

AEROSPACE PSYCHOLOGICAL QUALIFICATIONS

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The purpose of this section is to familiarize the reader with the U.S. Navy and Marine Corps Aviation Selection Test battery (ASTB), its utilization within the aviation officer selection program, and its effectiveness as a selection device. To accomplish these objectives, the development of the current test battery is briefly summarized, followed by discussions of the current usage of the test. Evidence of test effectiveness is offered to illustrate the importance of the ASTB in aviation officer selection.

The U.S. Navy and Marine Corps Aviation Selection Test battery is a paper-and-pencil type test used as the primary instrument for selecting student naval aviators (pilots), student naval flight officers (NFOs), and officer candidates for Officer Candidate School (OCS). The test battery was developed specifically for naval aviation to provide:

1. A selection tool that is economical in both time and money
2. An accurate probability statement of an applicant's potential for completing aviation training, and
3. A standardized, fair evaluation of thousands of applicants annually from throughout the United States and the naval services.

History and Development: Psychological Assessment in Aviation Selection

In the early 1900's the selection of flight candidates was based primarily on physical qualifications. The high attrition rates of flight candidates and the high incidence of World War I pilot casualties due to human error emphasized screening inadequacies and the need for psychological assessment. In 1939 the National Research Council, upon the request of the Civil Aeronautics Authority, undertook a program to select candidates for a nationwide light plane training program. Favorable acceptance of this initial development of aviation selection tests led to the creation of the Medical Research Section of the Bureau of Aeronautics. The responsibility for directing the development and validation of psychological tests for use

in pilot selection was later transferred to the Aviation Psychology Section of the Bureau of Medicine and Surgery.

With World War II came increasing demands for aviators and improved selection procedures. The Pensacola 1000 Aviator Study evaluated the predictive validity of the three selection tests then in use: the Wonderlic Personnel Test, the Bennet Mechanical Comprehension Test, and the Purdue Biographical Inventory, plus approximately 10 other psychological, psychomotor, and physical tests. The results verified the effectiveness of the three instruments and indicated the usefulness of psychomotor devices in prediction. However, these devices were never implemented because they could not be administered easily and inexpensively at decentralized test stations and they tended to be unreliable measures.

In 1942 a single index, the Flight Aptitude Rating (FAR), was introduced. The FAR was a result of the application of multiple regression techniques to selection research, and reflected the combination of a Mechanical Comprehension Test (MCT), and a Biographical Inventory (BI). The following year the Wonderlic Personnel Test was replaced with the aviation Classification Test, a test of general intelligence which included judgment, arithmetic, vocabulary, meter reading, and checking.

Studies continued to refine tests in the aviation selection test battery and to permit development of new tests. Since results showed that spatial orientation was significant in the prediction of success in flight training, the Spatial Apperception Test (SAT) was included in the revised test battery implemented in 1953. This version consisted of the Aviation Qualification Test, SAT, MCT, and BI.

The management and operation of the aviation selection test program was assigned to the Naval Aerospace Medical Institute (NAMI) in 1981. Monitoring of the tests is carried on continuously at NAMI to ensure that the tests maintain predictive validity. The current U.S. Navy and Marine Corps Aviation Selection Test battery was developed by the Bureau of Medicine and Surgery (BUMED). The total development

involved extensive field studies of many tests and empirical validation procedures. The revision was implemented in 1992.

Aerospace Psychological Qualifications

A 1992 Department of Defense review of aviation selection test research, development, validation, interpretation, and use determined that the test was consistent with federal guidelines on employee selection.

Data Banks

Maintenance of the selection testing program requires the monitoring of test validity and the conduct of studies to respond to recruiting, training, and operational issues related to the prediction and assessment of performance in aviation missions. Two data banks: the Selection Test Data Bank, and the Flight Student Data Bank, provide the necessary data. The active selection Test Data Bank contains all applicant test data since 1992. Test data prior to 1992 are archived. Data on approximately 10,000 applicants are added to the data bank annually.

Each flight student who attrites from the advanced stage of jet training represents a loss of up to \$1.8M to the Navy. Attrition from fleet replacement squadron training is even more costly. Since World War I, military psychologists have tried to reduce attrition by developing valid tests to select candidates who will complete training programs and continue on as naval aviators. After screening with the Aviation Selection Test Battery, the current attrition rate up through primary flight training is approximately 17%.

Research and Development

Because of the practicality, standardization, and the low cost of paper-and-pencil screening, this approach continues as the primary selection tool. Current selection research for alternate approaches includes: the Automated Pilot Examination (APEX), the evaluation of flight simulators, the evaluation of vestibular disorientation tests, integrated multitask performance, cognitive tests, psychomotor tests, tests of selective attention ability as predictors of flight performance, the evaluation of the role of computer interactive testing and personality assessment.

Description

The ASTB consists of five paper-and-pencil tests: Math-Verbal Test(MVT), Mechanical Comprehension Test(MCT), Spatial Apperception Test(SAT), Aviation and Nautical Test(AN), and the Biographical Inventory(BI). There are two equivalent forms of each of the tests. Descriptive information regarding the tests is provided in Table12-1.

The five ASTB scores

Under current usage, aviation officer selection is based upon five scores: The Academic Qualification Rating (AQR) score, the Flight Aptitude Rating (PFAR/FOFAR) score, for both pilot (PFAR) and NFO (FOFAR) and the Biographical Inventory (BI) rating for both pilot (PBI) and NFO (FOBI). The AQR is a general aptitude test and is predictive of ground school performance. The PFAR/FOFAR represents a combination of scores on the MVT, MCT, ANT, and SAT. These tests measure familiarity with mechanical concepts, ability to visualize the relationship between the attitude of a plane and the territory over which it flies. The PFAR/FOFAR is predictive of success or failure in the flight training program. The Biographical Inventory assesses the individuals personal history.

Scores from the MVT and MCT are combined to form the Officer Aptitude Rating(OAR) which is used in selection for non-aviation officer programs. The Commander, Navy Recruiting Command, and the Commandant of the Marine Corps determine which non-aviation programs use these tests and issue appropriate directives regarding their usage.

Score Interpretation

The tests are manually scored at the recruiting station and forwarded to the Operational Psychology Department (Code 341), Naval Aerospace Medical Institute, for machine scoring and verification.

Performance on the AQR, PFAR/FOFAR and PBI/FOBI is scaled in stanines, the contraction for "standard nines." The stanine scale is a condensed form of the T-scale. Stanine scores span three standard deviations on either side of the mean in a standard normal distribution.

The scores range from 1 to 9 and have a mean of 5.

Performance on the OAR is scaled in T-scores. T-scores span three standard deviations on either side of the mean in a standard normal distribution. The scores range from 20 to 80 and have a mean of 50. A percentile rank gives the percentage of scores in the whole distribution that fall below a given score.

Qualifications Standards

The Bureau of Medicine and Surgery (BUMED) sets the minimum acceptable scores on the aviation selection tests. Selection standards may be adjusted in response to changes in manpower requirements as well as in availability and quality of applicants. Accordingly, the Bureau of Naval Personnel (BUPERS), Headquarters, U.S. Marine Corps, and Headquarters, U.S. Coast Guard may set higher minimum score requirements.

BUMED sets the absolute minimum scores for pilot selection at 3/3/3 (AQR/PFAR/PBI), 3/3/3 (AQR/FOFAR/FOBI) for NFO selection. The Navy Recruiting Command uses 3/4/4 for pilots and 3/4/3 for NFO's. The Marine Corps uses 4/6/4 (AQR/PFAR/PBI) for pilots and also 4/6/4 (AQR/FOFAR/FOBI) for NFO's.

Effectiveness of the Aviation Selection Test Battery Role of Selection Tests

In a recent year, well over 100,000 individual prospects were contacted by recruiters from the naval services in order to fill the 2000 seats in aviation ground school classes at the Naval Aviation Schools Command (NASC). Even with such a high degree of prescreening, about one-fourth of those who enter undergraduate pilot training do not earn their wings. Aviation selection tests play an important, early role in the screening of aviation officer applicants; the objective of testing is to select those applicants most likely to succeed in training.

Correlations with Aviation Training Grades

Correlation coefficients indicate the degree of relationship between two variables. Higher correlations signify that variations in one variable are more closely associated with variations in the other variable. Table 12-2 presents the correlation coefficients between each of the subtests of the aviation selection test and three aviation training grades. Correlations of about .30 are moderately strong and indicate an association between certain pairs of variables. The most notable of these associations are the correlation between the AQR and NASC final grade and the correlation between the PFAR/FOFAR and primary flight grade. The values of these correlations, together with the remainder of the pattern of correlations, help to demonstrate that the selection tests are predictive of the intended criteria: academic success and success in flight training.

Prediction of Success in Training

Higher ASTB scores are associated with a greater probability of success in training. As reported earlier, plans are underway to revise/revalidate the current test battery in order to maintain its sensitivity. There is every reason to expect a revised test battery to make predictions of success as well as, or better than, the earlier version.

Cost Effectiveness of the ASTB

If the aviation selection tests were not used, many unqualified or minimally qualified applicants would be admitted to training since almost half now score below required minimums. Attrition rates would certainly increase accordingly. Ten percent more attritions, a conservative estimate, would mean 200 additional attritions per year. The 200 attritions would occur at different phases of training and the more progress a student makes before attriting, the higher the cost. Attrition costs are averaged among the different pipelines.

Thus, a conservative estimate of 200 fewer attritions means that the current ASTB saves about 12 million dollars in training costs annually. Increases in prediction capability as a result of revising the test will save additional training dollars at the rate of six million dollars for each five percent.

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Table 12-1

U. S. Navy and Marine Corps Aviation Selection Tests

Title	Item Content	Attributes
Math Verbal Test (MVT) 37 Items, 35 Minutes	Quantitative Ability Verbal Ability Following Directions	General Intelligence
Mechanical Comprehension Test (MCT) 30 Items, 15 Minutes	Mechanical Aptitude	Ability to perceive physical relationships and solve practical problems in mechanics
Spatial Apperception Test (SAT) 35 Items, 10 Minutes	Spatial Orientation	Ability to perceive spatial relationships from differing orientations
Aviation and Nautical Information Test (AN) 30 Items, 15 Minutes	Aviation and Nautical Knowledge	Shows interest in Naval aviation
Biographical Inventory (BI) 71 Items, 20 Minutes	Personal history interests and attitudes	Maturity, risk-taking behavior, and informal acquisition of aerospace knowledge

Table 12-2

Correlations of Selection Test Scores with Aviation Training Grades

1994 - 2000

	Naval Aviation Schools Command Final Grade	Primary Academic Grade	Primary Flight Grade
AQR	.345	.314	.276
PFAR	.283	.257	.309
FOFAR	.305	.281	.252
PBI	.135	.141	.141
FOBI	.157	.151	.108