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RESEARCH MEMORANDUM 60-20

Standardization of Armed Forces Qualification Test AFQT-7 and-8

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PERSONNEL RESEARCH BRANCH

Research and Development Division
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Research Memorandum 60-20

STANDARDIZATION OF ARMED FORCES QUALIFICATION TEST AFQT-7 AND -8

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STANDARDIZATION OF ARMED FORCES QUALIFICATION TEST AFQT-7 AND -8

New forms of the Armed Forces Qualification Test, AFQT-7 and -8, were developed for implementation 1 July 1960. In previous research phases, pools of items for the new forms had been constructed by the Army, Navy, Air Force, and Marine Corps and organized in two experimental booklets of 300 items each (Bayroff, Morton, Hilligoss and Kehr, 1958). On the basis of scores obtained on two mobilization samples of 1000 cases each, items were selected for the final forms, each form containing 100 items divided equally among four content areas--verbal, arithmetic reasoning, tool functions, and spatial relations-- and arranged in spiral omnibus form (Bayroff, Morton, Anderson, and Hilligoss, 1960).

It is the purpose of the present Research Memorandum to describe the standardization of the final forms, AFQT-7 and -8. In anticipation of sub- sequent operational introductions of editorial revisions of AFQT-7 and -8, the forms used for purposes of standardization (identical to those introduced for operational use on 1 July 1960) were designated AFQT-7A (PT 3787) and -8A (PT 3789). The standardization data and norms obtained for AFQT-7A and -8A will apply equally to all subsequent editions of AFQT-7 and -8.

SAMPLING AND DATA COLLECTION

Data collection procedures for the standardization of AFQT-7 and -8 followed those used for the predecessor forms of AFQT. Each form of the AFQT and a reference test were administered in counterbalanced order to each of four mobilization samples. The AFQT Reference Test R-9, used in the present study, is an editorial revision of Classification Test R-5 used in standardi- zing earlier AFQT forms. As a basis for determining the equivalence of AFQT-7 and -8, forms were administered in counterbalanced order to two additional samples. All services (including the Marine Corps) participated in data collec- tion for the standardization.[1] Quotas for selected training installations and AFES were established to provide samples typical of the World War II peak mobilization population in mental ability, proportionate representation among the services, and widespread geographic distribution.

Recorded scores on operational AFQT-5 or -6 were used in selecting cases for both the standardization and equivalence studies. The R-9, administered to the standardization groups, was used in the development of norms. The use of operational AFQT 5-6 scores (rather than scores from an experimentally administered reference test) in selecting cases for the item selection, standardization, and equivalence phases of AFQT-7 and -8 development was a departure from procedures used for earlier forms of AFQT. In addition to the obvious savings in time and labor, justification for using operational scores for selection of cases was based on the following considerations:

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[1] The Marine Corps did not participate in data collection for the equivalence study.

(1) current administration of operational AFQT 5-6 is judged to be satisfactory; (2) correlation coefficients between operational AFQT 5-6 scores and scores on the reference test used in its standardization (R-5) are high--.84.and .86; and (3) prediction of AFQT 7-8 scores from a reference test is not involved in these phases of the development of AFQT 7-8.

Being able to limit the use of the experimentally administered reference test to the establishment of norms reduces possible bias in norms which could result from its use for both the selection of cases and the establishment of norms.

For the standardization, AFQT-7 and R-9 were administered to a total of 1852 examinees; AFQT-8 and R-9 were administered to 1797 examinees. For the equivalence study, both AFQT-7 and -8 were administered to an additional 1028 examinees. To fulfill the score distribution requirement for samples representing each testing order, papers were selected from the pool of unscored answer sheets on the basis of the examinee's recorded percentile score on operational AFQT-5 or -6. Table 1 identifies each standardization and equivalence sample in terms of tests administered, order of testing, and sample size.

Training installations and Armed Forces Examining Stations participating in the data collection are listed below.

Training Installations

> Army--Fort Dix, New Jersey; Fort Jackson, South Carolina;
> Fort Knox, Kentucky; Fort Carson, Colorado.
>
> Navy--Great Lakes, Illinois; San Diego, California.
>
> Air Force--Lackland Air Force Base, Texas.
>
> Marine Corps--Parris Island, South Carolina.

Armed Forces Examining Stations

> New York, New York; Fort Jackson, South Carolina; Louisville,
> Kentucky; Denver, Colorado; Chicago, Illinois; Oakland,
> California; Baltimore, Maryland; Atlanta, Georgia; Dallas,
> Texas; Houston, Texas; San Antonio, Texas.

STATISTICAL ANALYSIS

All answer sheets for AFQT-7, AFQT-8, and R-9 were scored (R-1/3W) in PRB and checked. For Samples 1-6, frequency distributions in unit intervals were prepared (raw scores for AFQT-7 and -8 and percentile scores for R-9).

Table 1

IDENTIFICATION OF AFQT-7 AND -8 STANDARDIZATION AND EQUIVALENCE SAMPLES

	Sample	N	Test Order 1st	Test Order 2nd
Standardization	1	500	R-9	AFQT-7
	2	500	AFQT-7	R-9
	3	500	R-9	AFQT-8
	4	500	AFQT-8	R-9
	5 (1 and 2)	1000	(AFQT-7 and R-9)	
	6 (3 and 4)	1000	(AFQT-8 and R-9)	
Equivalence	7	300	AFQT-7	AFQT-8
	8	300	AFQT-8	AFQT-9
	9 (7 and 8)	600	(AFQT-7 and -8)	

Table 2 shows, for samples 1-6, the AFQT-7 and -8 raw score means and standard deviations, and the product-moment correlation coefficients with R-9 and with operational AFQT 5-6. The coefficients were found to be satisfactorily high, those with R-9 (r's = .85 to .87) being similar to those found with R-5 for the AFQT-5 and -6 standardization samples (r's = .84 to .86) (Mundy, Goldstein, and Bayroff, 1957).

Since comparisons of data for samples 1 and 2 and for samples 3 and 4 showed that test order had no appreciable effect of the parameter estimates or on correlation with reference variables, data for the two orders combined (samples 5 and 6) were used for standardization purposes.

The equivalence of AFQT-7 and AFQT-8 was established on the basis of (1) the close similarity of their score distributions, means, standard deviations, and correlation with reference variables R-9 and operational AFQT 5-6 and (2) data obtained from administration of both forms to the equivalence samples. For equivalence sample 7 (AFQT-7 given first) and sample 8 (AFQT-8 given first), the similarity of means, standard deviations, and correlation between the two forms was evidence that test order had no effect (Table 3). Correlation coefficients between AFQT-7 and -8 (.94 and .92) were comparable to those obtained in the AFQT 5-6 equivalence study in which r's of .95 and .93 were obtained for the two test orders (Mundy, Goldstein, and Bayroff, 1957).

Table 2

CORRELATION OF AFQT-7 AND -8 WITH REFERENCE TEST

Sample	N	AFQT-7 raw score		AFQT-8 raw score		R-9 raw score		AFQT-7 or -8 vs:	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	R-9	Operational AFQT 5-6
1	500	61.2	23.2			53.4	25.2	.85	.89
2	500	60.7	23.4			52.2	23.4	.86	.90
3	500			59.2	23.2	53.4	24.5	.85	.89
4	500			60.3	23.0	53.2	24.4	.85	.90
5	1000	61.0	23.3			52.8	24.3	.87	.90
6	1000			59.8	23.1	53.3	24.5	.86	.89

Table 3

COMPARISON OF AFQT-7 AND AFQT-8

Equivalence Samples	N	AFQT-7		AFQT-8		AFQT-7 vs -8
		Mean	S.D.	Mean	S.D.	r
7 (AFQT-7 given first)	300	60.6	21.8	60.3	22.3	.94
8 (AFQT-8 given first)	300	60.7	22.1	59.4	22.2	.92
9 (samples 7 and 8)	600	60.6	21.9	59.8	22.2	.94

Since test order showed no influence on the parameter estimates or correlation coefficients, data for the combined equivalence samples (sample 9) were used. The reliability, as indicated by the correlation between AFQT-7 and -8, was .94, with a standard error of measurement of 5.37 for AFQT-7 and 5.44 for AFQT-8.

PREPARATION OF CONVERSION TABLE

Frequency and cumulative percentage distributions of raw scores on AFQT-7, AFQT-8, and R-9 were used as the basis for deriving raw-to-percentile conversions for AFQT-7 and -8. Distributions were prepared for samples 5 and 6, separately and combined. The R-9 scores used were the percentile score conversions derived in the standardization of the original form of the test. The procedures used for each sample and for the combined samples were as follows: For each AFQT raw score, starting with zero, the percentile value assigned was the R-9 standardization percentile score which showed the same cumulative percentage frequency in the sample as did the given raw score. Any gaps in the resulting raw-to-percentage conversions were smoothed.

Comparison of the resulting AFQT-7 and AFQT-8 conversion tables justified the use of a single raw-to-percentile conversion table based on the combined AFQT-7 and -8 score distributions.

SUMMARY

AFQT-7 and -8 were standardized on samples (1,000 examinees for each form) selected to duplicate the World War II mobilization population in mental ability, to provide proportionate representation among the Services, and to provide widespread geographic representation. An additional 600 examinees, providing distribution characteristics similar to those used for the standardization, were used to establish the equivalence of the two forms. Two reference tests were used: Operational AFQT 5-6 to select the samples and R-9 to develop the percentile norms.

Data showed AFQT-7 and -8 to be highly comparable to each other and to AFQT-5 and -6 with respect to score distributions, means, standard deviations and correlation with reference variables AFQT 5-6 and R-9. Data on equivalence samples gave further evidence of the comparability of AFQT forms -7 and -8.

The data obtained supported the use of a single raw-to-percentile conversion table for AFQT-7 and -8, developed by the equi-percentile method, using R-9 scores as a "tie-back".

REFERENCES

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3. Bolanovich, D. J., Mundy, J. P., Burke, Laverne, K., and Falk, Gloria H. Development of the Armed Forces Qualification Test, Forms 3 and 4. Technical Research Report 1078. October 1953.

4. Mundy, J. P., Goldstein, L. G., and Bayroff, A. G. Development of The Armed Forces Qualification Test, Forms 5 and 6. Technical Research Report 1101. April 1957.

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TABLE FOR CONVERTING RAW SCORES TO PERCENTILE SCORES ON AFQT-7 AND AFQT-8

Raw Score	Percentile Score	Raw Score	Percentile Score	Raw Score	Percentile Score	Raw Score	Percentile Score
100	100	74	67	49	29	24	11
99	99	73	65	48	28	23	11
98	99	72	63	47	27	22	10
97	98	71	62	46	26	21	10
96	98	70	61	45	25	20	9
95	97	69	60	44	24	19	9
94	96	68	58	43	23	18	8
93	95	67	56	42	22	17	8
92	94	66	54	41	21	16	7
91	93	65	52	40	20	15	7
90	92	64	51	39	19	14	6
89	91	63	50	38	18	13	6
88	90	62	49	37	18	12	5
87	89	61	48	36	17	11	5
86	88	60	46	35	17	10	4
85	87	59	44	34	16	9	4
84	85	58	42	33	16	8	3
83	83	57	40	32	15	7	3
82	82	56	38	31	15	6	3
81	81	55	36	30	14	5	2
80	80	54	34	29	14	4	2
79	78	53	33	28	13	3	2
78	76	52	32	27	13	2	1
77	74	51	31	26	12	1	1
76	72	50	30	25	12	0	1
75	70						