DOCUMENT RESUME

ED 097 358 TM 003 987

AUTHOR	Wilbourn, James M.; Guinn, Nancy
TITLE	Feasibility of Using Special Measures in the Classification and Assignment of Lower Mental Ability Airmen.
INSTITUTION	Air Force Human Resources Lab., Lackland AFB, Tex. Personnel Research Div.
REPORT NO	AFHRL-TR-73-31
PUB DATE	Nov 73
NOTE	22p.
EDRS PRICE	MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS	*Ability; Aptitude Tests; Classification; Enlisted Men; *Nonverbal Tests; *Predictive Ability (Testing); Predictor Variables; *Selection; Test Validity; *Vocational Schools

ABSTRACT

A battery of 11 nonverbal tests were administered to a sample of 2,362 non-prior service enlistees who had been selected to one of seven technical schools. The usefulness of additional aptitudinal and educational data was also investigated. The number of significant relationships between certain nonverbal tests and final technical school grade varied as a function of mental category and career field. When all nonverbal tests were used as a composite, significance was found in all courses for the total group and in three of five courses for the lower mental ability groups. On cross-validation the number of significant relationships between the nonverbal composite and final school grade were reduced to four total group courses and one lower ability group course. When added to the selector aptitude index (AI), the nonverbal tests made a significant and unique contribution to the prediction of technical school success over and beyond the selector AI alone. Further investigation indicated that additional aptitudinal and educational data added significantly to the prediction system in some courses. Results indicate that the use of nonverbal tests as well as other aptitudinal and educational data could make a significant contribution if added to the operational selection and classification battery. (Author)

AFHRL-TR-73-31

AIR FORCE HUMAN RESOURCES LABORATORY

FEASIBILITY OF USING SPECIAL MEASURES IN THE CLASSIFICATION AND ASSIGNMENT OF LOWER MENTAL ABILITY AIRMEN

By

James M. Wilbourn
Nancy Guinn

PERSONNEL RESEARCH DIVISION
Lackland Air Force Base, Texas 78236

November 1973

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

NOTICE

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This report was submitted by Personnel Research Division, Air Force Human Resources Laboratory (AFSC), Lackland Air Force Base, Texas 78236, under project 7719.

This report has been reviewed and cleared for open publication and/or public release by the appropriate Office of Information (OI) in accordance with AFR 190-17 and DoDD 5230.9. There is no objection to unlimited distribution of this report to the public at large, or by DDC to the National Technical Information Service (NTIS).

This technical report has been reviewed and is approved.

LELAND D. BROKAW, Technical Director
Personnel Research Division

Approved for publication.

HAROLD E. FISCHER, Colonel, USAF
Commander

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFHRL-TR-73-31

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE *(and Subtitle)*: FEASIBILITY OF USING SPECIAL MEASURES IN THE CLASSIFICATION AND ASSIGNMENT OF LOWER MENTAL ABILITY AIRMEN

5. TYPE OF REPORT & PERIOD COVERED

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

James M. Wilbourn
Nancy Guinn

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS

Personnel Research Division
Air Force Human Resources Laboratory
Lackland Air Force Base, Texas 78236

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

77190901

11. CONTROLLING OFFICE NAME AND ADDRESS

HQ Air Force Human Resources Laboratory
Brooks Air Force Base, Texas 78235

12. REPORT DATE

November 1973

13. NUMBER OF PAGES

20

14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*

15. SECURITY CLASS. *(of this report)*

Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

non-verbal aptitude battery
validation
selector AI
educational variables
selection and classification
technical school success

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

A battery of eleven non-verbal tests were administered to a sample of 2,362 non-prior service enlistees who had been selected to one of seven technical schools. The usefulness of additional aptitudinal and educational data was also investigated.

The number of significant relationships between certain non-verbal tests and final technical school grade varied as a function of mental category and career field. When all non-verbal tests were used as a composite, significance was found in all courses for the total group and in three of five courses for the lower mental ability groups. On cross-validation the number of significant relationships between the non-verbal composite and final school grade were reduced to four total group courses and one lower ability group course.

(OVER)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

Item 20 (Continuted).

When added to the selector aptitude index (AI), the non-verbal tests made a significant and unique contribution to the prediction of technical school success over and beyond the selector AI alone. Further investigation indicated that additional aptitudinal and educational data added significantly to the prediction system in some courses.

Results indicate that the use of non-verbal tests as well as other aptitudinal and educational data could make a significant contribution if added to the operational selection and classification battery.

PREFACE

This work was conducted under Project 7719, Air Force Personnel System Development on Selection, Assignment, Evaluation, Quality Control, Retention, Promotion, and Utilization; Task 771909, Development and Validation of Specialized Test Measures for Specific Subgroups of Air Force Personnel.

This research was accomplished in support of RPR 69-21, Nonverbal Aptitude Assessment.

TABLE OF CONTENTS

		Page
I.	Introduction	5
II.	Method	5
III.	Results and Discussion	6
	Validity of the Non-Verbal Tests	6
	Comparison of Predictive Efficiency of Selector AI versus Non-Verbal Battery	7
	Usefulness of Additional Aptitudinal and Education Data in Predicting Training Performance	7
IV.	Summary and Conclusions	8
	References	19

LIST OF TABLES

Table		Page
1	Technical Training Courses	10
2	Description of the Non-Verbal Tests	11
3	Samples Sizes	12
4	Correlations Between Non-Verbal Tests and Final Technical School Grade–Validation Sample	13
5	Means and Standard Deviations of Non-Verbal Tests–Validation Sample	14
6	List of Variables	15
7	Subtests and Aptitude Composites Comprising the Airman Qualifying Examination–66	16
8	The Stability of Multiple Correlations as a Result of Cross-Application of Regression Weights	17
9	Results of Regression Analyses–Validation Sample	18

FEASIBILITY OF USING SPECIAL MEASURES IN THE CLASSIFICATION AND ASSIGNMENT OF LOWER MENTAL ABILITY AIRMEN

I. INTRODUCTION

The traditional approach in the selection and classification of Air Force personnel has been to assess the ability of a prospective airman by various paper-and-pencil tests. Then, based on the individual's demonstrated test performance, his interests, AF needs, and the specified prerequisites of the particular career field, the airman is assigned to one of the several career specialties for which he qualifies. However, for some time, there has been a growing concern as to whether these conventional aptitude measures completely reflect an individual's capability. Numerous factors have been identified as having an adverse effect on test scores: lack of motivation, poor educational opportunities, limited exposure to the various news and information media, reading disability, and inadequacies in the family's educational, cultural, social, and economic background (Freeberg, 1970; Anastasi, 1968).

A search for valid measures to be used with disadvantaged personnel has resulted in the development of various culture-fair, non-verbal, and non-cognitive measures (Pintner, 1945; Porteus, 1950; Cattell, 1950; Raven, 1941). In the military setting, one of the initial efforts to test illiterate or disadvantaged personnel resulted in the development of the Army Beta during World War I (Yerkes, 1921). In 1950, another project was initiated by the U.S. Army to derive an entirely new non-verbal test of military trainability (Rulon, 1950, 1952; Rulon & Schweiker, 1953). Other governmental agencies have recognized the need for developing a test battery which could be used in lieu of more verbal measures. When Federal-State Employment Service programs were redirected to provide comprehensive services to disadvantaged persons, an attempt was made to adapt testing methods for persons whose experience with tests has been meager and unsuccessful. Since the U.S. Employment Service had found the General Aptitude Test Battery (GATB) a valuable tool to measure aptitudes for job applicants and candidates for occupational training, an effort was made to develop an operational nonreading edition of the GATB (U.S. Dept of Labor, 1968). Currently the U.S. Navy is also investigating the validity of experimental versions of non-verbal measures for possible inclusion in their operational selection procedures.

Overall, non-verbal tests have not been found to correlate well with verbal measures of intelligence. While most verbal tests do correlate fairly well with success in academic endeavors, non-verbal tests have not (Rulon, 1950). In an Army study, however, Maier (1971) found that the specific test content of the non-verbal test was important in placing the test in an academic or mechanical cluster; that is, that certain non-verbal tests, such as shop mechanics, were closely related to mechanical type tests. Others, such as radio code, clerical speed, and pattern analysis were more closely related to academic type tests. Maier concluded that non-verbal tests do not form an independent, separate cluster of their own. Regardless of their relationship to other tests, it is generally recognized that the value of non-verbal measures is not as a substitute for verbal tests but to provide additional information concerning an individual's capabilities (Anastasi, 1968).

The problem of economic utilization of manpower has become increasingly important with the advent of the volunteer force. Recent Air Force studies projecting the quality and quantity of the future force suggest that a large segment of our enlisted personnel will be comprised of airmen with lower aptitude qualifications (Valentine & Vitola, 1970; Vitola & Valentine, 1971; Vitola & Alley, 1972; Vitola & Brokaw, 1973). In an effort to estimate more accurately the true potential of these individuals so that an optimum match can be made between their abilities and job requirements, this research has been designed to evaluate the usefulness of other test measures and/or information to augment and improve the data base upon which selection, classification, and assignment decisions can be made.

II. METHOD

The sample population consisted of 2,362 non-prior service airmen in basic military training, during the period March through June 1971, who received orders to attend one of the seven technical training courses listed in Table 1. Entrants into these particular technical training courses were selected due to the

large input of lower mental ability personnel into these career specialties. Special attention was directed to those airmen who had been classified by their test performance on the Armed Forces Qualifying Test (AFQT) as Category III or IV (i.e., AFQT scores in the 10-64 range).

All subjects were administered a three hour test battery consisting of a biographical inventory and eleven non-verbal tests described in Table 2. Test scores on the aptitude indexes of the Airman Qualifying Examination (AQE) were retrieved from airman record files maintained by the Personnel Research Division, Air Force Human Resources Laboratory. Upon completion of technical training, final school grades were obtained from the technical training files for criterion use.

Technical training course populations were randomly divided into two groups for validation and cross-validation purposes. The specific number of cases in each of the validation groups by technical training course are presented in Table 3.

III. RESULTS AND DISCUSSION

Validity of the Non-Verbal Tests

Table 4 presents the restricted correlations between each of the non-verbal tests and final school grade in technical training for each of the category subgroups by technical training course. Means and standard deviations for these tests are presented in Table 5. For the lower ability subgroups composed of Category III and IV personnel, the relationship between each of the non-verbal tests and final school grade varies widely among the career fields. All tests have a significant relationship with the criterion in the Security Specialist Course (81130). In the Aircraft Maintenance (43131) course, little if any relationship is found between a majority of the non-verbal tests and the criterion. It is realized that the small number of cases in several of the course subgroups tend to make the relationships noted somewhat unreliable. However, the validities of one or more of the non-verbal tests are of sufficient magnitude to emphasize their usefulness in the classification and assignment of lower mental ability personnel. Those non-verbal tests, given to subgroups of Category III and IV personnel, which have a majority of significant correlations across the five career specialties are pattern matching, dial reading, card patterns, wheels and dominoes (Table 4). Those having a larger number of insignificant correlations among subgroups of Category III and IV personnel are mazes, number reversal, coding, number size and precision counting.

In the correlational analysis of subgroups containing all categories of personnel, two additional career fields were added: Law Enforcement (81230) and Medical Service (90230). Although these two career fields did not have a sufficient number of subjects for the Category III and IV analysis, they were included in the total sample analysis in order to explore the usefulness of the non-verbal tests in a wider variety of training courses.

With the larger sample size of the subgroups containing all categories, significant correlations between the non-verbal tests and the criterion are more prevalent. Those tests indicating a sizeable relationship for the total sample across a majority of the courses include number reversal, pattern matching, dial reading, card patterns, wheels, and dominoes. Those indicating insignificant relationships with a larger number of training courses are mazes and number size. Although more tests were found to be significant in the total group analyses, the significance/non-significance of the individual non-verbal tests found in the total group is similar to the results of the Category III and IV analyses.

Multiple linear regression analysis (Bottenberg & Ward, 1963) was used to investigate the usefulness of the non-verbal tests and additional aptitudinal and educational data when used separately or in combination with the selector aptitude index (AI) for predicting final performance in technical training. A list of the variables used in the regression analysis is given in Table 6. Specific subtests included in each AI composite are presented in Table 7.

To determine the stability of the multiple correlations based on various sets of predictor variables from one sample to another, the regression weights computed on one sample from a particular course were cross-applied to the other sample.

The significance of the multiple correlation based on all eleven non-verbal tests was computed and presented in the first column of Table 8. For total samples including all categories, the composite of all

non-verbal tests was significantly related to final school grade in all technical training courses used in this study. For the lower category personnel, the results were more variable. The non-verbal test composite was significant for three of the five courses (i.e., Aircraft Maintenance, 43131; Security, 81130; and Medical Helper, 90010). Correlations were not significant for the Fire Protection (57130) and Administrative (70230) courses. Again, the insignificant correlations for the non-verbal test composite may be due to the small sample size of Category III and IV personnel in these courses.

To give some indication of the stability of the relationships between predictor composites and the criterion, a cross-validation procedure was utilized where regression weights developed on the validation sample were cross-applied to a different sample. The results of this analysis for the non-verbal composite are presented in Table 8. This cross-application resulted in a shrinkage in the size of the multiple correlations in a majority of instances. Due to this shrinkage, the non-verbal composite for the total group was significant after cross-application in only three of the technical courses (43131, 70230, 81230), and for the lower ability group only in the 81130 course did the correlation remain significant. Even though the non-verbal composite was not consistently significant in both validation and cross-validation samples, those instances in which the non-verbal composite remained significant lends credence to the possible value in expanding such research to a larger number of courses to provide a more meaningful evaluation of these measures.

Comparison of Predictive Efficiency of Selector AI versus Non-Verbal Battery

After the usefulness of non-verbal measures has been established, the next question centers on whether a better job of placing the right man in the right job can be accomplished as effectively with the traditional selector aptitude index or by the combined use of the selector aptitude index and the non-verbal battery. Summary of the results of this regression analysis is given in Table 9. A comparison of the squared correlation coefficients used in regression analysis 1 indicates whether the non-verbal tests make a unique and valid contribution over and above the selector aptitude index alone. In every total sample containing all categories, it was found that the non-verbal tests added significantly to prediction of final school grade over the predictive efficiency of the selector aptitude index alone.

For the lower mental ability categories, the non-verbal battery added significantly in three career specialties (43131, 81130, 90010). In the Fire Protection (57130) and Administrative (70230) sample of lower category personnel, no significant contribution was made by the non-verbal tests over and above the selector aptitude index used alone.

As indicated in Table 8, the significance of the relationship between the non-verbal and the selector AI composite and the criterion, when regression weights were cross-applied, produced results identical to the non-verbal composite when used alone.

Usefulness of Additional Aptitudinal and Education Data in Predicting Training Performance

In previous research, the utility of various kinds of preservice educational data that can be economically obtained and used in improving selection and classification procedures has been investigated (Brokaw, 1963; Lecznar, 1964; Judy, 1960, 1965). The types of educational data studied in the past include total number of years of education, high school graduation, courses taken in high school, and estimated level of performance in various academic areas. Results of these studies indicate that such information produces varying degrees of validity with performance in technical training. Overall, high school record information, especially for the lower categories of mental ability, appears to warrant further study of their potential use in the selection process. With the availability of high speed computers, which can assimilate and evaluate a large amount of information rapidly and efficiently, additional aptitudinal and educational data could feasibly be included in the selection process.

To study the predictive efficiency of such data against training criteria, regression equations based on a composite of predictor variables listed in Table 6 (i.e., AQE aptitude indexes, AFQT scores, non-verbal tests, educational level, and type of high school curriculum) were compared to equations based on the combination of only the selector AI and non-verbal tests.

Results of these analyses are presented in Table 9, Regression Analyses 2. For Category III and IV groups, such data added significantly to prediction of training performance in the Aircraft Maintenance (43131) and Medical (90010) courses. In all other training courses, the additional aptitudinal and

educational data made no significant contribution to predictive efficiency over and above a composite of the selector AI and non-verbal battery. For the total group analysis, significance of the additional data was found in the same courses enumerated above plus the Fire Protection (57130) course. Overall, it appears that the usefulness of such data is not universal among career specialties nor do such data add more to predictive efficiency with groups of lower ability personnel than with samples containing all categories of personnel.

The overall significance of the multiple correlations of the composite containing all predictors and the cross-application of weights is identical to the results of the analyses based on the other two composites with one exception (Table 8). For Category III and IV personnel, the original composite correlation for the 57130 career field also reaches statistical significance although the correlation obtained on cross-validation did not reach statistical significance.

IV. SUMMARY AND CONCLUSIONS

In an attempt to strengthen current selection and classification procedures which consist primarily of verbal aptitude tests, a battery of non-verbal tests was assembled to determine whether these measures could be used to assess more accurately the true potential of lower mental ability airmen.

A battery of eleven non-verbal tests along with a biographical inventory was administered to a sample of 2,362 non-prior service enlistees selected to attend one of seven technical schools.

A multiple linear regression analysis was applied to the non-verbal tests, aptitude scores, and certain educational variables to investigate their usefulness in predicting technical school performance.

It was found, for the lower mental ability groups, that the relationship between each of the non-verbal tests and final technical school grades varied among career fields. With the total group, a greater number of non-verbal tests were found to be significant with the criterion. However, in both the low mental ability and total groups, certain subtests appear to be significantly related to the criterion measures in a majority of courses.

For the total group subsamples, multiple correlations based on a composite of all the non-verbal tests were significantly related to the criterion in every course; in the lower ability subgroup analysis, correlations were significant in only three of the five courses. The variability in significance between the total and lower ability groups could be a function of sample size since the number of Category III and IV personnel was small in several courses. When regression weights were cross-applied to another sample to estimate the stability of the obtained relationships, the non-verbal relationships remained significant in only four of the total group courses along with one lower ability group course. Nevertheless, it is apparent that non-verbal measures do have a sizeable relationship with the final technical school performance, and further investigation of the value of these measures appears warranted.

Analyses to determine whether the non-verbal composite adds to predictive efficiency revealed that these measures do make a significant and unique contribution to the prediction of technical training performance over and above the selector AI alone in all but two courses. Only for the lower category personnel in the 57130 and 70230 career fields did these tests fail to make a significant difference in prediction.

Subsequent analyses to investigate the contribution of additional aptitudinal and educational data in the prediction of training performance indicated that the value of these data was not universal for all courses. Only for subgroups in the 43131 and 90010 courses and the all-category 57130 subgroup were such data found to make a significant contribution to predictive accuracy over and above the Selector AI and non-verbal composite. Although the restricted relationships of this full predictor composite appear promising, the correlations obtained on cross-validation procedures were no better than those obtained with the non-verbal and selector AI composite.

With the possibility of an increased number of lower ability airmen enlisting in the volunteer force, the need to optimize selection and classification procedures to achieve maximum utilization of available manpower resources becomes imperative. As demonstrated by the results of this research, non-verbal tests as well as additional aptitudinal and educational data do add significantly to our current operational indexes in many instances. In order to investigate the value of a more comprehensive selection procedure, it is suggested that an expanded project be undertaken to evaluate more thoroughly the usefulness of non-verbal and other non-cognitive data in the selection process.

Table 1. **Technical Training Courses**

Course Number	Description
ABR 43131	Aircraft Maintenance Specialist
ABR 57130	Fire Protection Specialist
ABR 70230	Administrative Specialist
ABR 81130	Security Specialist
ABR 81230	Law Enforcement Specialist
AQR 90010	Medical Helper
ABR 90230	Medical Service Specialist

Table 2. **Description of the Non-Verbal Tests**

Title	Description	Number of Items	Time* Limit (min)
Number Reversal	A measure of perceptual speed and accuracy in finding the exact reversal of a series of 4-7 digits	48	7
Pattern Matching	A measure of abstract reasoning ability comprised of pictorial reasoning problems which require the subject to select the part that completes a specified pattern among 5 alternatives	38	20
Dial Reading	A measure of numerical ability which requires the subject to read a dial quickly and accurately	30	4
Paired Letters	A measure of perceptual speed and clerical ability in finding a pair of letters or figures identical to the underlined pair in each item	34	3
Coding	A symbol substitution test involving five figures corresponding to response categories on the answer sheet which measures learning and short term memory	120	3
Card Patterns	A reasoning test comprised of pictorial problems using playing card suits arranged in patterns and series	50	20
Mazes	A test measuring carefulness and perceptual speed and accuracy patterned after the Porteus Mazes	60	15
Wheels	A measure of mechanical reasoning in which the subject determines the direction of a series of wheels when the direction of one wheel in the series is given	60	10
Dominoes	A reasoning test comprised of pictorial problems of dominoes arranged in numeric patterns and series	88	25
Number Size	A measure of perceptual speed and accuracy in which the subject is required to determine whether a series of individual numbers are higher or lower than a specified test number	32	2 (each part)
Precision Counting	A measure of perceptual speed and accuracy in which the subject is required to count the number of symbols contained in that pictorial item	50	4

*Does not include instructions and sample items

Table 3. **Samples Sizes**

Technical Training Course	AFQT Categories	Validation Sample	Cross-Validation Sample	Total Sample
ABR 43131	All categories	315	314	629
	Cat III & IV	213	213	426
ABR 57130	All categories	87	87	174
	Cat III & IV	62	62	125
ABR 70230	All categories	95	95	190
	Cat III & IV	90	89	179
ABR 81130	All categories	223	222	445
	Cat III & IV	169	168	337
ABR 81230	All categories	74	73	147
AQR 90010	All categories	236	236	472
	Cat III & IV	116	115	231
ABR 90230	All categories	153	152	305

Table 4. **Correlations Between Non-Verbal Tests and Final Technical School Grade—Validation Sample**

Group Designation	N	Number Reversal	Pattern Matching	Dial Reading	Paired Letters	Coding	Card Patterns	Mazes	Wheels	Dominoes	Number Size	Percision Counting
All Categories												
43131	315	.24**	.31**	.22**	.16**	.11	.22**	.01	.20**	.21**	.22**	.13*
57130	87	.35**	.50**	.59**	.48**	.45**	.44**	.25*	.53**	.48**	.32**	.25*
70230	95	.28**	.28**	.36**	.48**	.29**	.34**	.19	.41**	.30**	.16	.17
81130	223	.38**	.48**	.41**	.41**	.35**	.40**	.26**	.39**	.48**	.33**	.39**
81230	74	.38**	.35**	.27*	.29*	.13	.47**	.04	.47**	.29*	.16	.35**
90010	236	.19**	.32**	.36**	.15*	.15*	.24**	.13*	.39**	.27**	.06	.14*
90230	153	.31**	.52**	.38**	.27**	.27**	.36**	.07	.34**	.34**	.29**	.24**
Categories III and IV												
43131	213	.11	.17*	.18*	.06	−.03	.07	−.04	.08	.09	.18*	.09
57130	62	.22	.44**	.36**	.27*	.30*	.36**	.08	.33**	.45**	.18	.28*
70230	90	.14	.25*	.14	.33**	.09	.25*	.04	.21*	.32**	.17	.07
81130	169	.33**	.37**	.39**	.38**	.38**	.41**	.33**	.36**	.46**	.32**	.39**
90010	116	.29**	.32**	.37**	.11	.15	.36**	.06	.28**	.25**	.14	.17

*Significant at or beyond the .05 level.

**Significant at the .01 level.

Table 5. **Means and Standard Deviations of Non-Verbal Tests–Validation Sample**

Group Designation	N		Number Reversal	Pattern Matching	Dial Reading	Paired Letters	Coding	Card Patterns	Mazes	Wheels	Dominoes	Number Size	Precision Counting
All Categories													
43131	315	$\bar{X}$	29.10	27.52	10.42	21.41	45.87	39.62	33.15	45.00	49.90	48.77	32.44
		SD	7.74	4.76	4.25	5.92	11.77	5.01	9.27	12.61	11.13	10.55	6.77
57130	87	$\bar{X}$	28.74	26.45	9.39	20.23	44.94	38.36	32.34	41.44	46.14	47.13	30.95
		SD	8.09	5.58	4.50	6.76	12.35	5.36	9.15	13.09	13.43	12.11	7.83
70230	95	$\bar{X}$	28.01	24.04	8.23	19.68	44.49	36.89	29.95	32.04	41.40	47.52	31.24
		SD	6.70	5.62	4.23	6.40	10.67	5.63	9.22	14.20	11.96	10.41	6.18
81130	223	$\bar{X}$	29.19	26.59	9.85	21.66	46.71	38.52	31.99	41.10	46.44	48.83	32.74
		SD	8.06	5.81	4.70	6.77	14.18	5.67	9.83	14.02	13.31	11.48	8.11
81230	74	$\bar{X}$	30.45	27.07	10.88	22.72	46.84	39.35	30.65	41.45	46.97	49.92	33.03
		SD	7.90	6.53	4.96	5.79	13.39	5.11	11.10	12.85	13.48	11.31	6.93
90010	236	$\bar{X}$	32.75	29.50	12.24	24.17	51.41	40.81	33.80	44.87	52.61	51.60	34.04
		SD	7.76	5.13	4.97	5.92	13.73	4.88	10.80	13.09	13.01	11.87	7.33
90230	153	$\bar{X}$	32.89	29.50	12.93	24.62	51.35	40.63	34.81	46 33	52.90	51.26	34.35
		SD	7.61	5.40	4.67	6.32	14.11	4.73	10.36	12.93	11.85	10.85	7.16
Categories III & IV													
43131	231	$\bar{X}$	28.06	26.23	9.09	20.29	45.43	38.50	32.69	42.67	46.59	47.97	31.66
		SD	7.87	4.81	3.85	6.73	11.70	5.36	8.82	12.68	10.07	9.75	6.89
57130	62	$\bar{X}$	27.25	25.19	8.37	19.92	43.03	37.27	30.54	36.73	43.68	47.48	30.92
		SD	9.03	4.95	4.20	6.55	11.31	5.69	8.94	12.50	12.22	11.86	7.12
70230	90	$\bar{X}$	28.42	23.58	8.27	20.12	44.48	36.76	29.07	33.68	41.52	47.77	31.41
		SD	6.70	6.40	4.05	7.06	12.36	5.68	8.43	13.41	11.18	10.90	7.34
81130	169	$\bar{X}$	28.80	25.63	8.90	20.15	44.81	36.79	31.51	37.55	43.72	46.14	31.56
		SD	7.93	5.41	4.12	7.44	13.50	5.68	10.44	13.45	12.11	11.41	7.86
90010	116	$\bar{X}$	30.58	28.02	10.47	23.09	46.93	38.55	32.08	38.41	47.88	49.66	33.19
		SD	7.67	5.22	5.02	5.91	12.02	5.71	10.47	12.85	12.88	11.75	7.02

Table 6. **List of Variables**

Predictor variables	Description
AFQT score	Continuous variable based on percentile score obtained on Armed Forces Qualifying Test (AFQT)
Aptitude indexes	Continuous variables based on percentile scores obtained on Airman Qualifying Examination (AQE) for four aptitude indexes: Mechanical, Administrative, Electronics, and General
Educational level	Categorical variable with three categories: high school non-graduate, high school graduate, attended/graduated from college
Type of high school curriculum	Categorical variable with four categories of curriculum emphasis: trade or commercial, agricultural, college, and general
Non-verbal tests	Continuous variables based on raw scores obtained on each of the following non-verbal tests: number reversal, pattern matching, dial reading, paired letters, coding, card patterns, mazes, wheels, dominoes, number size, and precision counting
Selector aptitude index (AI)	Continuous variable based on percentile score on aptitude index used as prerequisite for entry into a particular career field
Criterion variable	
Final school grade	Numeric grade assigned upon completion of technical training course

Table 7. **Subtests and Aptitude Composites Comprising the Airman Qualifying Examination–66**

Subtest	No. of Items	Subtest Composite for Aptitude Index			
		General	Administrative	Mechanical	Electronics
Arithmetic Computation	60		X		
Arithmetic Reasoning	16	X	X		X
Data Interpretation	10				X
Electrical Information	15				X
General Mechanics	15			X	
Hidden Figures	16	X		X	
Mechanical Principles	15			X	
Pattern Comprehension	18				X
Shop Practices	15			X	
Work Knowledge	30	X	X		

Table 8. **The Stability of Multiple Correlations as a Result of Cross-Application of Regression Weights**

		All Non-Verbal Tests		All Non-Verbal Tests & Sel AI		Composite of All Predictors[c]	
Course	Group	A[a]	A/B[b]	A	A/B	A	A/B
43131	Total	.40**	.22	.44**	.25	.52**	.39
	Cat. III + IV	.32*	.14	.32**	.15	.41*	.18
57130	Total	.67**	.58**	.68**	.61**	.78**	.60*
	Cat. III + IV	.54	.33	.56	.36	.68*	.34
70230	Total	.61**	.17	.61**	.17	.66**	.22
	Cat. III + IV	.45	.37	.46	.37	.57	.33
81130	Total	.58**	.58**	.60**	.60**	.66**	.57**
	Cat. III + IV	.58**	.46**	.59**	.48**	.64**	.50**
81230	Total	.63**	.38	.63**	.39	.74**	.48
	Cat. III + IV	Insufficient N to compute					
90010	Total	.46**	.48**	.47**	.48**	.57**	.53**
	Cat. III + IV	.49**	.39	.51**	.38	.62**	.42
90230	Total	.62**	.52**	.66**	.54**	.69**	.64**
	Cat. III + IV	Insufficient N to compute					

[a]"A" corresponds to the validation sample.

[b]"A/B" indicates the cross-application of regression weights.

[c]Includes all AIs, AFQT, Non-Verbal Tests, Educ Level, and Type of High School Curriculum.

*F-test significant at or beyond the .05 level.

**F-test significant at the .01 level.

Table 9. **Results of Regression Analyses–Validation Sample**

Category Designation & Technical School Group		Regression Analysis 1[a]					Regression Analysis 2[b]				
		Full Model	Restricted Model	df_1	df_2	F	Full Model	Restricted Model	df_1	df_2	F
All categories–	43131	.1929	.1068	11	302	2.9310**	.2751	.1929	9	293	3.6908**
	57130	.4580	.1678	11	74	3.6025**	.6161	.4580	9	65	2.9744**
	70230	.3780	.0024	11	82	4.5018**	.4295	.3780	9	73	.7319
	81130	.3591	.1770	11	210	5.4259**	.4321	.3591	9	201	2.8690
	81230	.4019	.0314	11	61	3.4353**	.5414	.4019	9	52	1.7585
	90010	.2221	.0906	11	223	3.4269**	.3223	.2220	9	214	3.5175**
	90230	.4355	.2725	11	140	3.6745**	.4790	.4355	9	131	1.2146
Categories III & IV	43131	.1007	.0093	11	200	1.8470*	.1708	.1007	9	191	1.7950*
	57130	.3107	.0846	11	49	1.4612	.4685	.3107	9	40	1.5212
	70230	.2078	.0198	11	77	1.6614	.3267	.2078	9	68	1.3342
	81130	.3436	.1070	11	156	5.1126**	.4058	.3436	9	147	1.7115
	90010	.2569	.0701	11	103	2.3536*	.3806	.2569	9	94	2.0868*

[a]Regression analysis 1 - Full model includes selector AI and all non-verbal tests.
Restricted model includes selector AI.
Hypothesis tested: Non-verbal tests make no contribution to prediction of final school grade over and above the Selector AI alone.

[b]Regression analysis 2 - Full model includes all AQE AIs (Mechanical, Administrative, Electronics, General), AFQT score, non-verbal tests, educational level, and type of high school curriculum taken.
Restricted model includes selector AI and non-verbal tests.
Hypothesis tested: Additional aptitudinal and educational data make no contribution to prediction of final school grade over and above the selector AI and non-verbal tests.

*Significant at or beyond .05 level.
**Significant at .01 level.

REFERENCES

Anastasi, A. *Psychological testing.* (3rd ed.) New York: McMillian, 1968.

Bottenberg, R.A., & Ward, J.H., Jr. *Applied multiple linear regression.* PRL-TDR-63-6, AD-413 128. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, March 1963.

Brokaw, L.D. *Prediction of success in technical training from a self-report information on educational achievement.* PRL-TDR-63-11, AD-414 888. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, April 1963.

Cattell, R.B. *Handbook for the individual or group culture-free intelligence test: Scale I.* Champaign, Ill.: Institute for Personality and Ability Testing, 1950.

Freeberg, N.E. Assessment of disadvantaged adolescents: A different approach to research and evaluation measures. *Journal of Educational Psychology*, 1970, **61**(3), 229-240.

Judy, C.J. *Appraisal of education requirements for airmen specialties.* WADD-TN-60-264, AD-252 253. Lackland AFB, Tex.: Personnel Laboratory, Wright Air Development Center, December 1960.

Judy, C.J. *Use of high school record information in predicting succes in electronics training.* PRL-TR-65-5, AD-616 731. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, March 1965.

Lecznar, W.B. *Years of education as a predictor of technical training success.* PRL-TDR-64-2, AD-437 940. Lackland AFB, Tex.: Personnel Research Laboratory, Aerospace Medical Division, February 1964.

Maier, M.H. *Effects of general ability, education, and racial group on aptitude test performance.* TRN 228. Arlington, Va.. US Army Behavior and Systems Research Laboratory, Military Selection Research Division, May 1971.

Pintner, R. *Pintner general ability tests, non-language series: Intermediate test.* Manual of Directions, Yonkers-on-Hudson, New York: World Book Co., 1945.

Porteus, S.D. *The Porteus maze test and intelligence.* Palo Alto, Calif.: Pacific Books, 1950, p. 194.

Raven, J.C. Standardization of progressive matrices, 1938. *British Journal of Medical Psychology*, 1941, **19**, 137-150.

Rulon, P.J. *Development of a non-verbal classification test*. Report No. 877. Dept of the Army, Personnel Research Section, 1950.

Rulon, P.J. *A semantic test of intelligence.* Proceedings, 1952 Invitational Conference on Testing Problems, Educational Testing Service, 84-92.

Rulon, P.J., & Schweiker, R.F. *Validation of a non-verbal test of military trainability.* Technical Report No. 1076. Dept of the Army, Personnel Research Branch, 1953.

U.S. Dept of Labor. *Development of a nonreading edition of the general aptitude test battery.* USES Test Research Report No. 23, 1968.

Valentine, L.D., Jr., & Vitola, B.M. *Comparison of self-motivated Air Force enlistees with draft-motivated enlistees.* AFHRL-TR-70-26, AD-713 638. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, July 1970.

Vitola, B.M., & Alley, W.E. *Characteristics of 18-year-old enlistees who enter the Air Force before becoming draft-eligible.* AFHRL-TR-72-5, AD-744 039. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, February 1972.

Vitola, B.M., & Brokaw, L.D. *Comparison of 1970 and 1971 Air Force enlistees by draft vulnerability category.* AFHRL-TR-7 .49, AD-760 537. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, March 1973.

Vitola, B.M., & Valentine, L.D., Jr. *Characteristics of Air Force enlistees related to draft vulnerability.* AFHRL-TR-71-29, AD-730 593. Lackland AFB, Tex.: Personnel Division, Air Force Human Resources Laboratory, June 1971.

Yerkes, R.M. (Ed.) *Psychological examining in the United States Army. Memoirs of National Academy of* Science, 1921, **15**, p. 890.