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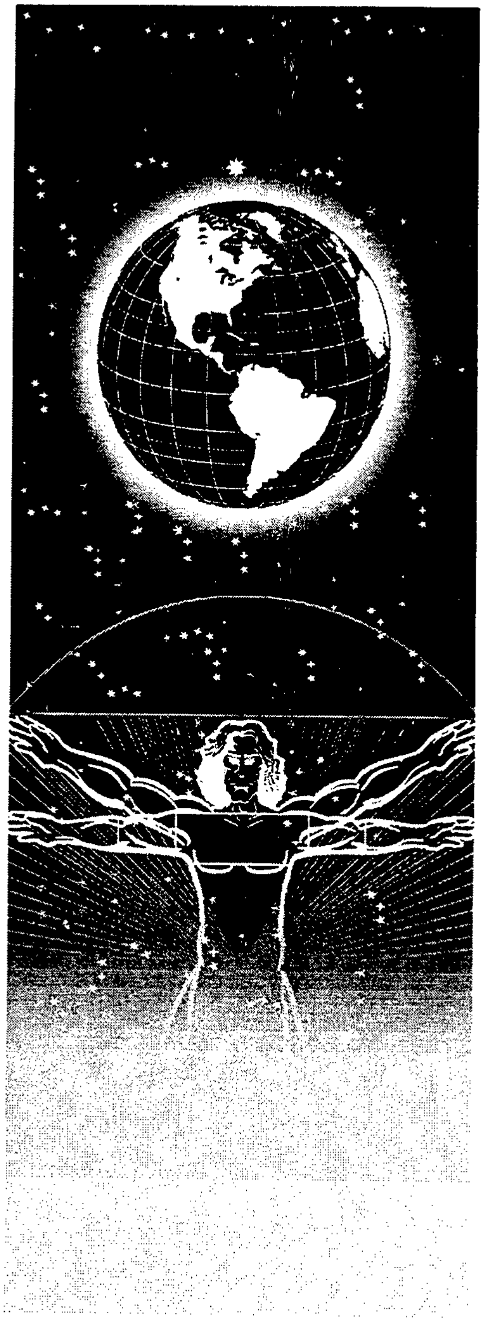

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GROUP DIFFERENCES IN THE ROLE OF g AND PRIOR JOB KNOWLEDGE IN THE ACQUISITION OF SUBSEQUENT JOB KNOWLEDGE

Thomas R. Carretta
Thomas W. Doub

HUMAN EFFECTIVENESS DIRECTORATE
WARFIGHTER TRAINING RESEARCH DIVISION
Training Effectiveness Branch
7909 Lindbergh Drive
Brooks AFB TX 78235-5352

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AIR FORCE RESEARCH LABORATORY
WARFIGHTER TRAINING RESEARCH DIVISION
6001 South Power Road, Building 558
Mesa AZ 85206-0904

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THOMAS R. CARRETTA
Project Scientist

DEE H. ANDREWS
Technical Director

LYNN A. CARROLL, Colonel, USAF
Chief, Warfighter Training Research Division

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Carretta, T.R.
Doub, Thomas W.

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Warfighter Training Research Division
Training Effectiveness Branch
7909 Lindbergh Drive
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The role of ability and prior job knowledge on the acquisition of subsequent job knowledge was examined for 41,976 participants in technical training. Comparisons were made for samples of men and women and for Whites, Blacks, and Hispanics. Ability and prior job knowledge were measured prior to entering job training and subsequent job knowledge was measured at the completion of job training. The structural equation model that was used had been statistically confirmed and had shown a role for both ability and prior job knowledge. In all groups, the relative causal impact of ability was far greater than that of prior job knowledge. It should be noted, however, that the relative causal effect of ability and prior job knowledge varied by group, being greater for women and Blacks. Contrary to expectations, prior job knowledge had virtually no causal role regarding the acquisition of subsequent job knowledge for women. The R square for predicting subsequent job knowledge was about equal for men and women, but less for Blacks than for Whites or Hispanics.

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CONTENTS

Page

INTRODUCTION 1

METHOD 2
Participants 2
Measures 3
Job Families 4
Analyses 4

RESULTS 5

DISCUSSION 10

REFERENCES 12

FIGURES

Figure No.

1 Ree, Carretta, and Doub (in press) Structural Model of the Role of *g* and Prior Job Knowledge (JK_P) on the Acquisition of Subsequent Job Knowledge (JK_S) 2
2 Path Models for Group Comparisons 10

TABLES

Table No.

1 Means and Standard Deviations of the Scores by Group 6
2 Correlations of the Scores by Group 7
3 Correlations Among the Latent Variables by Group 8
4 Summary of Model Testing Results by Group Comparison 9

PREFACE

This effort was conducted under Work Unit 1123-B1-01, Pilot Selection and Classification Support, which is dedicated to research into the selection and classification of U.S. Air Force aircrew personnel. The authors thank Drs Malcolm James Ree and William C. Tirre for their helpful comments on the analyses on an earlier version of the paper. This paper has been accepted for publication in the Personality and Individual Differences journal.

Send written correspondence to AFRL/HEAB, 7909 Lindbergh Drive, Brooks AFB, TX 78235-5352. Send electronic mail to Thomas.Carretta@williams.af.mil.

GROUP DIFFERENCES IN THE ROLE OF *g* AND PRIOR JOB KNOWLEDGE IN THE ACQUISITION OF SUBSEQUENT JOB KNOWLEDGE

INTRODUCTION

Several principles must be considered when studying the measurement of ability in sex or ethnic groups. For instance, the same factors should be measured for all groups and the relationships among the factors should be the same for all groups. McArdle (1996) contends that factorial invariance (i.e., equality of factor loadings) should be established before other group comparisons (e.g., mean differences) are considered. Further, McArdle contends that a failure to observe factorial invariance may indicate that the psychological constructs being measured are qualitatively different for the groups being compared. This, in turn, would limit the interpretability of other comparisons.

Previous research examining invariance in structural models across groups has focused for, the most part, on factorial models of ability (Carretta & Ree, 1995, 1997b; DeFries, et al., 1974; Humphreys & Taber, 1973; Michael, 1949; Ree & Carretta, 1995). These studies have demonstrated a remarkable degree of factoral similarity in the structure of ability across diverse groups.

Only one study was found that used structural models to examine invariance in causal models of ability, job knowledge, and job performance across groups. Carretta and Ree (1997a) used structural models to examine sex differences in the role of ability and prior job knowledge on the acquisition of subsequent job knowledge and work sample performance in a sample of 3,369 male and 59 female U. S. Air Force pilot trainees. Carretta and Ree viewed their results as tentative because of the small sample of female pilot trainees in their sample. Their model showed a direct influence of general cognitive ability (*g*) on the acquisition of job knowledge and an indirect influence on work sample performance. The direct and indirect influence of cognitive ability on flying skills was stronger for females than for males. Additionally, the path between prior job knowledge and work sample performance was stronger for females than for males.

The purpose of this research was to examine the role of ability and prior job knowledge in the acquisition of subsequent job knowledge for men and women and for three ethnic groups. The model used specifies positive causal paths for both *g* and prior job knowledge in the acquisition of subsequent job knowledge and was based on the findings of Dye, Reck, and McDaniel (1993), Hunter (1983, 1986), Ree, Carretta, and Teachout (1995), and Ree, Carretta, and Doub (in press).

The model being tested in this experiment was statistically confirmed by Ree et al. (in press). Ree et al.'s results showed a role for both ability and prior job knowledge for 42,399 U. S Air Force enlisted personnel in two broad job families (electronic and mechanical). Similar results were observed when analyses considered electronics jobs only, mechanical jobs only, and for all jobs. For the model that included all jobs (Figure 1), the R^2 for predicting subsequent job knowledge (JK_S) was .80 and the causal impact of ability (*g*) was about three times that of prior job knowledge (JK_P). The current research extends these findings by evaluating the suitability of the Ree et al. model for men and women and for Whites, Blacks, and Hispanics.

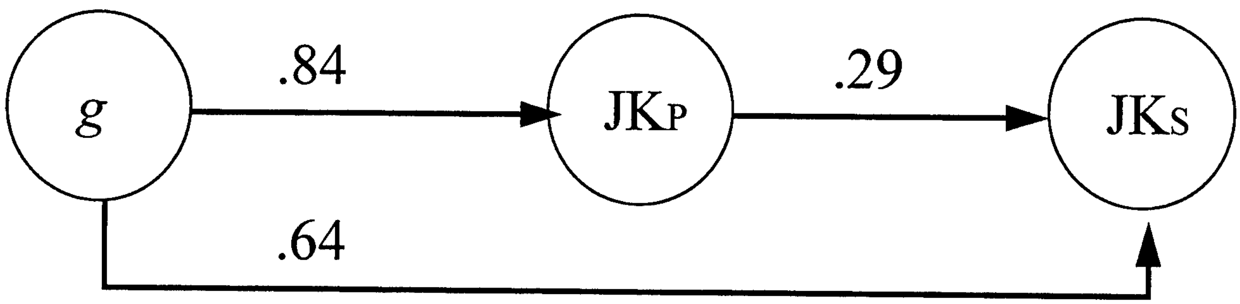

Figure 1. Ree, Carretta, and Doub (in press) structural model of the role of *g* and prior job knowledge (JK_P) on the acquisition of subsequent job knowledge (JK_S).

METHOD

Participants

The participants were 41,976 U. S. Air Force enlisted personnel who attended and completed a technical training course for one of several job specialties in either the electronics or mechanical career field. They were between about 17 and 23 years old, mostly male (90.8%) and White (87.1%), with a high school or better education (99%). All had tested for enlistment qualification between 1984 and 1988. They had been selected for formal technical training on the basis of both *g* and prior job knowledge from scores on the enlistment qualification battery. Enlisted personnel trained in job specialties in either the general or administrative career field were not included in this experiment because there are no job knowledge tests for those career fields.

The samples consisted of 38,134 males, 3,842 females, 35, 635 Whites, 4,205 Blacks, and 1,080 Hispanics. For most training courses, applicants must qualify on only one of the technical composites (either electronics or mechanical). A few courses require applicants to qualify on both electronics and mechanical composites, and some allow qualification on either the electronics or mechanical knowledge composites.

Measures

The Armed Services Vocational Aptitude Battery (ASVAB) is a multiple aptitude battery composed of 10 tests. It is based on a detailed written taxonomy of test and item specifications that defines the content and psychometric characteristics of each test. The ASVAB has been validated for training (Earles & Ree, 1992) and job performance (Ree, Earles, & Teachout, 1994).

The ASVAB has an hierarchical factor structure that includes *g* as a higher-order factor and three lower-order factors of verbal/quantitative, speed, and technical job knowledge (Ree & Carretta, 1994). The verbal and quantitative tests are Word Knowledge (WK), Paragraph Comprehension (PC), Arithmetic Reasoning (AR), and Mathematics Knowledge (MK). Numerical Operations (NO) and Coding Speed (CS) are the two speed tests. The technical knowledge tests are Electronics Information (EI), Mechanical Comprehension (MC), Auto and Shop Information (A/S), and General Science (GS). Brief descriptions of the tests are provided below. More detailed descriptions and example items of the tests are available in the *ASVAB Information Pamphlet* (DOD, 1984) which is given to all applicants prior to testing.

g and prior job knowledge. Measures of general cognitive ability (*g*) and prior job knowledge, (JK_P) were extracted from the ASVAB (Earles & Ree, 1992). As in Ree et al. (in press), *g* was extracted as a latent factor from the two verbal and two quantitative tests (WK, PC, AR, and MK). WK measures knowledge of synonyms and PC measures short-paragraph reading comprehension. AR assesses the ability to solve arithmetic word problems, and MK measures problem solving using high school mathematics.

Job knowledge was extracted as a latent factor from the EI, MC, and A/S tests. The GS (technical knowledge) and the NO and CS (speed) tests were not used because they do not measure job knowledge that is specific to any job family. The EI test measures knowledge about elementary electrical principles and electronics. MC measures knowledge of mechanical principals and tools. The A/S test assesses knowledge about automotive systems and shop practices.

Criterion. The criterion, subsequent job knowledge acquired during training (JK_S), was an observed variable. It was based on final grades on job knowledge tests taken during technical training. These grades were the average percent correct on several (at least four, but sometimes more) multiple-choice tests and ranged from 70 to 99. Each technical course scaled the grades independently and no common metric exists for the set of grades. Those assigning the training grades did not estimate their reliability nor were the data available to directly estimate reliability.

Course length varies by job specialty. Typically, these training courses last between two and eight months. Attrition rates for these courses are quite low, averaging about 6%. Attrition from military courses has several characteristics. Some who fail are separated from service. Others are transferred to different training courses or to jobs that do not require formal training.

Job Families

All enlisted Air Force jobs are categorized into one of four major job families (mechanical, administrative, general, and electronics). These job families were determined by clustering regression equations of the ASVAB tests (Alley, Treat, & Black, 1988) and policy decisions by senior executives. As previously noted, only electronics and mechanical jobs were considered in this experiment because there are no job-specific technical knowledge tests on the ASVAB for administrative or general jobs.

The Air Force uses both general ability (i.e., Armed Forces Qualification Test, or AFQT) and specific composites (Mechanical, Administrative, General, and Electronics) of the ASVAB for placing applicants into specific jobs. All applicants for enlistment are screened on *g* via the composite of two verbal and two quantitative tests (i.e., AFQT). For jobs in the electronics family, applicants must also achieve minimum scores on a composite made up of Electronics = AR + MK + EI + GS. EI provides a measure of prior job knowledge for electronics jobs. Applicants for mechanical jobs must qualify on a composite made up of Mechanical = MC + GS + 2 A/S. MC and A/S are measures of prior job knowledge for mechanical jobs. Even though GS is a measure of technical knowledge, it is not a content-relevant measure of job knowledge for these electronics or mechanical occupations.

The assignment of jobs to job families and minimum test score requirements are controlled by official regulations. Electronics jobs include the broad areas of aircraft electronics, communications-electronics repair and maintenance, missile electronics maintenance, precision measurement equipment repair and calibration, and others. Mechanical jobs include the broad areas of missile, vehicle, and airframe maintenance, munitions and weapons, fuels, structural/pavements, and others.

Analyses

Data were combined across the electronics and mechanical job families as Ree et al. (in press) reported that the model combining all jobs did not differ from models based on specific job families. This general model was superior to the job-family-specific models (electronics or mechanical separately) as the measure of prior job knowledge (JK_P) was more reliable because it was based on three tests (EI, MC, and A/S) rather than one (electronics = EI) or two (mechanical = MC and A/S).

Participants represented a range-restricted sample because they had been selected, at least in part, on the basis of their ASVAB scores. To correct for the estimation bias introduced by range restriction, each group-specific correlation matrix of test scores and criterion was corrected. The multivariate procedure of Lawley (1943) was used within each sex and ethnic group to correct the mean, variance, and correlation estimates of the tests and criterion back to that particular group's normative sample (Bock & Moore, 1984; Ree & Wegner, 1990).

Structural equation analyses based on the range-restricted-corrected correlations were estimated with the LISREL 8 program (Jöreskog & Sörbom, 1993). All measurement models included a mixture of latent and observed variables.

General cognitive ability (*g*) was a latent variable derived from the verbal (PC, WK) and quantitative (AR, MK) tests. An Eigenanalysis of the four cognitive tests was done separately for males, females, Whites, Blacks, and Hispanics to determine whether *g* was being measured in the same way for each group. The magnitude of the Eigenvalues was examined. A relatively large first Eigenvalue would be consistent with a general factor.

Prior job knowledge (JK_P) was a latent variable derived from the Electronics Information (EI), Mechanical Comprehension (MC), and Auto and Shop Information tests (A/S). The criterion, subsequent job knowledge (JK_S), was an observed variable. The reliability (.80) of the observed criterion was taken from a study of validity generalization by Pearlman, Schmidt, and Hunter (1980). This value was used in the structural equation analysis.

The models tested were designed to compare the majority group (males or Whites) with the minority group (females, Blacks, or Hispanics). The base model had all restrictions in place, thus imposing the same model for the two groups being compared (males vs. females, Whites vs. Blacks, or Whites vs. Hispanics). Subsequent models relaxed restrictions on the means, variances, and causal links in a prescribed order. If the release of a constraint results in a significantly better fit (e.g., reduced chi-square), this is support for differing models for the groups being compared (i.e., lack of invariance), and thus, evidence for potential bias.

Once the final model was determined for each pair of groups (males vs. females, Whites vs. Blacks, and Whites vs. Hispanics), the direct and indirect influence for each antecedent variable was calculated as was the R^2 for the dependent variable of subsequent job knowledge. Goodness-of-fit for the structural models was measured by the chi-square value, Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). The CFI is an extension of the Tucker-Lewis (TLI) fit index, but is less sensitive to sample size than the TLI. CFI values above .90 are considered as good fit. Model chi-square and RMSEA provide measures of error per parameter estimated. The lower the chi-square and RMSEA the better.

RESULTS

Tables 1a and 1b show the means and standard deviations for the seven ASVAB tests and criterion by group. Prior to correction-for-range restriction, females had higher means than males on all four verbal and quantitative tests that contribute to the measure of *g* (average *d* value of -.299). Males, however, scored higher on the three technical knowledge tests (average *d* value of .942). After correction for-range-restriction to the normative samples, the difference on the verbal and quantitative tests almost vanished (average *d* of .055), but males still scored higher than females on the technical knowledge tests (average *d* of .868).

Table 1. Means and Standard Deviations of the Scores by Group

a. Males and Females

	Observed				Corrected for Range Restriction			
	Males		Females		Males		Females	
Score	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AR	54.78	6.32	55.59	6.04	51.33	10.22	48.55	9.58
WK	54.22	4.77	56.28	4.11	49.92	10.23	50.03	9.68
PC	54.98	5.11	57.04	3.96	49.12	10.41	50.97	9.54
A/S	58.32	6.50	49.38	5.82	55.18	9.81	44.60	6.84
MK	54.80	7.53	56.45	7.02	50.70	10.32	49.28	9.57
MC	58.52	6.45	54.20	6.25	53.78	10.22	46.10	8.19
EI	56.77	7.00	51.45	6.40	53.55	10.02	46.28	8.53
Criterion	87.45	6.24	86.20	6.15	84.30	8.50	81.12	8.29

b. Whites, Blacks, and Hispanics

	Observed						Corrected for Range Restriction					
	Whites		Blacks		Hispanics		Whites		Blacks		Hispanics	
Score	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AR	55.23	6.23	52.01	6.20	54.05	6.04	51.87	9.53	41.45	7.31	43.84	8.98
WK	54.75	4.59	52.71	4.89	51.65	5.45	52.14	8.38	40.25	10.76	43.15	11.07
PC	55.45	4.92	53.32	5.50	54.24	5.25	51.94	8.78	41.75	10.80	43.53	11.50
A/S	58.44	6.53	51.27	6.63	54.60	6.70	51.92	9.35	41.07	7.41	47.12	10.08
MK	55.00	7.56	54.19	6.97	54.65	7.23	51.54	9.78	43.41	7.71	44.51	9.19
MC	58.78	6.33	53.44	6.45	56.27	6.28	51.93	9.52	41.28	7.15	44.02	9.55
EI	56.72	7.04	53.33	7.00	54.30	7.02	51.98	9.17	41.10	8.33	43.30	10.18
Criterion	87.66	6.19	85.05	6.05	86.19	6.36	84.32	7.81	77.97	6.98	78.75	8.40

Whites scored higher than Blacks and Hispanics on all tests, both prior to and after correction for range restriction. Prior to correction, Whites averaged .373 *d* higher than Blacks and .288 *d* higher than Hispanics on the verbal and quantitative tests. They also averaged .806 *d* and .433 *d* higher on the technical knowledge tests. These mean differences increased after correction for range restriction (1.117 *d* and 1.104 *d* for the verbal and quantitative tests; 1.165 *d* and .751 *d* for the technical knowledge tests).

Tables 2a through 2e show the correlations of the tests and criterion by group. Note that the corrected intercorrelations differ across sex and ethnic groups as each group was corrected back to its normative sample. Corrected correlations were used in all analyses that follow.

Table 2. Correlations of the Scores by Group

a. Males

Score	AR	WK	PC	A/S	MK	MC	EI	Criterion
AR	1.0000	0.3165	0.3297	0.1516	0.6464	0.4431	0.2980	0.3863
WK	0.7231	1.0000	0.4827	0.2106	0.3411	0.3502	0.4165	0.2937
PC	0.7172	0.8159	1.0000	0.1476	0.3138	0.2775	0.3101	0.2813
A/S	0.5558	0.6525	0.5693	1.0000	-0.0025	0.3691	0.4285	0.2344
MK	0.8313	0.6830	0.6699	0.4327	1.0000	0.3894	0.3017	0.3803
MC	0.7028	0.6824	0.6382	0.7468	0.6164	1.0000	0.4280	0.3285
EI	0.6857	0.7760	0.6899	0.7478	0.6196	0.7666	1.0000	0.3422
Criterion	0.6963	0.6751	0.6500	0.5892	0.6609	0.6460	0.6713	1.0000

b. Females

Score	AR	WK	PC	A/S	MK	MC	EI	Criterion
AR	1.0000	0.2600	0.2700	0.0097	0.6270	0.2959	0.2303	0.3657
WK	0.7070	1.0000	0.4399	0.1602	0.2354	0.2086	0.3218	0.2574
PC	0.6671	0.7937	1.0000	0.0843	0.2501	0.1594	0.2454	0.2369
A/S	0.5479	0.6052	0.5537	1.0000	-0.1336	0.2670	0.2576	0.0492
MK	0.8216	0.6590	0.6214	0.4783	1.0000	0.2272	0.2248	0.3725
MC	0.6767	0.5985	0.5602	0.5816	0.6329	1.0000	0.2656	0.1363
EI	0.6257	0.6880	0.6078	0.6247	0.5800	0.6054	1.0000	0.2358
Criterion	0.6774	0.6671	0.6263	0.4962	0.6580	0.5282	0.5788	1.0000

c. Whites

Score	AR	WK	PC	A/S	MK	MC	EI	Criterion
AR	1.0000	0.3284	0.3359	0.0893	0.6583	0.4127	0.2772	0.3736
WK	0.6617	1.0000	0.4876	0.0998	0.3666	0.2937	0.3711	0.2855
PC	0.6224	0.7522	1.0000	0.0545	0.3365	0.2276	0.2686	0.2703
A/S	0.4333	0.3964	0.2766	1.0000	-0.0281	0.3645	0.4568	0.2159
MK	0.8147	0.6306	0.5882	0.3099	1.0000	0.3785	0.2889	0.3777
MC	0.6352	0.5054	0.4245	0.6995	0.5470	1.0000	0.4391	0.3166
EI	0.5939	0.6053	0.4684	0.7002	0.5215	0.7023	1.0000	0.3400
Criterion	0.6410	0.5790	0.5283	0.4825	0.6078	0.5675	0.5867	1.0000

d. Blacks

Score	AR	WK	PC	A/S	MK	MC	EI	Criterion
AR	1.0000	0.1447	0.1814	-0.0490	0.5759	0.2550	0.1402	0.3203
WK	0.6218	1.0000	0.4079	0.0485	0.2246	0.2011	0.2851	0.1667
PC	0.6012	0.7940	1.0000	-0.0204	0.1909	0.1236	0.1842	0.1614
A/S	0.4815	0.5240	0.4425	1.0000	-0.1689	0.2510	0.3070	0.0521
MK	0.7243	0.6460	0.6280	0.4317	1.0000	0.2299	0.1499	0.3377
MC	0.5046	0.5197	0.4625	0.5968	0.4874	1.0000	0.2948	0.1458
EI	0.5391	0.6339	0.5533	0.6272	0.5105	0.6048	1.0000	0.2005
Criterion	0.5294	0.5138	0.4924	0.3953	0.5391	0.3796	0.4584	1.0000

e. Hispanics

Score	AR	WK	PC	A/S	MK	MC	EI	Criterion
AR	1.0000	0.1877	0.2236	0.0109	0.6285	0.3244	0.2185	0.3556
WK	0.7109	1.0000	0.4481	0.1872	0.1756	0.2707	0.2673	0.1905
PC	0.6754	0.7981	1.0000	0.0504	0.2097	0.1857	0.2213	0.2103
A/S	0.5944	0.6433	0.5691	1.0000	-0.0989	0.2776	0.3237	0.1490
MK	0.8046	0.6608	0.6489	0.5201	1.0000	0.2972	0.2655	0.3839
MC	0.6908	0.6368	0.5918	0.7341	0.6370	1.0000	0.3152	0.2174
EI	0.6958	0.7217	0.6611	0.7497	0.6506	0.7430	1.0000	0.2976
Criterion	0.6660	0.6257	0.6154	0.5792	0.6550	0.5859	0.6411	1.0000

Note: Correlations above the diagonal are observed; below the diagonal were corrected-for-range restriction (Lawley, 1943).

Eigenanalyses of the four tests used to measure *g* were done separately for each group. In each case, one large factor was disclosed that accounted for most of the variance (males, 80.5%; females, 78.4%; Whites, 75.9%; Blacks, 75.2%; Hispanics, 78.8%). Minor verbal and quantitative content factors accounted for the remaining variance. This is consistent with an earlier experiment that examined factor structure of the ASVAB for sex and ethnic groups (Ree & Carretta, 1995). Others have defined this common variance as *g* (Jensen, 1980) and have used scores from these tests as measures of *g* (Herrnstein & Murray, 1994).

Table 3 provides the correlations among the latent variables for each group as estimated in the measurement model by LISREL 8.

Table 3. Correlations Among the Latent Variables by Group

Males			Females		
g	JK_P	JK_S	g	JK_P	JK_S
1.000			1.000		
0.903	1.000		0.904	1.000	
0.778	0.758	1.000	0.772	0.694	1.000

Whites			Blacks			Hispanics		
g	JK_P	JK_S	g	JK_P	JK_S	g	JK_P	JK_S
1.000			1.000			1.000		
0.806	1.000		0.808	1.000		0.874	1.000	
0.725	0.677	1.000	0.625	0.546	1.000	0.749	0.709	1.000

Note: Correlations were estimated by the structural equation program. *g* is general cognitive ability. JK_P is prior job knowledge, and JK_S is subsequent job knowledge acquired during training.

The models fit the data well. Table 4 summarizes the sequential model testing for the models comparing males and females, Whites and Blacks, and Whites and Hispanics. Consistent with the mean and standard deviation comparisons reported in Table 1, release of the constraints involving means and variances led to substantial improvement in model fit. Relaxing constraints involving path values also helped improve fit (as measured by reduction in chi-square) but by a lesser amount.

The final group-specific causal models with all constraints released are shown in Figure 2a through 2c. The impact of *g* on JK_P was nearly identical for men and women (.904 vs. .903 for $g \rightarrow JK_P$), but the values for the other two paths differed. The $g \rightarrow JK_S$ path was much stronger for women (.793) than for men (.504), whereas the $JK_P \rightarrow JK_S$ path was stronger for men (.303) than for women (-.024). However, the total of the direct and indirect effects of *g* on JK_S was about the same for both sexes (.778 for men and .772 for women). The R^2 values for JK_S were .622 for men and .596 for women.

Table 4. Summary of Model Testing Results by Group Comparison

a. Males vs. Females

Restrictions Relaxed	Chi-Square	df	df Difference	Diff.	RMSEA	CFI
1. None: everything fixed	20,489	60	----	----	0.0901	0.948
2. Means for JK_P free	13,379	57	3	7,110	0.0746	0.957
3. Means for JK_S free	12,552	56	1	827	0.0729	0.959
4. Mean for *g* free (same as all means free)	11,354	52	4	1,196	0.0720	0.962
5. Variances of latent variables free	11,009	49	3	345	0.0730	0.963
6. Variances of observed variables free	10,703	42	7	306	0.0778	0.964
7. Path from $JK_P \rightarrow$ observed variables free	10,648	40	2	55	0.0795	0.964
8. Path from $g \rightarrow$ observed variables free	10,584	37	3	64	0.0824	0.965
9. Path from $g \rightarrow JK_P$ free	10,212	36	1	372	0.0821	0.966
10. Path from $g \rightarrow JK_S$ free	10,206	35	1	6	0.0832	0.966
11. Path from $JK_P \rightarrow JK_S$ free	10,121	34	9	85	0.0841	0.966

b. Whites vs. Blacks

Restrictions Relaxed	Chi-Square	df	df Difference	Diff.	RMSEA	CFI
1. None: everything fixed	21,954	60	----	----	0.0957	0.960
2. Means for JK_P free	20,417	57	3	1,537	0.0947	0.956
3. Means for JK_S free	20,408	56	1	9	0.0955	0.956
4. Mean for *g* free (same as all means free)	13,410	52	4	6,998	0.0803	0.940
5. Variances of latent variables free	12,830	49	3	580	0.0809	0.943
6. Variances of observed variables free	11,991	42	7	839	0.0845	0.946
7. Path from $JK_P \rightarrow$ observed variables free	11,816	40	2	175	0.0860	0.947
8. Path from $g \rightarrow$ observed variables free	10,205	37	3	1,611	0.0831	0.954
9. Path from $g \rightarrow JK_P$ free	10,141	36	1	64	0.0839	0.955
10. Path from $g \rightarrow JK_S$ free	10,130	35	1	11	0.0851	0.955
11. Path from $JK_P \rightarrow JK_S$ free	10,082	34	1	48	0.0861	0.955

c. Whites vs. Hispanics

Restrictions Relaxed	Chi-Square	df	df Difference	Diff	RMSEA	CFI
1. None: everything fixed	11,975	60	----	----	0.0735	0.971
2. Means for JK_P free	11,661	57	3	314	0.0745	0.969
3. Means for JK_S free	11,659	56	1	2	0.0751	0.969
4. Mean for *g* free (same as all means free)	10,428	52	4	1,231	0.0737	0.951
5. Variances of latent variables free	10,364	49	3	64	0.0757	0.951
6. Variances of observed variables free	10,222	42	7	142	0.0813	0.952
7. Path from $JK_P \rightarrow$ observed variables free	10,189	40	2	33	0.0831	0.952
8. Path from $g \rightarrow$ observed variables free	9,986	37	3	203	0.0856	0.953
9. Path from $g \rightarrow JK_P$ free	9,885	36	1	101	0.0863	0.953
10. Path from $g \rightarrow JK_S$ free	9,880	35	1	5	0.0875	0.953
11. Path from $JK_P \rightarrow JK_S$ free	9,870	34	1	10	0.0888	0.953

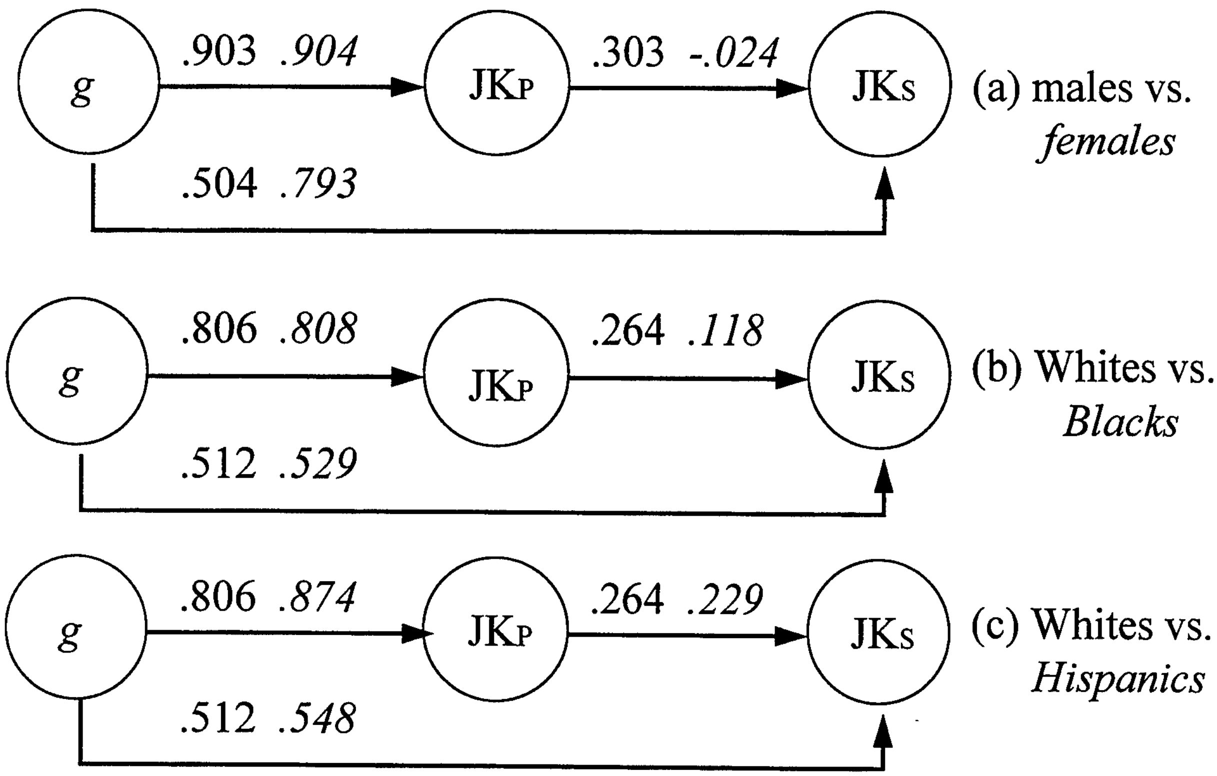

Figure 2. Path models for group comparisons.

Note. Figure 2a, 2b, and 2c compare males and females, Whites and Blacks, and Whites and Hispanics, respectively. The path coefficients for females, Blacks, and Hispanics are in italics.

The White-Black and White-Hispanic comparisons produced similar, but not identical, causal models for those groups. The impact of *g* on JK_P was nearly identical for Whites (.806) and Blacks (.808), but slightly greater for Hispanics (.874). The $g \rightarrow JK_S$ values were .512, .529, and .548 respectively, for Whites, Blacks, and Hispanics, and the $JK_P \rightarrow JK_S$ values were .264, .118, and .229. The total effect of *g* on JK_S was greater for Whites (.725) and Hispanics (.749) than for Blacks (.625). Also, the R^2 values for JK_S were greater for Whites (.550) and Hispanics (.573) than for Blacks (.395).

DISCUSSION

Although the joint models that fixed parameter estimates to be equal between pairs of groups fit the data well, the sequential model tests comparing joint models for males and females, Whites and Blacks, and Whites and Hispanics indicated that model fit could be improved substantially by allowing separate group estimates of the parameters. Relaxing equality constraints for means and variances was especially helpful in improving model fit. This is not surprising given the long history of observing group mean differences on aptitude tests.

The effect of g on acquisition of subsequent job knowledge was greater than the effect of prior job knowledge for all groups--this is consistent with Hunter (1983). However, the relative impact of g versus prior job knowledge and the manner in which it exerted its influence (directly vs. indirectly through JK_P) varied substantially by group.

For men and women, total causal influence of g on subsequent job knowledge was about equal (.778 vs. .772) as was the amount of variance accounted for in subsequent job knowledge (R^2) by the antecedent variables (.622 vs. .596). However, the influence of g was split between direct and indirect for men whereas for women, it was entirely direct. This is consistent with a research effort on the role of ability and prior job knowledge on the acquisition of additional job knowledge and work sample performance for male and female pilot trainees (Carretta & Ree, 1997a). Carretta and Ree found that g exerted a greater causal influence for women than for men, but that the variance accounted for in the final training performance criteria was about equal for both sexes.

Perhaps the most surprising result in the current experiment was the near zero $JK_P \rightarrow JK_S$ causal path for women. This implies no role for prior job knowledge in the acquisition of subsequent job knowledge for women. We can speculate this is because of the relatively low level of technical knowledge for women. As noted elsewhere (Ree & Carretta, 1995), in high school-level students, males have traditionally been much more likely than females to enroll in classes in electronics, automotive shop, and machine shop. In contrast, both sexes enroll almost uniformly in English and mathematics courses. Women must apply their intelligence to learning the technical material during training that they have not learned prior to training.

For the ethnic groups, total causal influence of g on subsequent job knowledge was somewhat greater for Whites and Hispanics than for Blacks. However, relative effect of g versus prior job knowledge on subsequent job knowledge was less for Whites (.725/.264 = 2.75 times) and Hispanics (.749/.229 = 3.27 times) than for Blacks (.625/.118 = 5.29 times). It should also be noted that the amount of variance accounted for in subsequent job knowledge by the antecedent variables was greater for Whites (.550) and Hispanics (.573) than it was for Blacks (.395). The cause for this is unknown, but appears related to the weak causal link from $JK_P \rightarrow JK_S$ for Blacks.

These results suggest that measures of g will be better predictors of training performance than measures of prior job knowledge. This appears especially true for women and Blacks. One possible reason for this is that women and Blacks are less likely to acquire the type of prior job knowledge measured by the ASVAB tests than are males, Whites, and Hispanics. Evidence for this interpretation is provided by the large male-female and White-Black mean score differences observed on the technical knowledge tests. As a result of their relatively poor prior technical knowledge, women and Blacks can be expected to rely more on their general cognitive ability when entering these technical training programs. Implications for selection applications are that tests of general cognitive ability may be beneficial for recruiting qualified women and Blacks. This may cause problems with apparent job relatedness, but using tests of general cognitive ability will serve the testing agency and the applicant.

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