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Validation of Air Force Classification Tests
Against Academic Grades in an
Aviation High School

By
Lloyd G. Humphreys

University of Illinois
Contract AF 41(657)-279

XEROX

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AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
LACKLAND AIR FORCE BASE, TEXAS

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**VALIDATION OF AIR FORCE CLASSIFICATION TESTS AGAINST
ACADEMIC GRADES IN AN AVIATION HIGH SCHOOL**

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Lloyd G. Humphreys

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Project 7717, Task 17154
Contract AF 41(657)-279

Personnel Laboratory
AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
Lackland Air Force Base, Texas

FOREWORD

This is the second in a series of reports covering research sponsored by the Air Force under Contract AF 41(657)-279 with the University of Illinois. The initial report was issued as Technical Note WADD-TN-60-265, *Equipercntile conversions as a function of training in a technical curriculum*.

The principal investigator is Dr. Lloyd G. Humphreys, Head of the Department of Psychology, University of Illinois, Urbana. Dr. Leland D. Brokaw is the monitor for Personnel Laboratory.

Acknowledgments are due to Mr. Emmanuel Lask who gathered the data on which this report is based; and to Mr. Aart Hazewinkel and Mr. James Terwilliger who contributed to the analysis of the data.

The project was made possible through the extensive cooperation of Mr. Frank Woehr, Principal of the Aviation High School, in arranging for the testing sessions and in making criterion data available from the school records.

ABSTRACT

Air Force classification tests and the Army General Classification Test were validated against individual course grades in an aviation high school. Course grades showed low to moderate levels of reliability, with those in the terminal aviation-mechanic curriculum somewhat less reliable than grades in the pre-engineering technical curriculum. Most of the multiple correlations of classification test scores with course grades were at a usefully high level. Highest correlations with Air Force aptitude indexes were somewhat lower, and correlations with AGCT still lower. For selection purposes the Air Force classification tests do a better job than the AGCT general intelligence test. The Air Force tests that have the highest utility for selection are Arithmetic Reasoning, Physics, and Pattern Comprehension. Additional mechanical and numerical content, as well as the use of keyed biographical data items, may improve prediction in this school situation.

This is the first of a series of reports detailing the long-range validity of Air Force selection tests for technical academic criteria. The Aviation High School provides a unique opportunity for collection of predictor and criterion information for the same individuals over an extended period of time.

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VALIDATION OF AIR FORCE CLASSIFICATION TESTS AGAINST ACADEMIC GRADES IN AN AVIATION HIGH SCHOOL*

STATEMENT OF THE PROBLEM

As part of a cooperative research project involving the Air Force, the Aviation High School of New York City, and the University of Illinois, it was desired to validate Air Force classification tests against course grades in the Aviation High School. This report contains the results of one such validation.

As background for this study a description of the setting is necessary. The Aviation High School offers two curricula only: a pre-engineering technical curriculum and a terminal aviation mechanic curriculum. Prediction of performance in both sorts of training is of obvious importance to the Air Force. Prediction data will also help the Aviation High School do a better job of selection of students.

At midyear of the academic year 1958-59 the Airman Classification Battery (ACB) and the World War II Army General Classification Test (AGCT) were administered to approximately 1600 students in the high school under standard administrative conditions by Air Force personnel. Tests were scored and IBM cards punched by the Air Force, and cards were shipped to the contractor. In the following June and July the grade records of the students tested were available. All grades were recorded, including those from preceding years in the high school. Test and grade variables discussed here are listed and briefly described in Appendix A.

Two possibilities were considered in this, the first validation study to be done on these data. One was to sum selected grades to produce several meaningful criteria. A second was to correlate predictors against individual course grades. The latter plan was elected because in the data available for the first year too few students had consistently followed precisely the same curriculum to be able to do either a priori or empirical grouping on a large enough sample to be worth while.

Grouping of grades on the basis of factor-analytic findings will be accomplished in subsequent years of the project, since three years of test scores and grades will eventually be accumulated. Such data will provide opportunity to find more people having identical patterns of course enrollment. The same data will also provide information on the stability of functions measured by tests and course grades during the high school period.

PROCEDURE

The first step was to isolate samples of cases for whom test intercorrelations and correlations with grades could be computed. Rather than electing to maximize N , which would have led to as many correlational matrices as there were course grades, it was decided to require a minimum N of approximately 100 and to group as many courses together as possible in order to minimize the amount of computing.

Application of the above considerations produced six subsamples. Intercorrelations of all variables were then computed and multiple correlations for each course grade obtained.

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RESULTS AND DISCUSSION

Intercorrelational data are presented for the six subsamples in Appendix B, Tables 1-6. These data can be used in the first instance as a basis for inferences concerning reliability of the criteria.

There are many ways of estimating reliability. Certain of these ways relegate components of variance to "error" that are classified as nonerror by other methods. In estimating the reliability of a criterion measure for present purposes, components of variance classified as error should be those that are basically unpredictable by the tests at the time the tests are given. A parallel form of each criterion measure is desired, but unavailable. In the absence of parallel forms, the highest correlation that one variable has with another can be used as the estimate of reliability. Such an estimate is ordinarily a lower-bound one and when, as in the present case, there is typically an interval of time between the measures, instability of function as well as absence of a completely parallel form attenuates the correlations. With academic grades, on the other hand, there may also be factors producing spuriously high estimates, e.g., correlated reputation or interpersonal "error" factors. Nevertheless, these data constitute the best available basis for interpreting the general level of correlations to be obtained between tests and criteria. It is highly probable, as such estimates of reliability vary, that the correlations between tests and grades will covary. The factors, whatever they may be, that produce low correlations between grades in highly similar courses, will also tend to produce low correlations between predictor tests and course grades. While the writer is reluctant to correct multiple correlations for attenuation on the basis of reliability estimates of this type, reliability of the criterion must be a consideration in interpreting the accuracy of prediction from tests. The single highest correlation with other criterion variables has, therefore, been ascertained and the information summarized in Table 7, Appendix B.

THE RELIABILITY ESTIMATES

The overall impression of level of reliability of the academic grades from Table 1 is that they are moderately low. Looking more closely, it would appear that the Science grades are probably most reliable; only two of the four Mathematics grades and three of the four Shop grades are as reliable as Science grades (and the estimates for Shop are suspect because their highest correlations tend to be with Science and Mathematics grades, not with each other), while the English grades are generally low. For some of these variables multiple correlations as high as .40 to .50 are about as high as one could hope for.

There is less information pertinent to reliability estimation in Table 2 variables, since fewer grades are involved. In this sample, both English and Science estimated reliabilities are quite low and in the general range of the English grades from the preceding table.

There may be a difference in the reliability of grades in the two curricula. The set of Shop grades from Table 3 shows somewhat higher reliability estimates than the previous ones. Furthermore, more confidence can be placed in these since the correlations with each other are the ones used as the estimates.

Reliability estimates from the Table 4 sample are at about the levels of the highest values from previous samples and there are no apparent differences in reliability among the three kinds of courses represented.

Noteworthy among the intercorrelations of variables from Tables 5 and 6 are the high correlations involving the two Regent's Examinations. These correlations represent concurrent validation and involve one variable, a test, which is undoubtedly highly reliable. It is also possible that the grades include the test scores in both instances, which would result in a spuriously high part-whole correlation. It is quite certain in any event that the reliability estimates for these grades are too high.

VALIDITIES

In evaluating validity coefficients it is necessary to recall the setting of the study. Tests were given to all students at midyear. The grades of courses that appear latest in the curriculum within their group are nearest in time to the administration of the tests. There are few predictive validities in the strict sense, and these are predictive by only a few months. There are several instances, on the other hand, in which the grade occurs earlier in time than the test score. Because of common usage, however, prediction is used in this discussion to describe the relationships between tests and criteria.

Individual test validity coefficients will not be discussed. Instead the battery validities summarized by the multiple correlations will be presented. In each case the multiple correlation from the ACB will be compared with the validity of the AGCT and with the validity of the most predictive aptitude index.

The multiple correlations capitalize on chance, but have not been shrunken. Similarly, selection of the highest correlation involving an aptitude index capitalizes slightly on chance, but may still under-estimate the best shrunken validity to be obtained from the ACB. These preliminary findings will, in effect, be cross-validated later in the research so that if errors of interpretation arise they will be corrected.

An across-the-board descriptive comparison of validities can be made from the medians of the three statistics named above. Thus the median multiple correlation is .433, the median validity of AGCT is .195, and the median highest aptitude index is .295. It is a good guess that the best shrunken validity to be obtained from the ACB is between the first and third of these values. This in turn can be compared with a median estimated reliability of the criteria of .50. This is a rather creditable showing.

POTENTIAL SELECTION TESTS

The ACB was designed to be a classification battery in which a maximum number of tests would have significant differential validities. For selection purposes in the Aviation High School, however, the most useful tests are those that have large beta weights for a maximum number of criteria. There is of course some tendency for the size of weights to be a function of the criteria predicted so that the decision whether to include a particular item type in a selection test would depend in part on the importance of the course in question in the curriculum. Nevertheless a few item types do stand out.

One rough criterion of the importance of an item type for selection in the present data is to count the number of beta weights that seem to be of practical significance. An absolute value of .10 was set as the cut-off, and all weights this large or greater were tallied. The first tally made included substantial numbers of the negative weights which appear with relatively high frequency in Tables 8-13. These negative values are clearly of greater potential usefulness for classification than for selection purposes. For selection, suppressor weights must be used much more cautiously and introduced only with the most solid sort of evidence. Recounts were made, therefore, of the positive and negative weights separately. These data are summarized in Table 14.

In interpreting these results it should be borne in mind that there were 42 regression equations based on six independent samples from which the counts were made. Within a sample, errors of sampling are correlated to the extent that the criteria are correlated. These correlations are not high. From sample to sample the errors of sampling are independent. Thus, although beta weights are relatively unstable from sample to sample (as compared, for example, with correlation coefficients), a test that rather consistently has high weights can be earmarked with confidence as a potential selection test if choice is to be made from among the tests in the present battery. This analysis does at least take into account overlap among the predictors and in consequence is

more refined than counting the number of high validity coefficients. The results should, however, be checked later by a more traditional selection research design; e.g., by correlating the predictor tests against a single grade average.

Arithmetic Reasoning has the highest number of large positive weights (23) followed closely by Physics (22). Neither has many large negative weights. Pattern Comprehension is third with 16 and ahead of the two mechanical information tests with 10 and 14 respectively. For selection purposes a mechanical comprehension test would be preferred to tests of mechanical information. The Verbal Comprehension test, supposedly one of the best measures of "intelligence," is relatively low (12), there are a number of large negative weights (10), and its important contributions are to the prediction of criteria of generally low importance in a technical high school. Numerical Operations, not considered a good measure of general ability, stands up well (15), particularly in the terminal curriculum.

Biographical information also shows possibilities for use in a selection program. The present Electronics score has promise and presumably could be improved by an empirical keying procedure. Interestingly enough, it shows few large negative weights. Most of the large weights for the Mechanical score, on the other hand, are negative. Whether these negatives would stand up in larger samples should be determined, but such consistency makes the variable look promising for selection. The Administrative score has both large positive and large negative weights, and in about the same ratio as for the test of verbal ability. Scores with such characteristics are most useful for classification purposes.

On the low end of the scale of potential usefulness in this high school is the Clerical Matching test. This finding is not unexpected.

In summary, on the basis of the present evidence, a selection battery would certainly include Arithmetic Reasoning, Physics, and Pattern Comprehension. A score derived from biographical information would be a good bet. Some additional mechanical weighting, perhaps from a mechanical comprehension test, and additional numerical weighting, might be justified. Verbal ability is of less importance in this situation.

IMPLICATIONS FOR GRADING PRACTICES

The grades obtained on samples of students in the aviation mechanic curriculum were disappointing as criteria. As the prime example, Shop grades in the two curricula can be contrasted. Shop grades of the aviation mechanics, as compared to the pre-engineers, were less reliable, less predictable, and had their highest correlations with the "wrong" variables. With respect to the last of these three points, note that some of the highest correlations of Shop with other grades are those with Mathematics and Science, and the highest correlation with an aptitude index is with the Electronic rather than with the Mechanical. Shop grades in the pre-engineering curriculum, on the other hand, are more highly correlated with each other and are better predicted by the Mechanical Aptitude Index. This last seems particularly incongruous. If there were to be any difference in emphasis in Shop for the two curricula, it should be in the direction of emphasizing theory in the more technical curriculum.

Similarly the prediction of English grades at all levels studied in the terminal curriculum is relatively unsatisfactory. In addition to the low level of multiple correlations obtained, the patterns of weights are inconsistent. Verbal Comprehension is not a consistent predictor of English grades, while Physics shows unexpected strength in one sample.

TIME RELATIONSHIPS

There are only a few cases in this first validation study in which the course grade was removed in time by more than one year. Tables 8 and 10 contain the only examples. There seems to be no trend for the more remote relationships to be smaller than the ones involving shorter intervals.

SUMMARY

Air Force Classification Battery tests and the Army General Classification Test have been validated against individual course grades in the Aviation High School of New York City. The course grades showed evidence of low to moderate levels of reliability with a possibility that grades in the terminal, aviation mechanic curriculum were somewhat less reliable than those in the pre-engineering technical curriculum. Most of the multiple correlations, however, were at a usefully high level; the highest correlations with existing aptitude indexes were somewhat lower; relationships with the AGCT were lower still. For selection purposes the ACB tests will do a better job than a general intelligence test.

Tests that seem to have consistently high beta weights, and thus high utility for selection, are Arithmetic Reasoning, Physics, and Pattern Comprehension. Some additional mechanical and numerical content may also be indicated as well as the use of biographical data items.

APPENDIX A

DESCRIPTION OF VARIABLES APPEARING IN TABLES 1-14, APPENDIX B

AIRMAN TESTS

- 1 AGCT—the World War II Army General Classification Test
- 2 Mech Background—the empirically keyed mechanical score on the Biographical Inventory
- 3 Adm Background—the empirically keyed clerical score on the Biographical Inventory
- 4 Elect Background—the empirically keyed electronic score on the Biographical Inventory
- 5 Arith Reasoning—items are stated verbally and cover 8th grade arithmetic
- 6 Verbal Comprehension—a vocabulary test
- 7 Mech Principles—mechanical comprehension items of the Bennett type
- 8 Tool Functions—recognition of tool uses from drawings
- 9 Figure Recognition—simple items testing spatial orientation ability
- 10 Physics—items measure knowledge of academic physics at the high school level
- 11 Pattern Comp.—items are of the unfolded solids type used to measure visualization ability
- 12 Clerical Matching—highly speeded items of the figure matching type used in many tests of clerical aptitude
- 13 Numerical Operations—a test of the ability to handle the elementary numerical operations on a highly speeded basis
- 14 Mech Aptitude Index—the weighted composite derived from the preceding tests to predict success in mechanical occupations
- 15 Adm Aptitude Index—the weighted composite from the above tests used to predict success in administrative (clerical) jobs
- 16 General Aptitude Index—the weighted composite from the above tests used in place of a measure of general intelligence
- 17 Elect Aptitude Index—the weighted composite from the above tests used to predict success in electronic occupations

HIGH SCHOOL COURSES: MECHANICAL CURRICULUM

SAMPLE 1 COURSES (TABLES 1,8)

- 18 Shop 1—the first course in shop techniques
- 19 Shop 2—the second course in shop techniques
- 20 Shop 3—the third course in shop techniques
- 21 Shop 4—the fourth course in shop techniques
- 22 TD—trade drawing
- 23 Engl 1—the first course in English
- 24 Engl 2—the second course in English
- 25 Engl 3—the third course in English
- 26 Engl 4—the fourth course in English
- 27 Math 1—the first course in mathematics
- 28 Math 2—the second course in mathematics
- 29 Math 3—the third course in mathematics
- 30 Math 4—the fourth course in mathematics
- 31 Science 1—the first course in science
- 32 Science 2—the second course in science
- 33 Science 3—the third course in science
- 34 Science 4—the fourth course in science

SAMPLE 2 COURSES (TABLES 2, 9)

- 18 Engl 5 – the fifth course in English
- 19 Engl 6 – the sixth course in English
- 20 Science TBE – basic engine course
- 21 Science TEL – Electricity

HIGH SCHOOL COURSES: TECHNICAL CURRICULUM

SAMPLE 3 COURSES (TABLES 3, 10)

- 18 Shop 3 – the third course in shop techniques
- 19 Shop 4 – the fourth course in shop techniques
- 20 Shop 5 – the fifth course in shop techniques
- 21 Shop 6 – the sixth course in shop techniques

SAMPLE 4 COURSES (TABLES 4, 11)

- 18 Engl 1 – the first course in English
- 19 Engl 2 – the second course in English
- 20 Algebra 1 – the first course in algebra
- 21 Algebra 2 – the second course in algebra
- 22 Gen Science 1 – the first course in science
- 23 Gen Science 2 – the second course in science

SAMPLE 5 COURSES (TABLES 5, 12)

- 18 Engl 3 – the third course in English
- 19 Engl 4 – the fourth course in English
- 20 Math 10M1 – the first course in geometry
- 21 10M2 – the second course in geometry
- 22 R (10M) – the Regent's examination in geometry

SAMPLE 6 COURSES (TABLES 6, 13)

- 18 Chem 1 – the first course in chemistry
- 19 Chem 2 – the second course in chemistry
- 20 R (Chem) – the Regent's examination in chemistry
- 21 Phy 1 – the first course in physics
- 22 WH 1 – the first course in world history
- 23 WH 2 – the second course in world history

APPENDIX B
STATISTICAL TABLES

TABLE 1. Correlations of Air Force Tests and Aptitude Indexes
with Selected Grades in the Mechanical Curriculum, Sample 1

(N = 112)

Variable	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Mean	SD
1 AGC1	13	23	14	-02	29	23	18	06	08	22	07	30	29	34	28	31	39	90.10	13.1
2 Mech Background	08	04	06	07	05	-12	08	-11	-20	-06	02	-11	-02	02	05	-09	-04	5.0	1.8
3 Adm Background	02	00	-04	01	12	08	02	12	12	07	06	-03	06	02	01	07	00	3.2	1.7
4 Elect Background	-06	-05	-06	04	11	10	02	04	-12	00	-05	-29	-05	12	-04	06	-12	3.7	2.0
5 Arith Reasoning	14	11	15	03	08	08	26	08	14	24	19	39	23	32	33	17	23	3.4	1.4
6 Verbal Comprehension	05	14	-04	-10	-04	22	04	-20	07	-05	-23	05	12	16	19	25	25	3.6	1.4
7 Mech Principles	17	16	06	09	28	00	-02	-33	-07	-04	-02	10	05	05	25	30	21	4.1	1.7
8 Tool Functions	07	17	09	03	23	04	00	-25	-01	-21	07	10	03	-04	28	21	18	4.9	1.7
9 Figure Recognition	10	19	-01	-01	08	-09	03	-13	-02	16	03	11	10	-05	12	09	08	4.8	1.9
0 Physics	18	22	02	02	18	02	06	-20	-06	-03	08	18	06	22	40	36	30	4.2	1.7
1 Pattern Comp	21	28	16	18	35	-02	01	-05	00	13	18	19	26	14	31	18	23	3.3	1.7
2 Clerical Matching	03	04	-13	08	10	02	01	06	06	14	-10	07	02	16	05	19	13	4.7	1.9
3 Numerical Operations	04	11	02	-03	18	13	21	04	02	19	14	35	23	23	21	12	17	3.2	1.5
4 Mech Aptitude Index	16	22	06	07	24	-06	00	-33	-07	-08	01	05	02	-04	25	23	17	47.0	18.8
5 Adm Aptitude Index	05	09	-10	-05	09	21	12	02	13	16	-10	16	19	25	14	23	21	27.0	14.2
6 General Aptitude Index	14	20	08	-01	06	07	19	-07	09	23	06	31	22	23	32	22	25	33.6	15.2
7 Elect Aptitude Index	21	27	10	11	32	04	08	11	-04	11	17	28	20	29	43	32	29	32.4	16.2
8 Shop 1	27	27	34	23	30	03	28	11	25	22	30	36	21	13	24	22	26	74.3	7.7
9 Shop 2	34	24	24	20	24	14	30	10	19	35	32	25	29	40	55	34	31	70.5	10.4
10 Shop 3	23	20	45	45	43	11	31	28	47	12	35	40	52	30	27	25	48	70.9	10.5
11 Shop 4	21	21	45	48	48	-08	05	19	34	05	09	47	36	25	21	25	27	71.8	9.9
12 TD	30	24	43	48	18	18	17	16	33	18	23	43	37	26	26	28	36	68.5	10.5
13 Engl 1	03	14	11	-08	18	35	35	06	12	10	-03	17	06	28	11	10	30	71.4	8.6
14 Engl 2	28	30	31	05	17	35	28	26	25	28	32	20	29	42	23	24	70.7	8.7	
15 Engl 3	11	10	28	19	16	06	28	31	36	19	28	24	26	11	15	15	71.5	7.8	
16 Engl 4	25	19	47	34	33	12	26	31	02	22	36	34	18	13	20	30	71.8	9.0	
17 Math 1	22	35	12	05	18	10	25	36	02	21	21	21	25	39	34	16	15	70.8	7.4
18 Math 2	30	32	35	09	23	-03	28	19	22	21	24	24	29	26	39	18	33	71.2	8.3
19 Math 3	36	25	40	47	43	17	32	28	36	21	24	47	47	45	28	38	43	71.7	10.0
20 Math 4	21	29	52	36	37	06	20	24	34	25	29	47	45	45	28	40	52	72.4	11.6
21 Science 1	13	40	30	25	26	28	29	26	18	39	26	42	45	45	45	38	46	71.6	6.7
22 Science 2	24	55	27	21	26	11	42	11	13	34	39	28	28	45	40	41	72.7	7.9	
23 Science 3	22	34	25	25	28	10	23	15	20	16	18	38	40	38	40	50	68.0	8.1	
24 Science 4	26	31	48	27	36	30	24	15	30	15	33	43	52	46	41	50	69.6	9.2	

Note. — Decimal points omitted preceding all correlation coefficients.

**TABLE 2. Correlations of Air Force Tests and Aptitude Indexes
with Selected Grades in the Mechanical Curriculum, Sample 2**

(N = 176)

Variable	18	19	20	21	Mean	SD
1 AGCT	24	21	06	26	92.8	13.4
2 Mech Background	-19	-03	04	07	5.1	1.6
3 Adm Background	-16	-02	-16	-26	3.3	1.8
4 Elect Background	02	-03	-01	09	4.0	2.2
5 Arith Reasoning	17	11	11	18	3.7	1.6
6 Verbal Comprehension	23	20	12	11	4.1	1.6
7 Mech Principles	04	12	04	13	4.8	1.5
8 Tool Functions	00	13	11	15	5.4	1.5
9 Figure Recognition	-02	-02	06	14	5.1	1.8
10 Physics	14	25	14	30	5.5	1.5
11 Pattern Comp	04	17	15	20	3.8	1.6
12 Clerical Matching	10	12	06	08	5.0	2.2
13 Numerical Operations	12	13	11	11	3.4	1.8
14 Mech Aptitude Index	-04	07	06	15	54.0	17.7
15 Adm Aptitude Index	14	18	05	-01	31.5	16.2
16 General Aptitude Index	16	12	14	18	37.8	17.4
17 Elect Aptitude Index	14	23	16	32	41.8	15.4
18 Engr 5		33	12	30	73.4	8.2
19 Engr 6	33		25	31	71.6	10.4
20 Science TBE	12	25		26	65.4	10.2
21 Science TEL	30	31	26		68.3	12.6

Note. — Decimal points omitted preceding all correlation coefficients.

**TABLE 3. Correlations of Air Force Tests and Aptitude Indexes
with Selected Grades in the Technical Curriculum, Sample 3**

(N = 99)

Variable	18	19	20	21	Mean	SD
1 AGCT	04	18	01	14	109.1	9.9
2 Mech Background	14	26	30	36	4.4	1.7
3 Adm Background	-05	-08	-03	-14	4.0	1.8
4 Elect Background	-03	-02	11	11	4.9	2.2
5 Arith Reasoning	00	-05	10	14	5.6	1.5
6 Verbal Comprehension	-12	03	-18	-09	5.3	1.4
7 Mech Principles	31	34	25	24	5.3	1.7
8 Tool Functions	31	28	17	34	6.0	1.8
9 Figure Recognition	02	03	19	13	6.3	1.8
10 Physics	10	14	08	15	6.3	1.4
11 Pattern Comp	15	01	08	14	5.2	1.8
12 Clerical Matching	01	24	18	11	6.6	1.9
13 Numerical Operations	-16	-10	00	-05	5.3	1.6
14 Mech Aptitude Index	33	34	30	36	58.9	18.6
15 Adm Aptitude Index	-22	-07	-12	-19	51.5	15.7
16 General Aptitude Index	-04	-02	08	12	59.3	14.6
17 Elect Aptitude Index	12	03	14	20	58.5	16.2
18 Shop 3		41	21	52	76.0	7.3
19 Shop 4	41		36	45	77.1	7.4
20 Shop 5	21	36		58	75.1	10.1
21 Shop 6	52	45	58		75.9	8.2

Note. — Decimal points omitted preceding correlation coefficients.

**TABLE 4. Correlations of Air Force Tests and Aptitude Indexes
with Selected Grades in the Technical Curriculum, Sample 4**

(N = 98)

Variable	18	19	20	21	22	23	Mean	SD
1 AGCT	40	16	28	20	30	33	101.7	10.6
2 Mech Background	-13	-23	-17	-11	-13	-04	4.7	1.8
3 Adm Background	17	30	23	18	08	23	3.9	1.9
4 Elect Background	09	03	13	06	16	12	3.9	2.0
5 Arith Reasoning	44	28	35	32	37	38	5.1	1.5
6 Verbal Comprehension	23	16	12	12	35	31	5.0	1.4
7 Mech Principles	26	-12	02	07	30	25	5.2	1.8
8 Tool Functions	17	-16	-06	06	25	19	5.4	1.7
9 Figure Recognition	14	07	14	20	25	13	5.7	1.8
10 Physics	36	05	12	21	46	35	5.5	1.7
11 Pattern Comp	33	05	16	20	28	23	4.3	2.0
12 Clerical Matching	04	16	30	12	-03	16	5.6	2.0
13 Numerical Operations	09	24	30	19	00	07	4.5	1.7
14 Mech Aptitude Index	18	-17	-03	07	30	20	55.3	21.0
15 Adm Aptitude Index	24	46	44	28	19	33	44.8	15.0
16 General Aptitude Index	44	26	34	34	47	41	52.4	15.4
17 Elect Aptitude Index	47	11	24	28	49	40	47.2	17.8
18 Engr 1		43	44	38	61	54	78.2	7.4
19 Engr 2	43		44	38	34	47	78.8	7.2
20 Algebra 1	44	44		51	43	48	69.0	9.9
21 Algebra 2	38	38	51		42	44	67.3	14.0
22 Gen Science 1	61	34	43	42		49	79.4	8.8
23 Gen Science 2	54	47	48	44	49		80.5	7.6

Note. — Decimal points omitted preceding all correlation coefficients.

**TABLE 5. Correlations of Air Force Tests and Aptitude Indexes
with Selected Grades in the Technical Curriculum, Sample 5**

(N = 165)

Variable	18	19	20	21	22	Mean	SD
1 AGCT	-04	12	16	28	24	107.4	9.6
2 Mech Background	-14	-04	-04	-02	-06	4.2	1.8
3 Adm Background	19	12	-06	-03	04	4.1	1.8
4 Elect Background	15	15	-01	25	26	4.7	2.2
5 Arith Reasoning	-05	09	14	25	28	5.6	1.3
6 Verbal Comprehension	09	20	06	15	14	5.3	1.4
7 Mech Principles	-08	-07	14	16	15	5.1	1.8
8 Tool Functions	-08	-09	16	18	15	5.5	1.8
9 Figure Recognition	07	01	13	12	18	6.1	1.8
10 Physics	-07	04	24	24	26	6.2	1.4
11 Pattern Comp	-06	-02	12	21	18	5.2	1.8
12 Clerical Matching	06	10	-17	00	-06	6.2	2.0
13 Numerical Operations	01	16	-05	15	16	5.0	1.6
14 Mech Aptitude Index	-06	-09	18	16	15	55.3	20.0
15 Adm Aptitude Index	18	29	-10	09	12	50.6	15.8
16 General Aptitude Index	01	12	17	28	33	58.5	13.4
17 Elect. Aptitude Index	-02	07	21	34	34	57.9	15.7
18 Engr 3		41	18	20	24	79.0	7.0
19 Engr 4	41		36	41	39	77.9	8.8
20 Math 10M1	18	36		53	51	72.3	11.0
21 10 M2	20	41	53		86	74.9	11.2
22 R(10M)	24	39	51	86		75.9	17.0

Note. — Decimal points omitted preceding all correlation coefficients.

**TABLE 6. Correlations of Air Force Tests and Aptitude Indexes
with Selected Grades in the Technical Curriculum, Sample 6**
(N = 113)

Variable	18	19	20	21	22	23	Median	SD
1 AGCT	00	19	18	27	17	37	107.27	10.60
2 Mech Background	08	-04	-06	05	-05	14	4.47	1.79
3 Adm Background	-19	-18	-18	-10	14	-04	4.19	1.79
4 Elect Background	16	25	24	25	26	17	4.90	2.10
5 Arith Reasoning	16	23	25	31	30	31	5.46	1.54
6 Verbal Comprehension	01	18	26	17	30	23	5.12	1.45
7 Mech Principles	12	03	12	17	00	12	5.32	1.65
8 Tool Functions	12	08	13	08	-11	-02	5.84	1.79
9 Figure Recognition	16	09	11	21	26	27	6.03	1.92
10 Physics	25	35	38	25	10	17	6.26	1.40
11 Pattern Comp	06	19	21	28	23	21	5.06	1.73
12 Clerical Matching	-08	-07	-07	04	01	13	6.52	1.86
13 Numerical Operations	00	16	10	20	21	23	5.12	1.70
14 Mech Aptitude Index	19	05	13	17	02	14	57.96	18.78
15 Adm Aptitude Index	-11	05	06	13	34	23	50.53	16.33
16 General Aptitude Index	17	25	29	35	40	37	56.95	15.72
17 Elect Aptitude Index	24	39	41	39	30	29	57.52	15.56
18 Chem 1		59	57	42	22	21	75.53	8.14
19 Chem 2	59		81	49	37	30	72.50	8.73
20 R (Chem)	57	81		50	40	27	71.10	11.30
21 Phy 1	42	49	50		44	62	68.11	10.87
22 WH 1	22	37	40	44		48	79.57	8.26
23 WH 2	21	30	27	62	48		77.99	9.26

Note. — Decimal points omitted preceding all correlation coefficients.

TABLE 7. Estimated Reliabilities of Course Grades

Course	Reliability Estimate	Course	Reliability Estimate	Course	Reliability Estimate
Mechanical, from Table 1		Mechanical, from Table 2		Technical, from Table 5	
Shop 1	.36	Engl 5	.33	Engl 3	.41
Shop 2	.55	Engl 6	.33	Engl 4	.41
Shop 3	.52	Science TBE	.26	Math 10M1	.53
Shop 4	.48	Science TEL	.31	Math 10M2	.86
TD	.48			R (10M)	.86
Engl 1	.35	Technical, from Table 3			
Engl 2	.42	Shop 3	.52	Technical, from Table 6	
Engl 3	.36	Shop 4	.45	Chem 1	.59
Engl 4	.36	Shop 5	.58	Chem 2	.81
Math 1	.39	Shop 6	.58	R (Chem)	.81
Math 2	.39			Phy 1	.62
Math 3	.47	Technical, from Table 4		WH 1	.48
Math 4	.52	Engl 1	.61	WH 2	.62
Science 1	.46	Engl 2	.47		
Science 2	.55	Algebra 1	.51		
Science 3	.50	Algebra 2	.51		
Science 4	.50	Gen Science 1	.61		
		Gen Science 2	.54		

**TABLE 8. Multiple Correlations and Beta Weights of 12 Airman Tests
in Predicting Grades in the Mechanical Curriculum, Sample 1**

(N = 112)

Airman Tests	Shop				TD				Engl				Math				Science			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2 Mech Background	06	02	04	05	01	14	14	01	12	04	08	03	06	01	-15	-08	06	01	-15	-08
3 Adm Background	06	05	-02	-06	01	07	14	09	14	04	10	-07	07	-02	09	04	-02	09	04	04
4 Elect Background	-08	-05	-05	05	15	06	-01	-03	-15	-01	-06	07	-05	10	-07	-14	10	-07	04	-14
5 Arith Reasoning	10	-03	16	03	-09	01	30	18	16	22	19	25	11	25	18	01	25	18	01	06
6 Verbal Comprehension	-06	03	-09	-12	-16	25	-06	-11	10	-12	-35	-13	08	08	-02	08	08	-02	08	12
7 Mech Principles	11	-08	02	15	27	-09	-19	-30	-08	10	-16	01	-05	-09	-13	15	-09	-13	15	-01
8 Tool Functions	-10	11	08	-06	10	17	11	-05	04	-30	09	06	03	-15	17	00	-15	17	00	03
9 Figure Recognition	00	08	-07	-13	-08	-15	09	-10	-07	14	08	03	-02	-19	-04	-11	-19	-04	-09	-11
10 Physics	11	12	-08	-08	-10	-09	05	01	-06	-01	18	05	-09	21	29	23	21	29	23	19
11 Pattern Comp	14	21	18	24	34	05	-09	05	-01	04	08	08	25	13	18	07	13	18	07	17
12 Clerical Matching	00	-02	-12	12	09	01	-04	09	05	07	-16	-01	-02	15	-03	14	15	-03	14	08
13 Numerical Operations	-02	10	-01	-05	20	12	15	-01	-08	10	11	26	17	07	11	02	07	11	02	06
Multiple R	290	352	296	284	504	364	384	411	302	417	433	480	368	473	524	454	473	524	454	420
Correlation with AGCT	134	227	138	-025	293	228	182	057	076	217	073	300	289	341	280	306	341	280	306	389
Highest Correlation	206	268	097	112	315	214	188	113	133	226	174	311	221	289	434	321	289	434	321	286
with Aptitude Index	Elect	Elect	Elect	Elect	Elect	Adm	Gen	Elect	Adm	Gen	Elect	Gen	Gen	Elect	Elect	Elect	Elect	Elect	Elect	Elect

Note. — Decimal points omitted throughout.

**TABLE 9. Multiple Correlations and Beta Weights of 12 Airman Tests
in Predicting Grades in the Mechanical Curriculum, Sample 2**

(N = 176)

Airman Tests	Engl 5	Engl 6	Science TBE	Science TEL
2 Mech Background	-21	-08	03	00
3 Adm Background	-16	03	-13	-26
4 Elect Background	05	-05	03	14
5 Arith Reasoning	00	-12	-04	02
6 Verbal Comprehension	18	13	07	-07
7 Mech Principles	-01	-07	-13	-11
8 Tool Functions	-01	10	08	06
9 Figure Recognition	-09	-18	-02	07
10 Physics	13	27	13	30
11 Pattern Comp	-01	13	12	09
12 Clerical Matching	07	07	01	-01
13 Numerical Operations	04	17	10	08
Multiple R	373	376	271	443
Correlation with AGCT	241	212	057	265
Highest Correlation with Aptitude Index	164 Gen	230 Elect	159 Elect	318 Elect

Note. — Decimal points omitted throughout.

**TABLE 10. Multiple Correlations and Beta Weights of 12 Airman Tests
in Predicting Grades in the Technical Curriculum, Sample 3**

(N = 99)

Airman Tests	Shop 3	Shop 4	Shop 5	Shop 6
2 Mech Background	02	07	23	29
3 Adm Background	-04	-07	00	-13
4 Elect Background	00	-08	10	07
5 Arith Reasoning	-01	-12	08	14
6 Verbal Comprehension	-14	04	-26	-10
7 Mechanical Information	27	18	24	-12
8 Tool Functions	11	14	-09	29
9 Figure Recognition	-09	01	10	01
10 Physics	-09	06	-07	-05
11 Pattern Comp	20	01	07	12
12 Clerical Matching	01	24	09	09
13 Numerical Operations	-10	-04	-01	-09
Multiple R	418	452	459	503
Correlation with AGCT	036	179	011	138
Highest Correlation with Aptitude Index	327 Mech	341 Mech	297 Mech	358 Mech

Note. — Decimal points omitted throughout.

**TABLE 11. Multiple Correlations and Beta Weights of 12 Airman Tests
in Predicting Grades in the Technical Curriculum, Sample 4**

(N = 98)

Airman Tests	Engl 1	Engl 2	Algebra 1	Algebra 2	Gen Science 1	Gen Science 2
2 Mech Background	-19	-05	-09	-07	-26	-03
3 Adm Background	12	28	16	16	02	23
4 Elect Background	08	-11	04	-03	17	05
5 Arith Reasoning	34	19	20	21	28	27
6 Verbal Comprehension	-01	13	03	-01	09	16
7 Mech Principles	14	-20	01	-13	02	-01
8 Tool Functions	00	-13	-17	-02	09	10
9 Figure Recognition	00	13	10	16	16	02
10 Physics	16	20	19	25	28	17
11 Pattern Comp	07	-13	-07	-03	-05	-04
12 Clerical Matching	-02	10	21	07	-05	15
13 Numerical Operations	-05	14	17	06	-14	-08
Multiple R	557	524	534	435	620	550
Correlations with AGCT	401	158	283	199	305	328
Highest Correlation with Aptitude Index	467 Elect	456 Adm	437 Adm	340 Gen	489 Elect	406 Gen

Note. — Decimal points omitted throughout.

**TABLE 12. Multiple Correlations and Beta Weights of 12 Airman Tests
in Predicting Grades in the Technical Curriculum, Sample 5**

(N = 165)

Airman Tests	Engl 3	Engl 4	Math 10M1	Math 10M2	R (10M)
2 Mech Background	-11	00	-13	-14	-19
3 Adm Background	15	09	-03	-05	00
4 Elect Background	16	07	-03	24	24
5 Arith Reasoning	-01	05	07	15	16
6 Verbal Comprehension	16	21	-05	03	00
7 Mech Principles	01	-07	-03	05	09
8 Tool Functions	00	-05	13	14	10
9 Figure Recognition	13	02	11	01	11
10 Physics	-15	03	24	04	10
11 Pattern Comp	-04	-07	-08	07	-04
12 Clerical Matching	02	07	-12	00	-09
13 Numerical Operations	-08	09	-02	07	11
Multiple R	325	318	334	418	459
Correlation with AGCT	-039	115	159	276	235
Highest Correlation with Aptitude Index	177 Adm	286 Adm	206 Elect	343 Elect	340 Elect

Note. — Decimal points omitted throughout.

**TABLE 13. Multiple Correlations and Beta Weights of 12 Airman Tests
in Predicting Grades in the Technical Curriculum, Sample 6**

(N = 113)

Airman Tests	Chem 1	Chem 2	R (Chem)	Phy 1	WH 1	WH 2
2 Mech Background	-05	-13	-19	-04	02	15
3 Adm Background	-21	-21	-19	-12	13	-02
4 Elect Background	15	20	20	26	23	14
5 Arith Reasoning	05	01	07	14	24	18
6 Verbal Comprehension	-12	-01	10	03	29	15
7 Mech Principles	01	-15	-05	14	01	05
8 Tool Functions	05	08	11	-03	-13	-13
9 Figure Recognition	18	03	04	06	14	16
10 Physics	22	33	25	-03	-22	-09
11 Pattern Comp	-17	-01	01	17	19	13
12 Clerical Matching	-09	-06	-04	03	01	11
13 Numerical Operations	03	14	02	07	-08	02
Multiple R	395	491	501	461	542	466
Correlation with AGCT	001	189	179	267	166	372
Highest Correlation with Aptitude Index	240 Elect	386 Elect	410 Elect	390 Elect	405 Gen	373 Gen

Note.— Decimal points omitted throughout.

TABLE 14. Number of Beta Weights of Practical Significance for Airman Tests

	+ .10 or Greater	- .10 or Greater	Total
2 Mech Background	4	13	17
3 Adm Background	10	8	18
4 Elect Background	14	3	17
5 Arith Reasoning	23	2	25
6 Verbal Comprehension	12	10	22
7 Mech Principles	10	10	20
8 Tool Functions	14	6	20
9 Figure Recognition	12	6	18
10 Physics	22	3	25
11 Pattern Comp	16	2	18
12 Clerical Matching	8	3	11
13 Numerical Operations	15	2	17

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Aeronautical Systems Division. Personnel Laboratory, Lackland Air Force Base, Texas. VALIDATION OF AIR FORCE CLASSIFICATION TESTS AGAINST ACADEMIC GRADES IN AN AVIATION HIGH SCHOOL, by Lloyd G. Humphreys. August 1961. v + 17 p. (Project 7717, Task 17154) (ASD-TN-61-51) (Contract AF 41(657)-279, University of Illinois)
Unclassified report

Air Force classification tests and the Army General Classification Test were validated against individual course grades in an aviation high school. Course grades showed low to moderate levels of reliability, with those in the terminal aviation-mechanic curriculum somewhat less reliable than grades in the pre-engineering technical curriculum. Most of the multiple correlations of classification test scores with

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course grades were at a usefully high level. Highest correlations with Air Force aptitude indexes were somewhat lower, and correlations with AGCT still lower. For selection purposes the Air Force classification tests do a better job than the AGCT general intelligence test. The Air Force tests that have the highest utility for selection are Arithmetic Reasoning, Physics, and Pattern Comprehension. Additional mechanical and numerical content, as well as the use of keyed biographical data items, may improve prediction in this school situation. This is the first of a series of reports detailing the long-range validity of Air Force selection tests for technical academic criteria. The Aviation High School provides a unique opportunity for collection of predictor and criterion information for the same individuals over an extended period of time.

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