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BACKGROUND AND INTEREST MEASURES AS PREDICTORS OF SUCCESS IN UNDERGRADUATE PILOT TRAINING

By

Nancy Guinn
Bart M. Vitola
Sandra A. Leisey, A1C, USAF

PERSONNEL RESEARCH DIVISION
Lackland Air Force Base, Texas 78236

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NOTICE

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LELAND D. BROKAW, Technical Director
Personnel Research Division

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A sample of 593 pilot trainees in Officer Training School were administered the Strong Vocational Interest Blank and the Officer Biographical and Attitudinal Survey. Their performance in pilot training was monitored in order to assess the effectiveness of biographical, attitudinal, and interest data in predicting pilot training criteria. Using item analysis, four eliminee keys were developed from the survey data; regression analysis was utilized to select various models of predictors to be used as possible Pilot Selection Composites (PSC). Using the optimal cutoff score for PSC Model 1, 38 percent of the eliminees were correctly identified and only 10 percent of the graduate group incorrectly labeled as potential failures. For Model 2, 18 percent of the eliminee category was identified as high-risk for attrition along with seven percent of the successful graduates. With Model 3, 45 percent of the eliminees

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were labeled as potential failures along with 20 percent of the graduate group. The possibility of increasing the accuracy of prediction by using non-cognitive data and the operational usefulness of the composites are discussed.

PREFACE

This work was performed under Project 7719, Air Force Development of Selection, Classification, Assignment, Performance Evaluation, Retention, and Utilization Devices; Task 771909, Development and Validation of Specialized Procedures to Improve Personnel Classification and Assignment.

Special appreciation is expressed to Mr. Henry Clark and A1C S. Kay Wilson of the Computational Sciences Division, Air Force Human Resources Laboratory, for their professional and technical assistance in the planning, programming, and accomplishment of desired analyses for this project.

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BACKGROUND AND INTEREST MEASURES AS PREDICTORS OF SUCCESS IN UNDERGRADUATE PILOT TRAINING

I. INTRODUCTION AND BACKGROUND

Over the years a great deal of attention has been focused on decreasing training costs by developing techniques to select individuals for training programs who are most likely to succeed. Today with the stringent budgetary limitations imposed by Congress on military spending, more emphasis than ever has been placed on the armed services to find ways of maximizing the return on their training investment. The most costly type of training in the Air Force is the training of pilots. Although the cost of undergraduate pilot training varies depending on which costs are included or excluded in the specific estimates, the cost per pilot graduate with adjustment for attrition has been placed at $71,829.[1] This estimate does not include the addition of costs by Headquarters USAF to cover depot maintenance and centrally funded replenishment spares. The average training cost directly attributable to each elimination from undergraduate pilot training (UPT) has been estimated to be approximately $16,082. With costs of this magnitude, any selection program designed to identify potential eliminees could result in considerable savings.

A review of attrition rates reveals that the number of training eliminations in UPT varies by source of commission. As shown in Table 1, UPT trainees from Officer Training School (OTS) represent the largest percentage of eliminees while trainees from the Air Force Academy (AFA) have the lowest washout rate. A further look at the causes for attrition of OTS pilot trainees indicates that the two main reasons for elimination are flying deficiency and self-initiated (i.e., voluntary) elimination (Table 2). An investigation of the factors related to flying deficiency might include, in addition to the traditional aptitudes required for pilot trainees, motivational factors such as the desire to become a rated pilot and/or an expressed interest in flying. The self-initiated elimination (SIE) appears to represent a distinct motivational component since this type of elimination is initiated by the student himself rather than instructor pilot or superior. It would seem that the correlates of behavior related to these two main causes for elimination should include non-cognitive/non-intellectual factors in addition to cognitive abilities, and that the use of non-cognitive data in the selection of applicants for pilot training would make the selection process more cost-effective.

In Navy research, the usefulness of biographical and interest inventories have also been studied quite extensively (Abrahams & Neumann, 1971a; Abrahams & Neumann, 1973; Abrahams, Neumann, & Dann, 1969, Abrahams, Neumann, & Githens, 1968; Dann & Abrahams, 1970; LaGaipa, 1960; Neumann, Githens, & Abrahams, 1967). Scales developed from the Strong Vocational Interest Blank (SVIB) were found to be valid in identifying early motivational disenrollees from the Naval Academy, assessing the career motivation among NROTC applicants, and predicting NROTC officer retention (Abrahams & Neumann, 1971b; Abrahams & Neumann, 1973; Abrahams, Neumann, & Dann, 1969; Abrahams, Neumann, & Githens, 1968). Use of background information was also found to have sufficient predictive validity for the NROTC selection program; however, research using biographical and interview data to identify attritions from the Naval Academy indicated that interest data from the SVIB was far more predictive (Dann & Abrahams, 1970; Neumann, Githens, & Abrahams, 1967).

Table 1. Attrition Rates in UPT by Source of Commission for 1971 – 1973[a]

	Source of Commission			
Year	AFROTC	OTS	AFA	Total
1971	21.5%	36.4%	9.1%	29.1%
1972	20.6%	38.1%	12.8%	28.1%
1973	22.6%	36.0%	14.4%	27.2%

[a]Data furnished by Hq ATC, Training Analysis Division.

[1]Cost data for FY 73 furnished by Hq ATC/ACM, November 1975. These estimates represent the cost for UPT during the time period the sample population used in this study was in pilot training.

Table 2. **Types of Training Elimination for Students in UPT 1971 – 1973**[a]

Type Elimination	1971 N	1971 %	1972 N	1972 %	1973 N	1973 %
Flying Deficiency (FLY)	562	49	484	51	297	51
Academic Deficiency (ACAD)	17	2	4	0	10	2
Medical Elimination (MED)	143	12	116	12	53	9
Manifestations of Anxiety (MOA)	129	11	107	11	53	9
Self-Initiated Elimination (SIE)	295	25	222	24	159	28
Fatality	5	0	2	0	1	0
Other	7	1	13	2	7	1
Total Eliminated	1,158	100	948	100	580	100

[a]Data furnished by Hq ATC, Training Analysis Division.

In previous Air Force research, it was generally concluded that biographical and interest data was positively related to successful military outcomes (Mullins, Ewing, & Woods, 1962; Taylor, Murray, & Ellison, 1971; Tupes, 1952, 1957; Usdin & Shenk, 1973). In the study by Taylor et al. (1971), it was recommended that further research on the development of motivational assessment techniques for pilot training using biographical information be initiated. When a positive relationship was found between background/interest measures and expressed career intent, Usdin and Shenk (1973) also recommended that the study of the overall utility of background and interest measures be extended to include validating these instruments against training criteria.

Therefore, the purpose of the current study was to (a) develop biographical and interest keys for an Air Force sample of OTS pilot trainees with different training outcomes; (b) assess the validity of biographical and interest keys developed against the criterion of expressed career intent for pilot training criteria; and (c) validate and assess the value of non-cognitive data in predicting graduation/elimination in pilot training.

II. METHOD

A total of 593 officers who entered pilot training in Classes 73-02 through 73-09 comprised the sample population. These officers had received their commission by completing the 12-week OTS program for college graduates during the latter part of 1971. While in the officer training program at Lackland AFB, Texas, these students were administered the SVIB and an Officer Biographical and Attitudinal Survey (OBAS).

The SVIB is an empirically scored inventory based on patterns of likes and dislikes designed to distinguish among various occupations. There are 54 occupational keys and five supplemental keys. The OBAS is a 116-item inventory which contains background and attitudinal items including the importance-possibility scale. The importance-possibility scale is a group of 43 items which requests the respondent to indicate the importance of certain career needs and the extent to which these needs can be fulfilled in an Air Force job.

Response data from these test measures were keypunched and transferred to tape files for analysis. Data from the two inventories along with aptitude scores retrieved from the officer tape files comprised the predictor measures used in the analysis phase of this project.

Criterion data from UPT was also obtained from the officer tape files maintained by the Computational Sciences Division, Air Force Human Resources Laboratory (AFHRL), Lackland Air Force Base, Texas. Criteria used in the analyses were selected after a review was made of the different training outcomes in the sample population. Each criterion selected represented a different attrition category being compared to the success group. The number of cases in each attrition/success category during the three phases of UPT are shown in Table 3. Based on these data, separate analyses by training phase were not considered feasible.

Table 3. **Training Outcome of Sample Population by Training Phase**

Training Outcome Classification	T-41	T-37	T-38	Total
	Training Phase			
Attrition Category				
Academic Deficiency (ACAD)		3	1	4
Military Training Deficiency (MTD)			1	1
Flying Deficiency (FD)	43	28	33	104
Medical Deficiency (MED)	5	10	1	16
Self-Initiated Elimination (SIE)	12	45	6	63
Fear of Flying/Manifestation of Anxiety (MOA)	3	13	1	17
Other (OTHER)		2		2
Total Number of UPT Attritions				207
Success Category				
Total Number of UPT Graduates (GRAD)				386
Total UPT Sample				593

Final selection as a criterion was based on the hypothesized relevance of the criterion to the research objectives or the number of subjects available in one or more of the attrition categories. As large a number of subjects as possible in the criterion classification was desirable to permit meaningful analyses and to increase the stability in key development and probability of obtaining significant results in the cross-application analyses. Criterion Group 1 included all types of eliminees and those who graduated. Criterion Group 2 was composed of UPT flying deficiency eliminees and successful graduates. Criterion Group 3 contained those who elected to eliminate themselves (SIE) and UPT graduates; Criterion Group 4 included those classified as motivational attritions (SIE and MOA) along with the success group. All four criterion groups were used in the item analysis phase. Criterion Group 1 was used for the regression analyses. Table 4 delineates the composition of criterion categories.

Table 4. **Composition of Criterion Categories**

Criterion Group Number	Total N	ACAD	MTD	FD	MED	SIE	MOA	Other	Grad
		Training Outcomes Included in Criterion Group							
1	593	X	X	X	X	X	X	X	X
2	490			X					X
3	449					X			X
4	466					X	X		X

The sample population was scored on the standard SVIB scales, and keys developed previously by the Air Force (Shenk, 1973) were applied to the importance-possibility section of the OBAS. Definitions and weights used to generate these scores are contained in Appendix A. Two additional keys, SVIB/Pilot and OBAS/Pilot, which were developed by Usdin and Shenk (1973) against a criterion of expressed career intent, were also included to determine their validity against pilot training criteria.

Item and regression analyses were accomplished to develop keys for pilot training criteria and to assess the usefulness of these non-cognitive measures alone and in combination with operational aptitude measures in predicting pilot training outcomes.

For item analysis[2] the total survey respondent population was divided into two samples [half-sample 1 (HS_1) and half-sample 2 (HS_2)]. Using these samples, keys were developed based on item criterion

[2] The item analysis program was originally developed under government contract by the Service Bureau Corporation (Contract AF-41 (609-2788)) and monitored by Drs. Raymond Christal and Robert Bottenberg, AFHRL. For this project the program was modified by the Computational Sciences Division to accommodate a dichotomous criterion.

validity, a composite was built by selecting keyed items in a sequence to yield maximum prediction; and a cross-application of keys and item sequences was accomplished to insure stability from sample to sample. Omitted responses were considered as a valid alternative. The .01 significance key was selected for use in the validation and cross-application phases. Items were keyed based on the validity coefficient for each item alternative. Alternatives were keyed +1, −1, or 0, depending on the significance and sign of the validity coefficient.

Regression analysis (Bottenberg & Ward, 1963) was utilized for the model seeking phase to select the optimal set of predictors. Three models containing those predictor variables found to make the most valid and unique contribution to prediction of pilot training success were cross-applied to estimate the stability of the predictor composites. An optimum cutoff score in the predicted score range was determined for each model which would maximize the identification of potential eliminees to the minimum exclusion of pilot graduates. Finally, a distribution of predicted scores for graduates and eliminees was accomplished to determine the number of pilot trainee outcomes correctly or incorrectly identified by the selector composites' cutoff score.

III. RESULTS AND DISCUSSION

Construction and Cross-Validation of Keys from Biographical/Attitudinal Data

Four separate keys were developed from the response data of the OBAS: Total Elimination (TE); Flying Deficiency (FD); Self-Initiated (SIE); and Motivational Deficiency (MD). As shown in Table 5, the validity for the TE key is .37 for the criterion using only seven of the OBAS items. Cross-applying the TE key yields a validity of .13. While the decrease in the absolute size of the validity coefficient was sizeable, the significance of the validity coefficient upon cross-application reached the .05 level. Similar results were obtained for the FD key. The original validity was .40 but decreased to .14 when cross-applied. For those keys designed to tap the motivational component of eliminee behavior (SIE and MOA), the results of cross-validation were not encouraging. Although validities of .33 and .37 were obtained for the original keys, cross-applying these keys resulted in validity coefficients of .06 for both keys which were not significant at the .05 level. Nevertheless, these keys might be used advantageously in combination with aptitudinal and/or interest data since they tap areas of background and attitudinal information not presently included in operational selection tests.

Table 5. Composite and Cross-Validities of OBAS Keys for UPT Criteria

Criterion	Key	No. of Items	Composite Validity	Cross-Validity
Total Elimination	TE	7	.3684**	.1319*
Flying Deficiency Elimination	FD	5	.3953**	.1397*
Self-Initiated Elimination	SIE	6	.3249**	.0560
Motivational Deficiency Elimination (SIE/MOA)	MD	5	.3660**	.0617

*Significant at .05 level.

**Significant at .01 level.

Validity of SVIB Data and AF SVIB and OBAS Keys against Pilot Training Criteria

In the attempt to build a predictor composite of elimination keys, SVIB keys, and keys developed on previous Air Force samples, it became apparent that the variables for the proposed composite would have to be reduced to a manageable number. The first step to obtain this objective was to reduce the 59 SVIB keys to a minimum number which were significantly related to the overall criterion of elimination from pilot training. The correlations between the criterion of elimination and the keys used in this study (presented in Table 6) were not high enough to suggest use of only one of the keys as a single prediction instrument. For the entire sample of 593 pilot trainees, the SVIB-derived score with the highest validity

Table 6. Correlations Between SVIB-Scales/AF Keys and Elimination from UPT

Scale/Key	Correlation	Scale/Key	Correlation
Occupational Scales–SVIB		**Occupational Scales–SVIB**	
Dentist	.0514	Officer Worker	.0487
Osteopath	.0291	Purchasing Agent	-.0557
Veterinarian	.0911**	Banker	-.0062
Physician	.0115	Pharmacist	.0162
Psychiatrist	-.0638*	Mortician	-.0127
Psychologist	-.0892**	Sales Manager	.0272
Biologist	-.0358	Real Estate Salesman	.0107
Architect	.0051	Life Insurance Salesman	-.0043
Mathematician	.0282	Advertising Man	.0834**
Physicist	.0073	Lawyer	.1106**
Chemist	.0568	Author-Journalist	-.1190**
Engineer	.0642*	President, Mfg Concern	-.0042
Production Manager	.1057**	Credit Manager	.0388
Army Officer	.1479**	Chamber of Commerce Executive	-.0072
Air Force Officer	.1461**	Physical Therapist	.0909**
Carpenter	.0654*	Computer Programmer	.1550**
Forest Service Man	.0993**	Business Education Teacher	.0004
Farmer	.0472	Community Recreation Administrator	.0565
Math-Science Teacher	.0273		
Painter	.0422	**Nonoccupational Scales–SVIB**	
Policeman	.0404	Specialization Level	-.0653*
Personnel Director	.0462	Occupational Level	-.0402
Public Administrator	.0609	Masculinity-Feminity	.1508**
Rehabilitation Counselor	.0628*	Academic Achievement	-.0707*
YMCA Secretary	.0308	Occupational Introversion-Extroversion	-.0346
Social Worker	.0863**		
Social Teacher	.0904**	**OBAS Importance-Possibility Keys**	
School Superintendent	.0998**	Total Possibility	.0100
Minister	.0991**	Total Score	-.0257
Librarian	.2238**	Zero Frequency	.0084
Artist	-.0249	Positive Score	-.0302
Musician Performer	-.0286	Positive Frequency	-.0063
Music Teacher	-.1144**		
CPA Owner	-.0729*	**SVIB–Pilot Key**	.0067
Senior CPA	.0855**	**OBAS–Pilot Key**	.0114
Accountant	.0412		

*Significant at .05 level.

**Significant at .01 level.

with the UPT pass/fail criterion was the Librarian scale (.22). Although the Air Force officer key showed a relatively low relationship with the UPT criterion (.15), it may be that this key is more predictive of non-rated success in the Air Force. Results of regression analysis to identify the minimum number of SVIB scales which, when combined, are most predictive of success in pilot training indicated that 17 scales which produced a multiple correlation of .45 with the criterion appeared to be the optimal number. The scales selected for further regression analyses are listed in Table 7.

None of the importance-possibility scores which, in previous research, had shown a significant relationship with both career intention (Uhlir, & Shenk, 1973) and actual career status (Shenk, 1973) were found to be significantly related to the pilot training criterion. The interest and background/attitudinal keys developed on the sample to predict expressed career intent showed almost no relationship with the

Table 7. **Cumulative Multiple R and R^2 for 17 SVIB Scales**

Scale	Cumulative R	Cumulative R^2
Librarian	.2238	.0501
Musician	.2585	.0668
Pharmacist	.2854	.0815
Computer Programmer	.3024	.0915
Life Insurance Salesman	.3267	.1067
Physical Therapist	.3357	.1127
Math/Science Teacher	.3497	.1223
Public Administrator	.3669	.1346
Accountant	.3762	.1415
Office Worker	.3892	.1515
Author/Journalist	.4020	.1616
Carpenter	.4126	.1702
Dentist	.4199	.1764
Osteopath	.4328	.1873
Advertising Man	.4378	.1916
CPA Owner	.4435	.1967
Banker	.4483	.2010

UPT criterion. However, though the indicators of career potential have little or no relationship to UPT elimination/graduation, the usefulness of an indicator of personnel retainability should not be overlooked. If the SVIB/importance-possibility keys are found to retain the same relationship with actual career decision as that shown in previous research on expressed career intent, these keys could be effectively incorporated into the process for selection to pilot training. Initial selection would be based essentially on aptitudes and other non-cognitive data predictive of pilot training success. If the selection ratio of those qualifying on these measures is favorable, final selection based on some indication of retainability could be used to maximize the Air Force return on a costly training investment.

Selection of Optimal Selection Composite

In developing a selection composite for operational use, an evaluation must be made of the potential savings which might be accrued by the identification and rejection of possible eliminees against the additional cost in time and money in implementing the proposed screening system. The use of the SVIB and/or OBAS in addition to the Air Force Officer Qualifying Test (AFOQT) now in use would increase the overall cost of the operational testing program. Therefore, some attention was directed toward minimizing the number of measures which would be required, yet maximizing the identification of possible eliminees.

The first step in developing an optimal composite of predictors for use in selection of pilot trainees was to determine whether each predictor or group of predictors made a significant contribution in predicting graduation/elimination from pilot training. A summary of regression analyses is presented in Table 8.

Results of regression problems 1 and 2 indicate the 17 SVIB scales and OBAS eliminee keys made a significant contribution to the prediction of the criterion. In problem 3, it was found that the SVIB Pilot Key and OBAS keys previously developed on a criterion of expressed career intent were not significantly related to the pass/fail criterion. Combinations of the SVIB scales and/or OBAS keys with the AFOQT pilot composite are also significant at the .01 level (problems 4, 5, and 6). In comparing the effectiveness of the non-cognitive data with the AFOQT Pilot Composite (problems 7, 8, and 9), it was found that the SVIB scales and eliminee keys, alone and in combination, make a unique and significant contribution to predictive accuracy over and above the AFOQT Pilot Composite. On the other hand, results of regression problem 10 indicate the pilot composite also makes a significant contribution over and above the non-cognitive data.

Table 8. Summary of Regression Analyses

Problem	UPT Criterion	Full Model R^2	Full Model Predictors	Restricted Model R^2	Restricted Model Predictors	df_1	df_2	F Ratio
1	Pass/Fail	.2009	17 SVIB scales	.0000	– –	17	278	4.11**
2	Pass/Fail	.1674	4 OBAS Eliminee keys (TE, FD, SIE, MD)	.0000	– –	4	291	14.62**
3	Pass/Fail	.0049	Career intent keys (5 OBAS, 1 SVIB Pilot Key)	.0000	– –	6	289	.24ns
4	Pass/Fail	.3038	17 SVIB scales, 4 OBAS Elim keys, AFOQT Pilot Composite	.0000	– –	22	273	5.41**
5	Pass/Fail	.2146	17 SVIB scales, & AFOQT Pilot Composite	.0000	– –	18	277	4.20**
6	Pass/Fail	.1960	4 OBAS Eliminee keys & AFOQT Pilot Composite	.0000	– –	5	290	14.14**
7	Pass/Fail	.3038	17 SVIB Scales, 4 OBAS Elim keys & AFOQT Pilot Composite	.2922	17 SVIB scales & 4 Elim keys	1	273	4.52*
8	Pass/Fail	.3038	17 SVIB scales, 4 OBAS Elim keys & AFOQT Pilot Composite	.2009	17 SVIB scales	5	273	8.06**
9	Pass/Fail	.3038	17 SVIB scales, 4 OBAS Elim keys & AFOQT Pilot Composite	.1674	4 OBAS Elim keys	18	273	2.97**
10	Pass/Fail	.3038	17 SVIB scales, 4 OBAS Elim keys & AFOQT Pilot Composite	.0396	AFOQT Pilot Composite	21	273	4.93**

*Significant at .05 level.

**Significant at .01 level.

Based on these results, it appears that adding one or both of the non-cognitive measures to the AFOQT Pilot Composite in the selection of pilot trainees would be cost-effective. However, in evaluating the potential benefits of additional screening, some attention should be directed toward the practical rather than statistical significance of a new selection procedure which would include the administration of one or two additional measures. For this purpose, three models of predictor variables were formed, and the relative effectiveness of each model as a screening device was assessed. Model 1 included all three components: 17 SVIB scales, four OBAS keys, and the AFOQT Pilot Composite. Using all 22 predictors, a final multiple R of .55 was obtained; an R of .14 in the cross-application phase. Model 2 combined the 17 SVIB scales and AFOQT Pilot Composite. These 18 predictors produced a multiple R of .46; .11 on cross-validation. Model 3 was comprised of the four OBAS keys and the AFOQT Pilot Composite. For this model, the multiple R obtained on the validation sample was .44 with .14 on cross-validation. The obtained correlations in the validation and cross-validation samples were statistically significant at or beyond the .05 level with the exception of the cross-validity for Model 2.

It is realized that the magnitude of the multiple correlation decreases when the predictor composite is used on future samples. However, it should also be noted that the correlation obtained on the sample population previously screened by an operational selection test is somewhat lower than if it had been computed on an unrestricted population. From these results, Models 1 and 3 appear to demonstrate some usefulness in the selection of potential pilots.

Identification of Pilot Training Eliminees

Based on the regression analysis, it was concluded that the combination of aptitude, interest, and/or biographical data into a Pilot Selection Composite (PSC) could function as a screening technique to identify trainees who might be potential failures.

To estimate the correct classification rate and potential value of these psychometric measures, they should be applied to a sufficient number of new trainees entering pilot training. However, since the number of pilot eliminees is relatively small and due to the time required to obtain an additional sample, it was decided to assess the usefulness of the three predictor composites on the total sample even though a portion of the total sample had been used for the key development or the model seeking analyses.

The overall statistical significance of a predictor composite often does not reflect the actual practical value of a screening technique. A more useful assessment of the PSC models can be made by a comparison of the number of pilot trainees whose outcomes are correctly identified (i.e., hits) versus the number of pilot trainees incorrectly classified (i.e., false positives and misses). Hits include all personnel identified as graduates who have successfully completed pilot training and those identified as potential eliminees who did attrit from training. False positives include those successful graduates who were identified as potential eliminees; misses include eliminees classified as successful graduates.

Predicted scores based on the weighted linear combination of the variables in the three models were obtained for all 593 subjects. Cutoff scores for the three models were computed which differentiated between pilot trainees who would not be eliminated in some phase of UPT from those who would have difficulty in completing this training program. Table 9 shows the possible utility of the PSC models.

Table 9. **Predicted Versus Actual Outcomes for Three Models[a] of the Pilot Selection Composite**

Model Number	Actual UPT Outcome		Predicted Outcome: Success N	Success %	Failure N	Failure %	Total Group N	Total Group %
1	Success	N	349	73	37	32	386	65
		%	90		10		100	
			(hits)		(false positives)			
	Failure	N	129	27	78	68	207	35
		%	62		38		100	
			(misses)		(hits)			
	Total		478	100	115	100	593	100
			81		19		100	
2	Success	N	360	68	26	40	386	65
		%	93		7		100	
			(hits)		(false positives)			
	Failure	N	169	32	38	60	207	35
		%	82		18		100	
			(misses)		(hits)			
	Total	N	529	100	64	100	593	100
		%	89		11		100	
3	Success	N	310	73	76	45	386	65
		%	80		20		100	
			(hits)		(false positives)			
	Failure	N	113	27	94	55	207	35
		%	55		45		100	
			(misses)		(hits)			
	Total	N	423	100	170	100	593	100
		%	71		29		100	

[a]Models contain the following predictors:
Model 1 12 SVIB keys, 4 OBAS keys, AFOQT Pilot Composite.
Model 2 12 SVIB keys and AFOQT Pilot Composite.
Model 3 4 OBAS keys, and AFOQT Pilot Composite.

PSC Model 1. Thirty-eight percent of the eliminees were identified by Model 1 as high-risk for attrition and only ten percent of the UPT graduates were incorrectly classified by the PSC Model 1 cutoff score of .49. With a favorable selection ratio, the misclassification of ten percent of a group of potentially successful pilot trainees could be tolerated

The base rate of successful completion of UPT in the population sample was 65 percent (i.e., 386 of the total 593 were successful). Using the predictor composite, the rate of correct classifications of UPT outcomes (i.e., hits) is increased to 72 percent.

Table 10 shows the number of predicted/actual UPT outcome classifications by specific type of eliminee. Nineteen percent of the total sample was labeled as high risk by this composite cutoff. Of the 19 percent identified as potential failures, 68 percent did, in fact, eliminate for one reason or another. Among the various reasons for elimination, over 40 percent of the flying deficiency and self-initiated eliminees were identified by the PSC Model 1 cutoff score. Only 18 percent of the fear of flying category was identified as high risk. Obviously, the primary behavioral characteristics related to this type of failure were not tapped by the measures included in the proposed composite.

Table 10. **Descriptive Statistics and Percentage of UPT Trainees Above and Below Cutoff Point on Pilot Selection Composite MODEL 1 by Training Outcome**

		Training Outcome													
				Type Eliminee											
		UPT GRAD		ACAD, MED OTHER		FLY		SIE		MOA		Total		Total Group	
Cutoff Score		N	Col %	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %
PSC > .49		37	10	7	30	42	40	26	41	3	18	78	38	115	19
(Predicted Failure)	Row %		32		6		36		23		3		68		100
PSC < .49		349	90	16	70	62	60	37	59	14	82	129	62	478	81
(Predicted Success)	Row %		73		3		13		8		3		27		100
Total N		386	100	23	100	104	100	63	100	17	100	207	100	593	100
	Row %		65		4		17		11		3		35		100
Mean		.7052		.6791		.5694		.5341		.5108		.5349		.6458	
SD		.1729		.1931		.1180		.2018		.1802		.1906		.1966	

The means and standard deviations of PSC Model 1 scores are also shown in Table 10. Results of t-tests between the means of the graduate group and the loss groups indicate that in all comparisons the mean differences were significant at or beyond the .01 level.

PSC Model 2. Using the optimal cutoff score of .35, only 18 percent of the eliminees and seven percent of the UPT graduate category were identified as potential failures. While classification of 18 percent of the eliminees would decrease costs related to attrition, this model does not appear to be as effective in the identification of potential failures as the other two models. On the other hand, this model has the lowest rate of misclassification of potentially successful pilot trainees. Using this model, the rate of correct classifications of UPT outcomes increase from the base rate of 65 to 68 percent.

As shown in Table 11, 11 percent of the total sample was labeled as high-risk for pilot training using the .35 cutoff score. Of the 11 percent, 59 percent were eliminated from training. This model appears to identify approximately the same percentage of failures in the different eliminee categories.

Results of t-tests between the means of the graduate group and the loss groups presented in Table 11 indicate that in all comparisons except one the mean differences were significant at or beyond the .05 level. The mean comparison between UPT graduates and eliminees due to fear of flying was not significant. As indicated previously, this model appears to be the least effective as a screening device for pilot trainees.

Table 11. Descriptive Statistics and Percentage of UPT Trainees Above and Below Cutoff Point on Pilot Selection Composite MODEL 2 by Training Outcome

		Training Outcome													
				Type Eliminee											
		UPT GRAD		ACAD, MED OTHER		FLY		SIE		MOA		Total		Total Group	
Cutoff Score		N	Col %	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %
PSC > .35		26	7	5	22	19	18	11	17	3	18	38	18	64	11
(Predicted Failure)	Row %		41		8		29		17		5		59		100
PSC < .35		360	93	18	78	85	82	52	83	14	82	169	82	529	89
(Predicted Success)	Row %		68		3		16		10		3		32		100
Total		386	100	23	100	104	100	63	100	17	100	207	100	593	100
	Row %		65		4		17		11		3		35		100
Mean		.6645		.5570		.5377		.4940		.5324		.5261		.6162	
SD		.2140		.2349		.2086		.1833		.2251		.2076		.2217	

PSC Model 3. The Model 3 optimal cutoff score of .51 identified 45 percent of the failures and 20 percent of the graduates as high-risk for attrition. The misclassification of 20 percent of potentially successful pilot trainees is rather excessive for operational use. Using PSC Model 3, the rate of correct classifications of UPT outcomes is increased from the base rate of 65 percent to 67 percent.

Table 12 indicates that 29 percent of the total population would be identified by Model 3 as high-risk personnel. This model identifies a larger number of personnel as high-risk than the other two models. Of the 20 percent identified as high-risk, 55 percent were eliminated from training. Forty-seven percent of the flying deficiency category and 48 percent of the SIEs were identified by the PSC Model 3 cutoff score. As with the other models, the fear of flying category is less accurately predicted although PSC Model 3 identifies 24 percent of this category as compared to 18 percent identified by PSC Models 1 and 2.

Table 12. Descriptive Statistics and Percentage of UPT Trainees Above and Below Cutoff Point on Pilot Selection Composite MODEL 3 by Training Outcome

		Training Outcome													
				Type Eliminee											
		UPT GRAD		ACAD, MED OTHER		FLY		SIE		MOA		Total		Total Group	
Cutoff Score		N	Col %	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %
PSC > .51		76	20	11	48	[illegible]	47	30	48	4	24	94	45	170	29
(Predicted Failure)	Row %		45		6		29		18		2		55		100
PSC < .51		310	80	12	52	55	53	33	52	13	76	113	[illegible]	423	71
(Predicted Success)	Row %		73		3		13		8		3		27		100
Total		386	100	23	100	104	100	63	100	17	100	207	100	593	100
	Row %		65		4		17		11		3		35		100
Mean		.6615		.5639		.5065		[illegible]		.6000		.5275		.6147	
SD		.1956		.1764		.2012		.2199		.1504		.2033		.2082	

T-tests between means of the graduate group and the loss groups presented in Table 12 indicate that all comparisons between graduates and eliminees were significant at or beyond the .05 level.

The possible monetary savings from implementation of a selection procedure such as one of the PSC models can be demonstrated by using the sample population as an example. A total of 386 trainees graduated from pilot training in the OTS sample representing 65 percent of the total group. Using Model 1, the total number of trainees who achieved a predicted score of .49 or higher was 478; 349, or 73 percent of this group, were successful graduates. Assuming that 386 graduates were required to meet operational needs, using the 73 percent success rate of the Model 1 PSC cutoff, a total input of 529 would have been required instead of 593. Instead of the original 207 eliminees, only 143 would not have completed pilot training. The original number of eliminees (207), at an average cost of $16,082 (see Footnote 1) per eliminee, represents an approximate cost of $3,328,974. The lowered number of eliminees (143) represents a cost of $2,299,726, or a savings of $1,029,248.

Although the required input and number of eliminees change using PSC Model 3, the possible savings to be accrued are the same. This finding would tend to indicate that the additional costs associated with the administration of the SVIB are not warranted. From a cost standpoint, the PSC Model 3 is more effective than the other two models. The use of Model 3 would avoid the purchase and administrative time of a civilian test for screening. The only drawback in using PSC Model 3 is the high (20%) misclassification rate of potential UPT graduates. The selection ratio would have to be highly favorable before such a screening procedure could be used.

Using Model 2, a total input of 568 would be required. The lowered number of eliminees (182) using this model represents a cost of $2,926,924 or a savings of $402,050 from the costs associated with a total of 207 eliminees.

The savings based on this sample using the three PSC models are given for illustrative purposes only. Although the savings to be accrued from the total UPT input would be sizeable, the cost of program administration and recruitment to obtain a sufficient number of high quality trainees was not taken into account. It is also recognized that the savings calculated on OTS input would not accurately represent the costs associated with input from AFROTC and AFA.

IV. CONCLUSIONS AND RECOMMENDATIONS

The correlations obtained for the PSC models appear to indicate that a screening device using non-cognitive data has practical value in the selection of pilot trainees. Obviously, such a system's effectiveness would be related to the availability of qualified pilot applicants. If the selection ratio in the pilot applicant pool becomes less favorable, the percentage of false positives for the PSC models may be too high to warrant their use in the selection process.

If the number of potential pilot applicants outnumbers the projected need for pilot trainees, the concern about exclusion of false positives would not be a limiting factor in recommending the use of PSC Models 1 or 3 in an operational setting.

Based on the results of this preliminary study, the following courses of action are recommended:

1. Further research be accomplished on a new sample of pilot trainees to revalidate the OBAS and SVIB. The recent change in the UPT curriculum to permit the T-41 aircraft phase of training of UPT to be accomplished during Officer Training School necessitates further investigation. The present study did not attempt to predict the pass/fail criterion for any one phase of training. An evaluation of the PSC composites on successful completion of the T-41 phase appears appropriate followed by research on the usefulness of these measures in the later phases of UPT. Similar studies should also be accomplished on AFROTC and AFA pilot trainee input.

2. In the next revision of the AFOQT, items found significant in the development of the OBAS elimination keys can be considered for incorporation into the Pilot Biographical Inventory portion of the operational test.

3. The value of these screening techniques should be further evaluated by considering the (a) feasibility and cost of administering the additional tests, (b) the potential savings to be accrued by avoiding the training expenses of trainees who cannot complete UPT, and (c) the impact of the loss of potentially successful pilots.

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APPENDIX A: DEVELOPMENT OF EXPERIMENTAL SCORES

Various experimental scores were generated for responses to the Job Importance–Job Possibility Scale (Shenk, 1973). To obtain these experimental scores the following weighted values were first assigned to each alternative:

Alternative	Value	Importance Scale Response	Possibility Scale Response
a	1	Not important at all	No possibility at all
b	2	Somewhat below average in importance	Less than average possibility
c	3	Of average importance	Average possibility
d	4	Somewhat above average in importance	Better than average possibility
e	5	Extremely important	Very good possibility

Using these weights, the following experimental scores were generated for each subject:

Total Score — Algebraic sum (including both plus and minus values) for the weight applied to the item on the Possibility Scale subtracted from the weight applied to the same item on the Importance Scale.

Zero Frequency — The number of zero differences when the weight applied to the item on the Possibility Scale is subtracted from the weight applied to the same item on the Importance Scale; i.e., the number of times the importance weight was the same as the possibility weight.

Positive Frequency — The number of positive differences when the weight applied to the item on the Possibility Scale is subtracted from the weight applied to the same item on the Importance Scale; i.e., the number of times the importance weight was greater than the possibility weight.

Positive Score — The sum of all positive differences when the weight applied to the item on the Possibility Scale is subtracted from the weight applied to the same item on the Importance Scale; i.e., the importance weight was greater than the possibility weight.

Total Possibility Score — Sum of all the weighted responses for items on the Possibility Scale.

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SUPPLEMENTARY

INFORMATION

AIR FORCE HUMAN RESOURCES LABORATORY
Brooks Air Force Base, Texas 78235

Errata

Number	First Author	Title
AFHRL-TR-73-19 (AD-775 714)	Guinn	Effect of an All-Volunteer Force on Input into the School of Military Sciences, Officer Training Program
D-A025851 AFHRL-TR-76-9 (AD-A025 851)	Guinn	Background and Interest Measures as Predictors of Success in Undergraduate Pilot Training
AFHRL-TR-77-36 (AD-A042 689)	Valentine	Navigator-Observer Selection Research: Development of New Air Force Officer Qualifying Test Navigator-Technical Composite
AFHRL-TR-78-33 (AD-A058 418)	Hunter	Pilot Selection System Development

Due to scoring errors which were found in the data files of the Air Force Officer Qualification Test — Forms L, M, and N, all analyses using aptitude scores derived from these test forms which are contained in the subject technical reports above are considered erroneous.

NANCY GUINN, Technical Director
Manpower and Personnel Division