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Prediction of Success in FAA Air Traffic Control Field Training as a Function of Selection and Screening Test Performance

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16. Abstract This study compared correlations between Office of Personnel Management (OPM) selection test scores for Air Traffic Control Specialists (ATCSs) and scores from the FAA Academy's second-stage screening program with measures of field training performance. Field training performance measures were collected for 3,185 en route and 1,740 terminal ATCS developmentals. Baseline data were also collected from over 125,000 applicants who took the OPM ATCS selection battery and over 9,000 entrants to Academy programs. Separate analyses were conducted for developmentals assigned to en route centers, VFR towers, and terminal radar facilities. The Multiplex Controller Aptitude Test (MCAT) predicts field training performance better for en route developmentals than any other OPM test. MCAT is not predictive of field training performance for terminal developmentals, but scores on the Occupational Knowledge Test (OKT) are predictive. For both en route and terminal developmentals, Academy laboratory performance scores are more predictive of field training performance than are academic test scores; for developmentals at VFR towers, the average Academy block test score predicts about as well as the laboratory performance scores. Adjusting correlations for restriction in the range of scores on selection procedures revealed that while the OPM rating and the Academy course grade predict some measures of developmental training performance equally well, the Academy performance measures, particularly the laboratory performance scores, are better predictors of supervisor/OJT instructor ratings and training status than are OPM scores. It was concluded that it is not only appropriate, but also essential, that any analyses of training performance be conducted separately for developmentals in each option because of disparate relationships between predictors and criteria.

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PREDICTION OF SUCCESS IN FAA AIR TRAFFIC CONTROL FIELD TRAINING AS A FUNCTION OF SELECTION AND SCREENING TEST PERFORMANCE

C. A. Manning, P. S. Della Rocco, and K. D. Bryant

INTRODUCTION

Applicants for the job of Air Traffic Control Specialist (ATCS) in the Federal Aviation Administration (FAA) must undergo a two-stage selection process. First, they take a battery of written tests, meet medical and security qualifications, and complete an interview. If successful, they are hired. The next step is to complete a performance-based screening program. The purpose of this study is to compare correlations between measures of aptitude from both selection procedures to measures of success in field training.

The first method used to select ATCSs is the Office of Personnel Management (OPM) Air Traffic Control Specialist test battery. The battery is comprised of two aptitude tests, which determine a qualifying score, and a job knowledge test, which may add extra points to the qualifying score for those who pass the aptitude tests. The second type of selection procedure is undertaken at the FAA Academy in Oklahoma City. Applicants who pass the previously mentioned written test battery with a sufficiently high score, and pass the medical and security qualifications and the interview may be hired as FAA employees, but must successfully complete the Academy program in order to retain their positions.

Few studies have been conducted to ascertain the validity of the ATCS selection procedures. VanDeventer (1981) examined the validity of Academy programs in predicting field training attrition and supervisor ratings for developmentals who entered the Academy between 1976 and 1978. VanDeventer (1984) compared performance on the OPM ATCS selection tests with performance at the FAA Academy, but did not examine criteria based upon field training or job performance measures. Manning, Kegg, and Collins (1988) briefly discussed the relationship between Academy performance and status in field training. Other unpublished analyses examined the relationship between Academy component scores and field training status, but to date, no studies have been conducted which 1) correlate OPM ATCS selection test performance with measures of performance in field training, or 2) examine field training performance criterion measures other than training status and supervisor ratings. This study correlated measures obtained from both selection procedures with several measures of performance in ATCS field training. These analyses are important because they allow the FAA to evaluate the validity of its selection procedures.

METHOD

Measures included in the study.

OPM Battery. The OPM ATCS test battery is comprised of the Multiplex Controller Aptitude Test, the Abstract Reasoning Test, and the Occupational Knowledge Test. The Multiplex Controller Aptitude Test (MCAT) is a timed test that requires the applicant to combine visually presented information about the location and direction of flight of several aircraft with tabular data about their altitude and speed. The applicant must decide whether any aircraft in the problem will conflict with another by examining the information and computing time-distance functions to answer the questions. While the applicants included in this study received two scores for their MCAT performance (MCATA and MCATB), in this study, MCAT performance is reported as a single score: the sum of the two part scores (MCAT). The Abstract Reasoning Test (ABSR) is a civil service examination (OPM-157) that contains questions about relationships between symbols and relationships between letters. The Occupational Knowledge Test (OKT) is a job knowledge test that contains items related to air traffic control phraseology and procedures.

The MCAT comprises 80% of the initial qualifying score for the OPM battery, while the ABSR comprises 20%. After these weights are applied to the raw scores for each test, the resulting score is transmuted so that it becomes a part of a distribution having a mean of 70 and a maximum of 100. If the resulting Transmuted Composite score (TMC) is less than 70, the applicant is eliminated from further consideration. If, however, the applicant earns a TMC of 70 or above, he or she may receive up to 15 extra credit points (up to a maximum score of 100) based upon the score earned on the OKT. Up to 10 extra credit points (up to a maximum score of 110) may also be added based on veteran's preference. The sum of the TMC and all earned extra credit points is the OPM Rating (RAT).

The version of the OPM ATCS battery that includes the MCAT was implemented in September 1981, just after the Air Traffic Controller strike. For some time after the strike, applicants were selected on the basis of their performance on either the old battery (comprised of five Civil Service tests and containing no job knowledge test) or the new battery containing the MCAT. In October 1985, changes were made 1) to replace the versions used, 2) in the procedures for administering the MCAT, and 3) in the eligibility requirements for retesting. This study includes data from applicants who took the version of the OPM ATCS battery containing the MCAT, but excludes data from those applicants who took the more recent revised test battery.

Academy program. The Academy program is a selection procedure which serves as a second-stage screen for those successfully completing the initial selection requirements. The aptitude composition of the OPM ATCS test battery is necessarily limited because it is administered to tens of thousands of applicants. On the other hand, the measures used in the Academy program can be more job-related, as well as lengthy, because they are administered to fewer people. The purpose of the Academy program is to

evaluate the ability of a student to apply a set of procedures in an appropriate manner for the nonradar control of air traffic. The program includes several academic tests, six laboratory problems, and a Controller Skills Test.

The six laboratory problems, each one-half hour in length, require the student to apply the principles of air traffic control learned during the academic parts of the course to situations in which simulated aircraft move through a synthetic airspace. The performance of students is evaluated by certified instructors who formerly controlled air traffic. The grading instructors assign both a Technical Assessment (based on observable errors made) and an Instructor Assessment (based on the instructor's rating of the student's potential). These assessment scores are averaged to yield the laboratory score for a single problem.

The Controller Skills Test (CST) measures the application of air traffic control principles to resolve air traffic situations in a paper-and-pencil format. The composite score in the program is based on a weighted sum of the Block Average (BA; average of the academic block tests), the Comprehensive Phase Test (CPT); a comprehensive test covering all academic material), the Lab Average (AVL5); the average score on the best 5 of the six graded laboratory problems), and the Controller Skills Test (CST). A composite grade of 70 is required to pass.

From 1976-1985, the second stage screening process was conducted in two parts: the En Route Initial Qualification Training program and the Terminal Initial Qualification Training program. Each program addressed the application of nonradar procedures in a different type of airspace. Academy entrants were assigned to one or the other of the programs on a more or less random basis (no information about their aptitude, as measured by OPM rating, was used to make the "option" assignment).

For both the En Route and Terminal programs, the same weights were applied to the program components to yield the composite score (NLCOMP): 2% for the Block Average, 8% for the Comprehensive Phase Test, 65% for the Lab Average, and 25% for the CST. Those who successfully completed either the En Route or Terminal program went to a facility in the corresponding option. Those who did not successfully complete the program were separated from the GS-2152 job series.

In 1985, the two programs were combined into one, the ATCS Screening program. The purpose of the single program was to allow facility assignments to be based, when possible, upon the grade earned in the program. Although the screen program contains the same lessons, and the same or comparable tests and laboratory problems as those in the En Route program, it was necessary to change the weights applied to the component scores of the screen program to maintain the average pass rate obtained in the combination of the En Route and Terminal programs.

Because these programs differed considerably, and because many of the graduates of the recently implemented screen program have not yet completed their training, this study addresses only entrants and graduates of the En

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Route and Terminal programs, and excludes those in the screen. The performance of students from the En Route and Terminal programs will be examined separately.

Field training. After passing one of the Academy programs, successful students (now called developmentals) move to a field facility and begin field training. Facilities differ according to the amount and type of air traffic they control; thus, the amount and type of training undertaken by developmentals is dependent on the type of facility to which they are assigned. Because of the differences between the jobs performed by the different facilities, it was necessary to analyze the measures separately according to the type of facility providing the training.

The measures of field training performance included in this study are final disposition in field training at the first facility, variables reflecting success rates in specific phases of training (particularly those phases in which the developmental is taking on-the-job training), times to complete training phases, times to attain full performance level (FPL) status, and subjective performance ratings. Field training disposition was obtained by comparing automated personnel records with records of field training completions.

The field training performance variables (success rates, times to complete training phases) were obtained from FAA training phase completion reports that include information for each phase of qualification training completed by a developmental. Each report contains start and completion dates and a grade. Training times were computed by calculating the time between the start and completion of a phase.

Subjective performance ratings were provided by the ATCS supervisor or an OJT instructor on the phase completion report submitted at the completion of each training phase. Each subjective performance rating is a global assessment of a developmental's performance in a stage of training as compared with other developmentals. The global rating was used because an unpublished study expanding VanDeventer's (1981) results suggested that a global rating was predicted as well by the Academy program components as were other ratings addressing more specific aspects of performance.

Subjects. Three sets of analyses were conducted. The first set addresses the performance of applicants between 1981 and 1985 who took the version of the OPM ATCS test battery that contained the MCAT but did not contain the revised versions, testing procedures, or eligibility requirements. Data from these applicants were employed because the group of Academy entrants examined in this study applied during this time. The group of ATCS applicants consisted of 127,807 applicants who took the tests for the first time between September 1981 and September 1985.

The second set of analyses addresses Academy performance. The total population of Academy entrants from August 1981 to September 1985 consisted of 13,533 entrants. These were divided into three groups: 8,536 En Route and 4,997 Terminal entrants. Data were eliminated from the sample for entrants who repeated a program (although data for their first entry were

retained), for entrants who came from special emphasis programs and took the OPM ATCS test battery noncompetitively and for other entrants for whom no OPM scores were available.

The third set of analyses addresses field training performance. The sample of developmentals for which field training records were analyzed consisted of those from the group above who successfully completed one of the Academy programs. In order to obtain this sample, those entering directly into field training and bypassing the Academy program, those entering field training twice after repeating the Academy program, those entering the flight service station program as their first ATCS specialty, and those leaving field training for reasons unrelated to performance were eliminated from the sample of developmentals taking field training between August 1981 and January 1989.

Additional developmentals were eliminated from the sample because of the type of facility to which they were assigned. The level of complexity (though not the amount) of the traffic controlled by most en route facilities is fairly similar. On the other hand, the type, amount, and complexity of the traffic handled by the terminal facilities differs considerably. A relatively low number of Academy graduates enter certain types of facilities, e.g., level 1 en route centers and nonradar towers (because of the small number of facilities and employees staffing them) and level 5 terminal facilities (because many regions are reluctant to send new hires to the most complex terminal facilities).

Consequently, for the purpose of this study, the analyses of field training data were limited to developmentals entering level 2-3 en route centers (excluding Anchorage Center, which recently became a level 2 center), VFR towers, and level 2-4 terminal radar facilities. After training records were eliminated because of the restrictions discussed above, 4925 developmental records were available for analysis (3185 were for en route developmentals and 1740 were for terminal developmentals).

RESULTS

Applicants' OPM ATCS battery performance.

Table 1
Mean scores on OPM ATCS battery component tests
for all Sept 1981 - Sept 1985 applicants
N=127,807

Measure	Mean	Std. Dev.
MCAT	69.7	16.1
ABSR	30.5	9.5
OKT	28.8	11.3
TMC	73.1	12.2
RAT	74.1	13.1

Table 1 shows means and standard deviations for the component scores of all applicants who took the OPM ATCS battery between September 1981 and October 1985. No information is available regarding the demographic characteristics of the population of test-takers. Data for subsequent testing sessions were excluded from this analysis for applicants who repeated the testing process. The performance of these applicants was examined to serve as a baseline against which the performance of Academy entrants can be compared later in the study. Data were also provided to correct correlations between OPM component scores and Academy and field training performance for restriction in the range of scores caused by selection of only applicants with qualifying scores.

Performance of Academy entrants.

Table 2
Mean scores on OPM ATCS battery component tests
August 1981 - September 1985 En Route and Terminal entrants

	En Route			Terminal		
Measure	Mean	Std. Dev.	N	Mean	Std. Dev.	N
MCAT	90.0	7.1	5993	88.5	7.3	3095
ABSR	39.8	5.9	5993	39.1	6.3	3095
OKT	36.2	12.9	5996	39.4	13.4	3095
TMC	88.9	5.2	6006	87.7	5.4	3097
RAT	91.6	5.0	6035	91.4	5.1	3103

OPM ATCS Battery scores. Table 2 shows means and standard deviations of OPM component scores for Academy entrants by the type of program entered. While 70 is the minimum score for qualification, most regions, when possible, select only applicants having OPM ratings of 90 or above. The regions' preferences for selecting high scorers are evident from examining the table.

Table 3
Mean scores for Academy performance measures
August 1981 - September 1985 Academy entrants

	En Route			Terminal		
Measure	Mean	Std. Dev.	N	Mean	Std. Dev.	N
NLBA	92.4	9.5	5772	94.5	3.9	2992
NLCPT	91.1	6.6	5761	84.6	8.9	2990
AVL5	66.1	13.8	5444	70.9	13.3	2940
AVIA	77.7	11.3	5554	74.1	11.1	2988
AVTA	45.5	16.7	5554	54.9	17.0	2988
NLCST	76.1	12.4	5440	76.5	12.9	2941
NLCOMP	71.2	11.5	5429	73.9	11.1	2937

Academy performance measures. Table 3 shows means and standard deviations of the Academy performance measures for entrants from the En

Route and Terminal programs for those taking the OPM ATCS test battery. Because the En Route and Terminal programs were comprised of different lessons, tests, and laboratory problems, it is not appropriate to compare the performance measures from those two programs.

Note from examining the tables that the academic portions of the programs (block average, NLBA; comprehensive phase test, NLCPT) are considerably easier than the performance-based laboratory problems. The average instructor assessment (AVIA), the average of the instructor assessments made for individual laboratory problems, compensates for the low technical scores (AVTA, which is the average of the technical assessments made for individual laboratory problems). The Controller Skills test (NLCST) combines the application of nonradar procedures with the objective format of a paper-and-pencil test. The data show that, regardless of option, this test is more difficult for students than the other, more traditional, academic tests included in the programs.

Table 4
Correlations* between Academy and OPM battery component scores
En Route entrants 1981-1985
(N=5298)

Measure	MCAT	ABSR	OKT	TMC	RAT
NLBA	.16	.12	.15	.18	.19
NLCPT	.15	.09	.22	.17	.24
AVL5	.26	.15	.12	.28	.22
AVIA	.26	.14	.12	.28	.23
AVTA	.25	.15	.14	.27	.22
NLCST	.28	.21	.16	.32	.28
NLCOMP	.28	.18	.15	.31	.26

*All correlations were significantly different from 0 at $p < .01$.

Table 5
Correlations* between Academy and OPM battery component scores
Terminal entrants 1981-1985
(N=2930)

Measure	MCAT	ABSR	OKT	TMC	RAT
NLBA	.08	.05	.31	.08	.16
NLCPT	-.02*	.02*	.31	-.01*	.07
AVL5	.23	.11	.16	.24	.20
AVIA	.22	.10	.16	.23	.19
AVTA	.22	.12	.18	.23	.21
NLCST	.20	.15	.24	.22	.25
NLCOMP	.24	.13	.22	.25	.23

* Correlations are <u>not</u> significant at $p < .01$.

Correlations between Academy and OPM ATCS battery scores. Tables 4 and 5 show correlations between OPM ATCS battery components and Academy performance measures for the En Route and Terminal programs. All correlations, except those starred, are statistically significant at the .01 level.

Examination of the tables shows that the MCAT is more predictive of performance-based measures like the labs, CST, and consequently, the overall course grade, than the academic components.

Correlations between the Abstract Reasoning Test (ABSR) and the Academy components scores are lower than for the MCAT. The ABSR is most predictive of scores on the Controller Skills Test (CST) for both programs, though the correlation is lower, in general, with components of the Terminal program. The ABSR has lower correlations with the course grade than any other component of the OPM rating.

While most other components have higher correlations with measures from the En Route program than measures from the Terminal program, the Occupational Knowledge Test (OKT) has higher correlations with measures from the Terminal program. In general, the OKT is more predictive of academic performance measures (block average, NLBA; comprehensive phase test, NLCPT; and NLCST) than laboratory performance measures. Also, the OKT score has a higher correlation with the Terminal course grade (r=.22) than the En Route course grade (r=.15).

In examining the relative predictability of the Transmuted Composite score (TMC) as compared with the OPM rating (RAT), it appears that the TMC is more predictive of the lab scores and the course grade than the RAT. However, the RAT is more predictive of academic test performance than the TMC. Overall, TMC is the highest predictor of course grade, although the magnitude of the correlation is higher for the En Route than for the Terminal program.

Table 6
Correlations between Academy and OPM battery component scores
Adjusted for restriction in the range of OPM scores
En Route program

Measure	MCAT	ABSR	OKT	TMC	RAT
NLBA	.35	.19	.13	.40	.45
NLCPT	.33	.14	.19	.38	.54
AVL5	.51	.24	.11	.57	.51
AVIA	.52	.22	.11	.57	.53
AVTA	.51	.24	.12	.55	.51
NLCST	.55	.33	.14	.62	.61
NLCOMP	.55	.28	.13	.61	.58

Table 7
Correlations between Academy and OPM battery component scores
Adjusted for restriction in the range of OPM scores
Terminal program

Measure	MCAT	ABSR	OKT	TMC	RAT
NLBA	.17	.08	.27	.13	.38
NLCPT	-.04	.03	.27	-.02	.18
AVL5	.46	.17	.14	.49	.46
AVIA	.45	.15	.14	.47	.45
AVTA	.45	.18	.15	.47	.48
NLCST	.41	.22	.20	.45	.55
NLCOMP	.48	.19	.19	.50	.52

Tables 6 and 7 show the correlations between Academy and OPM component scores adjusted for restriction in range resulting from selecting entrants for the Academy from applicants with high OPM scores. Thorndyke's (1949) formula was used to calculate the adjustment for restriction in range. Adjusting the correlations between the MCAT, TMC, and RAT and the Academy components for restriction in range resulted in considerably higher correlations than those displayed in Tables 4 and 5. However, the correlation between the ABSR and Academy scores increased only slightly and the correlation between the OKT and Academy scores was reduced (because the standard deviation of OKT scores was not reduced by the selection process).

En route field training performance.

The differences between the type of services provided by en route and terminal facilities and the corresponding differences in the types of training provided to developmentals requires their training data to be analyzed separately. Consequently, the analyses of training performance measures will be conducted separately for each option and type of facility; first for en route developmentals, then for developmentals assigned to VFR towers, and finally for developmentals assigned to terminal radar facilities.

OPM and Academy performance scores for en route developmentals. Table 8 shows mean OPM ATCS battery and En Route Academy scores for developmentals assigned to en route facilities. Data were excluded from analyses of en route developmentals for those assigned to level 1 en route facilities or Anchorage Center.

Table 8
Mean OPM ATCS Battery and Academy performance measures
for Academy graduates at level 2-3 en route centers

Measure	Mean	Std. Dev.	N
OPM components			
MCAT	91.6	6.6	3002
ABSR	40.6	5.8	3002
OKT	37.5	13.3	3004
TMC	90.2	4.8	3006
RAT	92.6	4.9	3017
Academy components			
NLBA	95.2	5.3	3063
NLCPT	93.0	5.3	3063
AVL5	75.0	7.4	3063
AVIA	84.8	5.6	3063
AVTA	56.2	10.9	3063
NLCST	82.4	7.1	3063
NLCOMP	78.7	5.5	3063

En route field training performance measures. Tables 9-10 show field training performance measures for trainees entering level 2-3 en route centers. Total numbers and percentages of developmentals in each category are shown for discrete variables; means and standard deviations are shown for continuous variables.

Table 9
Field training phase completions for developmentals
at level 2-3 en route centers

Phase	Total N	% Pass	% Didn't Pass
V	3040	99.4	0.6
VI	3007	99.9	0.1
VII	2966	99.3	0.7
VIII	2928	87.9	12.1
IX	2560	93.4	6.6
X	2297	96.9	3.1
XI	2252	98.0	2.0
XII	2187	93.2	6.8
XIII	1937	97.8	2.2

Table 9 shows field training phase completions for developmentals in the sample. A comparison of the pass rates in the training phases shows that the most difficult phases are VIII, IX, and XII. (Phase VIII is the Radar-associated/Nonradar simulation phase; phase IX is the first OJT phase for Radar-associated/Nonradar duties; phase XII is the first OJT phase for radar duties). Phases V, VI, VII, and XI have virtually no failures; phases V and VII involve only academic training; phase VI consists of OJT on the assistant controller position. Phase XI is an academic/simulation phase for radar training which repeats much of the material covered in the Academy's radar training course, but is applied to the facility's specific airspace.

Because virtually all developmentals passed these phases and the academic phases have consistent training times, almost no variability can be observed in measures of training performance for these phases. Consequently, the measures of performance for phases V, VI, VII, and XI were excluded from further analysis.

It may also be noted by examining Table 9 that the total number of developmentals completing phase X is lower than the number completing phase XI; a new type of training (conducted on an experimental basis from 1986 until 1988, then implemented for all facilities as a optional track of training) has resequenced training so that phase X is not required to be completed until after phase XII.

Table 10
Continuous measures of field training performance for developmentals at level 2-3 en route centers

Measure	Mean	Std. Dev.	N
Radar-associated/Nonradar:			
Time in Ph IX	72.7	49.4	2529
Hrs in Ph IX	125.7	58.6	2532
Time in Ph X	131.5	111.5	2272
Hrs in Ph X	137.4	89.1	2268
Adj time in X	33.9	35.0	1859
Adj hrs in X	34.7	30.5	1867
Mean IPRA	4.0	0.6	2063
Radar:			
Time in Ph XII	90.9	60.2	2159
Hrs in Ph XII	141.1	59.8	2157
Time in Ph XIII	160.5	119.6	1929
Hrs in Ph XIII	161.1	94.4	1927
Adj time in XIII	41.4	34.6	1479
Adj hrs in XIII	40.3	27.3	1478
Mean IPRD	4.2	0.6	1695
Time to FPL (yrs)	3.0	0.6	1894

In Table 10, training times (e.g., time in phase IX) are the number of calendar days occurring between the beginning and the completion of a phase of training. The number of hours in a phase is the actual number of hours of on-the-job training (OJT) taken during the phase. Not all en route phases require OJT, but OJT phases are most frequently represented in these analyses (for reasons discussed above). Because the areas of specialization to which developmentals are assigned have varying numbers of sectors of airspace (usually ranging between 5 and 8), it was necessary to adjust the total times spent in certain training phases for the number of sectors in the area of specialization. In Table 10, adjusted time is the total number of calendar days in the phase divided by the number of sectors on which the developmental trained during that phase. The result is the average number of days per sector.

Similarly, the adjusted number of hours in a phase is the total number of hours divided by the number of sectors on which the developmental trained, yielding the average number of OJT hours per sector. This computation is necessary for only phases X and XIII in the en route option; phases IX and XII both encompass training for the first two sectors in the area of specialization (for the Radar-associated/Nonradar and radar positions, respectively) and no adjustment is required.

The indication of performance (IP) is the subjective performance rating made by a supervisor or OJT instructor. The rater evaluates the developmental's performance as compared with all other developmentals he or she ever observed in training in a specific phase. IPs are assigned for each phase of field training. The scale for an IP ranges from 1 (in the bottom 10% of all controllers observed in training in this phase) to 6 (in the top 10% of all controllers observed in training in this phase). For the purpose of these analyses, the IPs for the Radar-associated/Nonradar phases (VIII, IX, and X) were averaged to produce the IPRA variable and the IPs for the radar phases (XI, XII, and XIII) were averaged to produce the variable IPRD.

The data represented in Table 10 suggest that developmentals do not spend all of their time in training. The number of days in training encompasses calendar days and not work days; the average amount of time spent in the first OJT phase is less than 3 hours per day (2.8 hours in phase IX, the first phase of Radar-associated/Nonradar OJT, and 2.6 hours in phase XII the first phase of radar OJT). For subsequent OJT phases, training time is about 2 hours or less per day (2.1 hours in phase X, the phase reflecting OJT on the remainder of the Radar-associated/Nonradar sectors, and 1.8 hours in phase XIII, the phase reflecting OJT on the remainder of the radar sectors). The data in Table 10 also suggest that it takes longer for developmentals to complete radar OJT than nonradar.

Table 11
Discrete field training performance measures for developmentals at level 2-3 en route centers

I. Stage in training at which failure occurred

Total N	% Didn't Fail	% Failed Radar	% Failed Rad Assoc	% Failed Asst Cont
3063	71.5	7.7	20.1	0.8

(N missing=8)

II. Status in training

Total N	% Orig Option	% Switched Options	% Separated
3185	69.0	15.0	16.0

(N missing=0)

The results represented in Table 11 describe the stage in training at which failure occurred, and the final status in training for each

developmental. The variable describing the stage in training at which failure occurred is based upon data regarding phase completions, while the variable describing status in training is based upon personnel records describing reassignments, separations, etc. Section I includes categorical variables describing training status; the categories included as a part of the "stage in training" variable are: whether failure occurred at all, occurred during radar, Radar-associated/Nonradar, or assistant controller phases of training. This categorization is an ordinal scale measuring degree of success in specific phases of training, because those failing radar training (during phases XI, XII, or XIII) successfully completed all earlier phases, while those failing radar associate training (VIII, IX, or X) and those who failed Assistant Controller training (V, VI, or VII) failed during the earlier and earliest stages of training, respectively.

Section II of Table 11 describes status in training. The categories represent the final disposition in training at the first facility. ATCSs are categorized as remaining in the en route option (as FPL, still in training, or as a transfer to another en route facility before reaching FPL at the first en route facility), switching options (which usually occurs as a result of failure), and failing (and separating from the ATCS occupation). As mentioned above, those leaving for reasons unrelated to failure were excluded from all analyses. Again, this categorization is an ordinal scale where remaining in the original option is considered more desirable than switching options and switching options is considered more desirable than separating from the occupation. Switching options before reaching FPL status in the original option is considered less desirable than remaining in the en route option because most switches from the en route option occur as a result of failure, generally with involve a reduction in grade, and usually with a lower maximum grade than the GS-14 allowed at level 3 centers.

The percentage of developmentals in I categorized as "not failing" is slightly higher than the percentage of developmentals categorized as part of the original option in II. The reason for this is that not all failures or option switches are reported with phase completions. Recall that the loss rates reported in this table should not be interpreted as representing occupational losses, because those leaving for reasons unrelated to failure (about 4% of the total, on the average), were excluded from all analyses along with other developmentals entering the system through pre-Academy special training programs or entering the system noncompetitively.

Correlations between selection procedures and measures of field training performance for en route developmentals. Table 12 shows intercorrelations between the continuous measures of field training performance. The variables based on time to complete training are expected to have positive correlations with each other if the time required to finish training on one sector is related to the time required to complete training on another sector. Variables based on time to complete training are expected to have negative correlations with Indication of Performance variables (IPRA and IPRD) if learning to control air traffic within a sector quickly is considered desirable by supervisors and OJT instructors. The correlations in Table 12 suggest that 1) the correlations between days and

hours required to complete training within any given phase are lower than might be expected (probably due to operational constraints of the facilities), 2) the measures of training completion times for phases involving taking OJT on the first two sectors in the area of specialization (phases IX and XII) are more highly correlated with other training performance measures (both based upon training times for other phases and on supervisor/OJT instructor ratings) than are measures of training completion times in subsequent OJT phases (X and XIII), even though the latter measures were adjusted for the number of sectors on which the developmental trained, and 3) the indication of performance variables (IPRA and IPRD) have fairly high correlations with most of the other training performance measures, even though they are based upon assessments likely to be independent of training time.

Table 12
Intercorrelations* between measures of field training performance
for 1981-1985 En Route Academy graduates
N=(1143)

Measure	Days9	Hrs9	ADays10	Ahrs10	IPRA	Days12	Hrs12	Adays13	Ahrs13	IPRD	Cert
Days9	1.0	.50	.26	.20	-.24	.39	.31	.20	.28	-.18	.28
Hrs9		1.0	.16	.30	-.22	.29	.44	-.01*	.23	-.16	.06*
Adays10			1.0	.38	-.07	.28	.23	.18	.20	-.07	.23
Ahrs10				1.0	-.04*	.20	.32	.06*	.27	-.03*	.13
IPRA					1.0	-.20	-.23	-.06*	-.12	.36	-.22
Days12						*1.0*	*.51*	*.30*	*.25*	*-.31*	*.34*
Hrs12							1.0	.09	.42	-.28	.18
Adays13								1.0	.54	-.17	.42
Ahrs13									1.0	-.16	.27
IPRD										1.0	-.20

*Correlations are not significantly different from 0 at $p < .01$.

Also computed were Spearman Rank correlations among the categorical measures of training success and between the categorical variables and the continuous variables. It was found that the correlation between Training Status and Stage in Training at which failure occurred is .88. Spearman Rank correlations computed between the categorical variables and the continuous variables resulted in significant positive correlations with only the Indication of Performance measures [r(status,IPRA)=-.16, $p < .01$; r(stage, IPRA)=-.16, $p < .01$; r(status,IPRD)= -.12, $p < .01$; and r(stage,IPRD)=-.11, $p < .01$.] All other correlations with the categorical measures are nonsignificant, except for a significant correlation with the number of OJT hours required to complete phase XII [r(status,Hrs12)=.07, $p < .01$; r(stage,Hrs12)=.08, $p < .11$.]

Table 13 contains correlations between OPM ATCS battery scores and measures of field training performance at the en route centers. It was expected that the OPM components would have positive correlations with the IPs, and negative correlations with measures of training times and training status. However, most correlations between OPM component tests and field

training performance measures are not significantly different from 0.

Notable exceptions are the correlations between the MCAT and certain measures of field training performance. The MCAT is significantly correlated with the ordinal measures of status in training and stage of training in which failure occurred. However, some of the significant correlations between the MCAT and times to complete training are in an unanticipated direction from that predicted. For example, the correlations between the MCAT (and consequently, the TMC and the RAT) and times and hours to complete training in phases X and XII are positive. Other correlations between the MCAT and times to complete training are positive, but not significantly different from 0. Correlations between the MCAT and the mean IP measures are both significant and positive (as expected). However, while some correlations are significantly different from 0, less than 3 percent of the variance in the measures of training performance is accounted for by the OPM scores.

Table 13
Correlations* between OPM ATCS battery scores
and measures of field training performance
for 1981-1985 En Route Academy graduates

Measure	MCAT	ABSR	OKT	TMC	RAT
Spearman Rank correlations					
Training status (N=2992)					
Status	-.12*	.03	.00	-.10*	-.05*
When failed	-.12*	.03	.00	-.09*	-.05*
Pearson correlations					
Radar-associated/Nonradar training (N=1669)					
Time for Phase IX	.04	.04	.01	.04	.06*
Adj Time Phase X	.07*	.03	.03	.07*	.09*
Hrs for Phase IX	.05	.04	.01	.06*	.07*
Adj hrs Phase X	.11*	.04	.03	.11*	.13*
Mean IP Ph VIII-X	.11*	.03	.08*	.10*	.10*
Radar training (N=1131):					
Time for Phase XII	.05	.03	.00	.05	.04
Adj time Phase XIII	-.05	-.01	-.03	-.05	-.08*
Hrs for Phase XII	.08*	.09*	.00	.10*	.10*
Adj hrs Phase XIII	.04	.04	.03	.05	.06
Mean IP Ph XI-XIII	.11*	.01	.04	.10*	.10*
Time to FPL	-.11*	-.02	-.11*	-.10*	-.15*

*Significantly different from 0 at $p < .01$.

Table 14 shows correlations between Academy component scores (and course grade) and measures of field training performance. In general, the laboratory component scores are more predictive of the field training performance measures than are the academic components. The highest correlations are between Academy component scores and the OJT instructor/supervisor ratings (IPRA and IPRD), and the variables regarding status in training and the stage at which failure occurred. The correlation

between Academy component scores and the time required to attain FPL status is higher than the correlation with other temporal measures of training performance.

With regard to Tables 13 and 14, the degree to which the predictors correlated with the measures of field training performance depends on the criterion measure examined. The variables describing training status (status in training and stage of training at which failure occurred) along with the Indication of Performance variables are more highly correlated with the predictor variables than are the measures based on time, although the same patterns of predictor-criterion relationships are present for the temporal variables.

Table 14
Correlations* between Academy component scores
and measures of field training performance
for 1981-1985 En Route Academy graduates

Measure	NLBA	NLCPT	AVL5	AVIA	AVTA	NLCST	NLCOMP
Spearman Rank correlations							
Training Status (N=2992)							
Status	-.05*	-.04	-.24*	-.25*	-.22*	-.08*	-.24*
When failed	-.05*	-.04*	-.22*	-.24*	-.20*	-.08*	-.22*
Pearson correlations							
Radar-associated/Nonradar training (N=1669)							
Time for Phase IX	-.04	-.05	-.11	-.09*	-.11*	.00	-.10*
Adj Time Phase X	-.02	-.04	-.07*	-.04	-.08*	.00	-.07*
Hrs for Phase IX	.02	.00	-.06*	-.04	-.06*	-.02	-.06*
Adj hrs Phase X	.00	-.02	-.03	-.02	-.02	.03	-.01
Mean IPRA	.12*	.06*	.23*	.24*	.22*	.11*	.24*
Radar training (N=1131):							
Time for Phase XII	-.05	-.02	-.13*	-.12*	-.13*	-.08*	-.14*
Adj time Phase XIII	*-.03*	*-.06*	*-.11**	*-.08**	*-.11**	*-.07*	*-.12**
Hrs for Phase XII	-.03	.04	-.12*	-.08*	-.12*	.00	-.10*
Adj hrs Phase XIII	.02	.00	-.11*	-.08*	-.11*	.00	-.10*
Mean IPRD	.18*	.04	.24*	.23*	.24*	.07*	.24*
Time to FPL	-.09*	-.10*	-.16*	-.13*	-.18*	-.09*	-.18*

*Significantly different from 0 at $p < .01$.

Tables 15 and 16 show the correlations of OPM and Academy component scores with measures of field training performance, adjusted for restriction in range. Table 15 contains correlations adjusting for the restriction in the range of the OPM scores and Table 16 contains correlations adjusting for the restriction in the range of Academy scores. When corrected for restriction in range, RAT predicts time to attain FPL status as well as does NLCOMP, but NLCOMP predicts the supervisor/OJT instructor ratings (IPRA and IPRD) and training status considerably better than does the RAT. Other correlations between the temporal performance measures and the RAT are higher than corresponding correlations with NLCOMP, but are not in the predicted direction. MCAT and TMC predict training status better than does the RAT, which is influenced by points earned on the OKT and Veteran's Preference points, but RAT predicts other measures of field training performance better than does the TMC. While the uncorrected technical assessment (AVTA) predicts training status as well as does the instructor assessment (AVIA), correcting the correlations for restriction in range produced a considerably higher correlation between AVIA and training status.

Table 15
Correlations between OPM ATCS battery scores
and measures of field training performance
for 1981-1985 En Route Academy graduates
(adjusted for restriction in the range of OPM scores)

Measure	MCAT	ABSR	OKT	TMC	RAT
Training Status (N=2992)					
Status	-.28	.05	.00	-.25	-.13
When failed	-.28	.05	.00	-.22	-.13
Radar-associated/Nonradar training (N=1669):					
Time for Phase IX	.10	.07	.01	.10	.16
Adj Time Phase X	.17	.05	.03	.18	.24
Hrs for Phase IX	.12	.07	.01	.15	.18
Adj hrs Phase X	.26	.07	.03	.27	.33
Mean IP Ph VIII-X	.26	.05	.07	.25	.26
Radar training (N=1137):					
Time for Phase XII	.12	.05	.00	.13	.11
Adj time Phase XIII	-.12	-.02	-.03	-.13	-.21
Hrs for Phase XII	.19	.15	.00	.25	.26
Adj hrs Phase XIII	.10	.07	.03	.13	.16
Mean IP Ph XI-XIII	.26	.02	.03	.25	.26
Time to FPL	-.26	-.03	-.09	-.25	-.38

Table 16
Correlations between Academy component scores
and measures of field training performance
for 1981-1985 En Route Academy graduates
(adjusted for restriction in the range of Academy scores)

Measure	NLBA	NLCPT	AVL5	AVIA	AVTA	NLCST	NLCOMP
Training Status (N=2992)							
Status	-.09	-.05	-.42	-.46	-.33	-.14	-.46
When failed	-.09	-.05	-.39	-.45	-.30	-.14	-.43
Radar-associated/Nonradar training (N=1669):							
Time for Phase IX	-.07	-.06	-.20	-.18	-.17	.00	-.21
Adj Time Phase X	-.04	-.05	-.13	-.08	-.12	.00	-.15
Hrs for Phase IX	.04	.00	-.11	-.08	-.09	-.04	-.13
Adj hrs Phase X	.00	-.03	-.06	-.04	-.03	.05	-.02
Mean IPRA	.21	.08	.40	.45	.33	.19	.46
Radar training (N=1137):							
Time for Phase XII	-.09	-.03	-.24	-.24	-.20	-.14	-.28
Adj time Phase XIII	-.05	-.08	-.20	-.16	-.17	-.12	-.25
Hrs for Phase XII	-.05	.05	-.22	-.16	-.18	.00	-.21
Adj hrs Phase XIII	.04	.00	-.20	-.16	-.17	.00	-.21
Mean IPRD	.31	.05	.42	.43	.35	.12	.46
Time to FPL	-.16	-.12	-.29	-.26	-.27	-.16	-.36

Terminal field training performance: VFR.

The next set of analyses addressed the training performance of developmentals who successfully completed the Terminal Academy program and entered field training at VFR towers.

Table 17
Mean OPM ATCS Battery and Academy performance measures
for Terminal Academy graduates at VFR towers

Measure	Mean	Std. Dev.	N
OPM components			
MCAT	89.5	6.9	694
ABSR	39.0	6.3	694
OKT	40.2	13.7	694
TMC	88.3	5.2	696
RAT	91.7	5.1	697
Academy components			
NLBA	95.5	2.9	697
NLCPT	86.1	6.9	697
AVL5	76.2	7.3	697
AVIA	78.6	6.5	697
AVTA	61.5	10.5	697
NLCST	81.2	8.2	697
NLCOMP	78.6	5.2	697

OPM and Academy performance scores for terminal developmentals assigned to VFR towers. Table 17 shows means and standard deviations of OPM ATCS battery and Academy component tests for developmentals assigned to VFR towers.

VFR field training performance measures. Developmentals at VFR towers must successfully complete four phases of field training: Flight Data, Clearance Delivery, Ground Control, and Local Control. Tables 18-20 show field training performance measures related to these phases of training for trainees entering VFR towers. Total numbers and percentages of developmentals in each category are shown for discrete variables; means and standard deviations are shown for continuous variables.

Table 18
Status in training phases at VFR towers
for 1981-1985 Terminal Academy graduates

Phase	N	% Passed	% Didn't pass
Flight Data	687	99.4	0.6
Clearance Deliv	675	99.1	0.8
Ground Control	685	98.5	1.5
Local Control	667	95.1	4.9

Table 18 shows success rates in field training at VFR towers. A comparison of the pass rates in the training phases indicates a very low failure rate in every phase of VFR tower training. The phases with the highest loss rates are Local Control and Ground Control. Data regarding the *Flight Data and Clearance Delivery phases of training were eliminated from* subsequent analyses because virtually all developmentals passed these training phases.

Table 19
Status in training for developmentals
at VFR towers

Total N	% Orig Facility	% Switched Facility	% Switched Options	% Separated
697	91.1	1.7	0.3	6.9

Table 19 shows status in training for developmentals assigned to VFR towers. A higher percentage of VFR tower developmentals remained in their original option than did en route developmentals. VFR tower cab duties are considered easier than en route duties and is reflected in grade levels: the maximum grades at VFR facilities range from GS-10 to GS-12, while at level 2-3 en route facilities the maximum grades range from GS-13 to GS-14.

Table 20 shows continuous measures of field training performance for developmentals assigned to VFR towers. Again, time to complete phases of training is measured in calendar days, while hours in training are the actual number of OJT hours used to complete a training phase. Mean IPCB is the mean Indication of Performance for all phases of tower cab training at VFR towers. Time to FPL is the number of years between EOD and completion

of the Local Control Phase for those who successfully completed training. It can be seen that it takes mucn longer to complete Local Control than Ground Control and that standard deviations of training times and hours in all training phases are very high.

Table 20
Continuous measures of field training performance for developmentals at VFR towers

Measure	Mean	Std. Dev.	N
Time in Ground Control	84.8	58.7	680
Time in Local Control	189.1	111.2	652
Hrs in Ground Control	48.7	29.4	679
Hrs in Local Control	108.3	43.2	649
Mean IPCB	4.1	0.9	459
Time to FPL (yrs)	1.1	0.4	626

Correlations between selection procedures and measures of field training performance for developmentals at VFR towers. Table 21 shows intercorrelations between continuous measures of field training performance. Again, the correlations between times and hours required to complete training within a phase are higher than corresponding correlations between phases. High correlations are observed between times required to complete the Ground Control and Local Control phases and the time to attain FPL status; this is not surprising because these phases comprise the majority of tower cab training at VFR towers. Correlations between training times and the Indication of Performance measure were reasonably high.

Table 21
Intercorrelations* between measures of field training performance for 1981-1985 Terminal Academy graduates at VFR towers
N=(442)

Measure	DaysGC	HrsGC	DaysLC	HrsLC	IPCB	FPL
DaysGC	1.0	.29	.45	.18	-.27	.60
HrsGC		1.0	.15	.40	-.29	.22
DaysLC			1.0	.39	-.33	.87
HrsLC				1.0	-.35	.38
Mean IPCB					1.0	-.39
Time to FPL						1.0

* All correlations are significantly different from 0 at $p<.001$

Also computed were Spearman Rank correlations between the categorical measure of training status and the continuous measures shown above. None of the correlations was significantly different from 0 at the .01 level of significance.

Table 22 contains correlations between OPM ATCS battery component scores and measures of field training performance at VFR towers. As a rule, the correlations are both low and nonsignificant, with the exception of

correlations between the OKT score and several of the measures of field training performance. This finding was not observed for en route developmentals. It is anticipated that the significant correlation between the OKT scores and field training performance measures occurred for developmentals in terminal and not en route facilities because the majority of entrants having prior air traffic control experience (and consequently earning high OKT scores) would have ordinarily gained this experience by working in military terminal facilities. Military facilities more closely resemble the FAA's VFR and terminal radar facilities than they do the FAA's en route facilities. Other positive, but nonsignificant, correlations were observed between the MCAT, ABSR, TMC, RAT and the temporal training performance measures.

Table 22
Correlations* between OPM ATCS battery scores
and measures of field training performance
for 1981-1985 Terminal Academy graduates at VFR towers

Measure	MCAT	ABSR	OKT	TMC	RAT
Spearman Rank correlations (N=441)					
Status	-.04	.09	-.06	.00	-.05
Pearson correlations (N=441)					
Days GC	.06	.06	-.20*	.08	-.02
Hrs GC	.04	.07	-.14*	.06	-.01
Days LC	.00	.04	-.12*	.02	.00
Hrs LC	.02	.06	.00	.04	.06
Mean IPCB	.02	-.11	.14*	-.03	.04
Time to FPL	.03	.05	-.25*	.04	-.03

* Significantly different from 0 at $p < .01$.

Table 23
Correlations between Academy component scores
and measures of field training performance
for 1981-1985 Terminal Academy graduates
at VFR towers

Measure	NLBA	NLCPT	AVL5	AVIA	AVTA	NLCST	NLCOMP
Spearman Rank correlations (N=441)							
Status	-.04	.02	-.08	-.06	-.08	.00	-.08
Pearson correlations (N=441)							
Days GC	-.16*	-.12*	-.13*	-.10	-.12*	.04	-.12*
Hrs GC	-.07	-.07	-.13*	-.15*	-.15*	.00	-.13*
Days LC	-.16*	-.09	-.18*	-.13*	-.17*	-.03	-.18*
Hrs LC	-.12*	-.06	-.17*	-.20*	-.17*	-.06	-.18*
Mean IPCB	.16*	.12	.26*	.26*	.26*	.03	.26*
Time to FPL	-.18*	-.17*	-.19*	-.17*	-.19*	-.05	-.21*

* Significantly different from 0 at $p < .01$.

Table 23 contains correlations of the Academy component scores and course grade with measures of field training performance at VFR towers. As had been observed from the examining data from en route developmentals, the Lab performance scores are fairly good predictors of field training performance. The lab scores again have higher correlations with Indication of Performance ratings (IPCB) than any other field training performance measure. However, for terminal developmentals at VFR towers, the Block average is a fairly good predictor of field training performance; the CST grades are not correlated with any of the training performance measures; and status in training is not predicted well by any Academy component score.

Table 24
Correlations between OPM ATCS battery scores
and measures of field training performance
for 1981-1985 Terminal Academy graduates at VFR towers
(adjusted for restriction in the range of OPM scores)

Measure	MCAT	ABSR	OKT	TMC	RAT
Status	-.09	.14	-.05	.00	-.13
Days GC	.14	.09	-.17	.19	-.05
Hrs GC	.09	.11	-.12	.14	-.03
Days LC	.00	.06	-.10	.05	.00
Hrs LC	.05	.09	.00	.09	.15
Mean IPCB	.05	-.17	.12	-.07	.10
Time to FPL	.07	.08	-.21	.09	-.08

Table 25
Correlations between Academy component scores
and measures of field training performance
for 1981-1985 Terminal Academy graduates at VFR towers
(adjusted for restriction in the range of Academy scores)

Measure	NLBA	NLCPT	AVL5	AVIA	AVTA	NLCST	NLCOMP
Status	-.05	.03	-.15	-.10	-.13	.00	-.17
Days GC	-.21	-.15	-.23	-.17	-.19	.06	-.25
Hrs GC	-.09	-.09	-.23	-.25	-.24	.00	-.27
Days LC	-.21	-.12	-.32	-.22	-.27	-.05	-.36
Hrs LC	-.16	-.08	-.30	-.33	-.27	-.09	-.36
Mean IPCB	.21	.15	.44	.42	.40	.05	.50
Time to FPL	-.24	-.22	-.33	-.28	-.30	-.08	-.42

Tables 24 and 25 contain correlations of OPM and Academy component scores with measures of VFR training performance, adjusted for restriction in range. When corrected for restriction in range, the correlations between the OKT and training performance measures declined because the standard deviation of OKT scores for terminal Academy graduates is higher than the standard deviation in the unrestricted population of applicants. The results suggest that Academy scores (with the exception of the CST) are better predictors of most measures of field training performance at VFR facilities than are the OPM scores, although the OKT is somewhat predictive of training performance at VFR towers, and both OPM and Academy scores are poor predictors of VFR training status.

Terminal field training performance: Radar.

The final analyses address training performance of developmentals who successfully completed the Terminal Academy program and were assigned to terminal radar facilities.

OPM and Academy performance scores for terminal developmentals assigned to radar facilities. Table 26 shows means and standard deviations of OPM ATCS battery and Academy component tests for developmentals assigned to terminal radar facilities.

Table 26
Mean OPM ATCS Battery and Academy performance measures
for Terminal Academy graduates at radar facilities

Measure	Mean	Std. Dev.	N
OPM components			
MCAT	89.1	7.3	966
ABSR	39.6	6.2	966
OKT	41.4	13.4	966
TMC	88.2	5.3	966
RAT	91.9	5.3	966
Academy components			
NLBA	95.5	3.1	966
NLCPT	86.7	7.6	966
AVL5	77.7	7.5	966
AVIA	79.7	6.8	966
AVTA	63.9	10.8	966
NLCST	81.4	8.2	966
NLCOMP	79.7	5.5	966

Terminal radar field training performance measures. Tables 27-29 show field training performance measures for trainees entering terminal radar facilities. Total numbers and percentages of developmentals in each category are shown for discrete variables; means and standard deviations are shown for continuous variables.

Developmentals at terminal radar facilities may or may not take training related to tower cab operations, depending on whether or not a cab is collocated with the radar equipment. Moreover, within the past two years, several facilities split cab and radar duties administratively, considering the functions to be performed as if at separate facilities. All developmentals at terminal radar facilities are required to take the Flight Data training phase, but only those with collocated tower cabs will take Clearance Delivery, Ground Control, and Local Control. Furthermore, reporting training completion data for the Nonradar phase is not required at all terminal radar facilities.

Table 27
Status in training phases at terminal radar facilities
for 1981-1985 Terminal Academy graduates

Phase	N	% Passed	% Didn't pass
Flight Data	960	98.4	1.6
Clearance Deliv	915	98.6	1.4
Ground Control	917	96.2	3.8
Local Control	869	91.7	8.3
Nonradar	729	99.5	0.5
Radar	787	91.0	9.0

Table 27 shows field training phase completions for developmentals assigned to terminal radar facilities. In general, loss rates in training phases at radar facilities are higher than loss rates in corresponding training phases at VFR towers (compare with Table 18). The terminal radar training phases with the highest loss rates are Radar and Local Control, with Ground Control in third place. Less than a 2% failure rate is observed in the Flight Data, Clearance Delivery, and Nonradar Phases; consequently, measures of performance in these phases of training were eliminated from subsequent analyses.

Table 28
Status in training for developmentals
at terminal radar facilities

I. Stage in training at which failure occurred

Total N	% Didn't Fail	% Failed Radar/NR	% Failed Local	% Failed Other
964	79.9	7.4	7.5	5.3

II. Status in training

Total N	% Orig Facility	% Switched Facility	% Switched Options	% Separated
966	75.4	9.9	1.4	13.3

Table 28 shows status in training for developmentals assigned to terminal radar facilities. It can be seen that about 6% more developmentals at terminal radar facilities remained at their original facility than did en route developmentals (compare with Table 11). However, their status differed after being transferred. The percentage of developmentals separating from the two options was comparable (13.3% for terminal radar and 16.0% for en route). However, 15% of en route developmentals not succeeding at their original facility switched options, but only 1.4% of developmentals at terminal radar facilities did so. Most terminal radar failures who did not fail switched to another terminal facility.

Procedures for reassigning those who fail differ between the en route and terminal options. When en route developmentals fail training, they are not reassigned to another en route facility, because generally, most en route facilities control the same type and complexity of traffic. En route training failures are usually reassigned to either terminal facilities, if failure occurred during radar training, or to Flight Service Stations, if failure occurred during the Radar-associated/Nonradar phases of training.

Terminal failures, however, can be reassigned to another terminal facility because terminal facilities vary considerably in the types and complexities of traffic they controlled. Terminal reassignments are usually made from radar facilities to VFR towers, although some movement between different levels of VFR facilities may also occur. Terminal failures may also be separated from employment as GS-2152s, depending on the amount of training completed, and other factors.

Another difference between developmentals from en route and terminal radar facilities is the stage in training during which they failed. Similar percentages of en route and terminal radar developmentals failed during radar training (7.7% in en route as compared with 7.4% in terminal) but a much higher percentage of en route developmentals failed Radar-associated/Nonradar training (20.1%) than any stage of terminal radar training other than radar (12.8%).

Table 29
Continuous measures of field training performance for developmentals at terminal radar facilities

Measure	Mean	Std. Dev.	N
Time in Ground Control	91.8	56.0	907
Time in Local Control	201.7	108.0	851
Hrs in Ground Control	52.0	28.8	907
Hrs in Local Control	101.9	37.6	852
Mean IPCB	4.1	0.8	667
ADays Radar	108.6	70.1	312
AHrs Radar	72.5	48.1	311
IPRD	4.1	1.1	732
Time to FPL (yrs)	2.2	0.8	715

Table 29 shows continuous measures of field training performance for developmentals assigned to terminal radar facilities. Again, time to complete phases of training is measured in calendar days, while hours in training are the OJT hours used to complete the phase. Because some terminal radar facilities have different numbers of radar positions for which ATCSs are responsible, days in training and OJT hours required to complete training were adjusted for the number of radar positions handled by the facility. The mean IPCB is the mean Indication of Performance for the tower cab training (Phases V-IX) while IPRD is the mean Indication of Performance for the radar phase. Time to FPL is the number of years from EOD to completion of the Radar Phase for those who successfully completed training.

As was the case for VFR tower training, note that it takes considerably longer to complete the Local Control phase than Ground Control and that standard deviations for training times in all training phases are very high. However, the time to complete radar training is also high, despite the adjustment for the number of radar positions handled by the facility.

Correlations between selection procedures and measures of field training performance for developmentals at terminal radar facilities. Table 30 shows intercorrelations between continuous measures of field training performance at terminal radar facilities. Most correlations are significantly different from 0 at $p < .01$. The adjusted OJT hours for the radar phase is the variable having the lowest correlations with other measures of field training performance.

Table 30
Intercorrelations* between measures of field training performance for 1981-1985 Terminal Academy graduates at terminal radar facilities
N=(223)

Measure	DaysGC	HrsGC	DaysLC	HrsLC	IPCB	ADaysRD	AHrsRD	IPRD	FPL
Days GC	1.0	.33	.67	.20	-.39	.17	.08*	-.10*	.38
Hrs GC		1.0	.20	.40	-.31	.15*	.23	-.15	.37
Days LC			1.0	.32	-.38	.25	.13*	-.16	.48
Hrs LC				1.0	-.20	.26	.40	-.26	.19
Mean IPCB					1.0	-.17	-.07*	.30	-.31
Days RD						1.0	.73	-.24	.23
Hrs RD							1.0	-.20	.04*
Mean IPRD								1.0	-.16
Time to FPL									1.0

*Correlations are not significantly different from 0 at $p < .01$.

Table 31 contains correlations between the OPM ATCS battery component scores and measures of field training performance at terminal radar facilities. Table 32 contains correlations between Academy component scores and training performance measures.

Examination of Tables 31 and 32 shows some results similar to those observed for en route developmentals. Generally, the Academy component test scores are better predictors of field training performance measures than are the OPM ATCS battery component tests. Another result similar to that observed for en route developmentals is that the Academy laboratory measures and, consequently, the course grade, are better predictors of the measures of field training performance than are the academic tests. The ABSR again is significantly correlated with the temporal performance measures, but not in the predicted direction. On the other hand, the OKT and RAT (as opposed to the TMC, which did not include points contributed by the OKT) are better predictors of field training performance for developmentals at terminal radar facilities than they are for en route developmentals.

Academy components predict the categorical variables (Status and Stage of Training) and the Indication of Performance variables (IPCB and IPRD) better than other field training measures based upon training times.

Table 31
Correlations between OPM ATCS battery scores
and measures of field training performance
for 1981-1985 terminal radar developmentals

Measure	MCAT	ABSR	OKT	TMC	RAT
Spearman Rank correlations					
Training status (N=962)					
Status	-.05	.04	-.09*	-.03	-.08
Stage of training	-.05	.06	-.07	-.02	-.07
Pearson correlations					
Tower cab training (N=663)					
Days GC	.00	.15*	-.26*	.06	-.12*
Hrs GC	.00	.11*	-.20*	.04	-.10*
Days LC	-.03	.12*	-.18*	.02	-.10*
Hrs LC	-.03	.09	-.10*	.01	-.07
Mean IPCB	.03	-.03	.20*	.02	.13*
Radar training (N=294)					
Days RD	-.03	.07	-.14*	.00	-.09*
Hrs RD	-.02	.08	-.12	.02	-.07
Mean IP RD	.17*	-.02	.14*	.13	.15*
Time to FPL	-.03	.07	-.19*	.00	-.16*

* Significantly different from 0 at $p < .01$.

Table 32
Correlations between Academy component scores
and measures of field training performance
for 1981-1985 terminal radar developmentals

Measure	NLBA	NLCPT	AVL5	AVIA	AVTA	NLCST	NLCOMP
Spearman Rank correlations							
Training status (N=962)							
Status	-.12*	-.09*	-.26*	-.26*	-.25*	-.09*	-.28*
Stage of training	-.11*	-.06	-.25*	-.25*	-.24*	-.10*	-.28*
Pearson correlations							
Tower cab training (N=663)							
Days GC	-.09*	-.04	-.13*	-.12*	-.12*	.01	-.12*
Hrs GC	-.03	.00	-.09*	-.10*	-.10*	-.05	-.10*
Days LC	-.03	-.02	-.11*	-.12*	-.11*	-.08	-.13*
Hrs LC	-.02	.00	-.06	-.06	-.07	-.08	-.08
Mean IPCB	.15*	.12*	.26*	.28*	.23*	.08	.28*
Radar training (N=294)							
Days RD	-.04	-.05	-.14*	-.15*	-.10	-.12	-.18*
Hrs RD	.01	-.03	-.04	-.03	.00	-.17*	-.10
Mean IPRD	.08	.07	.29*	.34*	.28*	.11	.30*
Time to FPL	-.05	.00	-.13	-.19*	-.10	-.03	-.12

* Significantly different from 0 at $p < .01$.

Table 33
Correlations between OPM ATCS battery scores
and measures of field training performance
for 1981-1985 terminal radar developmentals
(adjusted for restriction in the range of OPM scores)

Measure	MCAT	ABSR	OKT	TMC	RAT
Training status (N=962)					
Status	-.11	.06	-.08	-.07	-.20
Stage of training	-.11	.09	-.06	-.05	-.17
Tower cab training (N=663)					
Days GC	.00	.23	-.22	.14	-.29
Hrs GC	.00	.17	-.17	.09	-.24
Days LC	-.07	.18	-.15	.05	-.24
Hrs LC	-.07	.14	-.08	.02	-.17
Mean IPCB	.07	-.05	.17	.05	.31
Radar training (N=294)					
Days RD	-.07	.11	-.12	.00	-.22
Hrs RD	-.04	.12	-.10	.05	-.17
Mean IP RD	.36	-.03	.12	.29	.35
Time to FPL	-.07	.11	-.16	.00	-.37

Tables 33 and 34 contain correlations of OPM ATCS battery components and Academy component scores with field training performance measures, adjusted for restriction in range. When corrected for restriction in range, RAT and NLCOMP have about the same correlations with temporal measures of the tower cab portion of training, but NLCOMP has higher correlations with the temporal measures of radar training, training status, and the Indication of Performance Variables than the RAT.

Table 34
Correlations between OPM ATCS battery scores
and measures of field training performance
for 1981-1985 terminal radar developmentals
(adjusted for restriction in the range of Academy scores)

Measure	NLBA	NLCPI	AVL5	AVIA	AVTA	NLCST	NLCOMP
Training status (N=962)							
Status	-.15	-.11	-.43	-.40	-.38	-.14	-.51
Stage of training	*-.14*	*-.07*	*-.42*	*-.39*	*-.36*	*-.16*	*-.51*
Tower cab training (N=663)							
Days GC	-.11	-.05	-.23	-.19	-.19	.02	-.24
Hrs GC	-.04	.00	-.16	-.16	-.16	-.08	-.20
Days LC	-.04	-.02	-.19	-.19	-.17	-.13	-.26
Hrs LC	-.03	.00	-.11	-.10	-.11	-.13	-.16
Mean IPCB	.19	.14	.43	.43	.35	-.13	.51
Radar training (N=294)							
Days RD	-.05	-.06	-.24	-.24	-.16	-.19	-.35
Hrs RD	.01	-.04	-.07	-.05	.00	-.26	-.20
Mean IPRD	.10	.08	.47	.51	.42	.17	.54
Time to FPL	-.06	.00	-.23	-.30	-.16	-.05	-.24

CONCLUSIONS

This study examined the relationships between the component test scores from the OPM ATCS test battery, the component test and average laboratory scores from the En Route and Terminal Academy screening programs, and measures of field training performance at three types of air traffic facilities: en route centers, VFR towers, and terminal radar facilities. This investigation was important because no previous studies have 1) analyzed the relationship between OPM selection test scores and field training performance, and 2) compared the relative contributions of the OPM and Academy selection procedures in predicting field training performance.

The data suggest that the validity of the predictor components depends upon the type of facility to which the developmental is assigned. For developmentals assigned to en route facilities, the MCAT has higher correlations with field training performance measures than any other OPM tests. The OKT and ABSR do not correlate well with the criterion measures

obtained for en route developmentals. However, for terminal developmentals, the OKT predicts field training performance at both VFR towers and terminal radar facilities better than any other test included in the OPM battery, while the MCAT has no relationship with most measures of terminal field training performance. The OKT may predict terminal performance better than en route because most applicants with high OKT scores gained their experience by working at military facilities which resemble the FAA's VFR and terminal radar facilities more closely than they resemble en route centers. The MCAT may fail to predict terminal training performance because its items address the movement of aircraft at constant speed through en route airspace and do not simulate the activities of converging aircraft.

An unusual finding for developmentals in both options is that some of the OPM components are correlated with the temporal measures of field training performance in an unpredicted direction. For enroute developmentals, the MCAT has significant positive correlations with several measures of training times, while for terminal developmentals at radar facilities, the ABSR has significant positive correlations with training time measures. The correlations of MCAT and ABSR with other types of training performance measures (training status, supervisor ratings, and time to complete training) are either in the anticipated direction or are nonsignificant. Additional analyses revealed that the unanticipated relationship between the MCAT and training times is present for developmentals at facilities in only one or two regions, while the corresponding correlations for facilities in other regions are not significantly different from 0. Similar results were observed for terminal radar facilities analyzed by region. Additional investigation is warranted to clarify these complex results.

For developmentals in both options, Academy lab scores, including both the average Technical Assessment and average Instructor Assessment, have higher correlations with the measures of field training performance than do academic tests. When adjusted for restriction in range, AVIA predicts en route training status much better than does AVTA, but this relationship does not occur for terminal developmentals. The academic tests have nonsignificant correlations with the objective criterion measures for developmentals at enroute and terminal radar facilities, but NLBA is significantly correlated with most training performance measures for VFR tower developmentals. Significant correlations are also characteristic of the relationship between most of the Academy component test scores and the subjective field performance ratings.

Academy scores appear to be much better predictors of the training performance measures than do OPM scores, until the correlations are adjusted for restriction in range. Upon analyzing the corrected correlations, it appears that the OPM rating predicts the amount of time required to complete en route and terminal radar training phases and to attain FPL status about as well, and for some variables, better than the corresponding Academy course grade. (However, for en route developmentals, the direction of prediction for all temporal variables except time to FPL is not in the predicted direction). On the other hand, for both options, course grade predict field supervisor/OJT instructor ratings and training status better

than does the OPM rating. OPM scores do not predict any measure of VFR tower training as well as the Academy course grade. Examining the terminal correlations adjusted for restriction in range suggested that including the ABSR in the computation of the RAT may have reduced its predictability as a result of combining the positive (though only marginally significant) correlations of ABSR with measures of training times with the corresponding negative correlations contributed by the OKT.

The other issue that should be addressed is the relevance of the measures of field training performance identified during this study as criteria. Each type of measure has its flaws; with regard to measurement error, other factors that might influence the the assigned values, and subjectivity of measurement. Several types of measures were included in the study to allow comparison and evaluation of their utility. Based on the results of the study, it appears that training status, subjective performance ratings, and time to reach FPL status may be the most productive measures of training performance to use in future studies, but additional research on this topic is warranted.

While the data are complex, it appears that it is not only appropriate, but also essential, that any analyses of training performance be conducted independently for developmentals in each option because of disparate relationships between predictors and criteria. It also appears that while Academy and OPM scores predict some measures of training performance about equally well, the Academy performance measures, particularly laboratory scores, are better predictors of supervisor/OJT instructor ratings and training status than are OPM scores.

REFERENCES

Manning, C. A., Kegg, P. S., and Collins, W. E. Studies of poststrike air traffic control specialist trainees: II. Selection and screening programs. FAA Office of Aviation Medicine Report No. FAA-AM-88-3, 1988.

Thorndyke, R. L.: Personnel Selection, New York: Wiley, 1949.

VanDeventer, A. D. Field training performance of FAA Academy Air Traffic Control Graduates. Presented at the annual Scientific Meeting of the Aerospace Medical Association, 1981.

VanDeventer, A. D. A followup evaluation of the new aptitude testing procedures for selection of FAA air traffic control specialists. In VanDeventer, A. D., Collins, W. E., Manning, C. A., Taylor, D. K., and Baxter, N. E. Studies of poststrike air traffic control specialist trainees: I. Age, biographical factors, and selection test performance related to Academy training success. FAA Office of Aviation Medicine Report No. FAA-AM-84-6, 1984.