DOCUMENT RESUME

ED 310 172 TM 013 863

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TITLE Comparison of Black and Nonminority Validities for the General Aptitude Test Battery. USES Test Research Report No. 51.
INSTITUTION Employment and Training Administration (DOL), Washington, D.C.
PUB DATE 87
NOTE 28p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Adults; *Aptitude Tests; *Blacks; Chi Square; Comparative Testing; Data Collection; Meta Analysis; Occupational Clusters; *Occupational Tests; Predictive Measurement; *Racial Differences; Statistical Analysis; Test Bias; *Test Validity; Whites
IDENTIFIERS *General Aptitude Test Battery; Type I Errors

ABSTRACT

Meta-analytic research techniques were used to compare the General Aptitude Test Battery (GATB) validities of blacks and non-minorities. The sample consisted of 7,854 black and 15,769 non-minority subjects from 113 Specific Aptitude Test Battery (SATB) validation studies analyzed since 1972. The first approach was to compare average validities weighted by sample size. Eight of nine differences were significant and favored the non-minority sample. The largest difference was 0.05. A second approach use a chi-square method developed in 1979 by J. E. Hunter, F. L. Schmidt, and R. Hunter. Two aptitudes revealed differences significant at the 0.05 level. Cumulative chi-square analyses across all studies showed significant differences at the 0.05 level for four aptitudes. The last two analyses attempted to correct for sources of Type 1 error present in the primary analysis. One compared job family validities and found significant differences for two of five job families. The second corrected for range restriction and criterion unreliability and found significant differences in 10 of 24 critical ratios. The results tend to mirror those of other researchers. Differences, when found, were small and inconsistently favored non-minorities. Given the various forms of Type 1 error and the methods of data collection, there was little indication that validities differ more than would be expected due to chance. Five tables provide study data. Appendices provide tables of the sample members' job information and the distribution of statistics for blacks and non-minorities. (Author/SLD)

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ACKNOWLEDGMENT

The United States Employment Service conducts a test research program for developing testing tools useful in vocational counseling and placement.

The purpose of this series of reports is to provide results of significant test research projects as they are completed. These reports will be of interest to users of USES tests and to test research personnel in State Employment Security Agencies and other organizations.

William Goode, former member of the Northern Test Development Field Center, and John Hawk of the Division of Planning and Operations assisted in the preparation of this report.

ABSTRACT

This study uses meta-analysis research techniques to compare the General Aptitude Test Battery (GATB) validities of blacks and nonminorities. The sample consists of 23,623 subjects from 113 Specific Aptitude Test Battery (SATB) validation studies analyzed since 1972.

Differences in validities were analyzed in several ways. The first approach compared average validities weighted by sample size. Eight of nine differences were significant, and favored the nonminority sample. The largest difference was .05. The second approach used the chi-square from Hunter, Schmidt, Hunter (1979). Two aptitudes showed differences significant at the .05 level. Cumulative chi-squares across all studies showed significant differences at the .05 level for four aptitudes. The last two analyses attempted to correct for sources of Type 1 error present in the primary analysis. The first approach compared job family validities (Hunter, 1983) and showed significant differences for two of five job families. The second compared aptitude validities corrected for range restriction and criterion unreliability, and showed significant differences in 10 of 24 critical ratios.

After analyzing all the data the results tend to mirror those found by Hunter, et. al., (1979), Hunter and Schmidt (1978), and Schmidt, Berner, and Hunter (1973). Differences, when found, are small and inconsistently favor nonminorities. Differences are best seen in light of three forms of Type I error (Hunter, et. al., 1979) which are known but not controlled for

INTRODUCTION

The U.S. Employment Service (USES), in cooperation with State Employment Security Agencies, has conducted a continuing program of occupational test research and development since the mid 1930's. Most of this effort has been devoted to developing and researching the General Aptitude Test Battery (GATB). The GATB consists of 12 tests measuring the following nine vocationally-relevant aptitudes:

General Learning Ability (G)
Verbal Aptitude (V)
Numerical Aptitude (N)
Spatial Aptitude (S)
Form Perception (P)
Clerical Perception (Q)
Motor Coordination (K)
Finger Dexterity (F)
Manual Dexterity (M)

The validation of the GATB for specific occupations has resulted in the development of over 470 Specific Aptitude Test Batteries (SATBs). These batteries consist of combinations of two, three, or four GATB aptitudes with associated cutting scores. All of the SATBs were developed from empirical research studies. In each study criterion data measuring job proficiency were collected along with GATB test scores. The validity of the aptitudes was measured by the correlation between aptitude test scores and the criterion.

One issue that the USES has been concerned with is what variables affect or moderate GATB validities. Some of the variables that have been postulated to moderate test validity are minority group status, sex, geographic area, age, education and work experience. The present study looks at one of these variables, minority group status. The study uses meta-analysis research techniques on SATB validation data to determine if there are differences in validities between blacks and nonminorities.

The issue of race differences on employment tests is an important subject which has caused a plethora of discussion. It is important to the practitioner who wishes to select the most able candidates for employment as well as to the candidate who is concerned that a test may not measure his or her job related abilities as accurately or completely as it measures the abilities of other candidates. It is important because the Equal Employment Opportunity Commission (EEOC) Guidelines on Employee Selection Procedures (U.S. EEOC, 1978) established the legal requirement for showing a test's fairness.

Although multitudes of individual studies have looked for validity differences across races, few have had the statistical power needed to accurately deal with this problem. Cumulative studies involving subject Ns unrivaled in single study analysis have shown that evidence for real differences in validity occurs at chance levels (Bartlett, Bobko, Hannen, Mosier, 1978; Hunter, Schmidt, Hunter, 1979; Schmidt, Berner, Hunter, 1973; Schmidt, Hunter, 1977; Schmidt, Pearlman, Hunter, 1980). Studies investigating the effect of differential sample size, differential range restriction and a variety of statistical artifacts predict the false finding of validity differences almost perfectly (Schmidt, Hunter, 1977; Schmidt, Pearlman, Hunter, 1980).

In summing up the state of affairs, the National Research Board of the National Academy of Sciences (1982) stated, "we find little convincing evidence that well constructed and competently administered tests are more valid predictors for one population subgroup than for another: individuals with higher scores tend to perform better on the job, regardless of group identity."

The present study applies cumulative research techniques to the investigation of validity differences between blacks and nonminorities in GATB research data. In so doing it supplements the evidence cited above and extends the data base to the perceptual and psychomotor tests found in the GATB.

SAMPLE

The sample consists of data from all SATB validation studies which have identifiable black and nonminority subsamples of 25 or more. There are 113 such studies with a total N of 23,623, a black N of 7,854, and a nonminority N of 15,769. The occupations covered by these studies come from all areas of the U.S. economy, but are more heavily concentrated in 'skilled' and 'semi-skilled' jobs.

Criterion data for most of these studies consisted of the sum of scores from two administrations of the Standard Descriptive Rating Scale. The scale was used to obtain employee job performance ratings from supervisors on five aspects of job performance (quantity, quality, accuracy, job knowledge, and job versatility) as well as "all around" ability. However, other types of criterion data were collected and criteria were combined in different ways (see Table 1). Appendix 1 contains a listing of all 113 studies and the sample sizes for blacks and nonminorities.

PROCEDURE

In each study, validities were calculated for blacks and nonminorities. These validities were then compared in several ways. The following chi-square (Hunter, et. al., 1979) was computed for each validity pair

$$\chi^2 = \frac{(Z_1 - Z_2)^2}{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}$$

where Z_1 and Z_2 are the validity coefficients in Fisher Z form for blacks and nonminorities, and N_1 and N_2 are sample sizes for blacks and nonminorities. The number of significant chi-squares was computed as well as the cumulative chi-square.

Mean validities weighted by sample size were calculated for blacks and nonminorities and tested for differences with the critical ratio.

TABLE 1

Number of Studies and Subjects for Each Criterion Type

Type of Study	# of Studies	# of Individuals	Criterion Measure CR1	CR2	CR3
Concurrent Standard DRS	96	19,613	Standard DRS	Standard DRS	Sum of CR1 and CR2
Two criteria collected but only one used as final	1	82	Special DRS	Work Sample	CR2
Multiple Hurdle	2	559	Standard DRS	Course grades	----------
	1	881	Special DRS	Standard DRS	----------
	1	92	Course grades	Standard DRS	----------
Final criterion is combination of different criteria	1	197	Special DRS	Ranking	Combination of CR1, CR2
Final criterion is combination of same criteria (not Standard DRS)	1	275	Broad category rating	Broad category rating	Sum of CR1 and CR2
	7	1,415	Special DRS	Special DRS	Sum of CR1 and CR2
Longitudinal Standard DRS	1	78	Standard DRS	Standard DRS	Sum of CR1 and CR2
Only one criterion	1	104	Mixed Standard Rating Scale	----------	----------
	1	327	Course grades	----------	----------
	113	23,623			

Two supplementary analyses were conducted in order to correct or reduce the effect of three possible sources of Type I error. The first of these analyses compared the job family validities (Hunter, 1983) of blacks and nonminorities within groups of comparable jobs. Hunter developed a grouping system of jobs based on the Data and Things ratings of the occupational codes in the Dictionary of Occupational Titles (DOT) (United States Department of Labor, 1977). Each job in the DOT is in one of the five job families (see Table 2). The regression weights for each job family were used to get predicted criterion scores and the correlation was computed between predicted and actual criterion scores for each study. Mean validities, weighted by sample size, for each of the five job families were computed for blacks and nonminorities and critical ratios were computed.

The second supplementary analysis compared mean aptitude and mean composite aptitude (Hunter, 1983) validities within job families. The three composites are summations of three aptitudes with the strongest communalities. The composite GVN equals aptitude G + aptitude V + aptitude N. The composites SPQ and KFM are formed similarly. The validities in this analysis were weighted by sample size and corrected for average range restriction (weighted by sample size) and average criterion unreliability (weighted by sample size).

RESULTS

Table 3 shows mean validities for blacks and nonminorities weighted by sample size, critical ratios, number of significant chi-squares and cumulative chi-squares. Mean validities are higher for nonminorities for all nine GATB aptitudes and the critical ratios are significant ($P<.05$) in eight cases. The number of significant chi-squares are significant for aptitudes G and S. Of the 73 chi-squares which were significant 52 favored whites and 21 favored blacks. Cumulative chi-squares were significant for aptitudes G, S, Q, and K.

Table 4 shows the results for the job family analysis. The critical ratios between black and nonminority job family validities are signficant for two of the five job families.

Table 5 shows the results for corrected validities within Job Families IV and V. Three of twelve validity differences are significant in Job Family IV, seven of twelve validity differences are significant in Job Family V.

DISCUSSION AND CONCLUSIONS

This study was conducted to investigate differences in validities between blacks and nonminorities in GATB research studies. Although many of the analyses offered evidence of significant differences, these differences were small, inconsistent, and found in the presence of many contraindications. Given the various forms of Type I error and the method of data collection, there is little indication that validities differ between blacks and nonminorities any more than would be expected due to chance. If validities differ at all between blacks and nonminorities, they do so at a very trivial level.

TABLE 2

Job Family and Test Battery Composition

Job Family	Contribution to Composite: Cognitive GVN	Perceptual SPQ	Psychomotor KFM	DOT Data-Things Code
I	59%	30%	11%	T=0=Setting up
II	13%		87%	T=6=Feeding-Offbearing
III	100%			D=0=Synthesizing =1=Coordinating
IV	73%		27%	D=2=Analyzing =3=Compiling =4=Computing
V	44%		56%	D=7=Copying =8=Comparing

TABLE 3

Aptitude Validity Comparisons

113 Studies

	Mean Validities[a] Black N=7854 Mean	SD	Nonminority N=15769 Mean	SD	Critical Ratios	Mean[a] Difference	Number of Chi-Squares Significant at .05	Cumulative Chi-Square
G	.13	.14	.17	.12	-2.68**	.033	11*	144.90*
V	.11	.14	.12	.11	- .87	.010	6	125.22
N	.13	.14	.17	.10	-3.19**	.040	7	135.05
S	.07	.14	.10	.12	-2.61**	.038	12*	145.99*
P	.08	.14	.12	.10	-2.32*	.034	10	132.97
Q	.10	.14	.14	.09	-2.61**	.041	9	147.78*
K	.06	.14	.10	.10	-3.19**	.041	8	139.06*
F	.05	.13	.10	.11	-3.33**	.042	5	130.11
M	.07	.12	.11	.11	-2.68**	.047	5	120.42

[a]Weighted by sample size
*Significant at .05 level
**Significant at .01 level

TABLE 4

Mean Weighted Job Family Validities

		Blacks		Nonminorities		
Job Family	Number of Studies	N	Validity	N	Validity	Critical Ratio
I	5	196	-.01	624	.05	-.81
II	1	44	.11	81	.07	.22
III	1	66	.19	292	.27	-.52
IV	62	3886	.15	9938	.19	-2.00*
V	44	3662	.12	4834	.20	-3.71**

*Significant at .05 level
**Significant at .01 level

The analyses provided in this report are affected by several sources of Type I error which make the given levels of significance inappropriate (Hunter, et. al., 1979). The first source of Type I error issues from nonnormal test score distributions which result when research samples have been test selected using the reeearch instrument or similar test. This source of error is believed to be small in the current study as most potential research samples were rejected if the GATB or a similar test had been used as a major selection tool for that position. Nonnormality of test score distributions may also derive from personnel pressures in which lesser qualified workers are weeded out or highly qualified workers are promoted. This form of Type I error raises the level of significance slightly in the chi-square statistic and more severely in the cumulative chi-square. By way of example, had the selection ratio of the sample been .50 with a test of true validity .50, we would expect to find .07 significant differences instead of .05, even if none exist at all.

Lack of complete independence between validity pairs is the second source of Type I error. This error occurs in our research because the same criterion is used in each sample to determine the correlations with each of the nine aptitudes. The correlations between the GATB aptitudes (.10 to .86) also is a source of this error. This error is controlled for within analysis of each individual aptitude, but precludes an accurate assessment of differences across all aptitudes.

The third source of Type I error bias is due to differential range restriction on the predictor variable. This error has the effect of showing significant differences between validities which would not be present had the range of scores been equal in both samples. Differential range restriction is present in favor of the nonminority sample in the majority of samples studied in this paper. This may be due, in part, to mean difference between blacks and nonminorities on test scores. If the validity of a test is .50 for both groups and a cut-off score selects 40% of nonminorities the observed correlation among the selected group would be .31. At the same time, mean differences may cause the cut-off score to select only 11% of blacks. The additional restriction in range would produce an observed correlation of .23 for blacks compared to .31 for nonminorities when no difference truly exists! Such an artifactual difference has little effect on single chi-squares but the effect on a cumulative chi-square over 113 such studies would show significant differences not at a 5% chance level, but 99% of the time (Hunter, et. al., 1979) as the expected value of the cumulative chi-square would be 139 (113 x 1.23).

Differences in criterion reliability provide another source of Type I error. Unreliability in the criterion lowers observed validities from values associated with a perfect measure of job performance. If criterion reliability varies between blacks and nonminorities then differences in validities would appear, though none truly exist. The mean criterion reliability for blacks in this study is .03 less than the mean criterion reliability for nonminorities.

The last observable artifact which may cause false differences in validities calculated across jobs is differential distribution among jobs of differing ability requirements. The job family structure developed by Hunter (1983) groups occupations by relative complexity and aptitude requirements. Using this system 49% of blacks are found in Job Family IV and 47% in Job Family V. On the other hand, 63% of the current sample of nonminorities fall in Job Family IV and 31% in Job Family V. If the job structure accurately divides jobs by aptitude requirements then some of the differences observed between black and nonminority validities calculated across jobs may be more the result of differences in job requirements than true differential validity.

Type II error occurs when real differences exist but are not seen as significant. This is not a problem in the current work as the sample size involved (23,623) provides extremely high statistical power.

In Table 3, comparisons of mean validities weighted by sample size yielded inconsistent results. Critical ratios were significant in eight of nine cases as the differences varied from as much as .05 to as little as .01, demonstrating the power derived from such a large sample size. But there are two problems in accepting these critical ratios at face value. First these validities are uncorrected for criterion unreliability or differential range restriction which exists in greater degree in the black samples, thus increasing any real difference that may exist. Second, there is a problem in making validity comparisons across all jobs. If the blacks and nonminorities are differentially distributed among groups of jobs which require different abilities (and this is the case here) then differences found between blacks and nonminorities may be more the effect of differences in jobs and less the effect of differences in aptitude validities. The amount of this effect is not known, or controlled for here.

While eight of the critical ratios were significantly different the number of chi-squares significant were only significant for aptitudes G and S. In each case, however, the significant differences were split in favor of blacks and nonminorities. For G, four of 11 significant chi-squares favored blacks, and for S two of 12 favored blacks. In a cumulative study investigating test fairness for the Spanish surnamed, Schmidt, et. al., (1980) examined the effect of Type I errors on the chi-square statistic. In interpreting the effect of differential range restriction and nonnormality of test score distributions, they concluded "A conservative rule of thumb would hold that findings of 10% or less significant would disconfirm the differential validity hypothesis. Proportions in the 5-7% range would constitute compelling evidence against the differential validity hypothesis." If we accept .07 as our nominal level of significance, then the number of significant chi-squares is not significant for any aptitude.

The cumulative chi-squares showed significant differences in four of the nine aptitudes. Due to the strength of this test, we would preclude real differences in five aptitudes. However, the presence of virtually any differential range restriction would falsely push the cumulative chi-square to a significant level. In a cumulative study of 866 black-white validity pairs Hunter, et. al., (1979) reviewed the effect of differential range restriction and nonnormality and concluded that these Type I errors would inflate the cumulative chi-square by a factor of .231. If this is the case here, then all cumulative chi-squares would fall below the expected value of 166.

In Table 4 validities are compared within the job family groupings devised by Hunter (1983). Each job family is a collection of occupations which are similar in aptitude requirement. In this analysis, differences between jobs should no longer interfere with investigations of differences between blacks and whites. The critical ratios for difference were significant for Job Families IV and V but this analysis is hindered because the first three job families contained too small a sample for accurate assessment. Although this analysis controlled for job differences, the validities involved are still affected by all other sources of Type I error.

Table 5 shows the results for comparison of validities corrected for range restriction and criteria unreliability, and calculated within Job Families IV and V. Such a comparison should alleviate most sources of artifactual differences in validity. Within each job family significant differences still exist for some aptitudes and composites. Data from this supplementary analysis may imply either: (1) small differences in true validity may exist, or (2) normal correction procedures may not fully relieve the effects of artifacts known to be present in chi-square and cumulative chi-square analysis presented in Table 3.

As a final note consideration should be given to the methodology involved in collecting the data used in these analyses. Each study presented here is a cumulation of research samples gathered at different sites throughout the country. While scores on the standard administration of the tests are thought to be equivalent across sites, the same assertion is less strongly supported for the criterion. Although the criterion is physically presented in identical fashion, the subjective impression of the different raters may effect the criterion scores obtained and, therefore, the mean and SD of criteria scores at each location may not equate to those at other sites. The effect of having a non-ultimate criteria across all locations would be to lower correlations. Such effect would presumably be more severe on minority group members as their respective sample sizes are much smaller at each location. No attempt to correct for any such anomaly has been made.

TABLE 5

Corrected Aptitude Validities Within Job Families

Aptitude	Job Family IV		Job Family V	
	Blacks N=3,886	Nonminorities N=9,938	Blacks N=3,662	Nonminorities N=4,834
G	.234	.257	.218	.238
V	.220	.208	.218	.185
N	.208	.248*	.156	.227**
S	.086	.123*	.107	.147
P	.110	.122	.087	.163**
Q	.172	.177	.116	.219**
K	.100	.136	.057	.151**
F	.058	.090	.059	.133**
M	.069	.100	.109	.147
GVN	.241	.264	.212	.238
SPQ	.148	.179	.135	.210**
KFM	.098	.138*	.102	.186**

*Significant at .05 level
**Significant at .01 level

Given the analyses presented in this report, little evidence is found to support the theory of differential validity. The differences that were found were small and inconsistent across types of analysis. Some or all sources of type I error remained uncontrolled for in each analysis and operated to the detriment of observed validity. Taken together, the results described here tend to mirror those of Hunter, et. al., (1979), and their conclusions that "findings of apparent differential validities in samples are produced by the operation of chance and a number of statistical artifacts and indicate that true differential validity probably does not exist."

REFERENCES

Bartlett, C. J., Bobko, P., Mosier, S. B., and Hannon, R. (1978). Testing for fairness with a moderated multiple regression strategy: An alternative to differential analysis. Personnel Psychology, 31, 233-241.

Hunter, J. E. (1983). Test validation for 12,000 jobs: An application of job classification and validity generalization to the General Aptitude Test Battery (GATB). Washington, DC: U.S. Department of Labor, Employment and Training Administration.

Hunter, J. E., Schmidt, F. L., & Hunter, R. (1979). Differential validity of employment tests by race: A comprehensive review and analysis. Psychological Bulletin, 86, 721-735.

Hunter, J. E. and Schmidt, F. L. (1978). Differential and single group validity of employment tests by race: A critical analysis of three recent studies. Journal of Applied Psychology, 63, 1-11.

Schmidt, F. L., Berner, J. G., and Hunter, J. E. (1973). Racial differences in validity of employment tests: Reality or illusion? Journal of Applied Psychology, 53; 5-9.

Schmidt, F. L. and Hunter, J. E. (1977). Development of a general solution to the problem of validity generalization. Journal of Applied Psychology, 62, 529-540.

Schmidt, F. L., Pearlman, K., and Hunter, J. E. (1980). The validity and fairness of employment and educational tests for Hispanic americans: A review and analysis. Personnel Psychology, 33, 705-724.

U.S. Department of Labor. (1977). Dictionary of Occupational Titles (4th ed.). Washington, DC: Author

U.S. Equal Employment Opportunity Commission, U.S. Civil Service Commission, U.S. Department of Labor, and U.S. Department of Justice. (1978). Uniform Guidelines on Employee Selection Procedures. Federal Register, 43 (166), 38295-38309.

Wigdor, A. K. and Garner, W. R. (1972). Ability Testing: Uses, Consequences, and Controversies. Washington, DC: National Academy Press.

APPENDIX 1

DOT Title and Code and Number of Black and Nonminority Subjects

SATB No. or Study No.	DOT Title	DOT Code	Number of Subjects	
			Blacks	Nonminorities
2	Stock Clerk	222.387-058	51	85
4	Sewing Machine Operator	787-682-046	68	92
9	Central Office Operator	235.462-010	31	65
10	Stenographer	202.362-014	88	482
10	Clerk-Typist	203.362-010	118	269
10	Typist	203.582.066	50	82
11	Carpenter	860.381-022	45	95
12	Machinist	600.280-022	38	213
28	Packager, Hand	920.587-018	105	298
31	Checker II	209.687-010	34	74
34	Bindery Worker	653.685-010	51	99
38	File Clerk II	206.367-014	71	126
43	Automobile Mechanic	620.261-010	94	264
44	Punch-Press Operator I	615.482-022	34	40
45	Shipfitter	806.381-046	75	150
47	Nursery School Attendant	359.677-018	97	61
53	Spinner, Frame	682.685-010	73	104
57	Upholsterer, Inside	780.681-010	74	93
61	Plumber	862.381-030	46	186

SATB No. or Study No.	DOT Title	DOT Code	Number of Subjects	
			Blacks	Nonminorities
63	Garment Folder	789.687-066	55	43
68	Refinery Operator	549.260-010	41	141
72	Electrician	824.261-010	61	266
74	Central Office Repairer	822.281-014	39	102
80	Radiologic Technologist	078.362-026	43	70
82	Sheet-Metal Worker	804.281-010	29	112
101	Assembler, Automobile	806.684-010	57	140
115	Weaver	683.682-038	49	67
120	Fire Fighter	373.364-010	33	96
124	Tractor-Trailer-Truck Driver	904.383-010	83	214
126	Welder, Combination	819.384-010	34	133
131	Industrial-Truck Operator	921.683-050	91	96
135	Production-Machine Tender	609.685-018	82	127
141	Bench Assembler	706.684-042	91	67
144	Machinist, Wood	669.380-014	30	58
145	Cashier-Checker	211.462-014	39	43
153	Loom Fixer	683.260-018	37	115
165	Packager, Hand	920.587-018	43	56

SATB No. or Study No.	DOT Title	DOT Code	Number of Subjects	
			Blacks	Nonminorities
168	Yarn-Texturing-Machine Operator	589.685-102	52	57
177	Millwright	638.281-018	56	236
179	Waiter/Waitress, Informal	311.477-030	60	159
180	Keypunch Operator	203.582-030	119	205
182	Laborer, Stores	922.687-058	38	71
199	Audit Clerk	210.382-010	61	214
200	Ticket Agent	238.367-026	46	143
200	Reservations Agent	238.367-018	93	200
201	Construction-Equiplment Mechanic	620.261-022	47	157
207	Welder, Arc	810.384-014	60	94
208	Gas-Appliance Servicer	637.261-018	39	162
211	Welder, Arc	810.384-014	138	290
211	Welder, Arc	810.384-014	30	48
217	Proof-Machine Operator	217.382-010	60	129
220	Coil Winder	724.684-026	42	66
228	Injection-Molding-Machine Tender	556.685-038	67	72
231	Surgical Technician	079.374-022	86	147
234	Office-Machine Servicer	633.281.018	30	160
235	Metal Fabricator	619.360-014	50	97
236	Police Officer I	375.263-014	42	79

SATB No. or Study No.	DOT Title	DOT Code	Number of Subjects	
			Blacks	Nonminorities
238	Cook	313.361-014	62	43
239	Ward Clerk	245.362-014	80	100
259	Teller	211.362-018	78	169
266	Drafter, Civil Drafter, Geological Drafter, Mechanical Drafter, Structural	005.281-010 010.281-018 007.281-010 005.281-014	40	221
267	Tire Builder, Automobile	750.384-010	74	120
270	Nurse, Licensed Practical	079.374-014	73	121
274	Food-Service Worker, Hospital	355.677-010	63	77
276	Salesperson, General Merchandise	279.357-054	57	110
278	Sales Clerk	290.477-014	46	99
280	Structural-Steel Worker	801.361-014	26	184
282	Nurse Aide	355.674-01	66	68
286	Computer Operator	213.362-010	53	131
287	Psychiatric Aide	355.377-014	190	116
293	Electronics Technician	003.161-014	66	292
309	Proof-Machine Operator	217.382-010	63	99
310	Electronics Assembler	726.684-018	59	105
313	Automobile-Body Repairer	807.381-010	40	39
326	Respiratory Therapist	079.361-010	97	335

SATB No. or Study No.	DOT Title	DOT Code	Number of Subjects	
			Blacks	Nonminorities
327	Psychiatric Technician	079.367-022	128	123
329	Administrative Clerk	219.362-010	130	229
332	Hotel Clerk	238.362-010	92	264
335	Extruding-Machine Operator	691.382-010	49	71
336	Knitting-Machine Operator	685.665-014	87	107
342	Water-Treatment-Plant Operator	954.382-014	48	149
348	Correction Officer	372.667-018	386	387
360	Yarn Winder	681.685-154	162	45
375	Lather	842.361-010	36	40
376	Mailing-Machine Operator	208.462-010	62	64
381	Electronics Assembler	726.684-018	44	43
384	Medical-Laboratory Technician	078.381-014	44	110
393	Hospital-Admitting Clerk	205.362-018	46	107
398	Teacher Aide II	249.367-074	88	161
414	Assembler, Electrical Accessories I	729.687-010	56	118
423	Diesel Mechanic	625.281-010	31	189
427	Spooler Operator, Automatic	681-686-018	44	81
434	Packager, Machine	920.685-078	53	91
436	Food-Service Worker, Hospital	355.677-010	54	56

SATB No. or Study No.	DOT Title	DOT Code	Number of Subjects	
			Blacks	Nonminorities
447	Welder, Production Line	819.684-010	62	104
456	Assembler, Small Products	739.687-030	58	95
465	Covering-Machine Operator	681.685-038	31	34
467	Electronics Assembler	726.684-018	107	144
469	Chemical Operator II	558.585-014	78	158
471	Electonics Inspector	726.684-022	321	219
472	Appliance Assembler, Line	827.684-010	31	73
473	Gambling Dealer	343.467-018	120	761
474	Customer-Service Representative	239.367-010	48	211
1001	Central-Supply Worker	381.687-010	190	203
1002	Data Typist	203.582-022	80	66
1003	Etched-Circuit Processor	590.684-018	75	170
1005	Assembler	723.684-010	32	55
1006	Machine Operator II	619.685-062	75	155
1008	Power-Reactor Operator	952.362-022	42	285
1010	Meter Reader	209.567-010	79	196
1011	Packager, Hand	920.587-018	75	95
1012	Environmental-Control-System Installer-Servicer	637.261-014	41	219
3048	Pipe Fitter	862.261-010	40	52

Appendix 2
Distribution of Sample Statistics for Blacks/Nonminorities

	Study Characteristics					Sample Characteristics
Statistics	Mean	SD	Minimum	Maximum	N	Skewness
G Mean	81.9/101.7	7.5/7.9	69/83	107/119	7888/15957	.301/.070
SD	13.5/15.3	1.7/1.5	10/12	21/ 22		.271/.248
V Mean	86.6/100.9	6.0/6.9	74/86	103/113	7888/15957	.664/.346
SD	11.0/13.7	1.6/1.2	7/11	17/ 18		.344/.249
N Mean	81.7/100.1	8.6/7.6	67/84	107/115	7888/15957	.002/.113
SD	16.2/16.2	2.0/1.8	11/12	24/24		.271/.237
S Mean	88.1/104.0	6.7/7.2	75/85	115/121	7888/15957	.505/.064
SD	16.0/17.8	2.1/1.3	9/14	22/24		.326/.240
P Mean	96.0/110.5	8.7/7.4	77/89	121/123	7888/15957	-.013/-.026
SD	19.9/19.7	2.5/2.1	14/13	28/29		.307/.221
Q Mean	103.4/114.7	8.5/8.0	88/99	125/132	7888/15957	.290/.315
SD	15.3/15.6	2.0/1.7	11/11	22/21		.308/.281
K Mean	102.1/105.2	8.7/7.6	82/87	121/122	7888/15957	-.068/-.081
SD	17.3/16.9	2.1/1.5	13/13	22/22		.355/.238
F Mean	91.7/99.4	7.2/6.3	74/80	110/114	7888/15957	.049/-.058
SD	20.1/21.0	2.4/1.9	13/17	27/26		.332/.237
M Mean	101.1/107.1	6.2/7.2	86/88	126/124	7888/15957	.073/-.051
SD	20.2/21.6	2.5/2.1	13/17	30/28		.342/.226
GVN Mean	250/303	21.8/21.9	210/254	314/346	7888/15957	.231/.060
SD	36.9/40.8	4.7/4.3	27/30	60/59		.259/.251
SPQ Mean	288/329	21.5/18.7	244/277	355/361	7888/15957	.172/.038
SD	42.4/43.4	5.2/4.4	29/34	62/62		.261/.227
KFM Mean	295/312	18.8/17.9	242/257	348/345	7888/15957	-.053/-.170
SD	45.9/48.2	6.0/5.2	30/37	61/67		.333/.241
Criteria M	48.2/57.6	43.8/68.6	28/33	500/545	7651/14885	-.099/-.272
SD	9.0/9.5	8.7/8.0	5/5	94/63		.416/.428