THE RELATIONSHIP BETWEEN FLIGHT TRAINING PERFORMANCE, A RISK ASSESSMENT TEST, AND THE JENKINS ACTIVITY SURVEY

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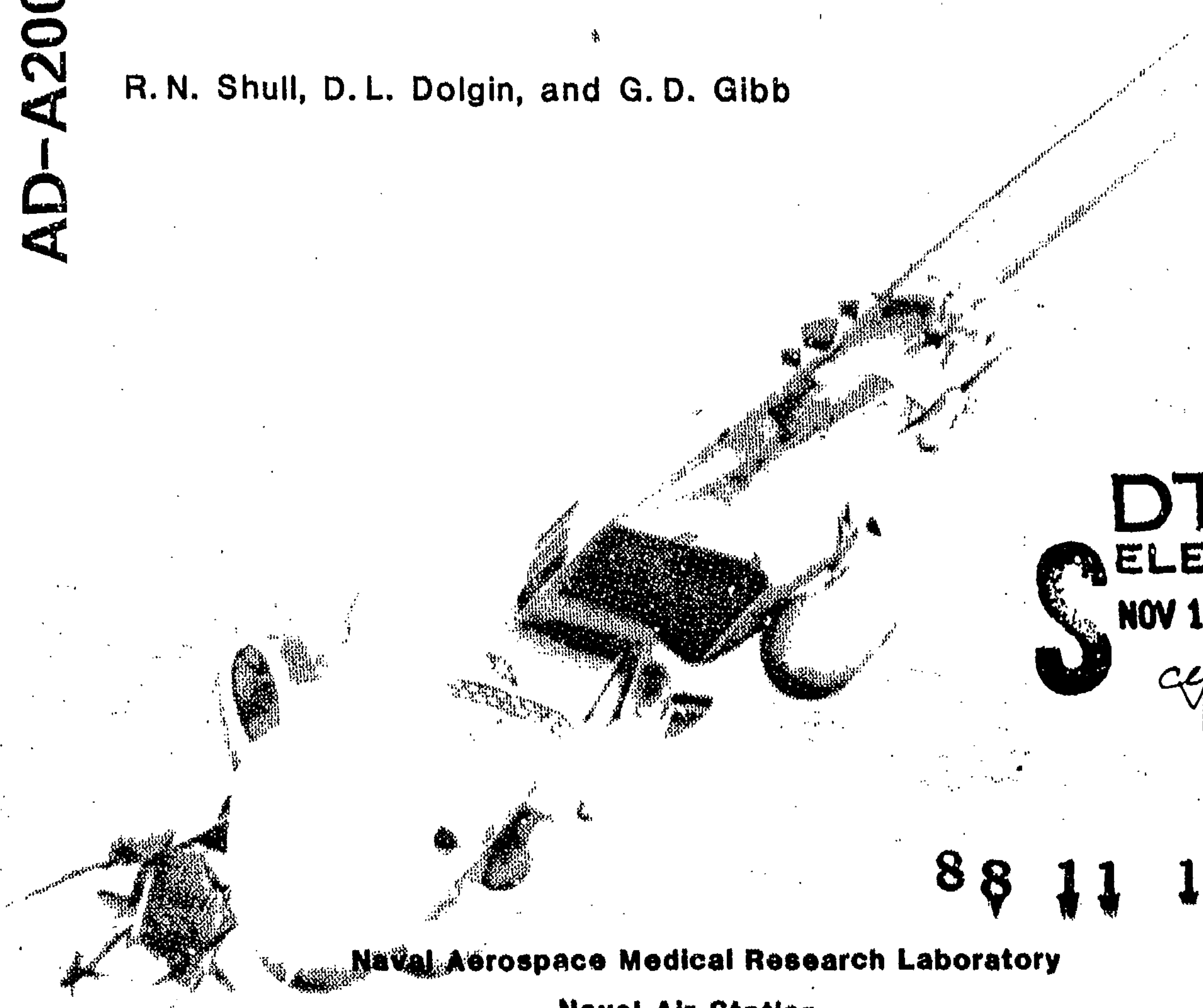

Naval Aerospace Medical Research Laboratory
Naval Air Station
Pensacola, Florida 32508-5700

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY Unclassified	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NAMRL-1339	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Aerospace Medical Research Laboratory 6b. OFFICE SYMBOL (If applicable) Code 03	7a. NAME OF MONITORING ORGANIZATION Naval Medical Research and Development Command
6c. ADDRESS (City, State, and ZIP Code) NAS, Pensacola, FL 32508-5700	7b. ADDRESS (City, State, and ZIP Code) NMC, NCR, Bethesda, MD 20814-5044
8a. NAME OF FUNDING / SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
63706N	M0096	001	1051

11. TITLE (Include Security Classification) (U) THE RELATIONSHIP BETWEEN FLIGHT TRAINING PERFORMANCE, A RISK ASSESSMENT TEST, AND THE JENKINS ACTIVITY SURVEY

12. PERSONAL AUTHOR(S) R. N. Shull, D. L. Dolgin, and G. D. Gibb

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Interim	FROM 8-86 TO 8-87	88-07	12

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Personality; motivation; prediction

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Current aircrew selection research at the Naval Aerospace Medical Research Laboratory has focused primarily on psychomotor and cognitive abilities. Evidence from studies on flight training attrition suggests that a number of failures may be attributed to personality or motivational factors rather than a lack of abilities. Because flight training success is a dynamic interaction of abilities, motivation, and personality factors, all three areas should be included to optimize the predictive validity of aircrew selection batteries. Two sets of data are presented; one set is from a computer-based risk assessment task, and the other is from the Jenkins Activity Survey. The data indicated few relationships between risk assessment measures and flight training criteria. We found only one indication that increased risk-taking was associated with successfully completing primary flight training. The Jenkins Activity Survey results indicated contradictory relationships between the scale measures and flight training criteria in the few significant findings observed.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL J. A. Brady, CAPT, MSC USN, Commanding Officer	22b. TELEPHONE (Include Area Code) (904) 452-3286 22c. OFFICE SYMBOL 00

DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted.
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

U.S. Government Printing Office: 1985-507-047

SUMMARY PAGE

THE PROBLEM

Current aircrew selection research efforts at the Naval Aerospace Medical Research Laboratory have focused primarily on the measurement of psychomotor and cognitive abilities. Evidence from studies of flight training attrition suggests that a number of failures may be attributed to personality or motivational factors rather than a lack of abilities. Because flight training success is a dynamic interaction of abilities, motivation, and personality factors, all three areas should be included to optimize the predictive validity of aircrew selection batteries.

THE FINDINGS

Two sets of data are presented; one set is from a computer-based risk assessment task, and the other is from the Jenkins Activity Survey. The data indicated few relationships between risk assessment measures and flight training criteria. We found only one indication out of six that increased risk-taking was associated with successfully completing primary flight training. Results from the Jenkins Activity Survey indicated contradictory relationships between the scale measures and flight training criteria in the few significant findings observed.

RECOMMENDATIONS

At this time, we cannot recommend including either test in a naval aircrew selection battery. We suggest further research involving these and other personality measurement tools to evaluate personality factors and aircrew selection. Specifically, risk test data correlated significantly with the successful completion of primary flight training. This finding suggests that a greater "willingness" to take risks may be associated with success in primary flight training. Continued research of the personality-performance relationship is warranted because operational aviation selection tests have an uncorrected predictive validity correlation of approximately 0.15 - 0.25 to a pass/attrite criterion for primary flight training, which leaves a considerable amount (75%) of variance unaccounted for.

Acknowledgments

The authors acknowledge the technical assistance of Peter Collyer, who developed the computer program for the risk assessment test, and Al Thomas, who tested the subjects. The conceptual framework for the risk assessment test was initially developed at the Human Resources Laboratory, Brooks Air Force Base, San Antonio, TX.

The authors would like to dedicate this report to the memory of Captain James O. Houghton, MC, USN. Without his support and encouragement, this study and related work could not have been accomplished.

INTRODUCTION

An increase in the number of U.S. Navy aircraft has resulted in a constant, if not escalating, demand for aviators. The high cost of training aviators on sophisticated aircraft underscores the importance of appropriate selection procedures that permit early and accurate identification of potentially successful aviation candidates. Ideally, selected candidates will complete the required flight training courses from primary flight training to operational certification. Every selectee for aircrew training who fails to complete primary flight training contributes to a possible operational manpower shortage if expected replacements necessary to maintain military readiness do not materialize on schedule. A highly desirable alternative is to minimize attrition rates by identifying and selecting only those candidates with the potential to succeed in the aviation environment.

Current aircrew selection research efforts at the Naval Aerospace Medical Research Laboratory (NAMRL) have focused primarily on the evaluation of candidates' psychomotor and cognitive abilities. While these abilities are necessary for successful performance in primary flight training, a number of failures may be attributable to personality and/or motivational factors (1). Helmreich (1) contends that flight ability must be regarded as a dynamic interaction of sensory-motor skills and personality characteristics. Perhaps certain personality characteristics or types do correlate with success in primary flight training, such that assessment of these would contribute significantly to the prediction of flight training performance. Personality tests have been used to hire airline pilots and executives in private industry as well as to select military pilots in foreign countries (2,3). There is no reason to assume that personality testing will not improve the aircrew selection process and many reasons to assume that it will. Nevertheless, a paucity of research deals with personality tests as part of aircrew selection efforts.

We hypothesized that willingness to take risks might contribute to success in flight training and that individuals with fewer Type-A traits would be more likely to fail primary flight training. With this in mind, we investigated two personality instruments: the NAMRL automated risk assessment test (4) and the Jenkins Activity Survey Form-C (JAS-C) (5). Subjects' scores on these tests were also compared to their scores on the current U.S. Navy/Marine aviation selection test battery (Academic Qualifications Test/Flight Aptitude Rating) to assess the relationship between the various measures of flight training performance.

METHOD

SUBJECTS

Student naval aviators (SNAs) participated as volunteer subjects for both tests. The risk test was administered to 440 SNAs (433 males, 7 females). The JAS-C was administered to 158 SNAs (155 males, 3 females); 108 of these also took the risk test. For both tests, the subject age range was 20-29 years ($\underline{M}$ = 23.21, $\underline{SD}$ = 1.52 for the risk test; $\underline{M}$ = 23.31, $\underline{SD}$ = 1.56 for the JAS-C). Before testing, all subjects were informed that test results would not affect their continuation in the flight program and would not be entered into their service record.

APPARATUS

The risk test was conducted using an Apple IIe microcomputer system with an Amdek Color I Plus monitor and an Apple IIe numeric keypad placed under the subject's right hand. The JAS-C was administered as a standard paper-and-pencil test.

TESTS

NAMRL Automated Risk Assessment Test

The risk test is a gambling task that was developed from a test described by Slovic (6). An initial version of this test was first outlined by Imhoff & Levine (7) and subsequently revised by Dolgin et al. (4). Decision making is one of the processes most widely cited as critical to piloting, and a tendency to take risks is considered to be one of the primary components of that attribute (7). The level of risk is typically measured by 1) the individual's willingness to accept a given level of probability to obtain a payoff, and 2) the time required to make such a response. Time-related measures of risk-taking may be important because piloting involves decisions that are often made under time constraints (7).

The risk test consisted of 3 sessions of 10 trials each. For each trial in Session 1, the subject viewed a matrix of squares identified by numbers. At the beginning of each trial, one square was a penalty square (PS), and nine were reward squares (RS) that were selected by pressing a key corresponding to the number in the square. The subject could select any of the squares, one at a time, and if the selected squares contained a payoff, the subject retained it. If a subject first selected a RS and then selected a second square, the probability of getting the PS was then 1 out of 8, and so forth. The probability of selecting the PS increased on each successive response as the number of PS available for selection decreased. If the subject selected the PS, the trial ended, and all points for that trial were lost. Thus, in any given trial, a subject could acquire a maximum of nine RS during each trial. Subjects could stop at any time during a trial. For example, if a subject acquired three RS, the subject could stop and keep the total points for those three RS. At that point, a new matrix of 10 squares would be presented, and the subject would begin again. The PS was randomly reassigned at the beginning of each trial.

During Session 2, 10 trials were again presented but differed from Session 1 in that the sessions were run with 2 randomly assigned PS for each trial. Session 3 consisted of 10 standard trials with 1 randomly assigned PS identical to the first session. This provided an opportunity to determine whether respondents were able to adjust their strategy according to risk. The average number of squares selected per trial and the average latency between choices were calculated and retained for each session/subject pair. The test (all three sessions) was self-paced and usually lasted about 15 min with no practice trials. The final scores for analysis were the number of responses (NR) made (based on the number of squares accumulated) and the corresponding response times (RT) for all responses during the session. The total number of points was the number of

RS chosen. Increased risk-taking on this test was represented by increases in the number of responses made and/or decreases in response times.

JAS-C

The JAS-C is a 52-item multiple-choice questionnaire that measures the Type-A behavior pattern and three other related factors: speed and impatience, job involvement, and competitiveness (5). Pred and colleagues (8) recently derived new measures from the JAS-C that consisted of two moderately correlated scales labeled "achievement striving" and "impatience/irritability." Achievement striving involves goal-oriented behavior and is positively correlated with the Work and Family Orientation Questionnaire (9). Of particular interest is the fact that high achievement striving is associated with superior aircrew performance and appears to have no negative health implications (10). Conversely, high impatience/irritability is associated with both negative health conditions (i.e., fatigue, sleep disturbance) and inferior flying performance as measured in commercial jet transport pilots (10).

Of the four scores derived from this test, the Type-A score (A scale) is an overall estimate of the behavior pattern that is characterized by extremes of competitiveness, aggressiveness, impatience, and time pressure. The speed and impatience factor (S scale) deals with time urgency, with high scorers tending toward impatience, irritation, and strong tempers. The job involvement factor (J scale) reflects the degree of occupational dedication, with high scorers showing propensity for challenging high-pressure jobs to which they are very committed. The hard-driving and competitive factor (H scale) involves the perception of one's self as being more driven and competitive than others, with high scorers being more achievement-oriented, conscientious, and energetic (5). For each item that contributes to a scale score, each response alternative is assigned numerical points based on the product of the item regression weight and the optimal scaling weight for that response. This self-paced test usually took approximately 20 min to complete.

Academic Qualification Test/Flight Aptitude Rating (AQT/FAR)

The AQT/FAR is the U.S. Navy/Marine Corps aviation officer selection test battery. It is used as the primary non-medical instrument for screening flight training applicants. The test battery is composed of four multiple choice tests: the Academic Qualification Test (AQT), Mechanical Comprehension Test (MCT), Spatial Apperception Test (SAT), and Biographical Inventory (BI). The AQT is a single test that measures such attributes as general intelligence, verbal and quantitative abilities, clerical skills, and situational judgment. The FAR is a combination of the MCT, SAT, and BI tests. The MCT assesses mechanical aptitude and the ability to perceive physical relationships. The SAT is a measure of spatial orientation that involves determining the angle of bank at which various aircraft are configured. The BI includes personal history, interests, and attitudes; assesses acquired aviation knowledge; and is the only untimed test.

RESULTS AND DISCUSSION

RISK TEST

Complete AQT/FAR scores were obtained for all 440 flight students who took the risk test. The means and standard deviations (SDs) of the AQT/FAR stanine scores and the scores obtained on the risk test, with their intercorrelations, are shown in Table 1. None of these correlations proved significant. For all tables, significance levels were adjusted to account for multiple comparisons between correlation coefficients.

TABLE 1. Intercorrelations of the Selection Test and Risk Test Scores (N = 440).*

Session	AQT	FAR	SAT	MCT	BI	Mean score	SD
S1-RT	-.026	-.074	-.029	-.105	-.053	3.58	1.39
S2-RT	.017	.015	.019	-.049	.039	2.49	1.02
S3-RT	-.015	-.062	-.015	-.101	-.043	2.25	0.85
S1-NR	.009	.043	.061	-.010	.027	4.76	0.95
S2-NR	.052	.017	.038	.024	-.022	3.22	0.64
S3-NR	.011	-.002	.032	-.019	-.017	4.87	0.88
Mean score	5.73	7.13	12.78	11.73	13.26		
SD	1.30	1.58	3.16	2.77	3.22		

*S1 = first session; S2 = second session; S3 = third session; RT = reaction time; NR = number of responses.

Of the 440 flight students, 217 completed or failed primary flight training. The correlations between their risk test scores and the pass/fail index (1 = pass, 2 = fail) are shown in Table 2. The correlation between the number of responses during Session 1 and the pass/fail index (r = -.184) was significant. The direction of the correlation indicates that greater risk taking is associated with completing primary flight training, but because the correlation is small and not significant when the session was repeated (S3-NR) we do not infer much from this one finding. This correlation may be due to: 1) chance alone; 2) subjects being unaware that only one PS was present during the third session trials, and thus, they responded under two PS conditions (increased risk) as in Session 2; or 3) risk taking behavior predicts flight performance only under low risk conditions as in Session 1. On the other hand, all RT correlations were positive even though not significant. This indicates no relationship between increased risk taking and the pass/fail index.

TABLE 2. Intercorrelations of the Risk Test Scores and Pass/Fail Index (n = 217).*

Index	S1-RT	S2-RT	S3-RT	S1-NR	S2-NR	S3-NR
Pass/Fail	.092	.131	.011	-.184**	-.064	-.023

*RT = reaction time; NR = number of responses.
**Above critical value (2-tail, .05 level).

None of the correlations between the risk test scores and grades received during preflight and flight training for those who successfully completed primary flight training was significant (Table 3).

TABLE 3. Intercorrelations of the Risk Test Scores and Primary Training Grades (n = 197).*

Grades	S1-RT	S2-RT	S3-RT	S1-NR	S2-NR	S3-NR	Mean score	SD
AI	-.064	-.053	-.053	-.122	-.021	.046	54.48	4.83
ACAD	-.065	-.139	-.090	-.008	-.057	.125	52.87	10.09
FLT-GRD	-.112	-.031	-.108	-.122	-.020	-.040	3.05	0.03

*S1 = first session; S2 = second session; S3 = third session;
RT = reaction time; NR = number of squares accumulated;
AI = initial aviation ground school; ACAD = academic performance in primary flight training; FLT-GRD = primary flight training grades.

JAS-C

Table 4 shows the correlations of the selection test stanine scores and the JAS-C scores. The direction of the significant correlation between the MCT and the H scale indicates that higher MCT scores are associated with decreased competitiveness. No significant correlations were found between the JAS-C scores and either the pass/fail index or primary flight training grades as indicated in Tables 5 and 6. On the S and H scales, our subjects' scores were similar to those of a reference population, ages 48-65, that was compiled by the testing service marketing the JAS-C. Although the Navy subjects scored higher on the A (70th percentile) and J (86th percentile) scales, indicating a possible difference in Type A-behavior, no evidence was found to indicate this difference can be used to predict flight performance.

TABLE 4. Intercorrelations of the Selection Test Scores and the Jenkins Activity Scale Scores (n = 158).

Scale	AQT	FAR	SAT	MCT	BI	Mean score	SD
A	-.044	-.031	-.013	-.105	-.029	276.37	60.97
S	.146	.033	-.029	.027	-.019	169.72	57.89
J	-.021	-.132	-.064	-.119	-.131	284.15	32.45
H	-.099	-.118	-.095	-.19[illegible]*	-.073	123.39	27.95
Mean score	5.64	6.86	12.28	11.51	13.04		
SD	1.31	1.65	3.26	2.97	3.15		

* Above critical value (2-tail, .05 level).

TAB[illegible]. Intercorrelations of the Jenkins Activity Scale Scores and the Pass/Fail Index (n = 149).

	Scale			
Index	A	S	J	H
Pass/Fail	-.001	-.030	.105	.152

TABLE 6. Intercorrelations of the Jenkins Activity Scale Scores and Primary Training Grades (n = 133).

	Scale					
Grades	A	S	J	H	Mean score	SD
AI	-.035	.052	-.047	-.135	53.70	5.25
ACAD	.088	.150	-.014	.080	50.30	10.02
FLT-GRD	.039	-.002	-.034	-.024	3.05	0.03

AI = initial aviation ground school; ACAD = academic performance in primary flight training; FLT-GRD = primary flight training grades.

CONCLUSIONS

Of the two tests investigated, only the risk test demonstrated any relationship to primary flight training success. Further research should examine the relationship between the risk test and flight training criteria under low risk conditions as in the first session of the risk test. The risk test should be reconfigured to include three sessions of identical levels of risk (i.e., PS = 1). This reconfiguration would also permit assessment of task stability. Continued investigation of the Jenkins Activity Survey is not warranted, as no evidence was found for the hypothesis that increased Type-A characteristics lead to a greater liklihood of completing primary flight training. Due to the significant correlation between risk-taking and primary flight training found for Session 1, a larger sample should be evaluated on the risk test to determine if the magnitude of this relationship is a stable one. The ability to take risks is certainly an important facet of learning to fly. The data presented here do not allow us to strongly state that the risk test scores relate to this ability. Given that the risk test contains relevant content-validity and reasonable psychometric properties, continued investigation is recommended.

RECOMMENDATIONS

At this time, we cannot recommend including either test in a naval aircrew selection battery. We suggest further research involving these and other personality measurement tools to evaluate personality factors and aircrew selection. Specifically, risk test data correlated significantly with the successful completion of primary flight training. This finding suggests that a greater "willingness" to take risks may be associated with success in primary flight training. Continued research of the personality-performance relationship is warranted because operational aviation selection tests have an uncorrected predictive validity correlation of approximately 0.15 - 0.25 to a pass/attrite criterion for primary flight training, which leaves a considerable amount (75%) of variance unaccounted for.

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