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**Comparison of the Air
Force Officer Qualifying
Test Form T and Form S:
Initial Item- and Subtest-
Level Analyses**



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Comparison of the Air Force Officer Qualifying Test Form T and Form S: Initial Item- and Subtest-Level Analyses

The *Air Force Officer Qualifying Test* (AFOQT) is an aptitude and achievement test used to qualify US Air Force (USAF) Reserve Officer Training Corps (ROTC) applicants for aircrew training as pilots, air battle managers, combat systems officers, and remotely-piloted aircraft pilots (Carretta, Rose, & Trent, 2016). From the time it was implemented in 1953, the AFOQT has been revised and modified several times. Changes and modification have been made to the AFOQT in recent years. This report focuses on the psychometric differences between the current Form T, implemented in 2015 (Carretta, Rose, & Trent, 2016) and the previous Form S, implemented in 2005 (Drasgow, Nye, Carretta, & Ree, 2008).

The content of Form T differs from the previous Form S. Form S included two spatial subtests (Rotated Blocks and Hidden Figures) that are not included in Form T. Reading Comprehension (RC) was not tested in the previous Form S and was added to Form T. General Science (GS) in Form S was modified to focus on Physical Science (PS) on Form T (i.e., item content focused on biology was excluded from PS). Verbal Analogies (VA), Arithmetic Reasoning (AR), Word Knowledge (WK), Math Knowledge (MK), Table Reading (TR), Instrument Comprehension (IC), Block Counting (BC), and Aviation Information (AI) are subsets that were part of Form S and are still included in Form T. For IC, the number of items increased from 20 to 25, and testing time was shortened from 6 to 5 minutes; aircraft and instrument graphics were modernized and subtest instructions were updated for clarity. For BC, the number of items increased from 20 to 30, and testing time increased proportionately from 3 to 4.5 minutes; instructions were also updated for clarity. The numbers of items and test instructions remained the same for AR, WK, MK, TR, and AI. Demographic data, item-level analyses, and subtest-level analyses are presented in this report. Comparisons are made on the psychometric properties of the current Form T and previous Form S. Tables are used throughout this report to compare the statistical results for both test forms.

Participants

An overview of the sample demographic data for the AFOQT Forms T1 and T2 as well as Forms S1 and S2 is illustrated in Table 1. The data for Form T1 and T2 was retrieved from responses from US Air Force officer applicants who were administered either the AFOQT Form T1 ($N = 5,681$) or Form T2 ($N = 5,199$) between 2015 and 2016 (Carretta, Rose, & Trent, 2016). The data for Forms S1 and S2 was retrieved from respondents who took Forms S1 ($N = 9,607$) or S2 ($N = 8,164$) between 2005 and 2008 (Morath, Parish, & Lodato, 2008). A comparison between the samples for each of the different forms indicates the demographic composition of the samples was overall very similar, although Hispanics and non-White applicants were somewhat more heavily represented in the Form T sample than in the Form S sample. The mean ages were 22.5 (T1), 22.4 (T2), 22.82 (S1), and 21.95 (S2). All participants for each of the test forms had completed at least 12 years of education. The composition of each of the samples consisted of primarily males (T1 = 75.2%; T2 = 75.3%; S1 = 75.4%; S2 = 75.2%) and Whites (T1 = 64.5%; T2 = 64.5%; S1 = 76.1%; S2 = 75.8%).

Table 1. Sample Demographic Data for AFOQT Forms T1, T2, S1, and S2

Variable	Form T1 (N= 5,681)	%	Form T2 (N= 5,199)	%	Form S1 (N= 9,607)	%	Form S2 (N= 8,164)	%
Sex								
Male	4,274	75.2	3,914	75.3	7,248	75.4	6,143	75.2
Female	1,399	24.6	1,279	24.6	2,266	23.6	1,959	24.0
Unknown	8	0.1	6	0.1	93	1.0	62	0.8
Race								
White	3,667	64.5	3,351	64.5	7,312	76.1	6,188	75.8
Black/ African-American	710	12.5	686	13.2	1,080	11.3	906	11.1
Asian	570	10.0	522	10.0	610	6.3	569	7.0
Native-American/Native Alaskan	296	5.2	315	6.1	150	1.6	130	1.6
Native-American/other Pacific Islander	154	2.7	126	2.4	158	1.6	146	1.8
Unknown	284	5.00	199	3.83	---	---	---	---
Ethnicity								
Hispanic	747	13.1	693	13.3	922	9.6	767	9.4
Non-Hispanic	4,834	85.1	4,406	84.7	---	---	---	---
Unknown	100	1.8	100	1.9	---	---	---	---
Education								

Completed 12 Years (high school)	74	1.3	86	1.7	3,734	38.9	3,526	43.3
Completed 13 Years	1,830	32.2	1,698	32.7	1,169	12.2	1,038	12.7
Completed 14 Years	1,163	20.5	1,104	21.2	858	8.9	754	9.2
Completed 15 Years	604	10.6	544	10.5	964	10.0	824	10.1
Completed 16 Years	1,392	24.5	1,229	23.6	2,183	22.7	1,524	18.7
Completed 17 Years	322	5.7	268	5.2	388	4.0	275	3.4
Completed 18 Years	201	3.5	190	3.7	224	2.3	138	1.7
Completed 19 Years	41	0.7	37	0.7	42	0.4	49	0.6
Completed 20 Years	26	0.5	19	0.4	11	0.1	14	0.2
Completed 21+ Years	22	0.4	19	0.4	20	0.2	10	0.1
Unknown	6	0.1	5	0.1	14	0.1	12	0.1
Academic Degree								
High School Diploma	3,363	59.2	3,150	60.6	6,166	64.2	5,681	70
Associates Degree	438	7.7	376	7.2	862	9.0	636	7.8
Bachelor's Degree	1,659	29.2	1,464	28.2	2,335	24.3	1,667	20.5
Master's Degree	187	3.3	179	3.4	170	1.8	128	1.6
Unknown	16	0.2	17	0.3	61	0.6	43	0.5

Note. The percentages for Race do not add to 100% because Form S and Form T test-takers had an option to choose more than one race. Form T test-takers could also choose not to respond. Form S test-takers were also given the option to choose more than one ethnicity.

Item-Level Analyses

Item Difficulty

P Values. Tables 2 and 3 summarize the differences in item difficulty between each form and their versions. The *p*-values for Forms T1 and T2 and Forms S1 and S2 were very similar within the forms. When compared against each other, the most difficult subtests for both Form T and Form S were AI and BC. TR was the easiest subtest across all forms with means for T1/S1 of .68/.67 and .68/.67 for T2/S2. Results indicate that all Form T subtests except for TR had lower mean *p*-values than those of Form S. Subtests on which mean item difficulty increased most substantially were: AR (S1/S2: .63-.64; T1/T2: .56), BC (S1/S2: .60-.61; T1/T2: .51-.54), and AI (S1/S2: .50-.52; T1/T2: .45-.48). In the science area, PS also tested more difficult when compared to the previous GS subtest. The mean item *p*-values for PS were .55 for T1 and .58 for T2. The means for GS were .66 and .65 for S1 and S2 respectively. RC was a subtest that was not included in Form S and therefore no information is available for comparison to Form T. Despite it being a recent subtest added to Form T, the mean item *p*-value for RC was higher than any of the other subtests at .69 for T1 and .71 for T2.

Table 2. Subtest Item Difficulty Statistics: Form T1 and S1

Form T1 <i>p</i> values				Form S1 <i>p</i> values			
Subtest	Min.	Max.	Mean	Subtest	Min	Max	Mean
VA	.30	.81	.60	VA	.34	.93	.66
AR	.27	.77	.56	AR	.26	.82	.63
WK	.35	.82	.61	WK	.39	.89	.63
MK	.25	.80	.59	MK	.43	.88	.64
RC	.37	.88	.69	RC	---	---	---
PS	.33	.85	.55	GS	.44	.82	.66
TR	.16	.97	.68	TR	.18	.96	.67
IC	.33	.78	.61	IC	.34	.89	.64
BC	.08	.87	.51	BC	.19	.92	.61
AI	.30	.85	.48	AI	.26	.78	.52

T1 *N* = 5,681; S1 *N* = 9,607**Table 3. Subtest Item Difficulty Statistics: Form T2 and Form S2**

Form T2 <i>p</i> values				Form S2 <i>p</i> values			
Subtest	Min.	Max.	Mean	Subtest	Min	Max	Mean
VA	.33	.81	.60	VA	.33	.85	.65
AR	.31	.76	.56	AR	.33	.82	.64
WK	.32	.85	.60	WK	.37	.90	.62
MK	.24	.81	.60	MK	.35	.88	.63
RC	.38	.93	.71	RC	---	---	--
PS	.31	.86	.58	GS	.43	.83	.65
TR	.15	.97	.68	TR	.18	.95	.67
IC	.35	.79	.60	IC	.31	.80	.61
BC	.17	.91	.54	BC	.28	.86	.60
AI	.23	.77	.45	AI	.07	.78	.50

T2 *N* = 5,199; S2 *N* = 8,164

Subtest-Level Analyses

Descriptive Statistics

Tables 4 through 7 summarize the means and standard deviations of subtest raw scores, and skewness and kurtosis of the raw subtest score distributions for Forms T1 and T2 and Forms S1 and S2. Note that results for standard error or *t*-test for skewness and kurtosis for Forms S1 and S2 were not available in the report written by Morath, Parish, and Ladota (2008).

Comparison of the means shows that VA, AR, WK, MK, and AI subtests had a higher difficulty on Form T than on Form S. Note that means are not directly comparable for BC and IC because these subtests included a greater number of items on Form T than on Form S.

Lower mean scores on Form T than Form S generally resulted in reduced ceiling effects for Form T. On Form S, all subtests except for AI were negatively skewed, with the greatest extent of negative skewness (skewness ranging from -.30 to -.49) for VA, GS, IC, and BC. Skewness statistics indicate reduced ceiling effects on Form T as compared to Form S for VA, AR, WK, MK, IC, and BC. The most significant improvements can be seen with AR (Form S1/S2 skewness: -.21 to -.23; Form T1/T2 skewness: +.03 to -.01), MK (Form S1/S2 skewness: -.16 to -.24; Form T1/T2 skewness: -.06 to -.08), and BC (Form S1/S2 skewness: -.32 to -.49; Form T1/T2 skewness: -.01 to -.02).

AI, which was positively skewed on both Form S and Form T, became more positively skewed on Form T (skewness: .46 to .54) than on Form S (skewness: .28 to .34), indicating a greater floor effect on Form T, at least among a sample of all AFOQT test takers (i.e., including both those who are and are not interested in applying for a pilot slot). It is unknown whether a floor effect would be found if pilot applicant scores were analyzed separately. Whereas GS (Form S1/S2) was negatively skewed (skewness: -.37 to .40), PS was positively skewed on T1 (skewness: +.37), but not T2 (skewness: -.06).

RC, which was included on Form T but not Form S, was substantially more negatively skewed (T1 skewness: -.57; T2 skewness: -.76) than either of the other Verbal subtests on Form S or Form T (skewness values on WK and VA ranging from -.09 to -.39).

Table 4. AFOQT Form TI Subtests Means, Standard Deviations, Skewness, and Kurtosis

Subtest	Mean	SD	Skew	Skew SE	Skew t-test	Kurt	Kurt SE	Kurt t-test
VA	15.11	4.42	-0.227	0.033	-6.88	-0.472	0.065	-7.26
AR	13.96	4.97	0.010	0.033	0.30	-0.681	0.065	-8.93
WK	15.22	5.55	-0.133	0.033	-4.03	-0.977	0.065	-15.03
MK	14.87	5.26	-0.060	0.033	-1.81	-0.892	0.063	-13.72
RC	17.18	4.00	-0.573	0.033	-17.36	0.000	0.065	0.00
PS	10.99	3.98	0.37	0.033	1.12	-0.835	0.065	-12.84
TR	27.05	5.86	-0.191	0.033	-5.78	-0.064	0.065	-0.98
IC	15.11	6.62	-0.361	0.033	-10.93	-0.917	0.065	-14.10
BC	15.38	5.79	-0.013	0.033	-0.39	-0.484	0.065	-7.13
AI	9.54	4.27	0.462	0.033	14.00	-0.557	0.065	-8.56

Note. *t*-test values $\geq \pm 1.96$ are statistically significant at $p < .05$

T1 $N = 5,681$

Table 5. AFOQT Form S1 Subtests Means, Standard Deviations, Skewness, and Kurtosis

Subtest	Mean	SD	Skew	Skew SE	Skew t-test	Kurt	Kurt SE	Kurt t-test
VA	16.58	4.26	-0.39	---	---	-0.34	---	---
AR	15.80	5.42	-0.23	---	---	-0.84	---	---
WK	15.88	5.46	-0.16	---	---	-0.96	---	---
MK	16.10	5.46	-0.24	---	---	-0.89	---	---
RC	----	---	---	---	---	---	---	---
GS	13.18	3.79	-0.37	---	---	-0.41	---	---
TR	26.86	6.53	-0.15	---	---	0.05	---	---
IC	12.73	5.29	-0.49	---	---	-0.89	---	---
BC	12.20	4.09	-0.49	---	---	-0.17	---	---
AI	10.43	4.46	0.28	---	---	-0.75	---	---

Note. *t*-test values $\geq \pm 1.96$ are statistically significant at $p < .05$

S1 $N = 9,607$

Table 6. AFOQT Form T2 Subtests Means, Standard Deviations, Skewness, and Kurtosis

Subtest	Mean	SD	Skew	Skew SE	Skew <i>t</i> -test	Kurt	Kurt SE	Kurt <i>t</i> -test
VA	14.88	4.63	-0.273	0.034	-8.02	-0.493	0.068	-7.25
AR	13.87	5.27	0.027	0.034	0.79	-0.747	0.068	-10.98
WK	14.76	5.55	-0.088	0.034	-2.58	-0.963	0.068	-14.16
MK	14.94	5.14	-0.081	0.034	-2.38	-0.814	0.068	-11.97
RC	17.74	4.30	-0.763	0.034	-22.44	0.287	0.068	4.22
PS	11.49	3.89	-0.058	0.034	-1.70	-0.723	0.068	-10.63
TR	27.26	6.50	-0.233	0.034	-6.85	0.036	0.068	0.53
IC	14.99	6.43	-0.257	0.034	-7.55	-1.022	0.068	-15.03
BC	16.29	5.27	-0.021	0.034	-1.00	-0.326	0.068	-4.79
AI	9.05	3.92	0.542	0.034	18.00	-0.231	0.068	-3.40

Note. *t*-test values $\geq \pm 1.96$ are statistically significant at $p < .05$

T2 $N = 5,199$

Table 7. AFOQT Form S2 Subtests Means, Standard Deviations, Skewness, and Kurtosis

Subtest	Mean	SD	Skew	Skew SE	Skew <i>t</i> -test	Kurt	Kurt SE	Kurt <i>t</i> -test
VA	16.16	4.17	-0.31	---	---	-0.39	---	---
AR	16.03	5.47	-0.21	---	---	-0.86	---	---
WK	15.51	5.73	-0.15	---	---	-1.00	---	---
MK	15.83	5.30	-0.16	---	---	-0.88	---	---
RC	----	---	---	---	---	---	---	---
GS	13.09	3.58	-0.40	---	---	-0.22	---	---
TR	26.68	6.71	-0.22	---	---	0.14	---	---
IC	12.12	5.42	-0.35	---	---	-1.03	---	---
BC	11.93	4.30	-0.32	---	---	-0.40	---	---
AI	9.91	4.42	0.34	---	---	-0.80	---	---

Note. *t*-test values $\geq \pm 1.96$ are statistically significant at $p < .05$

S2 $N = 5,199$

Internal Consistency

Subtest internal consistency results were very similar for Forms T1 and S1 and T2 and S2, with internal consistency in an acceptable range across Forms (Cronbach's alpha ranging from .71 to .91).

Tables 8 through 11 summarize the results for internal consistency for each test form. The number of items for IC and BC were increased by five and ten questions respectively for each subtest on Forms T1 and T2, but no significant changes in reliability were identified when compared to Forms S1 and S2.

Cronbach's alpha ranged from .73 (RC) to .91 (IC) for Form T1 and from .74 (IC) to .90 (IC) for Form T2, and both had reliabilities of .82. For Form S1, Cronbach's alpha ranged from .74 (GS) to .90 (IC) and

from .71 (GS) to .90 (IC) for Form S2. The reliability for both Forms S1 and S2 was .83. The highest item-total correlations for both Forms T1 and S1 were found for IC (T1, .57; S1, .52), WK (T1, .47; S1, .40), and MK (T1, .46; S1, .40). For Forms T2 and S2, IC (T2, .55; S2, .52) and WK (T2, .47; S2, .42). The lowest item-total correlations for T1 and S1 occurred for VA (T1, .37; S1, .27). VA also had the lowest correlation for T2 and S2; VA (T2, .37; S2, .24).

Table 8. Subtest Internal Consistency: Form T1

Subtest	N Items	Cronbach's Alpha	Item-Total Correlations		
			Min.	Max.	Mean
VA	25	.74	.21	.46	.37
AR	25	.80	.31	.50	.42
WK	25	.86	.33	.59	.47
MK	25	.84	.30	.57	.46
RC	25	.73	.21	.48	.36
PS	20	.76	.23	.61	.42
TR	40	.88	.12	.67	.37
IC	25	.91	.32	.65	.57
BC	30	.85	.28	.53	.43
AI	20	.79	.29	.61	.45

T1 N = 5,681

Table 9. Subtest Internal Consistency: Form S1

Subtest	N Items	Cronbach's Alpha	Item-Total Correlations		
			Min.	Max	Mean
VA	25	.76	.12	.43	.27
AR	25	.86	.24	.52	.40
WK	25	.85	.15	.53	.40
MK	25	.86	.18	.56	.40
RC	---	---	---	---	---
GS	20	.74	.16	.44	.30
TR	40	.89	.11	.65	.36
IC	20	.90	.31	.65	.52
BC	20	.82	.24	.59	.39
AI	20	.81	.21	.51	.38

S1 N = 9,607

Table 10. Subtest Internal Consistency: Form T2

Subtest	N Items	Cronbach's Alpha	Item-Total Correlations		
			Min.	Max.	Mean
VA	25	.77	.28	.54	.37
AR	25	.83	.30	.57	.42
WK	25	.85	.31	.61	.47
MK	25	.83	.30	.62	.45
RC	25	.78	.23	.53	.40
PS	20	.75	.28	.55	.41
TR	40	.89	.20	.68	.41
IC	25	.90	.31	.66	.55
BC	30	.82	.19	.60	.40
AI	20	.74	.27	.56	.41

T2 *N* = 5,199**Table 11. Subtest Internal Consistency: Form S2**

Subtest	N Items	Cronbach's Alpha	Item-Total Correlations		
			Min.	Max.	Mean
VA	25	.74	.07	.37	.24
AR	25	.86	.27	.53	.41
WK	25	.87	.16	.58	.42
MK	25	.85	.15	.54	.39
RC	---	---	---	---	---
GS	20	.71	.08	.42	.27
TR	40	.89	.16	.65	.37
IC	20	.90	.33	.70	.52
BC	20	.82	.28	.51	.38
AI	20	.81	-.11	.57	.37

S2 *N* = 8,164

Summary

The psychometric properties of Form T and Form S are generally similar. Despite the differences in the number of questions on Form S vs. Form T versions of IC and BC, and the inclusion of RC to Forms T1 and T2, overall, no significant changes in reliability were identified when compared to Forms S1 and S2.

Means and standard deviations show VA, AR, WK, and MK had a higher difficulty on Form T than on Form S. Skewness values indicated a reduction in ceiling effects for various subtests on Forms T1/T2 as compared to Forms S1/S2.

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