverse occupational groups ("criterion groups") should differ substantially. In addition, ability patterns should be appropriate to the work tasks characterizing the occupational groups. If, for example, groups composed of insurance agents, machinists, social workers, actuaries, and commercial artists had similar ability patterns, the validity and usefulness of the ability measures would be in serious doubt.

Appendix C of this report, a report of research on the DOT database (Prediger, 1989), and the previous ASVAB research report (Prediger, 1987a) describe the results of seven validity studies that provide a context for judging the relevance, for ASVAB interpretation, of the profile similarity model and job cluster scales. Each study followed the known-group method (e.g., see Cronbach & Meehl, 1955; Hattie & Cooksey, 1984; Thorndike, 1982) for assessing the construct validity of measures. Five of the studies involved the joint use of ability self-estimates and test scores. Several provided concomitant information concerning the relative importance of general mental ability in career counseling applications of ability measures.

Taken together, results from the studies show that career-related criterion groups differ substantially and in sensible ways on a wide variety of abilities--tested and self-estimated, cognitive and non-cognitive. Thus, interpretation of ability measures via the profile

similarity model is supported. Composite scores based on combinations of tested and self-estimated abilities (i.e., job cluster scale scores) were generally more effective in differentiating career groups than test scores alone.

Study Objectives

Given the results of related validity studies, this study's objectives were--

1. To determine whether new ASVAB Job Cluster Scales combining ability self-estimates and ASVAB Subtest scores differentiate high school students choosing a diverse range of occupations, and if so--

2. To determine whether ability differences among occupational choice groups are appropriate to the work tasks characterizing the occupations. (Research and practice supporting the use of occupational choice as a validation criterion are discussed in Appendix B of this report.)

Method

Sample

Study objectives required that self-estimates of abilities and occupational choices be available for students who had taken the ASVAB. Since neither is collected during ASVAB administration, the information was obtained from score reports for students who had also completed the measures in the Career Planning Program (CPP; ACT, 1988) or who had participated in the scaling of the ability self-estimates used in DISCOVER (Swaney, 1987).

Sample A. In June of 1986, 218 high schools that had administered the CPP to at least 100 juniors or seniors in 1984-85 and/or 1985-86 were contacted by mail. Schools that had administered the ASVAB to at least 20 students were asked to provide a copy of the ASVAB

score roster for their students. Rosters listing ASVAB Subtest scores for 3,169 students were received from 32 of the 218 schools. Each school also provided information on total enrollment by grade.

When at least 25% of the students in a grade had taken the ASVAB, computer records containing the 10 ASVAB Subtest standard scores were created for each of the students. (This percentage screen was used to eliminate schools that administered the ASVAB to relatively few students.) ASVAB and CPP student records were then matched by name and merged.

The ASVAB-CPP matched sample consisted of 1,109 students in 7 schools located in the following 5 states: Florida (1), Illinois (1), North Dakota (2), Ohio (2), and Texas (1). One school reported ASVAB scores for both Grades 11 and 12. Hence, there were 8 groups differentiated by school and grade. Table 3 provides an overview of sample sizes and test administration dates by group. As shown by Table 3, all CPP testing was completed in Grade 11. Time between CPP and ASVAB administrations ranged from 2 to 12 months, with a median of 7.5 months. For six of the eight groups, the CPP was administered first.

Sample B. As described by Swaney (1987), self-estimated abilities and occupational choices were obtained from Grade 12 students in 30 schools during the winter of 1986-87. Schools were contacted from each of four geographical regions spanning the U.S., and they represented a range of (a) community sizes, (b) school enrollments, and (c) percentages of school district residents with low incomes.

Of the 67 high schools contacted, 30 (45%) agreed to participate in a study to "enhance the validity of the . . . Self-Rated Abilities Inventory" used in DISCOVER. Each student

completed a questionnaire which asked for 15 ability self-estimates and which collected information on occupational choice and certainty of choice. Cases were retained that had (a) an occupational choice that could be classified into one of 23 ACT Job Families, (b) a valid certainty of occupational choice code, and (c) a valid response to all 15 of the self-estimated ability items.

As a follow-up to this project, participating schools were asked to provide ACT with a copy of the ASVAB score rosters for their students. Rosters were requested only if a school had administered ASVAB to at least 20 students in the same class that completed the self-estimate questionnaire. Of the 30 schools, 6 provided ASVAB score rosters. The three screens listed above eliminated 140 (15%) of the 919 cases from these six schools.

ASVAB and questionnaire records were matched by student name and merged. The matched sample consisted of 560 students in six schools (72% of the 779 students with questionnaire records from these schools) located in the following four states: North Carolina (2), Tennessee (1), Oklahoma (1), and Washington (2). As shown in Table 3, all ability self-estimates were obtained in Grade 12. Time between collection of the ability estimates and ASVAB administration ranged from 10 to 27 months, with a median of 16.5 months. In all but one school, ASVAB was administered during the student's junior year.

Total sample. Students in Samples A and B may be atypical in that volunteers rather than an entire grade often complete the ASVAB. In addition, schools in Sample A had conducted an unusual amount of vocational testing (i.e., administered both the CPP and ASVAB) within the span of 1 year. Nevertheless, the samples appear to contain a broad cross-section of high school juniors and seniors. For example, females constituted 53% of

the total sample (Samples A and B combined). For Sample A, the racial/ethnic distribution was as follows: 71% Caucasian-American/White, 11% Afro-American/Black, 9% other (e.g., Asian-American), and 9% who preferred not to respond. Response percentages for the question "What is the greatest amount of education you plan to complete during your life?" ranged from 3% for high school graduation to 60% for 4 or more years of college. Twenty-six percent of the Sample A students planned post-high-school programs of 2-years of less. Five percent choose the category "apprenticeship program; job training program in the military." Mean CPP Ability Test stanines ranged from 5.2 (Numerical Skills) to 5.5 (Language Usage) with a median of 5.3 for the six tests. National means and standard deviations for the six tests are 5.0 and 2.0, respectively.

For the total sample, the distribution of student occupational preferences across ACT Job Clusters was as follows: Business Contact (12%), Business Operations (15%), Technical (14%), Science (21%) Arts (15%), and Social Service (23%). On average, these figures differ by only 3 percentage points from national data for 12th graders (ACT, 1988).

Variables

Occupational group membership. When they completed the CPP, Sample A students were asked to find, on a list of 140 occupations, the occupation "closest to the one you are considering." The occupations on the list were grouped by ACT Job Cluster and, within job cluster, by ACT Job Family. For purposes of analysis, occupational choices were categorized into job families and job clusters. Students who preferred not to specify an occupational preference (n = 37) or who had invalid responses (n = 21) could not be included in the validation analyses. After screening, 1,051 cases were classified by job

cluster and job family (95% of the ASVAB-CPP matched sample).

Sample B students printed their occupational choice on the self-estimate questionnaire. The choices were classified into job families and job clusters by the study authors. As described above, all 560 cases in Sample B were classified by job family because cases with nonclassifiable occupations were deleted prior to matching with ASVAB records. Thus, classifiable occupational choices were available for 1,611 students in the total sample.

Certainty of occupational choice. For both Samples A and B, certainty of occupational choice was determined from a student's response to the following question: "How sure are you that the occupational choice you selected . . . will still be your first choice one year from now?" Only students answering "very sure" (29% of the classifiable cases) were eligible for the analysis sample used to address the first study objective. Additional screening for cases missing any of the ASVAB Subtest scores or ability self-estimates yielded an analysis sample consisting of 462 of the 1,611 students in the total sample.

ASVAB Subtest scores. As noted above, ASVAB Subtest scores were obtained from student rosters supplied by schools in the study samples. (A report by the U.S. DoD (1985) provides psychometric data.) Standard scores for each ASVAB Subtest were recorded from the student rosters. These scores were then transformed to stanines. Descriptions of the ASVAB subtests, taken from the ASVAB score report (Wall & Zytowski, 1991), are provided below.

1. Word Knowledge: Measures ability to select the correct meaning of words presented in context and to identify the best synonym for a given word.
2. Paragraph Comprehension: Measures ability to read and obtain information from

written passages.

3. Arithmetic Reasoning: Measures ability to solve arithmetic word problems.
4. Mathematics Knowledge: Measures knowledge of high school mathematics principles.
5. General Science: Measures knowledge of scientific terms and concepts. Important for school subjects such as the life and physical sciences.
6. Auto and Shop Information: Measures knowledge of automobiles, tools and shop terminology and practices.
7. Mechanical Comprehension: Measures knowledge of mechanical and physical principles, and the ability to visualize how mechanical objects work.
8. Electronics Information: Measures knowledge of electricity and electronics.
9. Numerical Operations: Measures ability to quickly and accurately perform arithmetic computations such as adding and subtracting. Important for occupations requiring the accurate organization, checking and filing of records.
10. Coding Speed: Measures ability to use a reference key and quickly assign code numbers to words. Important for occupations requiring the accurate organization, checking and filing of records.

Ability self-estimates. When Sample A students completed the CPP, they provided self-estimates for the nine abilities listed below. For each ability, students were asked to rate themselves, as compared with persons their own age, on the following 3-point scale: "Low (lower 25%)," "medium (middle 50%)," and "high (upper 25%)."

1. Scientific: Understanding scientific principles, doing science course work.

2. Creative/Artistic: Drawing, painting, playing a musical instrument, acting, dancing.
3. Creative/Literary: Expressing ideas or feelings through writing.
4. Helping Others: Caring for or teaching others, making others happy.
5. Meeting People: Talking with people, getting along with others, making a good impression.
6. Sales: Influencing people to buy a product or take a suggested course of action.
7. Leadership/Management: Leading/managing people to work cooperatively toward a common goal.
8. Organization: Keeping track of details, doing things in a systematic way.
9. Manual Dexterity: Making or repairing things easily and quickly with one's hands.

Unfortunately, assessments of two abilities (Language Usage, Space Relations) needed to obtain ASVAB Job Cluster Scale scores for students in Sample A were not included in the ASVAB or the CPP self-estimate unit. Hence, CPP test scores for these abilities were used. (See ACT (1988) for a description and psychometric data.)

Self-estimates for six additional abilities were obtained for students in Sample B. They are listed below.

1. Reading: Reading and understanding factual material in a magazine, textbook, etc.
2. Numerical: Doing arithmetic accurately and quickly; applying arithmetic (for example, in formulas and word problems).
3. Language Usage: Recognizing correct and incorrect uses of the English language (grammar, punctuation, etc.).
4. Clerical: Doing tasks such as looking up phone numbers in a directory, keeping

records (birthdays, addresses, etc.), sorting things.

5. Mechanical: Understanding everyday mechanical laws (for example, warm air rises) and how simple mechanical things work (for example, a lever or pulley).
6. Spatial: Looking at a drawing of something (for example--a house, a coat, a tool) and imagining how it would look from different sides; thinking in three dimensions.

Issues related to the use of ability self-estimates in career counseling are addressed in the discussion section of this report. Prediger (1992b, 1992c) provides a rationale for the use of informed self-estimates of ability in career exploration and planning.

ASVAB Job Cluster Scales. The contents of six ASVAB Job Cluster Scales paralleling the six ACT Job Clusters (and Holland's types) are described in Table 4. Each ASVAB Job Cluster Scale is based on a combination of ASVAB Subtest stanines and ability self-estimates (or CPP scores) transformed to approximate stanine equivalents. Abilities were assigned to job clusters on the basis of research summarized by Prediger (1992a) and descriptions of the ASVAB Subtests (U.S. DoD, 1985). The ability assignments parallel the assignments shown in Table 2.

A student's stanines for the abilities assigned to a given ASVAB Job Cluster Scale (see Table 4) were added together. The sum was then converted to a standard score through use of the ASVAB Job Cluster Scale means and standard deviations based on all students in the total sample. Thus, each student in the total sample had scores for six ASVAB Job Cluster Scales paralleling the six ACT Job Clusters and Holland's occupational groups.

Analysis Plan

Three related statistical procedures--multivariate analysis of variance (MANOVA),

discriminant analysis (DISANL), and hit rate analysis--were used to address the first study objective--to determine whether the raw ASVAB Job Cluster Scales differentiate occupational choice groups. The nature and relevance of these procedures are described in Appendix C of the previous report (Prediger, 1987a). For an extended discussion, see Tabachnick and Fidell (1983) and Tatsuoka (1971).

As previously noted, each student in the analysis sample (the 462 students who met the certainty screen and had a complete set of data) was assigned to one of the six ACT Job Clusters on the basis of his or her occupational choice. The job clusters served as criterion groups in the analyses addressing the first study objective. One-third of the analysis sample was randomly assigned to a hold-out group in order to cross-validate hit rates. Thus, there were 308 students in the validation (MANOVA and DISANL) sample and 154 students in the cross-validation (hit rate) sample.

The second study objective (to determine whether ability differences among the occupational choice groups are appropriate) was addressed by developing mean ability profiles for job families. Job families rather than job clusters were used because expectations regarding ability patterns are clearer for the more homogeneous job families. For example, the ability profile peaks and valleys for a given job cluster may be blurred due to variation in the work tasks characterizing job families in the cluster. Also, means for a given job cluster are sensitive to the relative sizes of the job families in the cluster. The larger the job family, the more influence it will have on the job cluster mean. Thus, the results for a job cluster may be dominated by the results for one or two job families.

Because so few of the 23 job families had 20 or more analysis-sample students, the

certainty screen was relaxed for the analyses addressing the second objective. The 1,241 students answering either "very sure" or "fairly sure" to the certainty question (77% of the classifiable cases) were included in the analyses. Of the 23 job families, 18 had at least 20 students with a complete set of scores for the ASVAB Job Cluster Scales. (Results for an additional group of 19 students are also reported.)

Relaxing the certainty screen in order to provide a sufficient number of cases for the profile analyses should yield conservative results. That is, to the extent that students are uncertain of their occupational choices, expected ability differences among occupational choice groups will be less likely to occur. If, for example, students are completely uncertain and choose occupations at random, no ability differences would be expected beyond chance variation.

Readers may wish to use two approaches to checking ASVAB Job Cluster Scale profiles against expectations. Through an intra-occupational analysis, the mean profile for a given job family can be examined in light of the work tasks characterizing the job family. Does the Vehicle Operations and Repair Job Family, for example, score higher on the Technical Scale than the other job cluster scales? Through an inter-occupational analysis, job family means can be compared, one scale at a time. Expectations regarding which job families will score highest and lowest on the Business Contact Job Cluster Scale, for example, can be checked against study results.

Results

Differentiation of Occupational Groups (Objective 1)

Overall differentiation. Results addressing the first study objective are presented in

Table 5. For the six ASVAB Job Cluster Scales, taken as a whole, Wilks' lambda is significant at far beyond the .01 level. (See table footnotes.) These results indicate that ASVAB Job Cluster Scale differences across occupational choice groups cannot reasonably be attributed to chance.

The proportion of total variance attributable to job cluster differences (as measured by the Wilks Index) was 40%. The overall, cross-validated hit rate was 43%. (The chance hit rate is 17%.) In a separate DISANL for the 10 ASVAB Subtests, which include those used to obtain the ASVAB Code, a cross-validated hit rate of 29% was obtained. Thus, use of the ASVAB Job Cluster Scales improved the ASVAB Subtest hit rate by about 50%. No doubt, the greater breadth of abilities covered by these scales contributed to this improvement.

Univariate F values for four of the six ASVAB Job Cluster Scales were statistically significant at beyond the .01 level. (See Table 5 footnotes.) The relative sizes of univariate F values do not necessarily reflect the unique contribution of measures to criterion group differentiation, however. When the measures are analyzed simultaneously, as in MANOVA, some may contribute little due to redundancy. Hence, readers are referred to the rank for unique contribution in Table 5.

Dimensions of differentiation. As shown by Table 5, three discriminant functions were warranted for the ASVAB Job Cluster Scales. Together, these discriminant functions accounted for 93% of the scales' discriminating power. Only two discriminant functions (78% of discriminating power) were warranted for the ASVAB Subtests. (Specifics regarding the discriminant functions are available from the senior author.)

Given that three discriminant functions were warranted for the ASVAB Job Cluster

Scales, occupational choice group differentiation achieved by the scales must depend on ability pattern. Three independent functions define pattern differences--one function, by definition, can not define pattern differences.

Appropriateness of Occupational Group Differences (Objective 2)

Figure 2 shows mean ability profiles for the job family with the most students in each of the six ACT Job Clusters. (Table 6 provides means for all job families with 19 or more students.) Because the ASVAB Job Cluster Scales are anchored to six widely recognized occupational types (Holland, 1985), the reasonableness of a job family's ability profile (an intra-occupational analysis) is relatively easy to determine.

Five of the six job families depicted in Figure 2 had a peak score on a different ASVAB Job Cluster Scale. More important, the scales with peak scores appear to correspond to predominant work tasks. For example, the Engineering and Other Applied Technologies Job Family scored highest on the Technical Job Cluster Scale; the Science Scale ranked a close second. The Financial Transactions Job Family scored highest on the Business Operations Scale; the Business Contact Scale ranked second. The Applied Arts (Visual) Job Family scored highest on the Arts Scale; the Technical Scale ranked second. Of the 19 job families with data in Table 6, 14 scored highest on the job cluster scale appropriate to their cluster; 3 scored second highest (see three-letter codes).

Overall, results for the inter-occupational analysis also appear to be reasonable. For example, Figure 2 shows that the Management and Planning Job Family ranked highest among the other job families on the ASVAB Business Contact Scale; the Applied Arts (Visual) Job Family ranked highest on the Arts Scale; and the General Health Care Job

Family ranked highest on the Social Service Scale. The Financial Transactions Job Family ranked highest on the Business Operations Scale. For the Technical Scale, the Engineering and Other Applied Technologies Job Family (Science Job Cluster) ranked higher than Vehicle Operation and Repair (Technical Job Cluster). However, this reversal appears to make good sense, given the nature of engineering work tasks and their complexity. The spread between the highest and lowest scoring job families in Figure 2 averaged .75 standard deviation units across the six ASVAB Job Cluster Scales. Further analysis of job family performance on the ASVAB Job Cluster Scales will be left to the reader.

Discussion

In accordance with the results of studies cited in previous reports (Prediger, 1987a, 1989) and in Appendix C, the results of this study indicate that the abilities of senior high school students differ substantially across broadly defined occupational groups. As in the previous studies, there was no indication that occupational groups differ only in level of general mental ability. When a variety of abilities are assessed, occupational differences are patterned and complex. Such results indicate that a counselee's ability profile (ability pattern) can be useful in identifying potentially compatible occupations--occupations pursued by persons with similar ability profiles. More than general mental ability needs to be considered. Thus, study results support DISCOVER's uses of ASVAB Subtest scores and ability self-estimates for career exploration and planning--rather than the singular ASVAB Code ("g"; Wall & Zytowski, 1981).

Ability Self-estimates as Tools for Career Counseling

In general, study results support the construct validity of self-estimated abilities.

However, the use of self-estimates in career counseling may be challenged by persons who doubt their objectivity (freedom from deliberate distortion) and accuracy as indicators of "true" abilities. Certainly, self-estimate scales are not objective in the same sense that ability tests are. Hence, their usefulness in employee (or military recruit) selection is limited, at best. In career counseling, however, there is no reason for deliberate distortion of self-estimates. The value of self-estimates in career counseling depends on their accuracy. As noted above, Prediger (1992b) discussed conditions related to the accuracy of ability self-estimates.

Unfortunately, it is often difficult (if not impossible) to obtain accurate, standardized measures with which to compare many work-relevant, self-estimated abilities (i.e., to obtain data bearing on concurrent validity). Hence, this study (and the related studies that were cited) examined the construct validity of self-estimates. The following question was addressed: Do the self-estimates of persons pursuing various occupations and educational programs differ in an appropriate manner? In each study, the answer was affirmative.

One could argue that validity data supporting ability self-estimates are not compelling when occupational choices are collected concurrently with the self-estimates. Occupational choices could have been influenced by the participants' perceptions of their abilities. If those perceptions were inaccurate, then occupational choices might reflect that inaccuracy. Thus, inaccurate self-estimates and the resulting occupational choices might be congruent simply due to their common basis.

If the occupational choices of young adults are inappropriate to the demands of the work world, their occupational choices would not be in substantial agreement with the occupation

in which they remain, as noted in the Appendix B review of research on this topic. Also young adults would not obtain scores on the CPP Ability Tests that are generally congruent with the work tasks characterizing their occupational choices, as shown in the previous ASVAB study (Prediger, 1987a) and other studies reviewed in that report. The results of such studies provide a body of research supporting the use of occupational choice as a criterion that can be used to validate self-estimated abilities.

Finally, it also seems reasonable that the occupational choices of a substantial proportion of 11th and 12th graders are based on a realistic understanding of their abilities--an understanding gained through more than 10 years of experience drawing on those abilities in and out of school. In particular, it seems reasonable that many 11th and 12th graders have had sufficient experience (direct and vicarious) with the work world to identify broad fields (e.g., job clusters, if not specific occupations) appropriate to their abilities.

Given this logic and the results of research, it would appear that the use of self-estimates in career counseling can broaden the scope of abilities (i.e., fill gaps in the abilities) assessed via traditional ability test batteries. Everyone has and is influenced by self-estimates of abilities (i.e., self-concepts). As Super (1957) has noted, "In choosing an occupation one is, in effect, choosing a means of implementing a self-concept" (p. 196; italics in original). Making self-estimates explicit, improving their accuracy, and systematically incorporating them in the career exploration/planning process appear to be worthy goals for measurement specialists and career counselors.

A Two-component Model of Occupational Ability Demands

In a study synthesizing occupational aptitude patterns developed by the U.S. Department

of Labor for a variety of occupations, Gottfredson (1986) claims support for the proposition that "general intellectual demands are the major gradient by which aptitude demands are organized. Stated another way, differences in the general intelligence demands among jobs not only constitute the single most important aptitude distinction among jobs, but also influence or constrain all other aptitude demands in some way" (p. 285). Gottfredson acknowledges that "aptitude demand patterns of occupations arise in large part from broad differences in the tasks workers actually perform [emphasis added] on the job" (p.288). However, "general intelligence demands" (p. 285), not work tasks, are ascribed primary importance.

Gottfredson's (1986) emphasis of general intelligence (general mental ability--the ASVAB Code) does not appear to be warranted by the data presented here. Instead, study results suggest different hypotheses:

1. Basic work tasks are the major determiners of the ability (aptitude) demands of occupations. Prediger (1992a) defined four basic work tasks (working with data, ideas, people, and things) and showed which work tasks are associated with each of the six ACT Job Clusters and Holland's (1985) six occupational groups.
2. When occupations are grouped into broad job clusters (each with a unique work task pattern), they differ mainly in ability pattern. As shown in the studies cited here, general mental ability is not the primary factor (discriminant function) differentiating job clusters. Job clusters with divergent work tasks have divergent and sensible ability profiles.
3. Within job clusters, occupations differ mainly in ability profile level. For example,

the ability profile pattern of some occupations in a given job cluster may center around a stanine level of 4; whereas the same ability profile pattern may center around a stanine level of 6 for other occupations in the cluster.

These hypotheses acknowledge that Gottfredson's (1986) "general intelligence" (general mental ability, the ASVAB Code, etc.) has a role in differentiating occupations without making it "the single most important aptitude distinction among jobs" (Gottfredson, 1986, p. 285). Instead, work tasks receive primary attention. A two-facet model of ability demands is proposed. Type of work task comprises the first facet. Work task complexity (difficulty) comprises the second facet.

The results of the studies reported here support a two-step approach to the use of ability measures in career counseling. First, use the profile similarity model to identify occupational groups (e.g., job families) with ability profiles appropriate to the counselee. Second, within those occupational groups, search for occupations with profile levels appropriate to the counselee--e.g., occupations attainable by the counselee through further education, training, or experience.

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Table 1

ASVAB Codes and Occupations Reported to Students

ASVAB Codes[a]	Estimated % of students receiving ASVAB Code			Examples of occupations reported to students[b]
	Whites	Blacks	Hispanics	
1	13%	1%	2%	Engineers, Physicians, Financial Managers, Lawyers
2	22	5	7	Navigators, Medical Lab Tech., Managers & Executives
3	20	8	11	Plumbers, Printing Workers, Sheet Metal Workers, Phone Installers
4	19	15	17	Painters/Paperhangers, Pipelayers, Truck Drivers, Welders
5	26	71	63	Logging Workers[c]

Note. Basis for estimates is described in Appendix A. Figures for the ASVAB Code 5 group are similar to Armed Forces Qualification Test figures for the same norm group cutoff (i.e., lowest 30%). See U. S. Department of Defense (1982; Table B-4).

[a]Based on ASVAB Academic Ability measure--i.e., "cognitive ability," "a g loaded measure" (Wall & Zytowski, 1991). [b]See "Occu-Find" in Exploring Careers: The ASVAB Workbook (for students). [c]No other examples could be obtained from the Department of Defense.

Table 2

Assignment of Work-Relevant Abilities to Job Clusters and Holland's Types

Ability	ACT Job Cluster[a]					
	Business Contact (E)	Business Operations (C)	Technical (R)	Science (I)	Arts (A)	Social Service (S)
	Abilities typically measured by tests					
1. Reading				X		X
2. Numerical	X	X		X		
3. Language Usage	X	X			X	X
4. Spatial			X	X	X	
5. Clerical		X				
6. Mechanical			X			
	Abilities for which test scores are seldom available					
7. Scientific				X		
8. Creative/Literary					X	
9. Creative/Artistic					X	
10. Manual Dexterity			X			
11. Meeting People						X
12. Helping Others						X
13. Sales	X					
14. Leadership/Mgmt.	X					
15. Organization		X	X			

Note. An "X" indicates the assignment of an ability to a job cluster.

[a]The six job clusters are similar to Holland's six types of occupations (shown in parentheses).

Table 3

Overview of Samples A and B

School	Sample size	Percent tested[a]	Time of data collection: Self-estimates[b] Grade	Self-estimates[b] Date	ASVAB scores Grade	ASVAB scores Date
			Sample A			
1	97	58	11	12/84	11	4/85
2	151	35	11	12/84	12	12/85
3	83	25	11	2/84	12	9/84
4	232	83	11	10/83	12	10/84
5	229	80	11	10/84	12	10/85
6	58	37	11	3/85	12	11/85
	74	40	11	1/86	11	11/85
7	185	76	11	2/85	11	12/84
			Sample B			
8	162	58	12	12/86	11	2/86
9	27	34	12	12/86	10	9/84
10	51	49	12	3/87	11	11/85
11	136	53	12	2/87	11	3/86
12	55	63	12	2/87	11	9/85
13	129	43	12	3/87	11	10/85

[a]Based on enrollment for grade in which ASVAB was administered.

[b]Collected via the CPP (Sample A) or questionnaire (Sample B).

Table 4

Content of ASVAB Job Cluster Scales

Ability	ASVAB Job Cluster Scale					
	Business Contact (E)	Business Operations (C)	Technical (R)	Science (I)	Arts (A)	Social Service (S)
ASVAB Subtests						
Word Knowledge				1/2		1/2
Paragraph Comprehension				1/2		1/2
Arithmetic Reasoning	1/2	1/2		1/2		
Math Knowledge	1/2	1/2		1/2		
General Science				1		
Auto and Shop Information						
Mechanical Comprehension			1			
Electronics Information						
Numerical Operations		1/2				
Coding Speed		1/2				
Ability Self-estimates						
Language Usage	1	1			1	1
Spatial			1	1	1	
Scientific						
Creative/Artistic					1	
Creative/Literary					1	
Helping Others						1
Meeting People						1
Sales	1					
Leadership/Management	1					
Organization		1	1			
Manual Dexterity			1			

Note. The weight an ability receives on a scale is shown by "1/2" or "1". The weights total to four for each ASVAB Job Cluster scale. As explained in the text, Language Usage and Spatial self-estimates were not available for Sample A members. Hence, CPP scores were used.

Table 5

Differentiation of Occupational Choice Groups by ASVAB Job Cluster Scales

Statistics	Results
MANOVA	
Wilks's lambda[a]	.60
Wilks's variance-explained index	40%
Univariate F (and rank for unique contribution)[b]	
Business Contact Scale	1.82 (3rd)
Business Operations Scale	5.76 (1st)
Technical Scale	2.63 (5th)
Science Scale	3.90 (4th)
Arts Scale	6.60 (2nd)
Social Service Scale	4.32 (6th)
DISANL	
No. of functions warranted by significance tests[c]	3
Among-group variance for all 5 functions: 49%, 23%, 21%, 6%, 1%	
Cross-validated overall hit rate: 43%	

[a] F (30, 1,190) = 5.45; $p < .0001$.

[b] For four of the scales, $p < .01$, F (5, 302); for the Technical Scale, $p < .05$; for the Business Contact Scale, $p > .10$. See Prediger (1987a, Appendix C) for description of procedure used to report the unique contribution of scales.

[c] Chi-square (20, $N = 308$) = 81.6, $p < .0001$ for Functions 2-5. For Functions 3-5, $p < .0001$. For Functions 4-5, chi-square (6, $N = 308$) = 11.0, $p > .05$.

Table 6

ASVAB Job Cluster Scale Mean Stanines for Job Cluster and Job Family Criterion Groups

Criterion group (and Holland code)	N	ASVAB Job Cluster Scale[a] E	C	R	I	A	S	Three-letter code[b]
Business Contact Cluster (E)	141	5.6	4.9	4.7	4.4	5.0	5.0	EAS
Marketing & Sales	60	4.9	4.4	4.3	4.0	4.8	4.6	EAS
Management & Planning	81	6.1	5.3	4.9	4.7	5.1	5.3	ECS
Business Operations Cluster (C)	200	5.0	5.3	4.7	4.6	4.6	4.9	CES
Records & Communications	56	4.3	4.8	3.6	3.5	4.4	4.9	SCA
Financial Transactions	105	5.3	5.7	5.1	5.1	4.9	4.8	CERI
Storage and Dispatching	6							
Business Machine/Computer Operation	33	4.9	5.2	5.1	4.9	4.3	4.8	CREI
Technical Job Cluster (R)	163	4.5	3.9	5.6	4.9	4.1	3.8	RIE
Vehicle Operation and Repair	93	4.7	4.2	5.9	5.3	4.4	4.0	RIE
Construction and Maintenance	29	4.5	4.0	5.8	4.7	3.7	3.2	RIE
Agriculture and Natural Resources	10							
Crafts and Related Services	8							
Home/Business Equipment Repair	4							
Industrial Equipment Operation and Repair	19	4.1	2.9	5.5	4.1	4.1	3.4	REIA
Science Job Cluster (I)	257	5.4	5.6	5.8	5.8	5.4	5.3	RIC
Engineering and Other Applied Technologies	133	5.5	5.5	6.1	6.0	5.3	4.9	RIEC
Medical Specialties and Technologies	80	4.9	5.4	5.2	5.4	5.3	5.4	CIS
Natural Sciences and Mathematics	23	5.8	6.1	6.2	6.6	5.8	5.7	IRC

Criterion group (and Holland code)	N	ASVAB Job Cluster Scale[a] E	C	R	I	A	S	Three-letter code[b]
Social Sciences	21	6.0	5.9	5.1	5.5	6.4	6.6	SAE
Arts Job Cluster (A)	175	5.2	5.1	4.9	5.2	6.0	5.5	ASEI
Applied Arts (Visual)	69	5.0	4.9	5.6	5.4	6.2	5.2	ARI
Creative/Performing Arts	37	4.6	4.5	4.4	4.9	6.1	5.0	ASI
Applied Arts (Written and Spoken)	69	5.8	5.7	4.4	5.2	5.7	6.0	SECA
Social Service Job Cluster (S)	305	5.0	5.0	4.5	4.8	5.1	5.5	SAEC
General Health Care	136	5.0	5.2	4.6	4.9	4.9	5.6	SCE
Education and Related Services	61	5.7	5.6	4.5	4.9	5.5	5.9	SEC
Social and Government Services	67	5.0	4.9	5.0	4.9	5.1	5.4	SAER
Personal/Customer Services	41	3.8	4.0	3.8	3.9	4.9	4.8	ASC

[a]To conserve space, scales are designated by codes for Holland's (1985) occupational groups. Holland's groups (and corresponding job cluster scales) represented by the codes are: E--Enterprising (Business Contact); C--Conventional (Business Operations); R--Realistic (Technical); I--Investigative (Science); A--(Arts); S--Social (Social Service).

[b]A dash under two or more codes indicates that the corresponding means were tied. The order for ties is arbitrary and follows the sequence ECRIAS.

BUSINESS CONTACT JOB CLUSTER

A. MARKETING AND SALES JOB FAMILY
Sales workers in stores; route drivers (milk, etc.); buyers; travel agents; sales workers who visit customers (real estate and insurance agents; stock brokers; farm products, office, and medical supplies sales workers)

B. MANAGEMENT AND PLANNING JOB FAMILY
Store, motel, restaurant, and agribusiness managers; office supervisors; purchasing agents; managers in large businesses; recreation/parks managers; medical records administrators; urban planners

BUSINESS OPERATIONS JOB CLUSTER

C. RECORDS AND COMMUNICATIONS
Office, library, hotel, and postal clerks; receptionists; computer tape librarians; office, medical, and legal secretaries; court reporters; medical record technicians

D. FINANCIAL TRANSACTIONS
Bookkeepers; accountants; grocery check-out clerks; bank tellers; ticket agents; insurance underwriters; financial analysts

E. STORAGE AND DISPATCHING
Shipping and receiving clerks; mail carriers; truck, cab, and airline dispatchers; cargo agents; air traffic controllers

F. BUSINESS MACHINE/COMPUTER OPERATION
Computer console, printer, etc., operators; office machine operators; typists; word-processing equipment operators; statistical clerks

TECHNICAL JOB CLUSTER

G. VEHICLE OPERATION AND REPAIR
Bus, truck, and cab drivers; auto, bus, and airplane mechanics; forklift operators; merchant marine officers; airplane pilots

H. CONSTRUCTION AND MAINTENANCE
Carpenters; electricians; painters; custodians (janitors); bricklayers; sheet metal workers; bulldozer and crane operators; building inspectors

I. AGRICULTURE AND NATURAL RESOURCES
Farmers; foresters; ranchers; landscape gardeners; tree surgeons; plant nursery workers; pet shop attendants

J. CRAFTS AND RELATED SERVICES
Cooks; meatcutters; bakers; shoe repairers; piano/organ tuners; tailors; jewelers

K. HOME/BUSINESS EQUIPMENT REPAIR
Repairers of TV sets, appliances, typewriters, telephones, heating systems, photocopiers, etc.

L. INDUSTRIAL EQUIPMENT OPERATION AND REPAIR
Machinists; printers; sewing machine operators; welders; industrial machinery repairers; production painters; laborers and machine operators in factories, mines, etc.; firefighters

SCIENCE JOB CLUSTER

M. ENGINEERING AND OTHER APPLIED TECHNOLOGIES
Engineers and engineering technicians in various fields; biological and chemical lab technicians; computer programmers; computer service technicians; drafters; surveyors; technical illustrators; food technologists

N. MEDICAL SPECIALTIES AND TECHNOLOGIES
Dental hygienists; EEG and EKG technicians; opticians; prosthetics technicians; X-ray technologists; medical technologists; dentists; optometrists; pharmacists; veterinarians

O. NATURAL SCIENCES AND MATHEMATICS
Agronomists; biologists; chemists; ecologists; geographers; geologists; horticulturists; mathematicians; physicists; soil scientists

P. SOCIAL SCIENCES
Marketing research analysts; anthropologists; economists; political scientists; psychologists; sociologists

ARTS JOB CLUSTER

Q. APPLIED ARTS (VISUAL)
Floral designers; merchandise displayers; commercial artists; fashion designers; photographers; interior designers; architects; landscape architects

R. CREATIVE/PERFORMING ARTS
Entertainers (comedians, etc.); actors/actresses; dancers; musicians, singers; composers; writers; art, music, etc. teachers

S. APPLIED ARTS (WRITTEN AND SPOKEN)
Advertising copywriters; disk jockeys; legal assistants; advertising account executives; interpreters; reporters; public relations workers; lawyers; librarians; technical writers

SOCIAL SERVICE JOB CLUSTER

T. GENERAL HEALTH CARE
Nursing aides; orderlies; dental assistants; licensed practical nurses; physical therapy assistants; registered nurses; dieticians; occupational therapists; physicians; speech pathologists

U. EDUCATION AND RELATED SERVICES
Teacher aides; preschool teachers; athletic coaches; college teachers;* guidance/career/etc., counselors; elementary and secondary school teachers; special education teachers

V. SOCIAL AND GOVERNMENT SERVICES
Security guards; recreation leaders; police officers; health/safety/food/etc. inspectors; child welfare workers; home economists; rehabilitation counselors; sanitarians; social workers

W. PERSONAL/CUSTOMER SERVICES
Grocery baggers; bellhops; flight attendants (stewards, stewardesses); waitresses and waiters; cosmetologists (beauticians); barbers; butlers and maids

Figure 1. Job clusters, job families, and examples of occupations in the ACT Occupational Classification System.

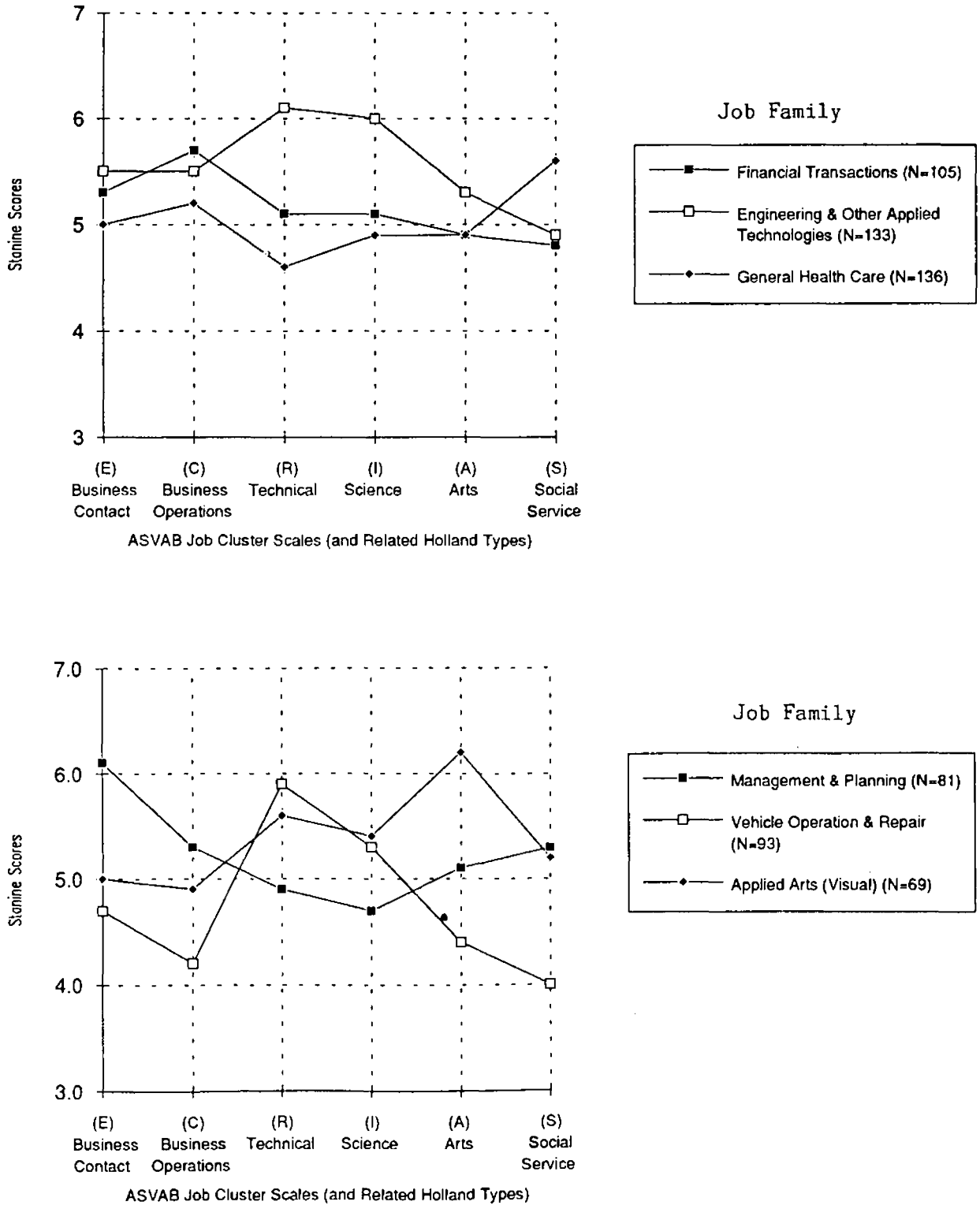

Figure 2. How occupational choice groups scored on the ASVAB Job Cluster Scales. (Mean scores for the largest job family in each ACT Job Cluster are profiled.)

APPENDIX A

Basis of Racial/Ethnic Group Performance Estimates for the ASVAB Academic Ability Composite

1. Source of data: U.S. Department of Defense (1982; Tables C-1, C-12, and C-15)
2. The "ASVAB Code" (provided to students for use in career planning) is based on a student's Academic Ability Composite score. Because the Department of Defense (DoD) has not published racial/ethnic group data for this composite, Table C-12 data for the highly similar "ASVAB General Aptitude Composite" were used. For cross-sectional samples of 888 11th graders and 754 12th graders (see description of this study's samples), the correlations between this composite and the Academic Ability Composite were both .98.
3. The racial/ethnic group performance estimates assume that racial/ethnic group differences are approximately the same for various nationally representative norm groups (e.g., Grade 11, Grade 12).
4. Median racial/ethnic group percentile ranks in Table C-12 were converted to the following ASVAB Academic Ability Composite z-scores through use of the normal distribution: Whites (0.13), Blacks (-1.08), Hispanics (-0.84), total norm group (0.00).
5. The above estimates of racial/ethnic group differences on the ASVAB Academic Ability Composite are highly similar to estimates based on scores for the four Academic Ability subtests in Table C-15 and scores for the Armed Forces Qualification Test (AFQT) in Table C-1.
6. Data in the DoD (1982) report do not support an accurate estimate of Academic Ability Composite score <u>variation</u> within the three racial/ethnic groups. Hence, a z-score standard deviation (SD) of 1.00 was used for each group. Because the DoD data <u>did</u> indicate that within-group variation was substantially <u>less</u> than this (as one would expect), **racial/ethnic group**

differences in ASVAB Academic Ability scores are likely to be under-estimated in this report.

7. Percentile limits for ASVAB Codes were translated to z-scores through use of the normal distribution. For example, the lower limit for an ASVAB Code of 1 (90th percentile) equals a z-score of 1.28.

8. The percent of students meeting each ASVAB code limit was determined for each racial/ethnic group through use of the group's z-score mean and SD. For example, Whites (mean = 0.13) have a z-score of 1.15 for the lower limit (1.28) of an ASVAB Code of 1. That is, z = (1.28 - .13)/1.00 = 1.15. As determined from the normal distribution, approximately 13% of the White students score above this point (i.e., receive an ASVAB Code of 1). The figures for Blacks and Hispanics were estimated in the same way.

Reference

U.S. Department of Defense. (1982). Profile of American youth: Nationwide administration of the Armed Services Vocational Aptitude Battery. Washington, DC: Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics).

APPENDIX B

Occupational Choice as a Validation Criterion

for Career Counseling Applications of Ability Measures

Occupational choice ("occupational preference," "vocational aspiration," etc.) has had a long history as a validation criterion in vocational research (e.g., see Holland & Gottfredson, 1975; Holland, Gottfredson, & Baker, 1990; Holland & Lutz, 1968). In response to a question regarding their use of vocational aspiration as a validation criterion, Holland et al. (1990) cite data showing that "aspirants for particular occupations resemble the employed adults in the same occupations" (p. 341). Additional support for the use of this validation criterion is summarized below.

Research on Occupational Choice Stability

Research has repeatedly shown that the occupational choices of young adults are reasonably predictive of subsequent choices and employment, especially when choices and occupations are categorized into broad groups. McLaughlin and Tiedeman (1974), for example, examined the "career stability" (p. 185) of a nationally representative sample of 9,588 high school senior males. The occupational plans of each sample member, as reported in 1960, 1965, and 1971, were allocated to one of Holland's (1973) six types of occupations. The 5-year and 11-year correspondence (hit) rates for the 1960 occupational plans of the high school seniors were 45% and 39%, respectively.

Cairo (1982) obtained the occupational choices of a cross-section of 18-year-old males and compared them with actual occupation at age 36. For purposes of comparison, the occupational choice and subsequent occupation of each of the 83 sample members were assigned to one of Roe's (1956) eight occupational groups. The 18-year hit rate for occupational choice versus occupation was 35% for Roe's eight category system. No data were reported for Holland's six category system. On the assumption that the Roe and Holland occupational classification systems are equally

effective (i.e., they differ only in number of classification categories), the Brennan-Prediger (1981) index can be used to estimate a hit rate for the six category Holland system. That estimate, 38%, is nearly identical with the 11-year hit rate in the McLaughlin-Tiedeman (1974) study.

Further evidence that the occupational choices of young adults are reasonably predictive of subsequent employment was provided by Bartling and Hood (1981) in a study that compared the occupational choices of 408 college-bound students (239 males and 169 females) with occupations 11 years later. Occupational choices and occupations were both classified according to Holland's (1973) occupational typology. Three levels of agreement between occupational choice and occupation were determined: "good hit," "poor hit," and "clean miss." Bartling and Hood's definition of a "good hit" was similar (but not identical) to agreement between the Holland type corresponding to occupational choice and the Holland type corresponding to actual occupation. Thus, their "good hit" rate provides an index of career stability similar to the others reported here. The 50% hit rate reported by Bartling and Hood is higher than he hit rates reported in the other studies, possibly because only college graduates were included in their study.

A longitudinal study by Prediger (1987a) also bears on the relevance of occupational choice as a criterion for test validation. Each sample member's occupational preference in Grade 11 was allocated to one of the six job clusters similar to Holland's occupational types and compared with the job cluster containing occupation pursued 6 years later. The overall hit rate for cluster preferred versus cluster pursued was 42%. The hit rates for 11th graders who said they were "very sure," "fairly sure," or "not sure at all" of their occupational preferences were 46%, 45%, and 33%, respectively. Thus, the predictive value of occupational preference varied by level of certainty, as one would expect.

For five of the six preference clusters, the number of students pursuing an occupation in the same cluster 6 years later constituted a plurality. The exception was the Arts Cluster. Only 10% of

the 143 11th graders choosing artistic occupations were pursuing related occupations 6 years later. Of the 1,650 persons in the final sample, only 30 were pursuing artistic occupations. Thus, there appears to have been little opportunity to implement preferences for artistic occupations.

Rationale for Using Occupational Choice as a Criterion in Validity Studies

Taken together, the studies cited above (and others reviewed by Whitney, 1969) indicate that occupational choices are reasonably predictive of subsequent choices and actual occupations, especially when choices and occupations are categorized into broad groups based on type of work. Many students establish a general direction for their careers during the high school years. To the extent that they have had an opportunity to develop and explore their abilities through experiences both in and out of school, their occupational choices should reflect personal strengths rather than weaknesses. Thus, occupational choice provides a useful criterion for validating ability measures--especially when accompanied by a screen for certainty.

In the studies summarized by Prediger (1987a) and in Appendix B, career groups based on occupational choice and certainty provided the criteria for determining the validity of ability measures for career counseling applications. If students choose occupations at random, no ability differences across choice groups would be expected beyond chance variation. Hence, the following question was addressed: Do the abilities of persons pursuing various careers differ in an appropriate manner? If expected differences were not found, counselors could raise serious questions about the validity of the ability measures. In each study, the answer to the question was affirmative.

Finally, because of the effects of the labor market on occupation pursued, one might argue that occupational choice is superior to occupation as a criterion for validity studies relevant to career counseling. Many persons, of necessity, find jobs wherever they can--even though their abilities may be better suited to something else. Gottfredson (1979), for example, documents the disparity between the occupational choices ("aspirations") of males in their late teens and the distribution of

occupations held by males in their mid to late 20s. She concludes that her study results are "a vivid reminder that the occupational world severely constrains the options of workers and that workers must in some way adjust to this reality" (p. 325). Given the constraints of the labor market, the use of occupational choice as a criterion for determining the career counseling validity of ability measures appears reasonable.

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APPENDIX C

Summary of Additional Validity Data for Job Cluster Ability Scales

This appendix presents abstracts and examples of results from two unpublished validity studies cited in the text.

Study 1: Prediger, D. J. (1986). A comparison of the career-counseling validity of ability self-estimates and test scores. Unpublished project notes. American College Testing, Research Division, Iowa City, IA.

Abstract. This study compared the career counseling validity of (a) self-estimates of standing on six cognitive abilities (e.g., numerical, spatial, mechanical); (b) test scores for the same abilities; (c) scores on Job Cluster Ability Scales based on self-estimates for nine largely noncognitive abilities (e.g., sales, organization, manual dexterity) plus self-estimates for the six cognitive abilities; and (d) scores on Job Cluster Ability Scales based on self-estimates for the same nine noncognitive abilities plus test scores for the same six cognitive abilities. Correlations between self-estimates and test scores for the six cognitive abilities were also obtained.

The sample consisted of 529 Grade 11 students from three schools in three mid-western states. Each provided self-estimates for the six cognitive and nine noncognitive abilities immediately prior to completing ACT Career Planning Program Ability Tests measuring the six cognitive abilities. The ability definitions used in obtaining the self-estimates were generally broader than the abilities assessed by the tests. Corrected correlations (see Table C1) between the ability self-estimates and test scores ranged from .40 (for Space Relations) to .72 (for Numerical Skills) with a median of .61.

To assess validity for career counseling applications, students in the sample were allocated to six job clusters on the basis of their first occupational choice. The job clusters were similar to Holland's six occupational types. Students answering "not sure" to the question "How sure are you that the occupational choice you selected . . . will still be your first choice one year from now?"

were excluded from the validity analyses. Multivariate analyses based on the ability self-estimates and test scores for the remaining 356 students (67% of the sample) showed that the six job clusters differed substantially on each of the four combinations of measures cited above. Self-estimates for the six cognitive abilities performed somewhat better than the corresponding test scores (see Table C2). Job Cluster Ability Scales based on self-estimates alone provided slightly better job cluster differentiation than Job Cluster Ability Scales based on self-estimates and test scores (see Table C3). Thus, the career counseling validity of self-estimates compared quite favorably with that of test scores.

Stanine profiles (mean = 5, SD = 2) for the six job clusters generally were as expected. For example, the peak score for each job cluster was on the Job Cluster Ability Scale appropriate to the job cluster. This finding held when self-estimates for the six cognitive abilities were substituted for the six test scores (see Figures C1 and C2).

Table C1

Correlations Between Ability Self-Estimates and Test Scores

	Self-estimates		Test scores		Correlation	
Ability[a]	Mean	SD	Mean	SD	Uncorrected	Corrected[b]
Reading Skills	6.2	1.9	5.8	1.7	.57	.69
Numerical Skills	5.6	2.2	5.2	1.9	.65	.72
Language Usage	6.0	1.9	6.0	1.7	.49	.62
Mechanical Reasoning	5.4	2.2	5.2	1.7	.48	.61
Space Relations	5.4	2.1	5.5	1.8	.35	.40
Clerical Speed/Accuracy	6.5	1.6	4.8	1.6	.21	.40
Median correlation						.61

Note. Results are based on 529 11th graders in three schools.

[a]Ability titles refer to the ACT Career Planning Program Ability Tests. [b]Correlations are corrected for attenuation and restriction/enhancement of range.

Table C2

Differentiation of Occupational Choice Groups by Ability Self-Estimates and Test Scores

	Results	
Statistics	Self-estimates	Test scores
Multivariate analysis of variance		
Wilks's lambda	.59*	.73*
Variance explained[a]	41%	27%
Univariate Fs for abilities		
Reading Skills	4.95	6.38*
Numerical Skills	5.47*	6.11*
Language Usage	10.53*	8.18*
Mechanical Reasoning	12.15*	7.06*
Space Relations	6.67*	3.55
Clerical Speed/Accuracy	3.90	1.11
Discriminant analysis		
Number of dimensions warranted[b]	2	1
Among-group variance for dimensions[c]	52%, 31%	69%
Hit rate for job cluster predictions[d]	41%	39%

Note. Results are based on 356 11th graders in three schools. Ability titles refer to ACT Career Planning Program Ability Tests.

[a]Based on the Wilks Index. [b]Remaining dimensions (discriminant functions) for which $p > .0001$ were defined as unwarranted. [c]Percent of total among-group variance associated with each dimension (function). [d]Chance hit rate is 17%; a priori criterion group weights were not used. *$p \leq .0001$

Table C3

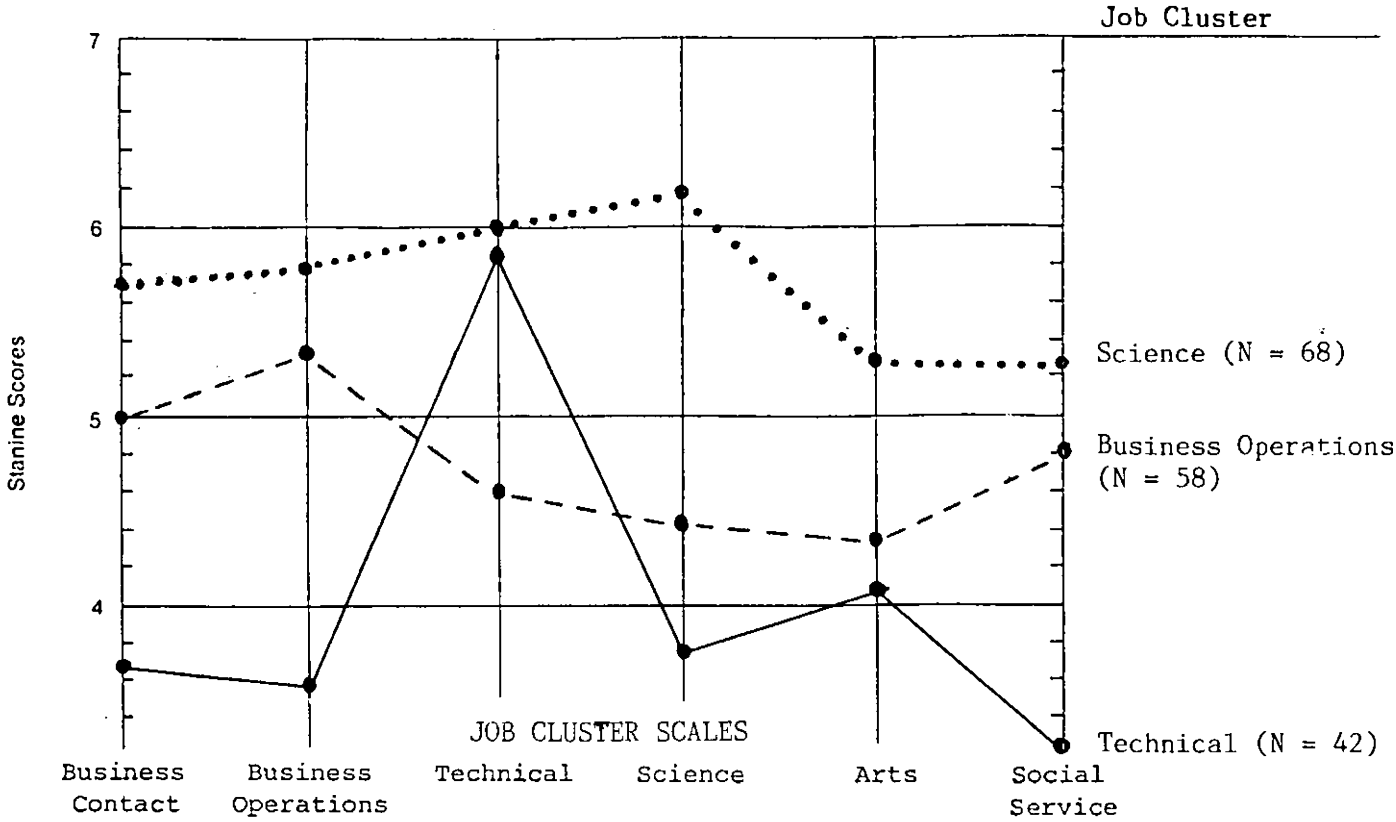
Differentiation of Occupational Choice Groups by Job Cluster Scales

Statistics	Results: Self-estimates alone	Results: Self-estimates and test scores
Multivariate analysis of variance		
Wilks's lambda	.56*	.60*
Variance explained[a]	44%	40%
Univariate Fs for Job Cluster Scales		
Business Contact	5.86*	5.38*
Business Operations	7.46*	5.91*
Technical	8.67*	5.86*
Science	10.52*	10.24*
Arts	8.34*	5.89*
Social Service	11.81*	13.74*
Discriminant analysis		
Number of dimensions warranted[b]	3	2
Among-group variance for dimensions[c]	49%, 24%, 20%	60%, 22%
Hit rate for job cluster predictions[d]	42%	39%

Note. Results are based on 356 11th graders in three schools.

[a]Based on the Wilks Index. [b]Remaining dimensions (discriminant functions) for which $p > .0001$ were defined as unwarranted. [c]Percent of total among-group variance associated with each dimension (function). [d]Chance hit rate is 17%; a priori criterion group weights were not used.

*$p \leq .0001$



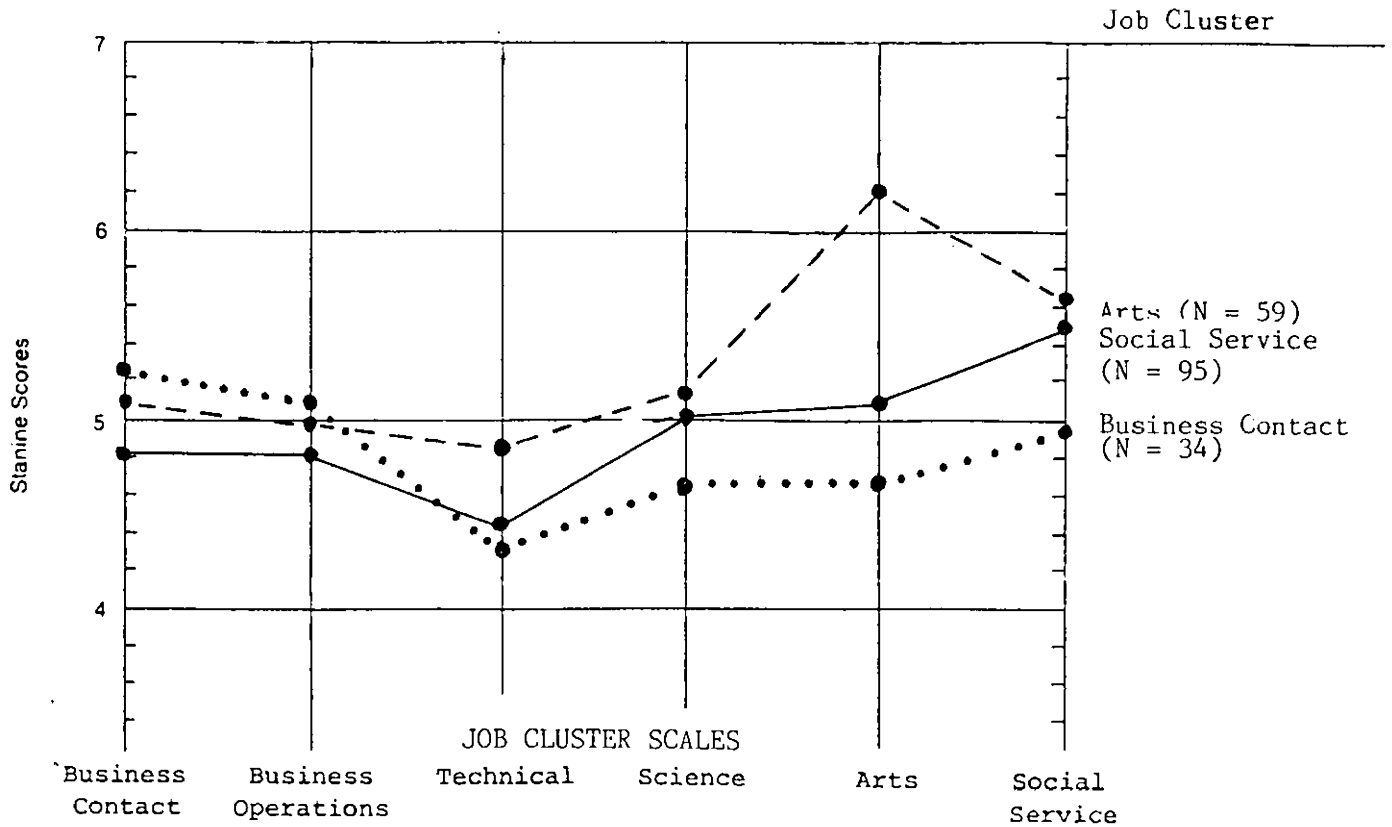


Figure C1. How occupational choice groups scored on Job Cluster Ability Scales based on ability self-estimates.

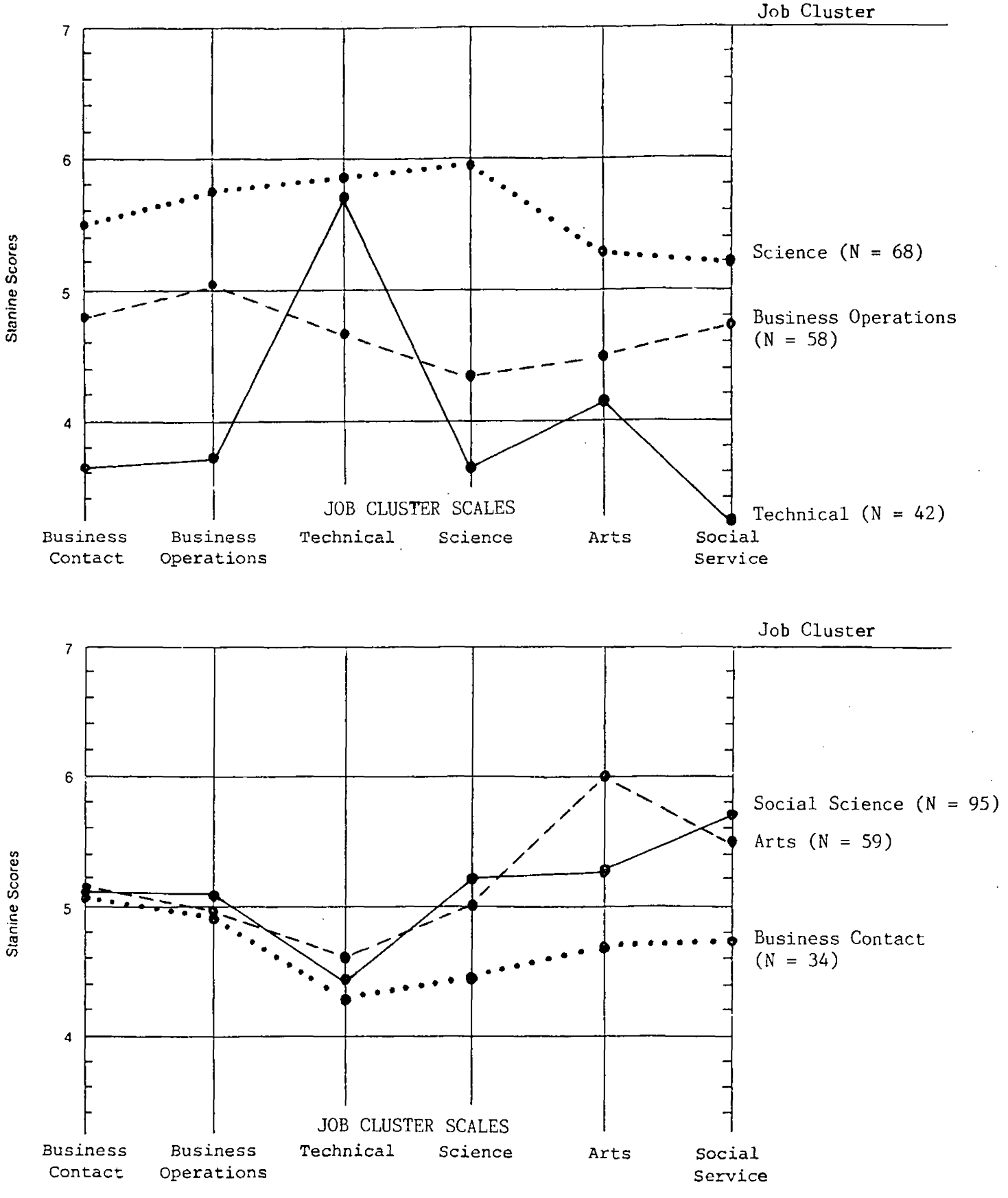


Figure C2. How occupational choice groups scored on Job Cluster Ability Scales based on ability self-estimates plus test scores.

Study 2: Swaney, K. B. (1987). The DISCOVER self-estimated abilities study: Methods and results. Unpublished manuscript, American College Testing, Research Division, Iowa City, IA.

Abstract. Self-estimates of ability have some of the same limitations as raw scores for ability tests. For example, identical raw scores for two abilities may indicate quite different ability levels. The same can be said for identical ability self-estimates. To address this limitation, ability test raw scores are scaled (normed) before they are interpreted. This report describes the procedures used to scale the 15 ability self-estimates obtained by DISCOVER, ACT's computer-based career planning system. Also addressed is the career counseling validity of DISCOVER's six Job Cluster Ability Scales. Each is based on a unique combination of four ability self-estimates.

The sample consisted of 3,000 seniors from 30 high schools in 11 states and all regions of the nation. These students completed the 15 ability self-estimates and indicated whether they were "very sure," "fairly sure," or "not sure" that their first occupational choice would be the same in a year. On the basis of occupational choice, students were assigned to one of six job clusters similar to Holland's six types of occupations. The scaling procedure, which was based on 965 "very sure" students, used a double cross-validation design to optimize indices of concurrent validity. The six job clusters served as criterion groups.

Score profiles for job clusters based on "very sure" students in hold-out samples generally were as expected. For example, the peak score for each job cluster was on the Job Cluster Ability Scale appropriate to the job cluster (see Figure 1)--a finding which indicates that the self-estimates have validity for career counseling applications. Degree of profile differentiation varied with certainty of occupational choice. The profiles of "very sure" students had the greatest differentiation.

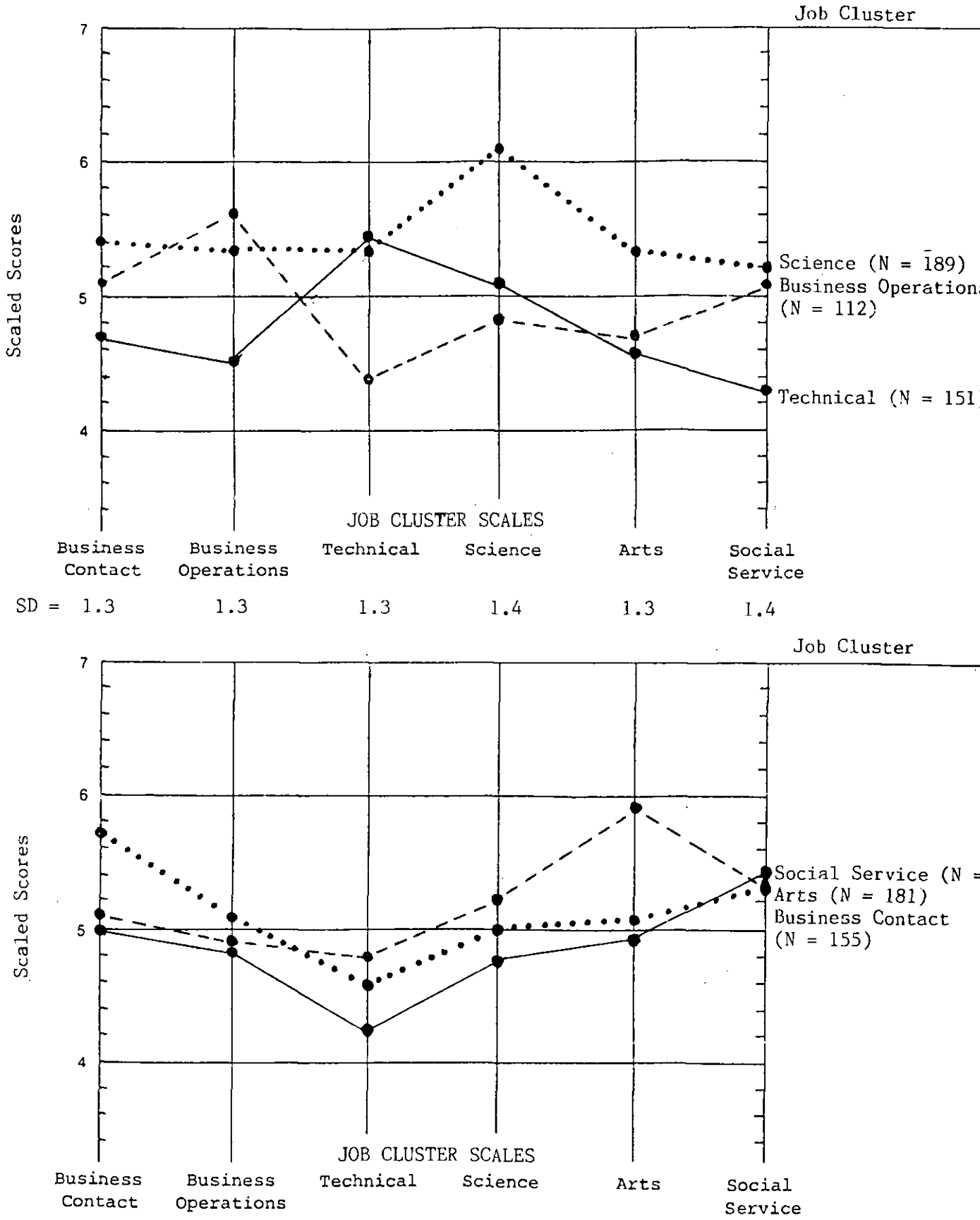


Figure C3. How occupational choice groups scored on Job Cluster Ability Scales based on ability self-estimates.