AD NUMBER

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UNANNOUNCED

Chanute #11

Personnel Research Section
May 7, 1941

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6 A.C.T.S. Mechanical Aptitude Study.

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Problem:

A study of the correlation between the A.C.T.S. Mechanical Movements, Surface Development and Shop Mathematics tests with the parts of MA-1 and of the reliability of these tests.

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Population:

Three groups of students at the A.C.T.S. - one group consisting of 92 weather observer recruits and the other two groups of airplane mechanics students with population of 169 and 220. All computations were based on the total population of 481 students.

Variables:

1. The General Mechanical Aptitude Test (MA-1) and its parts, (1) Mechanical Movements, (Gears and Pulleys), (2) Surface Development (Patterns and Forms) and (3) Shop Mathematics. Each part has 45 questions making a total of 135 questions for the whole test. There is a fifteen minute time limit for each part.

2. The A.C.T.S. tests: Mechanical Movements (6-RE), Surface Development (6-RC, 6-RD) and Shop Mathematics (5-RK).

Procedure and Results:

1. Correlations were computed between the A.C.T.S. tests: Mechanical Movements, Surface Development and Shop Mathematics and the parts of the MA-1. These correlations are given in Table I. The intercorrelations of parts of MA-1, based on a population of 1960 selectees, are also given in Table I for purposes of comparison.

2. Reliability coefficients were calculated by means of the Richardson-Kuder formula #21 and are given in Table II.

TABLE I

Correlations of A.C.T.S. Tests with Parts of MA-1 (N = 481 Students at Chanute) and Intercorrelations of Parts of MA-1 (N = 1960 Selectees)

	A.C.T.S.			MA-1		
	Mech. Move.	Surf. Dvlpt.	Shop Math.	Mech. Move.	Surf. Dvlpt.	Shop Math.
A.C.T.S.:						
Mechanical Movements				.549	.474	.332
Surface Development				.458	.448	.335
Shop Mathematics				.280	.216	.632
MA-1:						
Mechanical Movements	.549	.458	.280		.629	.595
Surface Development	.474	.448	.216	.629		.595
Shop Mathematics	.332	.335	.632	.595	.595	
Mean (N = 481)	24.29	33.98	7.83	31.45	37.10	22.86*
Sigma (N = 481)	9.32	11.39	2.84	6.40	8.65	5.43
Mean (N = 1960)				23.28	24.39	17.46
Sigma (N = 1960)				7.28	11.18	7.64

* Note the superior average scores of A.C.T.S. students on MA-1 tests. Their average scores for all three tests lie in Grade II.

Reliability coefficients of MA-1 based on 1960 selectees are also given in Table II.

Table II

Reliability of A.C.T.S. Tests and MA-1

		Reliability (Richardson-Kuder #21)	
		N = 481	N = 1960
A.C.T.S.:	Mechanical Movements	.833	
	Surface Development	.893	
	Shop Mathematics	.429	
MA-1	Mechanical Movements	.787	.843
	Surface Development	.934	.942
	Shop Mathematics	.620	.849
	Total	.900	.951

Conclusions:

The Reliability coefficients of the A.C.T.S. Mechanical Movements and Surface Development tests, .83 and .87 respectively, are satisfactory while the reliability of the A.C.T.S. Shop Mathematics test, .43, is not. However, these reliability coefficients are undoubtedly lower than the "true" reliability for two reasons. First, the Richardson-Kuder formula #21 "will in most cases underestimate and will never overestimate the reliability coefficient." Second, students at Chanute Field are a selected group, and correlations will be lower whenever the range of ability is limited. This second point is borne out by the reliability data on the parts of MA-1. The coefficients based on A.C.T.S. students are all lower than those based on a population of 1960 selectees. The reliability of Shop Mathematics is considerably lower - .62 as compared with .85.

The correlations between A.C.T.S. tests and parts of MA-1 (e.g. A.C.T.S. Mechanical Movements with MA-1 Surface Development) are significant correlations though they are not particularly high - correlations range from .22 to .47. Intercorrelations of parts of MA-1 range, on the other hand, from .60 to .63.

If the purpose of this study is to find whether the A.C.T.S. tests can be used as parallel tests to the parts of MA-1, the fact that the correlations are not high between Air Corps tests and dissimilar MA-1 parts (e.g. A.C.T.S. Mechanical Movements and MA-1 Surface Development)

would be no disadvantage if the correlation of similar A.C.T.S. tests and MA-1 parts (e.g. A.C.T.S. Mechanical Movements and MA-1 Mechanical Movements) were high. This, however, is not the case - for the two Mechanical Movements tests correlate .55, the two Surface Development tests correlate .45, and the two Shop Mathematics tests correlate .63. These are significant correlations, but they are not high enough to justify the assumption that the tests are measuring the same abilities. Although, as was pointed out in the discussion of reliability, these correlations are probably lower than the "true" correlation because they are based on data from a selected population.

THE MECHANICAL APTITUDE TEST MA-1 AS COMPARED WITH THE AIR CORPS TECHNICAL SCHOOLS TESTS.

SUMMARY

To 481 men taking airplane mechanics and weather observation courses, the Air Corps Technical Schools gave the Mechanical Aptitude Test MA-1, and the three A.C.T.S. tests of mechanical movements, surface development, and shop mathematics. Since the three sub-tests comprising the MA-1 battery are similar in content to the A.C.T.S. tests, the data furnish valuable information on the comparability of the three types of tests in the two batteries. Opportunity has been taken also to study the reliability of each of the six measures, and to report upon the average scores made by Air Corps Technical School students as compared with the average scores made by Army men in general. The findings are:

1. With respect to reliability, in both batteries the surface development test was found to have the highest reliability of any of the three types of tests. The mechanical movements test ranked next with respect to reliability in both batteries. The reliability of the shop mathematics test was barely satisfactory in the MA-1 battery, and definitely unsatisfactory in the A.C.T.S. battery. This result indicates that the shop mathematics test needs lengthening to about 50 items. At present, it has 45 items in MA-1 and only 20 items in the A.C.T.S. test.

2. With respect to average scores, it is found that the averages made by these 481 students fall in Army Grade II on all three MA-1 tests. The average MA-1 scores made by Army men in general, of course, fall in Army Grade III. Although the relevant data are not at hand, it may be presumed that as compared with Army men in general, these students are also a relatively selected group with respect to performance on the A.C.T.S. tests.

3. With regard to the comparability of the three types of measures, the test which was most comparable in the two batteries was the shop mathematics test. If the two shop mathematics tests were made the same length, they might be regarded as alternative forms of the same test. However, the two tests of mechanical movements show low comparability, and the two tests of surface development show very low comparability.

4. Except for the shop mathematics test, therefore, the MA-1 and A.C.T.S. batteries as constituted at present cannot well be regarded as parallel measures of the same set of functions.

Data

Table I presents the reliability coefficients. For comparison, the table includes the MA-1 reliability coefficients obtained in a separate study of 1960 inductees. As is to be expected, the latter coefficients are higher than the coefficients found in the present study, because the Air Corps Technical School students are a selected group. Since the facts concerning this selection are interesting and important in themselves, means and standard deviations for the two groups of men presented in Table II.

Table III presents the correlations for the tests in the two batteries. The three underlined correlations are the more pertinent ones. It should be noted that the differences between the underlined coefficients would be increased if all tests were equally reliable in both batteries.

Although the two batteries are not comparable, it may be desired to convert scores made on one battery into scores made on the other battery until such time as improved tests are available. MA-1 and A.C.T.S. scores which are roughly equivalent for purposes of selection are therefore provided in Table IV.

Table I

RELIABILITY COEFFICIENTS OF A.C.T.S. TESTS AND MA-1 TESTS

Tests	481 A.C.T.S. Students	1960 Inductees
A.C.T.S: Mech. Movements	.83	
Surface Development	.87	
Shop Mathematics	.43	
MA-1: Mech. Movements	.79	.84
Surface Development	.93	.94
Shop Mathematics	.62	.85
Total Score on MA-1	.90	.95

Table II

MEANS AND STANDARD DEVIATIONS OF SCORES FOR STUDENTS AND INDUCTEES

	481 A.C.T.S. Students		1960 Inductees	
	Mean	S.D.	Mean	S.D.
A.C.T.S: Mech. Movements	24.3	9.3		
Surface Development	34.0	11.4		
Shop Mathematics	7.8	2.8		
MA-1: Mech. Movements	31.5	6.4	23.3	7.3
Surface Development	37.1	8.7	24.4	11.2
Shop Mathematics	22.9	5.4	17.5	7.6

Table III

CORRELATIONS BETWEEN A.C.T.S. TESTS AND MA-1 TESTS

	A. C. T. S.		
	Mech. Move.	Surf. Devel.	Shop Math.
MA-1: Mech. Movements	.55	.46	.28
Surface Development	.47	.45	.22
Shop Mathematics	.33	.34	.63

Table IV

CONVERSION TABLES: MA-1 SUB-TEST SCORES
INTO A.C.T.S. TEST SCORES

Equivalent scores on MECH. MOVE. tests.		Equivalent scores on SURF. DEVEL. tests.		Equivalent scores on SHOP MATH. tests.	
MA-1	A.C.T.S.	MA-1	A.C.T.S.	MA-1	A.C.T.S.
41	38	44	43	38	15
37	31	36	33	30	11
34	28	32	27	26	9
30	22	27	21	22	7
26	16	19	10	18	5
21	9	13	2	14	3
17	3	7	0	10	1
13	0			7	0