

## Relationship between Psychological Tests and Performance during Pilot Selection and Training

MNC Sastry, AK Sengupta, V Chandramohan

*A battery comprising of perceptual, intellectual, motor and personality tests was administered to 90 cadets at the Air Force Selection Board, Mysore. The same battery was also administered to a sample of 42 cadets during mid-term training at Air Force Academy. The performance of the "Recommended" group in various psychological tests was compared with that of the "Non-recommended" group at the selection stage. Also similar comparison was made in respect of the "passed" and "failed" groups at the basic training level.*

*Spatial relations test, a paper and pencil test, and eye-hand coordination test, a computerised psychomotor test were found to be useful in predicting success/failure at the selection/training stage.*

**Keywords :** *Spatial relations, eye-hand co-ordination, Intelligence, pilot aptitude battery, flying training performance*

The system in vogue for selection of pilots for Indian Air Force was started in 1955 and is being continued without any significant addition or alterations in its content<sup>1</sup>. It did give useful results during the initial stages in that it helped in reducing the wastage rate during flying training.

Successful adaptation to the high technology cockpit is a new challenge that the pilots of modern military aircraft have to face. Modern military aircraft offer tactical capabilities unavailable to pilots earlier. Flight regimes are becoming more and more demanding in terms of critical time to respond. All these changes in the nature of the job of a service pilot are likely to be associated with certain other abilities and personality qualities not looked into by the existing Pilot Aptitude Battery (PAB). A *denovo* look into the selection system is, therefore, imperative<sup>2-4</sup>.

### Material and Methods

A battery of psychological tests (Table-I) was administered to a sample of 90 candidates who appeared before Air Force Selection Board with the sole aim of becoming pilots in Indian Air Force. Their ages ranged from 16 years 4 months to 18 years 9 months. All of them had undergone 12 years of schooling. As the candidates had

been told that this battery was part of the whole gamut of tests they had to undergo, the motivation to do the test was quite high. Out of the 90 candidates tested, 30 were selected by the Selection Board and 60 did not make the grade. The difference between the "Recommended" and the "Non-recommended" groups in various tests was statistically tested.

Table I : Psychological Tests Administered

- |     |  |
|-----|--|
| 1.  | Advanced progressive matrices (APM) <sup>5</sup> |
| 2.  | Numerical ability                                |
| 3.  | Abstract reasoning                               |
| 4.  | Spatial relations                                |
| 5.  | Mechanical comprehension                         |
| 6.  | Perceptual speed                                 |
| 7.  | Digit symbol substitution                        |
| 8.  | Eye hand coordination (Atari-21) <sup>3</sup>    |
| 9.  | 18 PF  |
| 10. | Eysanck's personality inventory (EPI)            |

The same battery of tests was tried out on another independent sample of 42 cadet trainees at Air Force Academy (AFA). 29 of them completed the flying training successfully and the remaining 13 failed to do so. The performance of the "passed group" in various tests was compared with that of the "failed group" and the differences found were tested for statistical significance.

Another independent sample studied at the training stage consisted of 62 cadet trainees. The same tests with the exception of Atari-21 were used. In addition, they were given Spatial Orientation test also. They did not differ from the other two NDA samples in age, education and other demographic variables. In respect of this sample, the performance in each test was correlated with marks in flying subject as well as marks in ground subjects during training at AFA.

## Results

In the selection stage, no significant difference between the two groups "recommended" and "Non-recommended", was seen in any of the tests except in eye-hand-coordination test, where the performance of the "Recommended" group was significantly higher (Table-II).

**Table-II Scores in Psychological Tests of 'Recommended' and 'Non-recommended' Candidates from Selection Board (mean values)**

Test	Recommended (n=30)	Non-recommended (n=60)	Mean diff	t value	p
Progressive Matrices	25.67	24.33	1.34	1.55	NS
Numerical Ability	32.17	30.95	1.22	1.21	NS
Abstract Reasoning	33.13	33.72	0.59	0.73	NS
Spatial Relations	26.53	26.67	0.14	0.12	NS
Mechanical Comprehension	31.80	30.43	1.37	0.72	NS
Perceptual Speed	66.53	63.53	3.00	1.32	NS
Digit Symbol Substitution	44.10	43.58	0.52	0.27	NS
Eye-hand Coordination (Atari-21)	46.17	38.27	7.90	2.42	<0.02

No significant difference was seen between these two groups in any of the scores-lie, extroversion or neurotic score of Eysenck's personality inventory (Table-III).

**Table-III Scores in EPI of 'Recommended' and 'Non-recommended' Candidates from Selection Board (mean values)**

Score	Recommended (n=30)	Non-recom (n=60)	Mean diff	t value	p
Lie	5.20	4.82	0.38	0.91	NS
Extroversion	12.80	12.02	0.78	1.28	NS
Neurotic	5.50	6.78	1.28	1.58	NS

Even in respect of the personality profiles of the two groups based on 16 PF questionnaire, no noticeable difference was observed (Table-IV).

**Table-IV STEN Grades of 'Recommended' and 'Non-recommended' Candidates from Selection Board in 16 PF Questionnaire (mean values)**

Group	A	B	C	E	F	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4
Recommended (n=30)	4	6	6	7	6	6	6	4	5	5	6	6	6	6	6	5
Non-recommended (n=60)	5	6	5	7	6	6	6	5	5	6	6	5	6	5	6	6

In the training stage Spatial Relations test and Intelligence test (APM) differentiated the passed group from the failed group. Eye-hand-coordination test showed a tendency to differentiate the two groups. The remaining tests did not differentiate the two groups (Table-V). No significant difference was seen between the two groups either in 16 PF profiles (Table-VI) or in neurotic as well as extroversion scores measured by EPI (Table-VII).

**Table-V Scores of Passed and Failed Groups of Cadet Trainees at Air Force Academy (mean values)**

Test	Passed (n=29)	Failed (n=13)	Mean diff	t value	p
Progressive Matrices	24.70	22.00	2.70	2.11	<0.05
Numerical Ability	29.26	29.77	0.51	0.27	NS
Abstract Reasoning	33.48	33.17	0.32	0.42	NS
Spatial Relations	29.26	24.38	4.87	2.55	<0.10
Mechanical Comprehension	36.83	38.31	1.48	0.51	NS
Perceptual Speed	58.71	59.25	0.54	0.15	NS
Digit Symbol Substitution	41.33	38.54	2.79	1.31	NS
Eye hand Coordination (Atari-21)	64.50	53.83	10.67	1.78	<0.01

**Table-VI STEN Grades of 'Passed' and 'Failed' Cadet Trainees at Air Force Academy in 16 PF Questionnaire (mean values)**

Group	A	B	C	E	F	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4
Passed (n=29)	5	6	5	6	5	6	6	5	6	6	6	6	5	5	5	6
Failed (n=13)	4	5	5	5	5	5	5	5	6	6	6	6	5	5	5	6

**Table-VII Scores in EPI of 'Passed' and 'Failed' Cadet Trainees at Air Force Academy (mean values)**

Score	Passed (n=29)	Failed (n=13)	Mean diff	t value	p
Extroversion	11.24	11.23	0.01	0.01	NS
Neurotic	8.86	7.92	0.94	0.94	NS

The correlation coefficients between performance in psychological tests and marks in flying subjects and ground subjects in 62 cadet trainees during the training stage are presented in Table-VIII. Four tests viz Intelligence (APM), Spatial Relations, Spatial Orientation and Digit Symbol Substitutions were found to have significant correlations with scoring in flying subjects. None of the tests was significantly related to performance in ground subjects.

**Table-VIII Product-moment Correlation between Psychological Tests and Flying Marks and Ground Marks of Cadet Trainees at AFA (n=62)**

Test scores	Correlation coefficients (r)	
	Marks in Flying subjects	Marks in Ground subjects
Progressive matrices	0.28*	0.06
Abstract reasoning	0.16	0.12
Spatial relations	0.60**	0.22
Mechanical comprehension	0.15	0.16
Perceptual speed	0.11	0.01
Digit-symbol substitution	0.53**	0.20
Spatial orientation	0.51**	0.19

\* Significant at 0.05 level \*\* significant at 0.01 level

### Discussion

From the results of the present study it was found that out of the total ten psychological tests administered, 5 tests, viz Advanced Progressive Matrices, Spatial Relations, Spatial Orientation, Digit Symbol Substitution and Eye-hand Coordination were useful in predicting success/failure at selection stage or at the training stage.

Spatial relations test had a significant correlation ( $r=0.60$ ) with marks in flying subjects at the training stage and also was effective enough to separate the passed group from the failed one in actual flying during mid-term training. Intelligence measured by Advanced Progressive Matrices test tended to be positively related ( $r=0.28$ ,  $P$ ) to marks in flying subjects and to performance in actual flying during mid-term training.

Digit Symbol Substitution Test and Spatial Orientation Test were positively related to marks

in flying subjects at the training stage ( $r=0.53$  and  $0.51$  respectively).

Eye-hand coordination test showed a fairly significant positive relationship with performance at the selection stage, but not so convincing a relationship with performance in actual flying at the training stage. Similar findings were reported by Cox and Bordelon<sup>6</sup> in the case of USAF Pilot candidates.

The principal goal of selection is to screen out those candidates with extremely low chances of completing training successfully. Screening of potential failures at the selection stage can prevent considerable attrition costs. As the aspirants for filling up vacancies of pilots have to go through different stages of screening, all the tests related to performance irrespective of the stage are to be considered in any integrated system of selection<sup>7</sup>.

The study has shown that there is a scope for inclusion of some more tests in the existing battery used at Selection Boards, to improve the system further. However, the weightage to be given to each variable and the stages at which various tests are to be given should be decided after collecting relevant data on a larger sample.

### REFERENCES

1. Bouche JJ : Interim Report on Selection of Officers for the Flying (Pilot) Branch, New Delhi, Air Headquarters, 1974; p.135
2. Kennedy RS : Television computer games : A new look in performance testing. *Aviat Space Environ Med* 1982 ; 53 :49-53
3. Idzikowski C, Baddeley A : Fear and performance in novice parachutists. *Ergonomics* 1987; 30 : 1463-1474
4. Basowitz H : Anxiety and Stress. New York, McGraw Hill, 1955.
5. Freeman FS : Theory and Practice of Psychological Testing. New Delhi, Oxford and IBH Publishing Co, 1965, p.369
6. Cox RH, Bordelon VP : Utilisation of psychomotor screening for USAF pilot candidates, *Aviat Space Environ Med* 1988; 59 : 640-645
7. Carlstedt L : Phased Selection of Pilots - Procedure and Validity. FOA report. Stockholm, Defence Research Institute, 1979.