Clearance number 99-302

Determinants of Enlisted Air Traffic Controller Success[1,2]

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Background: This paper provides a brief historical overview of air traffic controller (ATC) selection, reviews current US Air Force (USAF) selection procedures for enlisted ATC trainees, and summarizes the results of 3 recent studies. ***Method:*** Study 1 examined the validity of the operational selection test (i.e., Armed Services Vocational Aptitude Battery or ASVAB) against apprentice-level training performance. Study 2 evaluated the impact of alternative selection procedures on training attrition and eligibility for training. Study 3 reviewed the results of a survey of enlisted ATCs designed to identify the personnel characteristics and organizational factors that influence training and job performance. ***Discussion:*** The current selection composite demonstrated acceptable validity for predicting apprentice-level training performance. Alternative cut-score analyses revealed that raising the minimum qualifying score in order to reduce attrition by 5% would lead to an unacceptable 20% reduction in the number of eligible ATC candidates. Using a different ASVAB composite for selection would have less overall impact on the qualification rate, but would disproportionally disqualify women. Results of a survey of enlisted ATCs indicated they were generally satisfied and motivated. In addition, they identified several abilities required for on-the-job performance that are not measured by current USAF selection methods. These included memorization and retention of new information, spatial orientation/visualization, ability to work well in stressful environments, ability to shift between two or more sources of information, and ability to combine and organize information. Implications for ATC selection and training as well as future research directions are discussed.

A review of three US Air Force (USAF) Class "A" mishaps in 1993 and 1994 implicated air traffic controller (ATC) loss of situational awareness as a contributing factor. As a result, the Air Force undertook

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several initiatives to review ATC operations, including a "tiger team" examination of the manpower and personnel structure of the career field. The tiger team included representatives from Air Education and Training Command (AETC), the Air Force Flight Standards Agency (AFFSA), and the 2nd Air Force.

One of the resulting recommendations was to review current ATC screening procedures for possible improvements in the selection of ATC trainees. One concern that emerged from the tiger team review was the reliance for ATC selection solely on the Armed Services Vocational Aptitude Battery (ASVAB; 8), a paper-and-pencil multiple-choice test. The tiger team perception was that the ASVAB lacked measures of specific abilities related to ATC success, such as attention span, concurrent multiple task performance, decision making, and spatial reasoning.

The tiger team also was concerned that the screening system was deficient in identifying ATC trainees likely to succeed in the career field, based on observed attrition rates both in apprentice (3-level) technical training and in upgrade (5-level) training. As shown in Table 1, rate of attrition in apprentice-level training has increased since 1990, despite an overall reduction in the number of ATC trainees.

As a result of the tiger team report, AETC asked the Armstrong Laboratory (subsequently reorganized into the Human Effectiveness Directorate of the Air Force Research Laboratory) to evaluate current ATC screening procedures and recommend potential enhancements. Armstrong Laboratory personnel approached the ATC attrition problem by (a) reviewing the literature on ATC selection research within the USAF, as well as other military services and the Federal Aviation Administration (FAA), (b) analyzing archival data on the relationship between ASVAB scores and performance in apprentice-level technical training, and (c) surveying incumbent USAF ATC personnel. The results of the incumbent survey are described in detail in Siem and Carretta (22) and summarized herein.

A Brief History of ATC Selection

Since WWII, both military and civilian ATC trainees have been selected by means

TABLE 1. AIR TRAFFIC CONTROLLER APPRENTICE (3-LEVEL) TRAINING OUTCOMES: 1990=1995

Training Outcome	Year 1990	1991	1992	1993	1994	1995
Graduates	848	676	454	139	92	139
Eliminees	176	137	85	30	46	52
Total	1024	813	539	169	138	191
Graduation %	82.8	83.1	84.2	82.2	66.7	72.8

of psychological tests. The core abilities measured have been measures of cognitive ability including tests of numeric and symbolic reasoning, declarative and inductive reasoning, perceptual speed, and spatial (13).

In the 1970's, the FAA began the development of a simulation-based ATC job-sample test known as the Controller Decision Evaluation test (CODE; 16). The test consisted of a 45-minute movie that presented simulated air traffic in real time as it crossed an actual controller display. Several FAA studies reported validity and incremental validity for the CODE test (e.g., 5). A paper-and-pencil analog of the CODE test called the Multiplex Controller Aptitude Test (MCAT) was subsequently developed and validated by the FAA (6, 16). Stoker, Hunter, Batchelor, and Curran (23) examined the validity and incremental validity of the MCAT and four experimental perceptual and spatial abilities tests (Object Completion, Rotated Blocks, Perceptual Abilities, and Electrical Maze) for predicting enlisted USAF ATC training outcome. Regression analyses revealed that the MCAT and Rotated Blocks tests incremented the validity of the ASVAB composites when predicting a dichotomous ATC pass/fail training criterion. Despite Stoker et al.'s (23) recommendations, neither the MCAT nor the Rotated Blocks tests were operationally implemented to augment the ASVAB for USAF enlisted ATC trainee selection.

Starting in the late 1970's, ATC selection became a major topic in Europe (13). The German Armed Forces began development of an ATC job-sample test called the Air Traffic Control test and the UK Royal Air Force (RAF) announced the development of the first completely computer-based ATC selection test battery (14). The USSR implemented a new selection system for civilian air traffic controllers that combined information from nine paper-and-pencil aptitude tests and a neuropsychological examination (26).

Advances in ATC selection have continued in the 1990's. The FAA studied the utility of a 5-day computer-based test battery, the Air Traffic Control Specialist Pre-Training Screen (ATCS/PTS) for replacing a 9-week Academy Nonradar Screen Program (4). The computer-based battery included two information processing tests and a simplified radar-based ATC work sample test. A series of studies indicated (a) the ATCS/PTS was useful for predicting performance in the 9-week FAA Academy Nonradar Screen Program and (b) was as valid for predicting progress in field technical training as were scores from the 9-week FAA Academy Nonradar Screen. Based on these results, in 1992 the FAA decided to terminate the Academy Nonradar Screen Program and supplement its paper-and-pencil ATC selection test battery with the ATCS/PTS.

More recently, as the result of an ATC task analysis (1), the RAF revised its ATC selection battery (2). The revised ATC taxonomy and resulting test battery is similar in content to that described by Hunter and Schmidt (14), except that the new taxonomy is more detailed. Hunter and Schmidt's Reasoning domain (ability to solve problems involving verbal, numerical, or diagrammatic information) was divided into discrete numerical and verbal sections and their Mental Speed domain was renamed Work Rate. The revised RAF ATC selection battery includes tests of numerical, verbal, spatial, attentional capacity, and work rate.

In another recent effort, the Royal Netherlands Navy examined the validity of a selective-listening task (SLT) for ATC selection (3). Although initial results showed validity against a dichotomous ATC training criterion, after controlling for level of motivation the partial correlations between SLT performance and training outcome were nonsignificant. Further, no test of incremental validity of the SLT beyond operational selection methods was reported.

USAF ATC Screening and Training

Applicants for the enlisted ATC career field are required, as are all applicants for USAF enlisted jobs, to take the ASVAB prior to joining the military[3]. The ASVAB is a 10 test, multiple aptitude battery that takes about 2.5 hours to administer. Its factor structure (17) and reliability (10) have been studied, and it has been validated for training (10, 19) and job performance (20, 21). It is administered at Military Enlistment Processing Stations and other sites within the continental United States, as well as at locations overseas.

The tests are General Science (GS), Arithmetic Reasoning (AR), Word Knowledge (WK), Paragraph Comprehension (PC), Numerical Operations (NO), Coding Speed (CS), Auto and Shop Information (A/S), Mathematics Knowledge (MK), Mechanical Comprehension (MC), and Electronics Information (EI). The tests are not used separately, but rather are combined into composites. The Armed Forces Qualification Test (AFQT = AR + 2WK + 2PC + MK) score is used for entry into the US military regardless of job specialty, and four separate Aptitude Indices are used by the Air Force for determining eligibility for specific jobs: Mechanical (M = GS + 2A/S + MC), Administrative (A = WK + PC + NO + CS), General (G = AR + WK + PC), and Electronic (E = GS + AR + MK + EI).

The minimum qualifying AFQT percentile score for Air Force entrance is 40[4]. In addition, entry into the ATC career field requires passing a flight physical and a Reading Aloud Test, vision correctable to 20/20, and a minimum score of 53 on the G composite (25).

Applicants with qualifying scores on the AFQT and on the G composite are selected for ATC training in one of two ways. Some are selected for ATC training prior to Basic Military Training (BMT). Other applicants enter BMT with a guaranteed job in one of the four broad US Air Force career clusters (M, A, G, or E) and are assigned to a training specialty as part of a classification process during BMT. In either case, ATC candidates are provided only with minimal descriptions of the nature of a controller’s actual job duties, and the information that is provided tends to describe only the more attractive aspects of the job.

[3] Officers also work in the ATC career field, but mainly in a supervisory capacity that requires only minimal proficiency as a controller. The officer corps will not be discussed in this report as the main concern is with attrition of enlisted personnel.

[4] In addition to a minimum AFQT score of 40, acceptance into the USAF depends on other factors such as a credit check and achieving age 18 prior to graduation from basic military training (BMT).

Upon completion of BMT, ATC students attend an apprentice (3-level) training course at Keesler AFB in Biloxi, Mississippi. The course consists of 72 days of instruction divided into four blocks: (a) air traffic controller fundamentals (9 days), (b) control tower operations (25 days), (c) radar approach control operations (37 days), and (d) control tower operation certification (1 day). The fourth block consists of administration of the FAA ATC certification test that must be passed successfully to graduate from 3-level training (7).

Students can be eliminated from training at any point for a variety of reasons. The most common reasons for elimination are inadequate performance, self-elimination, academic failure, and a phenomenon known as “fear of controlling.” Attrition tends to stay at about the same rate through the 14-week course. Anecdotal evidence indicates that the primary reason for attrition varies somewhat by block of training, insofar as poor academic performance and self-elimination are more common in the first block (i.e. ATC fundamentals) than in the rest of the course.

The cost of graduating a student from apprentice (3-level) training in FY97 dollars, based on variable costs only, is $15,791. Based on an average completion of 36 days (50%), each eliminee represents a loss of about $7,895. Assuming a yearly product rate of 637 students (the FY98 Training Production Requirement) and an estimated attrition rate of 25%, attrition costs total to roughly $1,250,000 annually. Therefore, a reduction in attrition of only 5% would represent substantial cost savings ($250,000).

Upon graduation from 3-level training, controllers proceed to an operational assignment in either a tower or a radar approach control position, depending on the needs of the Air Force. Subsequent assignments also can vary between the two types of positions. Upgrades to 5- and 7-level occur as controllers gain more experience. Typically, it takes about 1.5 to 2 years for apprentice controllers to become fully qualified at their first base of assignment. Seven-level (craftsman) certification includes a formal 9-day course conducted at Keesler AFB. This course focuses mostly on the development of supervisory skills. The entire 7-level training sequence requires about 18 months to complete.

STUDY I: ASVAB UTILIZATION

Study I examined the validity of the ASVAB composites for predicting apprentice-level ATC training performance. The specific research question was whether an aptitude index other than G (the one currently used) might be a more valid predictor of enlisted ATC training performance. Analyses were done at the composite-score level, instead of the ASVAB tests, as the Air Force was interested in addressing the practical issue of examining the validity of the battery as it is currently used.

METHODS

Participants

The sample consisted of 1,069 USAF enlisted personnel who entered ATC training in calendar years 1990-1995 and who were tested on the ASVAB[5]. Most of the participants were male (71.1%) and White (81.2%). Education level for all participants was at least high school graduate or equivalent. Age at entry into the military ranged from 17 to 27 years. The graduation rate for 3-level training in the sample was 75.2% (804/1069). The most common reason for attrition was poor academic performance (n = 161). The other 104 eliminations occurred for a variety of reasons (e.g. fear of controlling, inadequate performance, self-elimination).

Measures

Predictors were the ASVAB M, A, G, and E composites. The criteria included final school grade (FSG) during technical training (graduates only) and passing/failing (P/F) training (graduates and eliminees). FSG ranged from 70 to 99 and represented the average percent correct on several multiple-choice tests.

Procedures

An historical database of ASVAB scores was matched against a technical training database. Those with ASVAB scores who were identified as entering either course 27230 (prior to 1 November 1993) or course 1C131 (after 1 November 1993) were retained.

Correlations were corrected for restriction in range (15) using means and standard deviations from an historical database of US Air Force enlisted applicants tested on the same forms of the ASVAB (see Study 2). Next, the validity of a summed composite (M + A + G + E) and a regression-weighted composite of the four ASVAB scores was computed in both observed and corrected for range restriction form. The regression analyses used forced-entry. Finally, after correction for range restriction, correlations of the ASVAB composites and ATC pass/fail training score were corrected for dichotomization of the criterion. Significance tests were conducted for the correlations of the test scores with the training criteria and for regressions that used the observed (uncorrected) data. All statistical tests were done using a .01 Type I error rate. No significance tests can be done for the corrected data.

The rational for examining the validity of the summed composite and the regression-weighted composite was to determine the maximum predictive utility that could be found by using the ASVAB composites in combination. It should be noted that the use of more than one ASVAB composite (M, A, G, E) for job qualification is not unusual in the Air Force. Many job specialties require qualification on two composites (in addition to the AFQT).

RESULTS

Final School Grade

All zero-order correlations of the ASVAB scores with FSG and the regression were significant at the .01 level. As shown in Table 2a, both before and after correction for range restriction, the G (.372 and .569) and E composites (.379 and .561) were the

[5] Only participants tested on the ASVAB forms in common use during that period were used in the analyses. The following ASVAB forms were used as the selection criterion: 15, 16, 17, 20, 21, 22, and CAT-ASVAB 01 and 02.

best predictors of FSG. The other two ASVAB composites were less valid (M, .293 and .428; A, .194 and .403). The four ASVAB composites were then summed and the resulting score correlated with FSG. The correlation was .394 for the observed data and .577 for the data corrected for range restriction. Finally, FSG was regressed on the four ASVAB composites. The multiple R was .411 for the observed data and .595 after range restriction correction (see Table 3). A comparison of the regression-weighted model with the individual ASVAB composites showed that considering all four ASVAB composites incremented prediction of FSG beyond using any individual ASVAB composite by itself (e.g., regression model vs. G alone: .411 vs. .372; $F(3, 799) = 8.92$, $p < .01$; regression model vs. E alone: .411 vs. .379; $F(3, 799) = 7.38$, $p < .01$). Despite this statistical significance, from a practical standpoint, after either G or E has been entered, the other ASVAB composites do little to increment the prediction of FSG (about .03 or .04 increment).

TABLE 2. CORRELATION MATRIX: US AIR FORCE ASVAB COMPOSITES AND ATC TRAINING PERFORMANCE

a. Final School Grade (FSG; n = 804):

Score	M	A	G	E	FSG
M	1.000				
A	0.056	1.000			
G	0.503	0.366	1.000		
E	0.724	0.203	0.770	1.000	
FSG	0.293	0.194	0.372	0.379	1.000

Score	M	A	G	E	FSG
M	1.000				
A	0.218	1.000			
G	0.597	0.622	1.000		
E	0.754	0.488	0.856	1.000	
FSG	0.428	0.403	0.569	0.561	1.000

b. Passing/Failing (P/F; n = 1,069):

Score	M	A	G	E	P/F
M	1.000				
A	0.059	1.000			
G	0.517	0.357	1.000		
E	0.743	0.200	0.765	1.000	
P/F	0.315	0.102	0.270	0.353	1.000

Score	M	A	G	E	P/F
M	1.000				
A	0.218	1.000			
G	0.597	0.622	1.000		
E	0.754	0.488	0.856	1.000	
P/F	0.396	0.244	0.391	0.454	1.000

Note. Correlations on the left are observed. Those on the right were corrected for range restriction (15). For FSG (n = 804), observed corelations greater than or equal to .085 are statistically significant at the .01 level (1-tailed test). For P/F (n = 1,069), observed correlations greater than or equal to .073 are statistically significant at the .01 level (1-tailed test).

Passing/Failing Training

As with the FSG analyses, all of the statistical tests involving the ASVAB composites and passing/failing training were significant at the .01 level. On the composite level, E was the best predictor of passing/failing training, both before and after correction for range restriction (.353 and .454; see Table 2b). The M (.315 and .396) and G (.270 and .391) composites were similar in validity. The A composite had the lowest validity (.102 and .244). As in the FSG analyses, the four ASVAB composites were summed and correlated with ATC P/F. The correlation was .358 for the observed data and .458 for the corrected data. The multiple R for the regressions of ATC P/F on the four composites were .365 and .465 for the observed and corrected correlations (see Table 3). It should be noted that in the P/F regression-weighted models, the G composite received a negative beta weight. This would be inappropriate and problematic in an operational selection system, because it would penalize applicants for good performance (i.e., high scores) on the tests making up the G composite.

Comparison of the regression-weighted model with the individual ASVAB composites showed little practical increment in predictive utility (e.g., regression model vs. E alone: .365 vs. .353; F (3, 1,064) = 3.28, ns). As observed with FSG, the E composite alone was nearly as predictive of ATC P/F as when used in combination with the other ASVAB composites. The fully corrected (range restriction and dichotomization) validities present a similar picture, with all values increasing as expected: M (.518), A (.519), G (.510), E (.593), summed composite (.599), and regression-weighted composite (.606).

Figure 1 displays the proportion of graduates and eliminees by G decile. The pattern clearly demonstrates that ATC trainees with higher G composite scores are more likely to graduate training (53-59: 64.3%; 60-69: 67.3%; 70-79: 77.6%; 80-89: 83.1%; 90-99: 96.5%).

TABLE 3. SUMMARY OF REGRESSION ANALYSES

a. Final School Grade:

Data Source	Regression Model (Beta weights)	R
Observed data	43.9172 + .0736*M + .0918*A + .1597*G + .1851*E	.411
Range-restriction-corrected data	43.7999 + .0788*M + .1166*A + .2582*G + .2240*E	.595

b. Pass/Fail:

Data Source	Regression Model (Beta weights)	R
Observed data	-1.1840 + .1289*M + .0485*A - .0084*G + .2539*E	.365
Range-restriction-corrected data	-1.1818 + .1473*M + .0638*A - .0147*G + .3245*E	.465

STUDY 2: ALTERNATIVE CUT SCORE ANALYSIS

One method of improving the effectiveness of the G composite is to raise the minimum or "cut" score required for entrance into the ATC career field. Inspection of the graduation rates by individual G percentiles (see Figure 1) suggested that raising the minimum from 53 to 62 would produce a 5.4% decrease in the overall attrition rate from 25% to 20%. Alternatively, the E composite might be substituted for the G composite, with a cut score of 54 producing a reduction in attrition comparable to a cut score for G at 62 (4.9%).

Raising or changing a cut score can result in reduced attrition, but may have other less desirable consequences. For example, a cut score of the 90th percentile would clearly screen out a high number of applicants likely to fail, but would also "qualify" too few trainees to organizational needs. More realistically, changes in cut score may have deleterious consequences on the rate of ethnic minorities and females that qualify for a job. Study 2 was therefore conducted to address possible consequences of raising the G composite minimum or substituting an E composite minimum requirement of 54 for the present G minimum of 53.

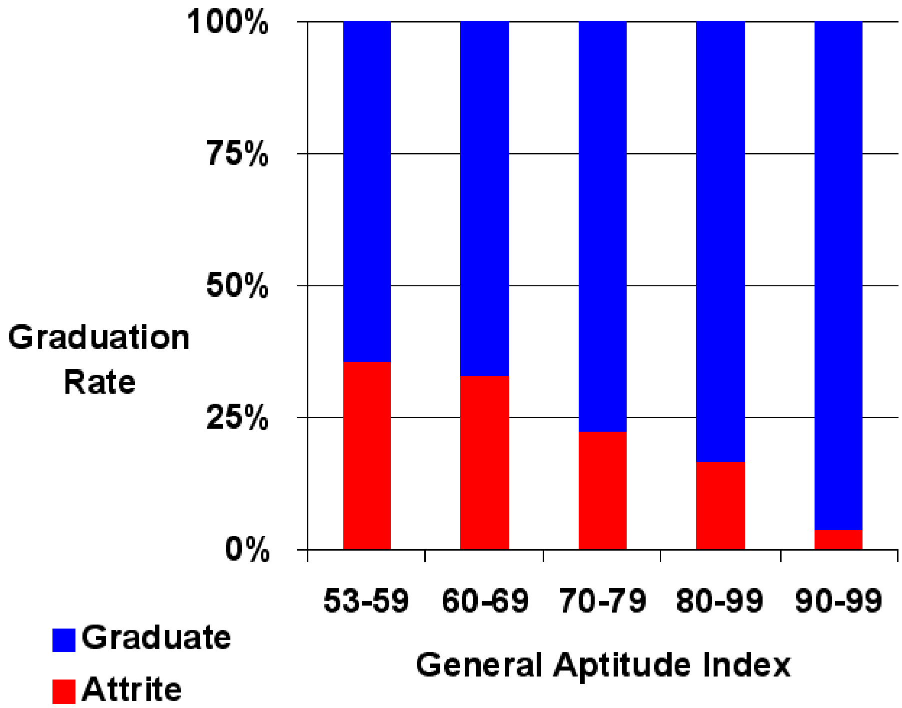

FIG 1. AIR TRAFFIC CONTROLLER APPRENTICE TRAINING ATTRITION RATE BY ASVAB GENERAL (G) COMPOSITE DECILE

METHOD

Participants

The sample consisted of 216,207 USAF enlisted applicants who tested on ASVAB forms 15, 16, 17, or CAT-ASVAB 01 or 02. There were 154,407 males and 61,800 females and 161,402 Whites, 37,478 African-Americans, 9,783 Hispanics, 902 Native Americans, and 4,467 Asians. The remaining 2,175 records lacked racial identity information.

Procedure

The data were extracted from an historical database of USAF applicants who tested on the same forms of the ASVAB as the ATC trainee sample in Study 1.[6]

RESULTS

Raising the Minimum G Composite

Males vs. females. As previously noted, the current minimum G composite value is 53. Raising the minimum qualifying G score to 62 reduced the number of eligible males from 93,369 to 77,915, representing a reduction of almost 17% in the number of eligible males. For females, the number of eligible candidates fell from 31,592 to 23,709, a reduction of about 25%.

Whites vs. African-Americans. Raising the minimum G composite from 53 to 62 reduced the number of eligible White applicants from 107,585 to 87,614, a reduction of almost 19%. For African-Americans, the number of eligible candidates would fall from 12,232 to 8,087 (i.e., a reduction of about 34%).

Using a Different Composite

Males vs. females. As previously noted, the current minimum G composite for enlisted ATC training qualification is 53. Changing the eligibility requirement to be an E composite of 54 *increased* the number of eligible male candidates from 93,369 to 100,193 (i.e., an overall *increase* of about 7% for males). However, if this procedure were used, the number of eligible female candidates would *decrease* from 31,392 to 24,334, representing a reduction of about 23% in the number of eligible females.

Whites vs. African-Americans. If the minimum qualifying score were changed to be an E score of 54, the number of eligible White applicants would be reduced from 107,585 to 104,267. This represents a reduction of only about 3% in the number of eligible Whites. For African-Americans, the number of eligible applicants would fall from 12,223 to 11,640, representing a reduction of only about 5%.

STUDY 3: ATC INCUMBENT SURVEY

Although the ASVAB composites were shown to be valid predictors of apprentice (3-level) training, program managers for the enlisted ATC career field were concerned that the ASVAB could not identify candidates likely to fail for non-academic reasons. They wanted to determine whether there were additional ability factors not

[6] The ASVAB data from these applicants provided the means and standard deviations used for correcting the ASVAB data in the previous study for restriction in range.

covered by the ASVAB that could help improve prediction of training performance.

In response to program managers' concerns, a coordinated effort was undertaken to survey enlisted ATCs to identify the personnel characteristics and organizational factors that may influence training and job performance. It was intended that results of this effort be used to help design a preliminary selection system.

METHOD

Participants

The survey sample consisted of 181 incumbent enlisted air traffic controllers. The majority of the participants were male (n = 155; 85.6%). The grade structure of the sample was: E-4 (n = 41; 22.7%), E-5 (n = 71; 39.2%), E-6 (n = 31; 17.1%), E-7 (n = 27; 14.9%), E-8 (n = 3; 1.7%), E-9 (n = 2; 1.1%), and missing (n = 6; 3.3%).

The protocol for the survey had been reviewed and approved by the Air Force Occupational Measurement Squadron located at Randolph AFB, TX. Participation in the survey was voluntary and responses to survey questions were confidential. Informed consent was obtained from all participants prior to their participation.

Measures

The survey (22) was designed to assess the importance of several factors thought to underlie ATC performance and to define key issues related to success in the enlisted ATC career field. These factors included basic abilities, organizational aspects, and the perceived work environment. Items that addressed organizational and personal concerns were developed based on interviews with trainers and program managers. The survey included 86 questions and was divided into four sections: Background Information, Motivation, Situational, and ATC Abilities.

Background information. The questions in this section focused on basic demographic information, as well as general information concerning job satisfaction. They concerned military grade, qualifications, and base of assignment. Also included were five general questions used by the Occupational Measurement Squadron to measure job satisfaction (11, 12, 24). These questions assessed job interest, training, use of talents, sense of accomplishment, and the likelihood of reenlistment. The questions in this section used mainly fill-in-the-blank or predetermined alternative response formats.

Motivation. This section assessed preferences for different types of work environments and the extent to which the ATC career field was rewarding. Responses were made using a 7-point Likert scale that ranged from (1) Strongly Disagree to (7) Strongly Agree.

Situational. This section measured the quality of life, acceptance of responsibility, decision making, and attitudes toward temporary duty assignments. It also included questions regarding technical instructors' concern toward students. Responses to questions in the Situational section used the same Likert scale as used in the Motivation section.

ATC abilities. The final section assessed the importance of several abilities for successful ATC performance relative to their importance for performance in other Air Force specialties. These items were based on the 28 task/job requirements defined by Dittmar, Weissmuller, Driskill, Hand, and Earles (9). A scale from (1) Very Low to (7) Very High was used to indicate the ability level required to complete the task discussed in each question. A score of four or greater on a given question indicated that the ability level required to perform the task should be higher than that typically found in other Air Force specialties.

Procedures

Surveys were mailed to each duty location and supplied to participants by their supervisor. The survey was distributed to 200 incumbent air traffic controllers at 19 bases. Two forms (i.e., paper-and-pencil or diskette) of the survey were distributed. About half (93 of 200) of the respondents chose the automated format. Once completed, the surveys were placed in a sealed envelope and returned to Brooks AFB for analysis. Participants provided informed consent per USAF Institutional Review Board procedures prior to completing the survey.

RESULTS

Because of the length of the survey (86 questions), results presented below represent only a summary. A complete list of survey questions and detailed information on responses are provided in Siem and Carretta (22).

Background Information

Examination of responses to the job satisfaction questions revealed that generally the enlisted ATCs had positive feelings about their job (see 22, Appendix B). Comparing their job to other enlisted specialties, the ATCs rated it as more interesting, providing a greater likelihood of using their training and talents, and providing a greater sense of accomplishment. Enlisted ATCs also stated that they were seldom made to feel uncomfortable in their job and usually were treated with respect. When asked about the likelihood of reenlistment, about 15% indicated they would retire (with at least 20 years service), 25% indicated that they would probably/definitely not reenlist, and 60% indicated that they probably/definitely would reenlist.

Motivation

Mean responses to the Motivation questions indicated a very positive attitude toward the ATC career field. As noted earlier, responses were made using a 7-point scale from (1) Strongly Disagree to (7) Strongly Agree. Means for 7 of the 12 questions were 6 or greater and indicated that the respondents liked the work environment and the high level of responsibility associated with their duties and that they found the job rewarding and exciting.

Situational

Overall, responses to these questions can best be described as neutral. Enlisted ATCs were neither extremely satisfied nor dissatisfied with the quality of life, temporary duty assignments, and technical instructors' concern toward students. The highest rated questions indicated they felt the ATC job carried a greater level of responsibility than other enlisted specialties (*M* = 6.0, SD = 1.3) and that mistakes were treated more severely for ATCs than other enlisted specialties (*M* = 6.0, SD = 1.2).

ATC Abilities

Questions regarding the importance of various abilities for successful enlisted ATC performance were divided into two sections (i.e., 16 agree-disagree scales; 29 requirements scales). As previously noted, responses to the agree-disagree questions used a 7-point scale that ranged from (1) Strongly Disagree to (7) Strongly Agree. Overall, the means for these questions were very high, indicating that respondents felt these abilities to be important for successful job performance. The mean value across all 16 agree-disagree questions was 5.975. Mean values for individual questions ranged from 4.1 to 6.7 and 12 of the 16 questions had values of 6 or greater. The ability rated least important had to do with understanding basic geometry (*M* = 4.1, SD = 1.5). The abilities rated most important dealt with the ability to prioritize (*M* = 6.7, SD = 0.6), assimilate information and make correct decisions (*M* = 6.6, SD = 0.6), work well in stressful environments (*M* = 6.5, SD = 0.8), and anticipate what has not yet happened (*M* = 6.5, SD = 0.7).

For the requirements scales, respondents rated the importance of several abilities *relative* to their importance for other enlisted specialties. Scale values ranged from (1) Very Low to (7) Very High. Results were consistent with a view of the ATC job requiring high levels of cognitive capacity and information processing and the ability to work well under stress. The abilities rated least important had to do with exerting muscular strength (*M* = 2.8, SD = 1.4) and the psychomotor abilities of control precision (*M* = 3.3, SD = 1.5) and multi-limb coordination (*M* = 3.7, SD = 1.5). The most highly rated abilities were memorization and retention of new information (*M* = 6.1, SD = 0.9), spatial orientation/visualization (*M* = 6.1, SD = 1.0), the ability to work well in stressful environments (*M* = 6.1, SD = 0.9), the ability to shift between two or more sources of information (*M* = 6.0, SD = 0.9), and combine and organize information (*M* = 6.0, SD = 1.0).

DISCUSSION

Results from Study 1 indicated that current USAF selection procedures (i.e. use of ASVAB composites) offer good prediction of enlisted ATC training performance. ASVAB validities were consistent with prior research findings for enlisted ATC trainees (23) and for a similar enlisted training specialty, weapons directors (18).

Alternative cut score analyses (Study 2) were done to determine the impact on attrition rate for either raising the minimal G composite from 53 to 62 or for using the E composite instead of G. Results indicated that although raising the G composite would reduce attrition by about 5% (from about 25% to 20%), the number of enlistees eligible for ATC training would decline by over 20%, making it difficult to recruit enough candidates for training. Using the E composite in lieu of the G composite also would reduce attrition by about 5%, but would have less of an overall impact on reducing the number of eligible candidates. However, the level of impact would vary greatly by sex. Using a minimal E composite of 54 would actually *increase* the number of eligible male candidates by about 7%, but *decrease* the number of eligible female candidates by about 23%. Using the E composite would be unacceptable as it would produce adverse impact for female candidates.

Although the ASVAB composites were shown to be valid predictors of apprentice (3-level) training, program managers for the enlisted ATC career field were concerned that the ASVAB could not identify candidates likely to fail for non-academic reasons. They wanted to determine whether there were additional ability factors not covered by the ASVAB that could help improve prediction of training performance. In response to program managers' concerns, a coordinated effort was undertaken to survey enlisted ATCs to identify the personnel characteristics and organizational factors that may influence training and job performance. It was intended that results of this effort be used to help design a preliminary selection system.

Survey results indicated a high level of job satisfaction and motivation for enlisted ATCs. Respondents liked the work environment and the high level of responsibility associated with their duties and said they found the job rewarding and exciting.

Responses to the situational questions indicated that in most respects enlisted ATCs felt their job to be comparable to other enlisted specialties. The most notable exceptions were that ATCs felt their job carried a greater level of responsibility than other enlisted specialties and that mistakes were treated more severely for ATCs than other enlisted specialties.

Respondents identified several abilities needed for successful on-the-job performance that are not measured by current selection procedures (i.e., ASVAB). These included memorization and retention of new information, spatial orientation/visualization, the ability to work well in stressful environments, the ability to shift between two or more sources of information, and the ability to combine and organize information. These survey results are consistent with a recent ATC job analysis conducted by the RAF (1). The most important abilities in the RAF analysis were spatial (i.e., reasoning/ visualization), attentional capacity (i.e., ability to process and store information in real time; deal with multiple tasks involving auditory/visual information; concentrate over long periods of time; note and remember changes over short/long periods), and work rate (i.e., solve simple problems quickly and accurately).

Based on the results of the ability requirements survey, USAF ATC program managers felt that a screening device that measures these abilities may help reduce attrition at the technical training school. They also expressed an interest that the screening device resemble the tasks ATCs perform on the job (i.e., have face validity). As a result, the USAF has begun a study to evaluate the utility of a "job sample" test for enlisted ATC selection. In this test, which was developed by the FAA (ATCS/PTS; 4), participants must control aircraft, adjusting their speed, altitude, and direction in order to send them to their proper destination (airport or transfer gate; see Figure 2 for a notional representation).

Although data collection has begun, this project is in an early stage and is expected to take at least another year to complete.

Analyses will focus on the predictive utility of the job sample test and whether or not it adds to the predictiveness of the ASVAB. As previously noted, the USAF in the mid-1980's (23) conducted a similar validation study. In that study, the validity and incremental validity of several experimental tests for predicting enlisted ATC training outcome were examined in the presence of the ASVAB composites. The experimental tests included a paper-and-pencil ATC job sample test (Multiplex Controller Aptitude Test or MCAT; 6) and four paper-and-pencil tests of perceptual and spatial abilities (Object Completion, Rotated Blocks, Perceptual Abilities, and Electrical Maze). Regression analyses revealed that the MCAT and Rotated Blocks tests incremented the validity of the ASVAB composites when predicting a dichotomous ATC pass/fail training criterion. Despite Stoker et al.'s (23) recommendations, neither the MCAT nor the Rotated Blocks tests were operationally implemented to augment the ASVAB for enlisted ATC candidate selection. Based on the results of Stoker et al., we are optimistic that the experimental computer-based ATC job sample test (see Figure 2) will demonstrate validity and incremental validity for enlisted ATC training.

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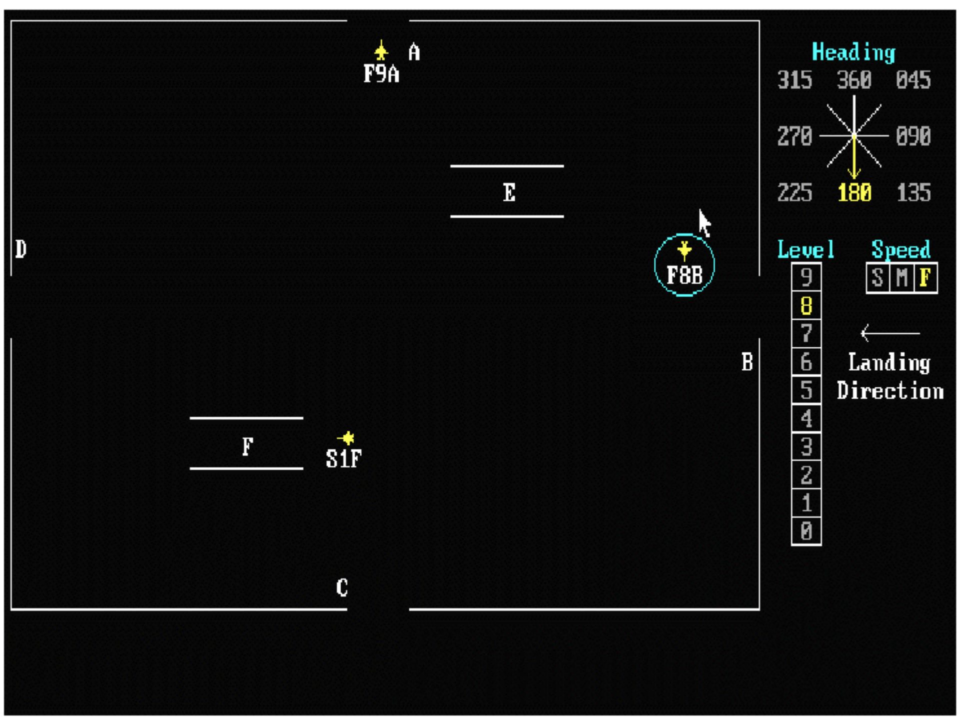

FIGURE 2. NOTIONAL REPRESENTATION OF ATC WORK SAMPLE TEST

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