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SUBJECT: Additional submission of studies to fortify transfer of function memo

REMARKS/COMMENTS:

These submissions were just received from our outlying branch. Sorry for the additional fax traffic; but I think you'll find these studies of particular interest.

Miller, Darrin A.

From: Weeks, Joseph L.
To: Miller, Darrin A.
Cc: Carretta, Thomas R.
Subject: FW: Input for Darran Miller request
Date: Tuesday, September 30, 1997 10:26AM

The attached file is from Tom. My input is as follows:

Historically, personnel data bases have been used to provide empirical information to conduct analyses and formulate responses to both internal inquiries (e.g., personnel test bias and personnel test validity) and external inquiries (e.g. the adverse impact of Air Force personnel testing systems) pertaining to personnel selection systems. The issue of adverse impact of personnel tests is one that will continue to surface as our national population diversifies. Census projections indicate that from 1990 to 2050 the Hispanic population will increase from 9 to 21 percent, the Black population will increase from 12 to 15 percent, the population of other minorities will increase from 4 to 11 percent and the White population will decrease from 78 to 53 percent. The increasing diversification of our national population will result in increased pressures for monitoring both the utility and adverse impact of personnel testing systems and will increase the appreciation of personnel data systems. The preservation and maintenance of personnel and training data bases refined by the Data Base function have been and will continue to be essential to the intelligent management of personnel issues within the Air Force.

From: Carretta, Thomas R.
To: Weeks, Joseph L.
Subject: Input for Darran Miller request
Date: Thursday, September 25, 1997 4:06PM

Joe,

Attached is my input. I have summarized several studies of group differences that would not have been possible without support from the database development section. Please pass this on to Darran as you see fit.

Tom

<<File Attachment: GROUPSUM.DOC>>

Recent Studies of Sex and Ethnic Group Differences on US Air Force Personnel Measurement Tests

The performance of sex and ethnic groups on ability tests has come under increasing scrutiny, especially when the tests are used for personnel selection in educational and occupational settings. The U. S. Air Force (USAF) has shown a long-term interest in ensuring equal opportunity and fair employment practices. Issues of interest include whether the tests measure the same things for all groups (i.e., factorial invariance), group mean score differences, and differential validity against training and on-the-job performance criteria.

In response to these issues, we routinely evaluate both operational and experimental test batteries for group differences. These analyses could not have been done without support from our database development section.

Below are listed several studies we have performed recently with the support of the files developed and maintained by our database development section:

1. Carretta, T. R. (1997). Group differences on US Air Force pilot selection tests. *International Journal of Selection and Assessment*, 5, 115-127.

Sex and ethnic group differences were examined on the operational composites and tests used to select applicants for U. S. Air Force officer commissioning programs and for pilot training. Results showed that large mean score differences in applicant samples were substantially reduced among the pilot trainees. Despite differences in test performance, there was no evidence of differential validity for groups. When group differences in predicted pilot training completion rate were observed, performance was overestimated for the minority group relative to the majority group. When regression equations were adjusted for unreliability of the predictors, the observed differences in intercepts were reduced or eliminated. No prediction bias was observed against the minority groups.

2. Carretta, T. R. (1997). Male-female performance on U. S. Air Force pilot selection tests. *Aviation, Space, and Environmental Medicine*, 68, 818-823.

Recently, the U. S. Air Force has conducted several studies to examine sex differences on pilot selection tests and training performance. Research has focused on mean score performance, the structure of ability, the predictive utility of pilot selection tests, and the causal role of ability and prior flying knowledge in the acquisition of additional flying knowledge and flying skills. Despite male-female mean score differences on pilot selection tests, confirmatory factor analyses indicated that the same factors were being measured for both groups. In studies of predictive bias, no evidence of differential validity was found for male versus female pilot trainees. An examination of causal models of ability and prior flying knowledge on the acquisition of additional flying knowledge and flying skills showed similar structure for men and women.

3. Carretta, T. R., & Doub, T. W. (in press). Group differences in the role of *g* and prior job knowledge in the acquisition of subsequent job knowledge. *Personality and Individual Differences*.

Based on data from 83 independent studies with a total sample of 42,399 participants, structural equation models were used to test three theories of the role of ability and prior job knowledge on the acquisition of subsequent job knowledge. Ability and prior job knowledge were measured before entering job training, and subsequent job knowledge was measured at the completion of job training. The three models were: a) a role for ability only, b) a role for prior job knowledge only, and c) a role for both ability and prior job knowledge. Results supported the model with a role for both ability and prior job knowledge. The R^2 for predicting subsequent job knowledge for the model including all jobs was .80. Three other analyses were conducted within job families with very similar results. In all analyses, the causal impact of ability was far greater than the causal impact of prior job knowledge. In the model that included all jobs, the causal impact of ability was about three times that of prior job knowledge.

4. Carretta, T. R., & Ree, M. J. (1995). Near identity of cognitive structure in sex and ethnic groups. *Personality and Individual Differences*, 19, 149-155.

Comparisons of aptitude factor structures were made in large samples of young Americans who took a multiple aptitude test battery. The factor model that was used had been statistically confirmed. It included hierarchical *g* and 5 lower-order factors representing Verbal, Math, Spatial, Technical Knowledge, and Perceptual Speed. The model showed good fit for both the sexes (male and female) and ethnic group (White, Black, Hispanic, Asian-American, and Native-American) comparisons. The proportions of total and common variance accounted for by *g* and the 5 lower-order factors were similar for men and women and for all 5 ethnic groups. Confirmatory factor techniques that imposed statistical constraints tested if the loadings of the tests were the same for both sexes and for Whites versus each of the other ethnic groups. Although many of the tests of the differences in the loadings were statistically significant, most differences were small in magnitude (less than .05). The most notable differences occurred for a test of aviation knowledge. It had a lower loading for men than for women on both hierarchical *g* and on the lower-order Technical Knowledge factor. It also had a lower loading for Whites than for Blacks and Asian-Americans on the lower-order Technical Knowledge factor. Correlations between factor loadings for the sex groups and for all pairs of ethnic groups were very high, approaching $r = 1.0$. Regressions between pairs of groups indicated that there was no mean difference in loadings between males and females and among the ethnic groups. These findings, along with previous research, present a consistent picture of near identity of structure of intellect for sex and ethnic groups.

5. Carretta, T. R., & Ree, M. J. (1997). A preliminary evaluation of causal models of male and female acquisition of pilot skills. *The International Journal of Aviation Psychology*, 7, 353-364.

Based on a previous study, a causal model of acquisition of pilot job knowledge and flying skills was tested on separate samples of male and female students. Causal model parameters were estimated separately for each sample and due to the small sample size for females, no between-groups statistical tests were conducted. The results are viewed as tentative because of the small sample of female students, however, the path coefficient parameter estimates are still useful. The model showed a direct influence of general cognitive ability on the acquisition of job knowledge and an indirect influence on the acquisition of flying skills. The direct and indirect influence of cognitive ability on flying skills was a little stronger for females than for males. Additionally, the path between prior job knowledge and flying performance was somewhat stronger for females than for males. Consistent with previous findings, the influence of early flying skills on later flying skills was very strong. No argument for a sex separated training syllabus is supported.

6. Carretta, T. R., & Ree, M. J. (1997). Negligible sex differences in the relation of cognitive and psychomotor abilities. *Personality and Individual Differences*, 22, 165-172.

Comparisons of cognitive and psychomotor aptitude factor structure were made for samples of men and women. The factor model was previously confirmed. It included two higher-order factors representing general cognitive ability (*g*) and psychomotor/technical knowledge (PM/TK) as well as 10 lower-order cognitive and psychomotor factors. All cognitive and psychomotor tests contributed to the factor representing *g*. The PM/TK factor was interpreted as representing Vernon's (1969) practical factor (*k:m*). The model showed acceptable fit for both sexes. The proportion of total and common variance accounted for by the higher-order factors and lower-order factors were similar for men and women. Confirmatory factor techniques that imposed statistical constraints tested if the factor loadings were the same for both groups. Although some of the differences in loadings were statistically significant, they were small in magnitude (0.05 or less). The most notable differences occurred for the loadings of two technical knowledge tests on *g* and for a single psychomotor test on PM/TK. All three tests had higher loadings for men than for women. Correlations between factor loadings for men and women approached $r = 1.0$. These results are consistent with previous research supporting the near identity of ability structure for men and women.

7. Ree, M. J., & Carretta, T. R. (1995). Group differences in aptitude factor structure on the ASVAB. *Educational and Psychological Measurement*, 55, 268-277.

Comparisons of aptitude factor structure were made in large, nationally representative samples of young Black, White, and Hispanic men and women who took the Armed Services Vocational Aptitude Battery (ASVAB). Confirmatory factor techniques imposing statistical constraints tested if the loadings of the tests were the same for sex and ethnic groups on a hierarchical general cognitive ability (*g*) factor and three residualized lower-order factors which included Verbal/Math, Technical Knowledge, and Speed. Tests that reflected common content in high school curricula, such as verbal and math, showed little sex or ethnic differences. The most outstanding difference was found

between men and women on the loading of the Electronics Information test on g and on the lower-order Technical Knowledge factor. In both cases, the loading was about zero for females and moderate for males. Patterns in high school course enrollment by sex suggested the reason for the difference. Women are much less likely to enroll in courses emphasizing technical knowledge.