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RELATIONSHIP BETWEEN AIR FORCE OFFICER QUALIFYING TEST SCORES AND SUCCESS IN AIR WEAPONS CONTROLLER TRAINING

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AIR FORCE SYSTEMS COMMAND
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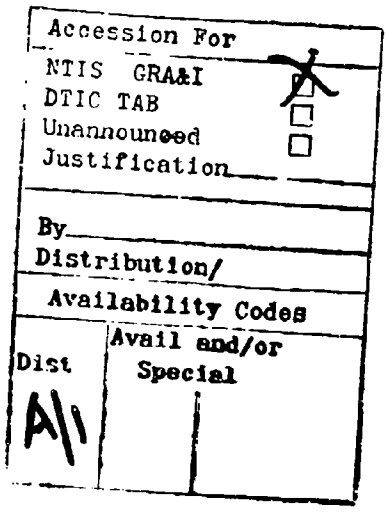

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This project investigated the relationship between Air Force Officer Qualifying Test (AFOQT) composite scores and student performance in Air Force air weapons controller training. The purpose of this study was to examine the feasibility of using AFOQT scores as one of the selection criteria for entry to the air weapons controller field. An analysis of training performance data for 968 students showed a significant positive correlation between AFOQT Academic Aptitude composite scores and successful completion of training. Thus, a range of possible minimum cutoff scores on this composite was recommended as a selection criterion. Data concerning the approximate cost of attrition rates (Fiscal Year 1982) for the five air weapons controller training organizations and the expected effects of establishing various minimum selection criteria were also presented. A separate data analysis of demographic factors, including age, and source of commission showed no consistent relationship between these variables and student performance that would be useful in establishing criteria based on these variables. The decision to use AFOQT scores as one of the selection criteria is now under management review at Air Force Headquarters.

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SUMMARY

Comments from training and operational personnel over the past few years have indicated that an unacceptably large number of air weapons controllers (AFSC 17XX) are not performing satisfactorily during training and/or in their field assignments. Over FYs 80, 81, and 82 training attrition rates in the eight air weapons controller courses have varied from 0% to 41%; the general trend was increasing attrition rates from FY 80 through FY 82.

The primary objective of this study was development of a selection strategy, based on Air Force Officer Qualifying Test (AFOQT) scores, for the air weapons controller career field. In addition, it explored performance differences attributable to background factors and documented aptitude levels of personnel currently assigned to AFSC 17XX.

Data concerning the cost of FY 82 attritions in training dollars to the air weapons controller training organizations were analyzed and presented in the report. An analysis of training performance data on 968 air weapons controller students found a significant and positive relationship between AFOQT Academic Aptitude composite scores and successful completion of training. These data were brought together in a set of analyses to show impact on training dollars lost through attrition if various cut-off scores on the Academic Aptitude of the AFOQT were employed as a prerequisite for course entry. A separate analysis of background factors, including age and source of commission, found no useful relationship between these variables and student performance.

It was recommended that the AFOQT be used as a screening device for entry into air weapons controller training.

PREFACE

This project was conducted by the Air Force Human Resources Laboratory (AFHRL) to examine the relationship between AFOQT composite scores and success in Air Force air weapons controller (Air Force Specialty Code 1741) training. It was implemented at the request of Headquarters United States Air Force (USAF/XOO). This report provides a summary of this special project (AFHRL-USAS-20-25). This project was a joint effort between the AFHRL Logistics and Human Factors Division at Wright-Patterson AFB and the AFHRL Manpower and Personnel Division at Brooks AFB.

Acknowledgements and grateful appreciation are extended to Mr. Bertram Cream and Dr. Bruce Gould of AFHRL for their managerial direction and support of this project; the military and civilian personnel at the air weapons controller training schools and operational units who gathered and recorded the relevant student data, including Mr. LaBarbera, Keesler AFB; Maj Sundstrom, Capt Granade, and Capt Lee, Tyndall AFB; Capt James and Capt Caire, Luke AFB; Maj Sheppard, Maj Dewey, and Lt Pingrey, Tinker AFB; and Maj Gardner, Langley AFB; and to Lt Col Shepherd, Maj Layton, and Maj Smith (USAF/XOORC) for their excellent support during the planning and implementation of this project. Finally, Dr. Larry Shadow of Hill AFB, Utah, provided an especially insightful review of an earlier draft of the report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

RELATIONSHIP BETWEEN AIR FORCE OFFICER QUALIFYING TEST SCORES AND SUCCESS IN AIR WEAPONS CONTROLLER TRAINING

I. INTRODUCTION

Objective

The primary objective of this study was development of a selection strategy for the air weapons controller Air Force Specialty Code (AFSC) 17XX career field based on the Air Force Officer Qualifying Test (AFOQT). At the present time, this career field has no special selection criterion. The secondary objectives were as follows:

1. To investigate relationships between AFOQT composites and various measures of training success.

2. To determine training performance differences attributable to background and bio-demographic factors.

3. To document current aptitude levels of personnel assigned to this career field.

Background

Over the past several years there has been growing concern about the need for selection criteria for personnel entering the air weapons controller (AFSC 17XX) career field. Comments from training and operational personnel during the past few years have indicated that personnel entering this career field have not been performing well either during training or in their field assignments. These concerns have been documented in several letters and reports (see Reference Note 1).

Issues

Table 1 shows the attrition rates and associated costs for the five air weapons controller training schools (eight courses) for fiscal years 1980 through 1982. As can be seen from this table, the attrition rates differ widely for each school and are not stable over the years covered. In fact, they range from a low of 0% attrition to a high of 41% attrition. However, it should be noticed that the rates generally increased for the 3 year period covered, especially for the more important courses.

The estimated FY82 attrition costs presented in Table 1 are considered to span the range from extremely conservative (per course-minimum) to liberal (per course-maximum), with the actual costs falling somewhere within this range. Of the 537 students who entered air weapons controller training programs in FY82, 88 were eliminated during training. This 16% attrition rate cost the Air Force between 2.3 and 4.6 million dollars in wasted training. Although the acceptability of this cost must be determined by HQ USAF and the Major Commands (MAJCOMs), establishment of a selection criterion for the 17XX career field appears to be warranted.

Table 1. Attrition Rates and Associated Costs for AFSC 1741 Training Programs

Course		Attrition			Estimated Attrition Costs (1982) dollars		
Tyndall AFB	FY	Elims	Trainees	Rate (%)	Per Student[a]	Per Course Minimum	Per Course Maximum[b]
1741X-000	80	20	405	5			
	81	8	241	3			
	82	28	188	15	11,782	329,896	329,896
1741A-003	80	10	131	8			
	81	16	97	16			
	82	35	86	41	27,671	968,485	968,485
1741B-000	80	14	141	10			
	81	23	120	19			
	82	12	74	16	32,921	395,052	1,059,144
					Subtotal	1,693,433	2,357,525
Tinker AFB							
E3A00C00BX	80	0	15	0			
	81	0	11	0			
	82	1	25	4	27,024	27,024	148,207
E3A00C00DX	80	1	71	1			
	81	6	80	8			
	82	11	77	14	52,387	576,257	1,909,270
E3A00C00GA	80	1	17	6			
	81	1	26	4			
	82	0	23	0	48,514	0	0
					Subtotal	603,281	2,057,477
Keesler AFB							
30LR1741D-002	80	4	36	11			
	81	3	111	3			
	82	0	23	0	4,280	0	0
Luke AFB							
1741F0L	80	1	66	2			
	81	0	54	0			
	82	1	41	2	20,512	20,512	141,695
					Total Estimated Attrition Cost (1982)	2,317,226	4,556,697

[a]Average training costs per student were reported by Headquarters Air Training Command and Headquarters Tactical Air Command. For estimation purposes, it was assumed that attrits averaged completion of half the training program. Therefore, the estimated FY82 attrition cost per student is one-half the training cost.

[b]The minimum estimated course attrition cost is the student cost multiplied by the number of attritions for the course. The maximum estimated course attrition cost includes the full cost of previous training and assumes the student was trained for a manual system (E30BP-1741-A003) and transitioned to an automatic system (1741B00).

Another major issue relevant to this career field is the level of competence of the students once they graduate from the training courses and perform their operational jobs throughout their careers. At the present time, there is no valid empirical methodology, nor adequate detailed job performance data, that can be used to correlate student performance during training with their later operational job performance. MAJCOM Standardization and Evaluation programs do provide some data concerning operational performance and are designed to ensure the operational competence of career field members. However, many factors may affect performance on these assessments, such as unit mission and tasking, training provided after formal schooling is completed, etc. Because of these factors, data from these assessments cannot be used to develop correlations between performance during training and performance in the field. Implementing an adequate selection criterion, however, can be expected to have a positive effect on the operational performance of air weapons controllers.

Headquarters USAF requested the Air Force Human Resources Laboratory to investigate the possibility of recommending minimum cutoff scores on the AFOQT as a selection criterion for entrance into this career field (see Reference Note 2). The AFOQT was chosen because it is given to all potential officers (except Air Force Academy graduates) and would not impose additional testing costs.

Related Research

Most of the previous research on selection criteria relevant to air weapons controllers has been done by the Federal Aviation Administration (FAA) for selecting Air Traffic Control Specialists (ATCSs). The FAA has experimented with various test batteries for ATCS selection since 1962. A review of the experience that the FAA has had with their various selection criteria from 1960 to 1980 can be found in Collins, Boone, and VanDeventer (1981). Other articles that describe FAA selection criteria research include Boone, VanBuskirk and Steen (1980), Cobb (1971), Cobb and Mathews (1973), Lewis (1978), and Mathews and Cobb (1974).

In one of the studies most relevant to air weapons controller selection policy, Cobb (1971) assessed the usefulness of seven previously validated, commercially available tests in predicting success in military ATCS training. Although the composite test scores predicted success somewhat better than the military aptitude screening measures in use at the time (primarily, the Air Force General Aptitude Index and the Marine Corps Military Screening and Classification Test), Cobb concluded that the military could significantly improve its selection procedures by merely raising the minimum scores required on existing military screening tests.

II. APPROACH

Method

A questionnaire was developed to acquire information on course content and duration, to identify students, and to obtain student performance data, such as academic grades, class standing, and an indication of whether or not the student completed the course. This questionnaire was sent to each of the five organizations responsible for training air weapons controllers (see Appendix). Each of these schools was asked to provide data for all students enrolled from 1 October 1979 through 1 July 1979.

Predictor data were obtained for the students identified in the questionnaires by retrieving their AFOQT scores from the AFOQT consolidated data base. The composites were Pilot, Navigator-Technical, Academic Aptitude, Verbal, and Quantitative.

The training organizations completed questionnaires on 1,465 students, or approximately 79% of all students trained during the period. To be used for data analysis, a questionnaire had to contain data on the student's course completion, and the AFOQT data base had to contain percentile scores on the student's Academic Aptitude, Verbal, and Quantitative composites. Out of the original sample of 1,465 questionnaires received from the training schools, a total of 968 (66%) remained after screening for completeness. This group constituted the sample used for the study.

Data Analysis

The data analysis consisted of generating a Pearson product-moment correlation matrix using the Bivariate Subsample Method for Missing Data (Stat Job, 1973) for the AFOQT composite scores and the performance data. The bivariate method is based on the subsample of data present for both values of a pair of variables and allows the investigator to control for missing data.

In addition, means and standard deviations for each AFOQT composite were computed, based on the total number of graduates and eliminees. Means and standard deviations were also computed for academic grade, course completion and student class rank.

III. RESULTS

AFOQT and Student Performance

One objective of this study was to determine if AFOQT scores were correlated with student performance in the five major air weapons controller training organizations. The higher the correlation, the stronger the relationship between the two variables, which results in greater accuracy of prediction. As can be seen from Table 2, there is a significant positive correlation between AFOQT composite scores and student performance for the students included in this study. The higher the level of significance (e.g., .01 is a higher level of significance than .05), the greater the chances that the obtained statistical correlation resulted from a real relationship between the variables, rather than from chance sampling error. All five of the composites were positively correlated with the performance criteria at the .01 level of significance. This level of significance leads to the reasonable assumption that the correlation did not occur by chance in the sample studied and that this composite could be used with a high level of confidence for predicting the performance of future students in these courses.

Table 2. Correlation of AFOQT Scores with AFSC 1741 Training Performance Data - Total Group Input

	AFOQT Composite							
Criteria	Pilot	Navigator-Technical	Academic Aptitude	Verbal	Quantitative	Mean	SD	N
Academic Grade	.228**	.284**	.352**	.280**	.329**	93.90	4.82	1186
Success[a]	.191**	.230**	.263**	.214**	.256**	.9154	.2885	1453
Student Class Rank	.280**	.392**	.384**	.311**	.378**	.5097	.2910	941

[a]Success was coded 0=FAIL, 1=PASS.
*Significant at .05 level.
**Significant at .01 level.

Table 2 shows that all of the AFOQT composites were able to predict student performance using the performance criteria that were chosen for this study. However, each of the composites yielded a different quantitative value. A closer examination of the data shows that the AFOQT Academic Aptitude composite had the most consistently high correlation with student performance and, thus, would be the best single predictor of student performance.

Figures 1 and 2 graphically show the relationship between the AFOQT Academic Aptitude composite and success or failure in training. As can be seen from these figures, students who failed to complete their training had lower scores on the AFOQT Academic Aptitude composite than those who completed their training. In Figure 1, the steeper slope of the attrition line below the 35th percentile shows that a higher percentage of attritions (compared to the percentage of graduates) occurred at the lower AFOQT academic aptitude scores. Figure 2 shows more specifically that, below the 35th percentile, there were more attritions than completions, while above the 60th percentile the reverse is true. There appears to be only a minimal difference in Academic Aptitude composite scores between those who failed in training and those who completed training for scores between the 35th and 60th percentiles.

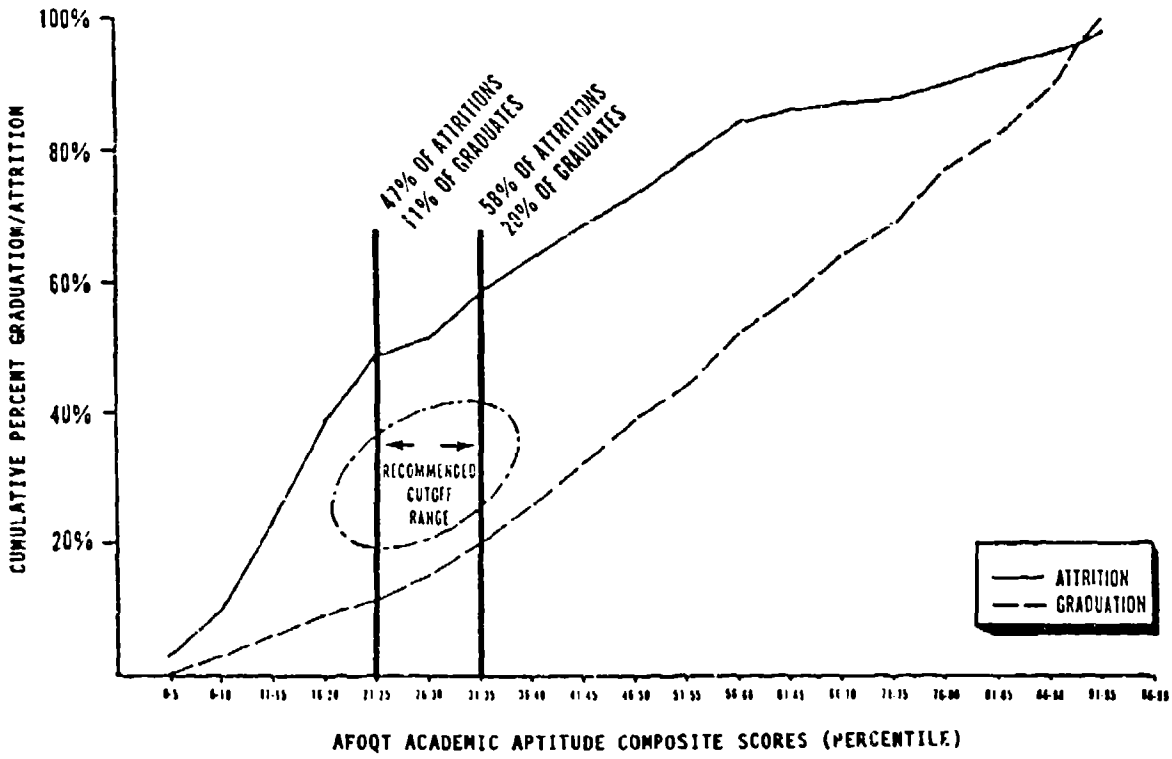

Figure 1. AFOQT academic aptitude scores and cumulative percent graduates versus attritions in AFSC 1741 training.

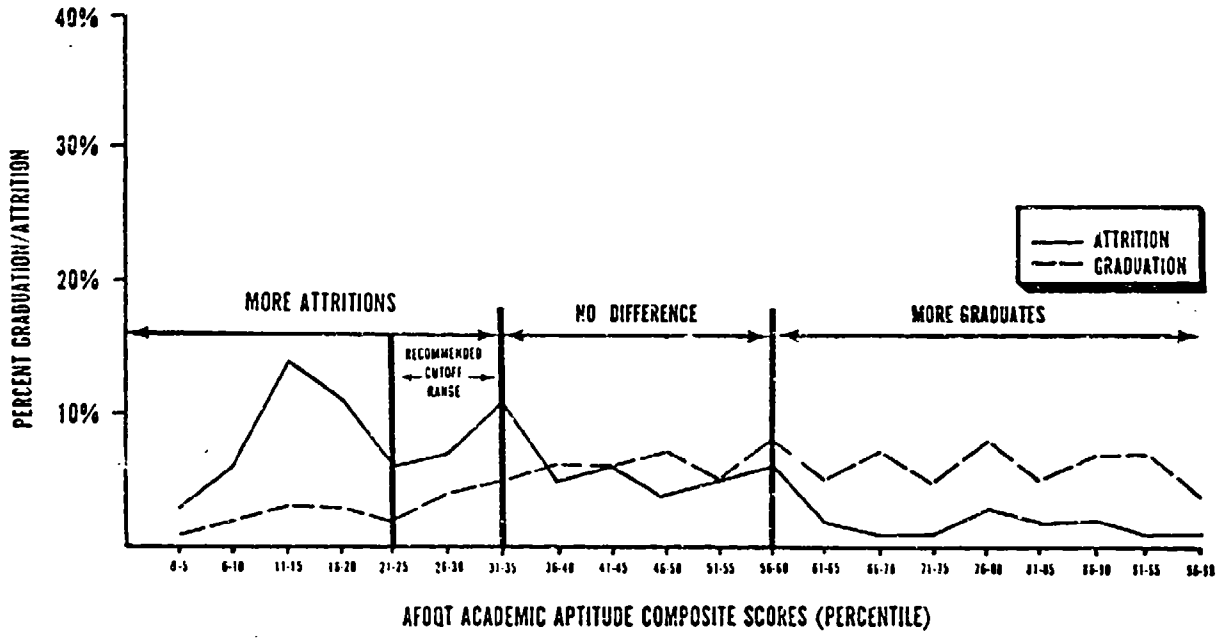

Figure 2. AFOQT academic aptitude scores and percent graduates versus attritions in AFSC 1741 training.

Tables 3 and 4 present the same data in a different format. Table 3 shows the percentages of attritions and graduations for each five percentage-point block on the Academic Aptitude composite. The change from a negative to a positive difference that occurs after the 35th percentile marks a clear choice for the upper boundary of a recommended cutoff score. Table 4 shows the cumulative percentage of successful and unsuccessful students in each five percentage-point interval. For the lower end of the composite score scale, scores between 01 and 25 accounted for 47% of the attritions, but only 11% of the graduating students; scores from 01 to 35 accounted for 58% of the attritions but only 20% of the graduating students. As this table demonstrates, the choice of a selection cutoff score is a trade-off between losing students who would have graduated from the schools had they been accepted and omitting students who would have failed had they been accepted. This issue, along with a set of recommendations concerning minimum selection criteria, will be addressed in more detail in the Discussion section.

Table 3. AFOQT Academic Aptitude Scores and Success in AFSC 1741 Training (Successive Percentile Blocks)

AFOQT Academic Aptitude Composite Score	Possible Cutoff Scores	% Graduated	% Not Graduated[a]	Difference
01-05		1	3	-2
06-10		2	6	-4
11-15		3	14	-11
16-20		3	11	-8
	Recommended Minimum Cutoff Range			
21-25	25	2	6	-4
26-30	30	4	7	-3
31-35	35	5	11	-6
36-40		6	5	+1
41-45		6	6	0
46-50		7	4	+3
51-55		5	5	0
56-60		8	6	+2
61-65		5	2	+3
66-70		7	1	+6
71-75		5	1	+4
76-80		8	3	+5
81-85		5	2	+3
86-90		7	2	+5
91-95		7	1	+6
96-99		4	1	+3

[a]Because of the rounding error involved in this calculation, this column only totals 97%. It does, however, include all of the appropriate data.

Table 4. AFOQT Academic Aptitude Scores and Success in AFSC 1741 Training (Cumulative Percentages)

AFOQT Academic Aptitude Composite Score	Possible Cutoff Scores	Cumulative % Graduated	Cumulative % Not Graduated[a]
01-05		1	3
06-10		3	10
11-15		6	23
16-20		9	34
	Recommended Minimum Cutoff Range		
21-25	25	11	40
26-30	30	15	48
31-35	35	20	59
36-40		26	64
41-45		32	70
46-50		39	74
51-55		44	80
56-60		52	86
61-65		57	88
66-70		64	89
71-75		69	90
76-80		77	94
81-85		82	96
86-90		89	98
91-95		96	99
96-99		100	100

[a]This column can be used to predict the percentage of eventual failures who would have been eliminated by a cut-off score at each successive Academic Aptitude score interval.

Demographic Factors and Student Performance

Table 5 provides the correlations between the socio-demographic variables examined in this study and student performance (see Reference Note 3). The table shows that the independent variables (age and source of commissioning) yielded different correlation values for the different criterion variables. Some were higher than others, giving different levels of statistical significance. A higher correlation indicates that the independent variable is a better predictor of the criterion variable. This means that each correlation must be evaluated in terms of its level of significance; the higher the level of significance, the greater the confidence that it would successfully predict performance in a study with future students. No significance (less than .05) for a variable indicates that it would not successfully predict performance of future students. In the present study, age was positively related to the performance criteria, but is not recommended as a selection criterion because of the difficulties inherent in recruiting older students as career field entrants and because FAA research has shown that this relationship tends to be negative after the age of 30 (Cobb & Nelson, 1974; Cobb, Young, & Rizzuti, 1976; Collins et al, 1981). Correlation of source of commission with training indicated that OTS graduates tend to pass at a higher rate than do ROTC graduates and to perform better academically.

Table 5. Correlation of Demographic Variables with AFSC 1741 Training Performance Data - Total Group Input

Criterion	Age In Years	Source of Commissioning[a]	Mean	SD	N
Academic Grade	.117	-.092*	93.90	4.82	1186
Success[b]	.160**	-.152*	.9154	.2885	1453
Student Class Rank	.030	.143**	.5099	.2910	941
Mean (Grads + Eliminees)	26.65	.630			
SD (Grads + Eliminees)	3.17	.499			
N	156	577			

*Significant at .05 level

**Significant at .01 level.

[a]Source of commission was coded: 0=OTS, 1=ROTC.

[b]Success was coded: 0=FAIL, 1=PASS.

A separate analysis was done to answer the question concerning whether students in these training programs who had previously been eliminated from undergraduate pilot training (UPT) performed as well as the students without this particular background. The obtained success rates were 91% for both groups.

Table 6 provides data concerning how well students in the air weapons controller training programs performed on the AFOQT Verbal, Quantitative, and Academic Aptitude composites, as compared to personnel in several other career fields. Although the average scores for the air weapons controller sample are somewhat lower than the scores for the other career fields listed, they are higher than those obtained for the Air Force-wide officer population. This table indicates that the 17XX career field is receiving students whose abilities are roughly comparable to those of other critical career fields. Adoption of a selection criterion such as that presented in this report would result in an increase in the average composite scores for the 17XX population. More importantly, it would lower the training program attrition rate, assuming that there were no changes in the school attrition rate policies. Whether to adopt a selection criterion for this career field can be determined only by a high-level management review and decision process aimed at a policy that would provide an adequate number of proficiently trained and operationally qualified air weapons controllers, while minimizing the attrition-related costs.

Table 6. Mean AFOQT Composite Scores - Air Weapons Controllers (AFSC 1741) vs. Other Career Fields

	N	Verbal	Quantitative	Academic Aptitude
UPT	2680	67.2	68.6	68.1
AFSC 51XX	178	62.4	62.4	67.0
UNT	787	62.4	65.5	66.5
AFSC 17XX[a]	968	60.4	49.9	56.0
AF-Wide		47.4	45.3	45.2

[a]These means are only for the 17XX students included in this study.

IV. RECOMMENDATIONS

Because of the generally high attrition rates and associated costs in the training programs for this career field, it is recommended that a minimum selection criterion, using the AFOQT Academic Aptitude composite, be implemented as soon as practical.

As Tables 3 and 4 show, the greatest gain in reducing the air weapons controller attrition rate, while minimizing the loss of potentially acceptable students, can be made by setting a minimum AFOQT Academic Aptitude composite score in the range between 25 and 35. A cutoff score of 25 on this composite should deny admission to approximately 40% of those students who would eventually fail to complete their training (and to 11% of those who might have passed), while a minimum cutoff of 35 should deny admission to approximately 59% of future failures (and to 20% of those who would likely have succeeded).

To achieve the same number of training program graduates, more potential students would have to be tested, but less would have to be enrolled. Each successively higher cutoff score up to 35 eliminates more potential attritions than potentially successful students. After that point, higher cutoff scores would either eliminate the same number of potential attritions as successful students or would actually eliminate more potentially successful students than eliminees. Thus, a cutoff score of 35 would maximize the efficiency of using the Academic Aptitude composite as a selection criterion.

The choice of a specific cut-off score from this range is an Air Force management policy decision and should be determined primarily by the need to obtain a specified minimum number of operationally qualified air weapons controllers from the number of available students. Regardless of which cutoff score is chosen, it is recommended that it be tried for a period of 18 months. The following possibilities would exist at the end of this 18-month trial period:

1. The attrition rate has been reduced to an acceptable level and the required number of new air weapons controllers is being provided by the training pipeline -- no changes in policy are required.

2. The attrition rate has been lowered to an acceptable level but insufficient numbers of new air weapons controllers are being provided -- this would require a re-examination of career field recruitment, selection, and management policy.

3. The attrition rate has not been lowered to an acceptable level -- this would require raising of the minimum cutoff scores, a larger scale research and development effort to produce a unique selection test battery for this career field, reexamination of school policies regarding acceptable levels of performance for graduation, or modification of training programs to provide remediation to students who are not able to pass through the "normal" pipeline.

Implementation of any of these choices would require a decision by Air Force Headquarters and the appropriate MAJCOM.

REFERENCE NOTES

1. The following letters and reports document concern regarding lack of specific selection criteria for the air weapons controller career field:

   Gaglio, S. S. (1981, August). Survey of S. I. A. Unpublished manuscript, 2625 Technical Training Squadron, Tyndall AFB, FL 32403-5000.

   Lee, R. J. (1981, September). Letter re: APQ student elimination, FY81. From USAF Interceptor Weapons School/TQTA to USAF Interceptor Weapons School/CC, Tyndall AFB, FL 32403-5000.

   North, J. C. (1979, May). Letter re: Minutes of AFHRL/552 AWACW meeting concerning weapons director selection study. From HQ 552D Airborne Warning and Control Wing, 552 AWACW/DOP, to meeting participants.

   Pahls, G. (1981, April). Memo for Record re: Analysis of entry level weapons controller training for FY80. USAF Interceptor Weapons School, USAF IWS/TT, Tyndall AFB, FL 32403-5000.

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2. A meeting of representatives from the training and air weapons controller career management communities and Air Force Headquarters (USAF/XOORC) was held on 29 and 30 Sep 1981 at Wright-Patterson AFB, OH. The purpose of the meeting was to consider alternative solutions to air weapons controller training cost and attrition rate issues. Four options were discussed: (a) raise performance standards (and, thereby, the attrition rates in the basic schools), to decrease downstream attrition and minimize the number of "marginal performers" who enter operational units; (b) establish minimum aptitude entrance standards; (c) use a combination of the first two alternatives; and (d) generate a Request for Personnel Research for AFHRL development of a special selection test battery for this career field. The last option involved the investigation of a psychomotor device previously developed for pilot selection, the development of experimental paper-and-pencil tests, or the development of a totally new psychomotor device. Those attending the meeting chose Option b.

3 Some of the training school representatives requested consideration of data on sex and race as possible predictors of training performance. These data were collected, but are not presented because their use as selection criteria is not feasible. Analysis of these data indicate that neither race nor sex had consistently significant correlations with training program performance.

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APPENDIX A: 17XX TRAINING ORGANIZATIONS AND COURSES

A. 3625 Technical Training Squadron, Tyndall AFB, FL (Air Training Command)

1. E30BP-1741X-000 Air Weapons Controller Fundamentals - 6-week training course for personnel initially entering the career field for later assignment to automated operational units.

2. E30BP-1741A-003 Air Weapons Controller Fundamentals Manual. 13-week course for personnel initially entering the career field for later assignment to manual operational units.

B. USAF Interceptor Weapons School, Tyndall AFB, FL (Tactical Air Command)

1741B00 -- 10-week course for students who have completed basic manual system training. Provides automatic positionally qualified (APQ) training as intermediate training for students transitioning into units with automatic equipment (SAGE/BUIC/AWACS).

C. 966 Airborne Warning and Control Squadron, Tinker AFB, OK (Tactical Air Command)

1. E3A00C00BX -- 18-week training program for AWACS Senior Directors/Mission Crew Commanders.

2. E3A00C00DX -- 24-week training program for AWACS Weapons Directors.

3. E3A00C00GX -- 19-week training program for AWACS Air Surveillance Officers.

D. 4950 Technical Training Wing, Keesler AFB, MS (Air Training Command)

30LR1741D-002 -- 8-week training program in Electronic Counter- Counter Measures (ECCM)

E. 607 Technical Training Squadron, Luke AFB, AZ (Tactical Air Command)

1741-FOL -- 7-week training program in automated 407L radar system for students being assigned to operational units with this equipment.

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