DIFFERENTIATING APTITUDE FACTORS AMONG CURRENT AVIATION SPECIALTIES

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An automated system of test construction is under development that involves accessing a large bank of test item data. In support of this development this study examined test material which, with the exception of a biographical inventory, covered a wide spectrum of cognitive abilities. The objective was to determine the kinds of test items that are most relevant for use in screening and classification for current aviation specialties, and thus to establish guidelines for investments into the test item bank.

By means of a series of factor analyses of test scores and criterion data five cognitive ability factors and a motivational factor were identified. The potential discriminatory validity of each factor was defined for the Naval Flight Officer (NFO) and pilot programs, and for various specialties within these programs.

The findings support the following recommendations:

1. Items measuring the classical triad of mechanical, numerical, and verbal abilities should be used; however, strong emphasis on verbal inputs into the item bank is not recommended.

2. Items measuring a Spatial Manipulation factor should be emphasized for pilots, and those measuring Numerical Intelligence should be emphasized for NFOs.

3. A Perceptual Flexibility factor should be explored further especially in view of its apparently unique association with helicopter performance.

4. Measures of the Flight Motivation factor as used in biographical inventories should comprise a significant input into the item bank.

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SUMMARY PAGE

PROBLEM

An automated system of test construction is under development that involves accessing a large bank of test item data. In support of this development this study examined test material which, with the exception of a biographical inventory, covered a wide spectrum of cognitive abilities. The objective was to determine the kinds of test items that are most relevant for use in screening and classification for current aviation specialties, and thus to establish guidelines for investments into the test item bank.

FINDINGS

By means of a series of factor analyses of test scores and criterion data five cognitive ability factors and a motivational factor were identified. The potential discriminatory validity of each factor was defined for the Naval Flight Officer (NFO) and pilot programs, and for various specialties within these programs.

RECOMMENDATIONS

The findings support the following recommendations:

1. Items measuring the classical triad of mechanical, numerical, and verbal abilities should be used; however, strong emphasis on verbal inputs into the item bank is not recommended.

2. Items measuring a Spatial Manipulation factor should be emphasized for pilots, and those measuring Numerical Intelligence should be emphasized for NFOs.

3. A Perceptual Flexibility factor should be explored further especially in view of its apparently unique association with helicopter performance.

4. Measures of the Flight Motivation factor as used in biographical inventories should comprise a significant input into the item bank.

INTRODUCTION

It is reasoned that as long as pilots and other aviation specialists are needed in large numbers there will be a continuing need for an economical and easily implemented testing program as a first filter, or primary selection and classification process, for use at diverse procurement points. Test instruments, therefore, must be monitored and maintained, and new ones must be produced in order to preserve predictive power and, hopefully, to achieve modest gains. A computer implemented methodology is under development that would:

1) Monitor item statistics and characteristics of current tests.

2) Indicate when specific portions need revision.

3) Generate new tests in accordance with programmed specifications.

4) Produce cross-validation data for new tests simultaneously with their generation, and

5) Assure proper weighting of all selectors.

The success of the system requires that experimental test material, or items, be generated and administered to new recruits on a continuing, cyclic basis in order to maintain up-to-date statistics. This is the most crucial step in the system. If new item-data input ceases, the system could become obsolute quickly in the face of growing intensity of specialization in aviation and the concomitant changes in flight training.

In support of this need the present study examined a wide spectrum of cognitive and biographical test material. The objective was to determine the kinds of test items that are most relevant for differentiating among current aviation specialties and success within these specialties.

PROCEDURE

Scores for the seven tests of the Guilford Zimmerman Aptitude Survey, the Hidden Figures test, and the four tests of the Navy and Marine Corps aviation selection battery were obtained for approximately 1700 aviation trainees. This group was divided into eleven mutually exclusive groups which reflected either successful completion of a given aviation specialty or attrition from training.

There were three pilot specialties, two pilot attrition groups, four Naval Flight Officer (NFO) or non-pilot specialties, and two NFO attrition groups. A method developed by Wherry in 1944 (1) for scaling qualitative data was used to assign "criterion" scores which were proportional to the means of a selected quantitative criterion variable. This entailed examining training performance data that were common to all groups. In this case all eleven categories of students had shared the common experience of flight preparation (flight prep.) training, and the mean flight prep. final grades for these eleven groups differed significantly among these groups. These means are shown in Table I. A data field was generated which assigned the mean value for a given group to each member of that group. This, therefore, produced a distribution that was differentiating within the total group, that was proportional to the mean of the total group, and that could be entered into a correlation matrix with the experimental test scores. In factor analysis of this matrix any variables loading on the same factor as this "special criterion" variable would be considered variables that differentiated among these classifications of students. Also included in the array of variables as criteria was a simple dichotomous code identifying the pilot specialties from the non-pilot specialties, and the attrition cases from the non-attrition or completion cases. For the three pilot completion groups advanced flight grades were also included. Factor analysis was selected as the optional statistical approach because it would define the various elements being measured and at the same time by means of criterion variable loadings give an indication of the external discriminating validity of each factor.

Table I

Mean Flight Preparatory Final Grades Assigned to Each Sub-Group

Sub-Group	Mean	S.D.	N*
Pilot Jet Completions	54.81	4.48	225
Pilot Propeller Completions	51.31	4.57	366
Pilot Helicopter Completions	49.38	5.64	106
Pilot Voluntary Attritions	50.66	5.39	380
Pilot Non-Voluntary Attritions	46.63	6.33	191
NFO Navigation Completions	49.81	4.75	83
NFO Radar Intercept Operator Completions	50.57	4.61	72
NFO Airborne Electronic Warfare Completions	50.78	4.42	32
NFO Basic Jet Navigation Completions	53.28	5.12	61
NFO Voluntary Attritions	48.11	5.38	47
NFO Non-Voluntary Attritions	45.02	5.82	58
Total Group	50.93	5.72	2,648

*The N used in scaling may differ from those included in the correlation computations.

ANALYSIS AND RESULTS

A series of eight factor analyses were performed by means of principal axis solution. The first involved the total group with the eleven category special criterion. The remaining ones used various combinations of subgroups and criteria which will be described as the description of results continues. In general, six factors were identified although for certain subgroup combinations only five emerged. The rotated factor matrices obtained by the Kaiser varimax method are contained in Appendix A.

Table II shows the six factors and the clustering of test variables that consistently, across groups, contributed to their identification and label. The "P" label means the primary or highest factor loadings within a factor and the "s" means secondary or moderate factor loadings.

Table II

Factor Loading Patterns of the Various Tests for Each of Six Factors

Test	I Mechanical	II Spatial Manipulation	III Perceptual Flexibility	IV Verbal Intelligence	V Numerical Intelligence	VI Flight Motivation
Verbal Comprehension				P		
General Reasoning				s	P	
Numerical Operations			P		s	
Perceptual Speed			P			
Spatial Orientation		P	s			
Spatial Visualization	s	P	s			
Mechanical Knowledge	P					s
Hidden Figures		s	P			
Aviation Qualification (AQT)				P	P	
Mechanical Comprehension (MCT)	P	s			s	
Spatial Apperception (SAT)		P				
Biographical Inventory (BI)						P

P indicates primary or highest factor loadings.
s indicates secondary or moderate factor loadings.

Factor I: "Mechanical" (M). The Mechanical Knowledge and Mechanical Comprehension Tests loaded the highest on Factor I. The Spatial Visualization Test tended to load here also but with smaller loading values than the two with the "P" label.

Factor II: "Spatial Manipulation" (SM) was defined by the Spatial Orientation, the Spatial Visualization, and the Spatial Apperception Tests. The Hidden Figures and the Mechanical Comprehension Tests were secondary contributors.

Factor III: "Perceptual Flexibility" (PF). Here the primaries were Numerical Operations, Perceptual Speed, and Hidden Figures. The secondaries were Spatial Orientation and Spatial Visualization.

Factor IV: "Verbal Intelligence" (VI). Verbal Comprehension and the Aviation Qualification Tests (AQT) were strong here with a little help from General Reasoning.

Factor V: "Numerical Intelligence" (NI). General Reasoning and the Aviation Qualification Test defined the factor with secondary support from Numerical Operations and Mechanical Comprehension. The General Reasoning Test presents verbally problems involving arithmetic solutions. It is reasonable that it contributes to both IV and V. The AQT has both verbal and mathematical content.

Factor VI: "Flight Motivation" (FM) was defined principally by the Navy's Biographical Inventory (BI), which is a non-cognitive test empirically constructed as a correlate of success in flight as opposed to failure or voluntary withdrawal. Mechanical Knowledge was the secondary here which probably is a reflection of interest.

Table III presents the per cent of total variance explained by each factor within each grouping. This table also serves as a reference point to define the group configurations:

(1) Total group: The criteria used here were membership in the 11 subgroups (the "special criterion"), and the membership in NFO or pilot trainee groups.

(2) The NFO trainee group with the completion vs attrition dichotomy as criterion.

(3) The NFO completion group with membership in the four advanced pipelines or specialties as criterion.

Table III

Per Cent of Total Variance Explained by Each Factor Within Each Group

	Factor	Total Group	NFO Compl/Attr	NFO Compl	Pilot Compl/Attr	Pilot Compl	Jet Compl	Prop Compl	Helo Compl
I	Mechanical	9.37	10.71	11.26	10.72	12.72	11.11	11.80	12.77
II	Spatial Manipulation	9.34	11.06	10.22	9.55	8.82	8.83	9.53	11.04
III	Perceptual Flexibility	6.34	9.15	9.00	6.51	9.34	11.07	8.49	10.20
IV	Verbal Intelligence	5.30	9.72	12.43	5.91	10.27	12.37	12.62	9.11
V	Numerical Intelligence	8.74	7.66		7.79				
VI	Flight Motivation	4.69	——	3.00	2.40	3.77	4.82	5.99	7.94
	Total	44.14	48.30	45.91	42.89	44.72	48.20	48.43	51.06
	N	1,729	366	243	1,363	674	213	368	93

(4) The pilot trainee group with the completion vs attrition dichotomy as criterion.

(5) The pilot completion group with membership in the three advanced pipelines as criteria.

Groups (6), (7), and (8) were the pilot completions within the jet, prop, and helo pipelines respectively. Criteria here were the final advanced training flight grades. The NFO completion group was not analyzed in this manner because of small Ns in some of the specialties.

Table III also shows the tendency for the Intelligence factor not to split into Verbal and Numerical when the groups are composed entirely of successful students. Note the bracketed points in the table.

The main concern of course was the potential for criterion discrimination among these various factors. Table IV gives the statistically significant factor loadings for the criterion variable within each group. The numbers in parentheses represent loadings within the .05 level, the others were within the .01 level of significance. It is emphasized that the values in Table IV are the factor loadings for the criteria variables and are not expected to be similar in magnitude to those loadings that most clearly describe a factor. A statistically significant criterion loading on a given factor is evidence, however, in support of the discriminatory validity of that factor with respect to the criterion. These results

Table IV

Criterion Factor Loadings for Each Group

Group/ Criterion	N	I Mechanical	II Spatial Manipulation	III Perceptual Flexibility	IV Verbal Intelligence	V Numerical Intelligence	VI Flight Motivation
Total Group 11 Categories	1729	.085	154	092	ns	254	284
Total Group NFO vs Pilot	1729	ns	160	-.080	-.094	(057)	571
NFO Group Completion vs Attrition	366	ns	ns	ns	ns	459	
NFO Group Completions, 4 Pipelines	243	ns	ns	ns	(131)		379
Pilot Group Completion vs Aturition	1363	122	148	ns	ns	126	281
Pilot Group Completions, 3 Pipelines	874	(080)	146	100	162		243
Pilot Group Jet Adv. Fl. Grade	213	ns	(138)	ns	ns		535
Pilot Group Prop. Adv. Fl. Grade	368	ns	210	ns	(107)		154
Pilot Group Helo. Adv. Fl. Grade	93	ns	ns	(.240)	ns		ns

indicate that the traditional Mechanical factor is still relevant in pilot selection although not as strong perhaps as the Spatial Manipulation factor. This factor shows discriminatory power between NFO and pilot as well as within various pilot sub-groupings.

Perceptual Flexibility has an interesting loading on the helicopter (helo) performance criterion. Numerical Intelligence is a strong indicant of NFO trainee success and to a less degree pilot success. The relatively weak criterion loadings on Verbal Intelligence support the view that a large investment in the item bank of measures of verbal intelligence would not be productive. Flight Motivation shows some strengths "across the board"; that is, between types (NFO/pilot) and within types (NFO pipelines, pilot completion/attrite, and pilot pipelines, especially jet).

CONCLUSIONS

In terms of the item bank objectives the data support these conclusions:

1) The classical ability triad has survived (mechanical, numerical, verbal) in aviation selection and classification, but strong emphasis on verbal inputs into the item bank is not recommended.

2) Measurements of the Spatial Manipulation factor should be emphasized for pilots and measures of Numerical Intelligence for NFOs.

3) Perceptual Flexibility should be explored further especially in view of its apparently unique association with helicopter performance.

4) Measures of the Flight Motivation factor, such as covered in the BI, should comprise a significant input into the item bank.

REFERENCE

1. Wherry, Robert J., Sr., Maximal weighting of qualitative data. Psychometrika 9: 263-266, 1944.

APPENDIX A

FACTOR MATRICES

ANALYSIS 1:
TOTAL GROUP

KAISER VARIMAX ROTATED FACTOR MATRIX
14 VARIABLES X 6 FACTORS

VAR. IDEN.	SM	M	VI	FM	PF	NI
Verbal Comprehension	0.101	-0.059	-0.632	-0.126	-0.012	0.141
General Reasoning	0.196	-0.116	-0.181	-0.077	0.133	0.625
Numerical Operations	-0.032	0.258	-0.033	-0.059	0.466	0.297
Perceptual Speed	0.174	-0.066	-0.026	0.035	0.566	0.003
Spatial Orientation	0.615	-0.172	-0.147	0.061	0.275	0.151
Spatial Visualization	0.573	-0.323	-0.076	-0.052	0.301	0.263
Mechanical Knowledge	0.031	-0.654	-0.089	0.175	0.058	-0.003
Aviation Qualification	0.141	-0.167	-0.506	-0.021	0.179	0.631
Mechanical Comprehension	0.272	-0.793	-0.041	0.086	-0.029	0.312
Spatial Apperception	0.566	0.004	-0.048	0.152	0.017	0.060
Biographical Inventory	-0.044	-0.109	0.025	0.390	0.014	-0.147
Hidden Figures	0.232	-0.187	0.049	-0.060	0.340	0.212
Special Criterion	0.154	-0.095	0.033	0.284	0.092	0.254
Pilot/NFO	0.160	-0.030	0.094	0.571	-0.080	0.057
Sum of Factor Ldgs Sqd	1.307	1.363	0.742	0.657	0.888	1.223
Per Cent of Variance	9.336	9.734	5.302	4.692	6.342	8.736

Total Per Cent of Variance of 6 Factors = 44.143

ANALYSIS 2:
NFO COMPL/ATTR

KAISER VARIMAX ROTATED FACTOR MATRIX
13 VARIABLES X 5 FACTORS

VAR. IDEN:	SM	M	VI	PF	NI
Verbal Comprehension	0.056	0.003	-0.603	0.026	0.013
General Reasoning	0.117	0.065	-0.403	0.202	-0.592
Numerical Operations	-0.080	0.327	-0.146	0.492	0.159
Perceptual Speed	0.177	-0.074	0.015	0.577	-0.095
Spatial Orientation	0.603	-0.073	-0.179	0.273	-0.202
Spatial Visualization	0.539	-0.119	-0.134	0.410	-0.309
Mechanical Knowledge	0.034	-0.908	-0.045	0.016	-0.140
Aviation Qualification	0.187	-0.050	-0.754	0.234	-0.371
Mechanical Comprehension	0.376	-0.579	-0.260	0.100	-0.271
Spatial Apperception	0.698	-0.137	-0.030	0.062	0.053
Biographical Inventory	0.069	-0.262	0.060	0.002	0.153
Hidden Figures	0.234	-0.077	-0.153	0.502	-0.083
NFO Compl/Attr	0.035	-0.035	-0.006	0.099	-0.459
Sum of Factor Ldgs Sqd	1.438	1.392	1.263	1.190	0.996
Per Cent of Variance	11.059	10.708	9.716	9.154	7.662

Total Per Cent of Variance of 5 Factors = 48.300

ANALYSIS 3:
NFO COMPLETIONS ONLY

KAISER VARIMAX ROTATED FACTOR MATRIX
18 VARIABLES X 5 FACTORS

VAR. IDEN.	PF	M	I*	SM	FM
Verbal Comprehension	0.011	0.004	-0.456	-0.094	-0.006
General Reasoning	0.178	-0.027	-0.591	-0.123	0.020
Numerical Operations	0.381	0.386	-0.294	0.060	0.237
Perceptual Speed	0.590	-0.058	-0.017	-0.154	-0.036
Spatial Orientation	0.283	-0.099	-0.254	-0.605	0.087
Spatial Visualization	0.469	-0.159	-0.217	-0.547	-0.195
Mechanical Knowledge	0.088	-0.837	-0.029	-0.027	0.087
Aviation Qualification	0.167	-0.138	-0.826	-0.169	0.229
Mechanical Comprehension	0.153	-0.711	-0.323	-0.320	0.007
Spatial Apperception	0.114	-0.097	-0.093	-0.660	0.099
Biographical Inventory	0.017	-0.204	0.138	-0.079	0.261
Hidden Figures	0.527	-0.014	-0.170	-0.194	0.075
NFO Advanced Pipeline Category	0.001	0.016	-0.131	-0.017	0.379
Sum of Factor Ldgs Sqd	1.170	1.464	1.616	1.329	0.390
Per Cent of Variance	8.996	11.258	12.432	10.223	3.003

Total Per Cent of Variance of 5 Factors = 45.913

*** Intelligence did not separate into verbal and numerical.**

ANALYSIS 4:
PILOTS COMPL/ATTR

KAISER VARIMAX ROTATED FACTOR MATRIX
13 VARIABLES X 6 FACTORS

VAR.IDEN.	PF	M	VI	SM	FM	NI
Verbal Comprehension	-0.011	0.075	-0.585	-0.120	-0.103	-0.107
General Reasoning	0.115	0.188	-0.200	-0.220	-0.136	-0.577
Numerical Operations	0.511	-0.237	-0.027	-0.097	-0.032	-0.069
Perceptual Speed	0.578	0.068	-0.032	-0.180	0.025	0.042
Spatial Orientation	0.233	0.199	-0.141	-0.656	0.091	-0.112
Spatial Visualization	0.241	0.387	-0.100	-0.542	-0.035	-0.236
Mechanical Knowledge	0.039	0.642	-0.099	-0.004	0.189	0.009
Aviation Qualification	0.163	0.190	-0.567	-0.155	0.033	-0.609
Mechanical Comprehension	-0.052	0.760	-0.092	-0.230	0.052	-0.244
Spatial Apperception	0.029	-0.022	-0.071	-0.513	-0.022	-0.055
Biographical Inventory	-0.001	0.040	0.039	0.072	0.383	0.131
Hidden Figures	0.305	0.246	0.065	-0.234	-0.080	-0.191
PASS/ATTRITE	-0.012	0.122	0.050	-0.148	0.281	-0.126
Sum of Factor Ldgs Sqd	0.846	1.394	0.768	1.242	0.312	1.013
Per Cent of Variance	6.510	10.722	5.908	9.551	2.400	7.793

Total Per Cent of Variance of 6 Factors = 42.885

ANALYSIS 5:
PILOTS COMPLETIONS ONLY

KAISER VARIMAX ROTATED FACTOR MATRIX
13 VARIABLES X 5 FACTORS

VAR. IDEN.	FP	M	I*	SM	FM
Verbal Comprehension	-0.060	0.012	-0.596	0.155	0.007
General Reasoning	0.364	0.345	-0.433	0.120	-0.247
Numerical Operations	0.602	-0.159	-0.198	-0.003	-0.025
Perceptual Speed	0.550	0.053	0.054	0.177	0.101
Spatial Orientation	0.243	0.218	-0.207	0.604	0.079
Spatial Visualization	0.328	0.415	-0.202	0.475	-0.048
Mechanical Knowledge	-0.007	0.633	-0.061	-0.016	0.211
Aviation Qualification	0.270	0.297	-0.763	0.120	-0.098
Mechanical Comprehension	-0.045	0.829	-0.179	0.184	0.007
Spatial Apperception	0.036	-0.015	-0.083	0.592	0.014
Biographical Inventory	-0.040	0.053	0.120	-0.019	0.528
Hidden Figures	0.398	0.319	-0.024	0.203	-0.130
Pipe Category	0.100	0.080	-0.162	0.146	0.243
Sum of Factor Ldgs Sqd	1.214	1.654	1.335	1.121	0.490
Per Cent of Variance	9.341	12.723	10.266	8.622	3.766

Total Per Cent of Variance of 5 Factors = 44.717

* Intelligence did not separate into verbal and numerical.

ANALYSIS 6:
PILOTS JET PIPELINE COMPLETIONS

KAISER VARIMAX ROTATED FACTOR MATRIX
13 VARIABLES X 5 FACTORS

VAR. IDEN.	PF	M	I*	SM	FM
Verbal Comprehension	-0.142	-0.041	-0.698	0.147	-0.090
General Reasoning	0.397	0.258	-0.499	0.028	0.055
Numerical Operations	0.717	-0.189	-0.190	0.029	0.094
Perceptual Speed	0.496	-0.015	0.051	0.245	-0.032
Spatial Orientation	0.297	0.122	-0.151	0.597	0.072
Spatial Visualization	0.354	0.275	-0.301	0.524	-0.091
Mechanical Knowledge	-0.046	0.677	-0.013	-0.066	0.059
Aviation Qualification	0.272	0.249	-0.756	0.130	0.058
Mechanical Comprehension	0.034	0.778	-0.202	0.183	0.064
Spatial Apperception	-0.007	-0.059	-0.039	0.566	0.183
Biographical Inventory	-0.205	0.218	0.317	0.024	0.506
Hidden Figures	0.402	0.267	-0.034	0.197	-0.077
Adv. Flt. Grade	0.085	-0.005	-0.074	0.138	0.535
Sum of Factor Ldgs Sqd	1.439	1.444	1.608	1.148	0.627
Per Cent of Variance	11.069	11.105	12.372	8.828	4.822

Total Per Cent of Variance of 5 Factors = 48.196

*** Intelligence did not separate into verbal and numerical.**

ANALYSIS 7:
PILOTS PROP PIPELINE COMPLETIONS

KAISER VARIMAX ROTATED FACTOR MATRIX
13 VARIABLES X 5 FACTORS

VAR. IDEN.	I*	M	FM	SM	PF
Verbal Comprehension	0.415	0.068	0.052	-0.176	0.036
General Reasoning	0.536	0.199	-0.179	-0.203	-0.301
Numerical Operations	0.272	-0.295	0.031	-0.038	-0.503
Perceptual Speed	-0.041	0.081	0.075	-0.111	-0.597
Spatial Orientation	0.257	0.174	0.067	-0.744	-0.111
Spatial Visualization	0.277	0.368	0.011	-0.438	-0.375
Mechanical Knowledge	0.090	0.797	0.111	0.006	-0.070
Aviation Qualification	0.897	0.179	-0.092	-0.106	-0.210
Mechanical Comprehension	0.304	0.710	-0.058	-0.173	-0.027
Spatial Apperception	0.049	-0.011	-0.145	-0.535	-0.090
Biographical Inventory	-0.096	0.051	0.810	0.051	-0.018
Hidden Figures	0.184	0.231	-0.081	-0.185	-0.428
Adv. Flt. Grade	0.107	-0.001	0.154	-0.210	-0.087
Sum of Factor Ldgs Sqd	1.641	1.534	0.778	1.239	1.104
Per Cent of Variance	12.622	11.797	5.987	9.533	8.492

Total Per Cent of Variance of 5 Factors = 48.431

* Intelligence did not separate into verbal and numerical.

ANALYSIS 8:
PILOTS HELO PIPELINE COMPLETIONS

KAISER VARIMAX ROTATED FACTOR MATRIX
13 VARIABLES X 5 FACTORS

VAR. IDEN.	M	PF	I*	FM	SM
Verbal Comprehension	-0.201	0.114	-0.459	-0.171	-0.185
General Reasoning	0.268	-0.227	-0.220	-0.522	-0.096
Numerical Operations	-0.192	-0.584	-0.003	-0.179	0.175
Perceptual Speed	-0.111	-0.609	-0.037	0.030	-0.275
Spatial Orientation	0.210	-0.373	-0.075	-0.048	-0.640
Spatial Visualization	0.348	-0.150	0.031	-0.406	-0.630
Mechanical Knowledge	0.658	-0.039	0.090	-0.118	-0.026
Aviation Qualification	0.197	-0.191	-0.915	-0.078	-0.050
Mechanical Comprehension	0.871	0.029	-0.166	-0.032	-0.224
Spatial Apperception	-0.003	-0.027	-0.180	0.194	-0.626
Biographical Inventory	-0.007	0.001	0.070	0.656	-0.088
Hidden Figures	0.308	-0.539	0.076	-0.199	-0.138
Adv. Flt. Grade	0.097	-0.240	-0.048	0.030	-0.082
Sum of Factor Ldgs Sqd	1.660	1.325	1.184	1.032	1.435
Per Cent of Variance	12.772	10.195	9.110	7.940	11.041

Total Per Cent of Variance of 5 Factors = 51.058

*** Intelligence did not separate into verbal and numerical.**