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Assessing Prior Experience in the Selection of Air Traffic Control Specialists

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16. Abstract

Qualification standards published by the U.S. Office of Personnel Management (OPM) describe the minimum experience or education that individuals must have to qualify for specific positions within the federal government (OPM, 2009). These standards are developed and revised in conjunction with the appropriate federal agency. The purpose of the current research project was to evaluate the OPM qualification standard for the Air Traffic Control (ATC) Series 2152 and provide recommendations for renewing the standard for Federal Aviation Administration (FAA) human resources personnel. In addition to general and specialized experience and education requirements, the ATC Series 2152 qualification standard includes seven alternate requirements for use in qualifying applicants for selection by the FAA as air traffic control specialists (ATCSs). These alternate requirements reflect prior, relevant experiences of the applicants seen as adequate to qualify them for selection. In Study 1, biographical questionnaire data were used to assess the relationship between five of the seven alternate requirements and performance of prospective ATCSs in training at the FAA Academy in Oklahoma City, Oklahoma. Having prior experience in ATC, holding a prior instrument flight rating, and having a pilot's license all had a positive relationship with FAA Academy training performance and, with slight modifications, were recommended for retention as alternate requirements. The relationship between having experience as a dispatcher for an air carrier and FAA Academy training performance was not significant. However, the alternate requirement was recommended for retention due to the small number of ATCSs having experience in air-carrier dispatch. There was also no relationship found between having experience as a navigator/bombardier in the Armed Forces and FAA Academy training performance, and a recommendation was made to eliminate it as an alternate requirement. The remaining alternate requirements were addressed in Study 2, using a more qualitative approach of interviews and document review. For one alternate requirement, an update to the name of the military job referenced in the requirement was proposed. The final alternate requirement, which reflected an obsolete pay scale and testing procedures, was recommended for elimination. Based on results of Studies 1 and 2, suggestions were made for additional data collection to validate and extend the current standard to ensure that only those applicants most likely to succeed as ATCSs are selected. Periodic review of the OPM 2152 qualification standard is necessary as the role of the ATCS and the experiences of the populations being targeted for recruitment continue to evolve.

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ASSESSING PRIOR EXPERIENCE IN THE SELECTION OF AIR TRAFFIC CONTROL SPECIALISTS

INTRODUCTION

The U.S. Office of Personnel Management (OPM) supports the federal government in workforce hiring. One aspect of their work is to publish qualification standards for occupations within the federal government. Qualification standards, developed in consultation with the appropriate federal agency (OPM, 2009), detail the educational and experience requirements applicants should have to qualify for specific positions within the federal government.

Qualification standards may represent an occupational group or series. One such occupation is the Air Traffic Control (ATC) Series 2152. For position classification purposes, the ATC Series is part of the Transportation Group, 2100-2199. There is no group qualification standard for the Transportation Group, but individual occupational requirements do exist. For the ATC Series 2152, applicants may meet minimum qualification requirements on the basis of education or experience. To qualify based on education, applicants must have earned at least a bachelor's degree. Experience is divided into general and specialized experience. General experience is used to hire applicants with no background in ATC. However, applicants must have progressively responsible work experience that demonstrates the potential for learning and performing ATC work (Air Traffic Controller Occupational Handbook, 2003). Specialized experience is experience as an air traffic controller in a civilian or military ATC facility.

In addition to education and experience, the ATC Series 2152 qualification standard includes a list of alternate requirements to qualify applicants for selection as an ATCS. The alternate requirements include the specialized experience requirement and extend that requirement to include other examples of prior, relevant experience. The alternate requirements also include the general experience requirement, accompanied by an additional written test requirement. Alternate requirements can apply to either civilian or military hires. Applicants hired with prior, relevant experience, as provided under the specialized experience provision of the qualification standard or the alternate requirements, may be exempted from attending the ATC basic training course for new hires at the FAA Academy but generally must attend and successfully complete the initial training course that follows the basic training course before reporting to a facility.

To be useful in selecting ATCSs from civilian or military applicants, the OPM standard and alternate requirements should reflect current military jobs or work experience,

as well as be able to discriminate among the applicants by distinguishing the effective from the ineffective performers. The OPM standard and alternate requirements should also reflect current FAA personnel practices. The purpose of the present study was to assess the OPM qualification standard for the ATC Series 2152, focusing on the specialized experience or alternate requirements used to qualify and select ATCSs from among applicants with relevant experience. These include applicants with civilian or military ATC or aviation-related experience. An outcome of the research will be to provide the FAA's Office of Human Resource Management (AHR) with recommendations for revising the alternate requirements based on both current military practices and the utility of the alternate requirements for selecting ATCSs from among those applicants with relevant experience.

The FAA ATCS Applicant Qualification Process

Currently, applicants seeking employment as ATCSs begin the process by applying on-line in response to a specific vacancy announcement. Vacancy announcements for ATCSs target three major populations of applicants. One group, referred to as general public applicants, has no prior experience in ATC. The second group has experience in ATC and, depending on their experience, may qualify to apply under vacancy announcements for (a) Veteran's Recruitment Appointment (VRA) authority, (b) former Department of Defense air traffic controllers eligible for transfer or reinstatement or retired military controllers, (c) former FAA ATCSs who are reinstatement eligible, or (d) holders of a control tower operator's license with a facility rating of tower/cab. The third group of applicants targeted for hiring by the FAA is graduates of an Air Traffic-Collegiate Training Initiative (AT-CTI) program from an accredited college or university.

Once an application is made in response to a specific vacancy announcement, the applicant's qualifications are screened against the criteria for that announcement, as well as for more general criteria required of all applicants. For example, to qualify, all applicants must be citizens of the United States. Applicants are judged to be qualified if they meet both the qualification criteria for the specific vacancy announcement and the more general criteria for all ATCSs. As part of the minimum qualifications, those applicants with no experience as ATCSs (i.e., general public) and those who apply as AT-CTI graduates must take and pass the Air Traffic-Selection and Training (AT-SAT) test battery. Applicants with ATCS experience do
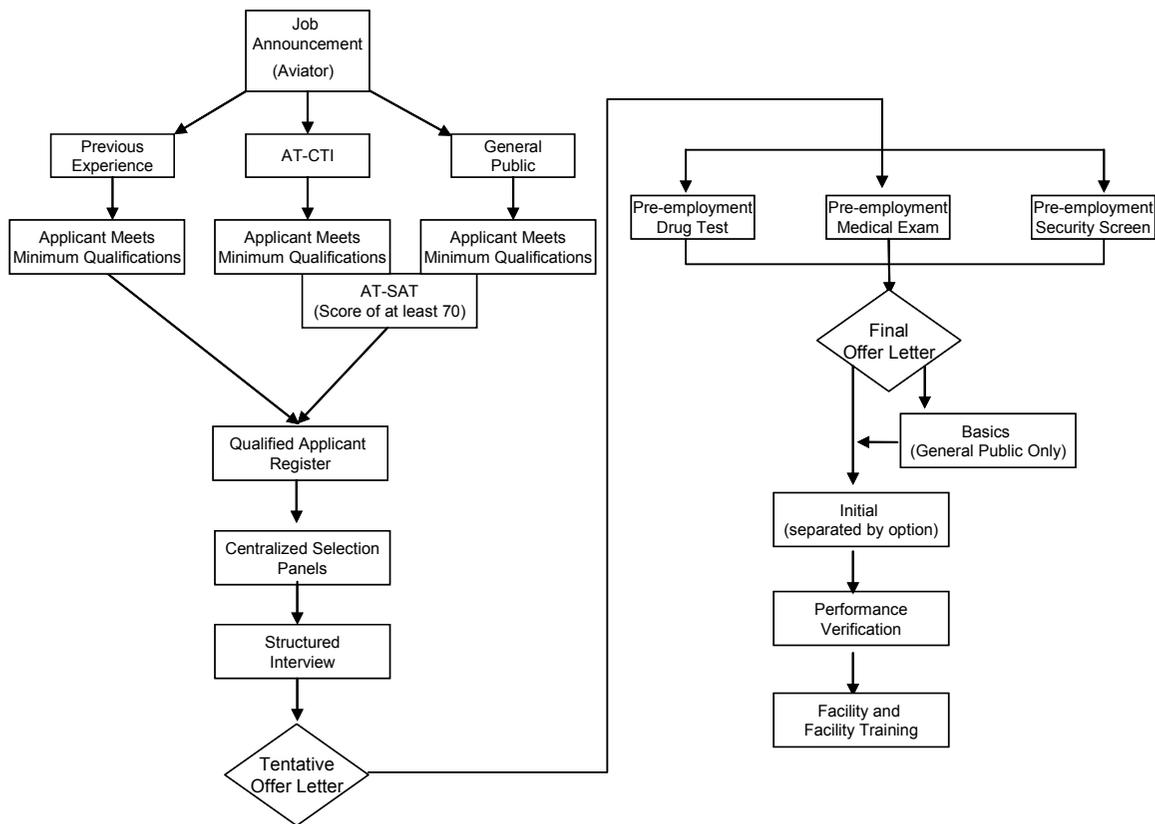
Figure 1. ATCS Hiring and Academy Training Timeline

not take AT-SAT. Figure 1 shows the ATCS hiring and Academy training timeline.

The OPM qualification standard may not be as detailed as the specific vacancy announcements but should be consistent with the FAA ATCS qualification process to provide accurate information to ATCS applicants. The education and experience requirements listed in the OPM qualification standard for the ATCS are consistent with FAA qualification processes, with the exception of pay scale information related to the General Schedule system, which is no longer used by the FAA. In addition to education and

experience requirements, the current OPM qualification standard defines seven alternate requirements as qualifying experience. These alternate requirements, listed below in Table 1, are the focus of this investigation.

Two studies were conducted to address these alternate requirements. Where data were available, a quantitative analysis was conducted to assess the degree to which the alternate requirement was related to training performance in the FAA Academy. This analysis is presented in Study 1. A second study, a qualitative analysis based on interview data and a review of pertinent documents, was conducted

Table 1. Alternate Requirements for Qualifying ATCS Applicants

1.	Hold or have held an appropriate facility rating and have actively controlled air traffic in civilian or military ATC terminals or centers;
2.	Hold or have held an FAA certificate as a dispatcher for an air carrier;
3.	Hold or have held an instrument flight rating;
4.	Hold or have held an FAA certificate as a navigator or have been fully qualified as a navigator/bombardier in the Armed Forces;
5.	Have 350 hours of flight time as a copilot or higher and hold or have held a private certificate or equivalent Armed Forces rating;
6.	Have served as a rated Aerospace Defense Command Intercept Director;
7.	Meet the requirements for GS-5 and pass the written test with an appropriately higher score.

to assess those alternate requirements for which no data were available. Each of the requirements is addressed with recommendations for retention, revision and retention, or elimination.

STUDY 1
METHOD

This study uses a quantitative approach to address alternate requirements 1-5 (see Table 1).

Participants

Biographical information, pre-employment screening test scores, and performance scores in the FAA Academy, gathered from 12,858 prospective ATCSs attending the FAA Academy between 1986 and 1992, were used in Study 1. The large amount of data available during this timeframe was due to the August 1981 strike of the Professional Air Traffic Control Organization (PATCO), the subsequent firing of more than 10,000 ATCSs (Schroeder, Broach, & Farmer, 1998), and the FAA hiring a considerable number of ATCSs to replace the fired controllers. Hiring during the mid-and late 90s and into the early 21st century occurred at a much slower pace than during the decade after the strike. The workforce stabilized after 1992 and the FAA hired only about 100 controllers per year through 1997 (Aul, 1998). More recently, from 2000-2010, biographical data on newly hired ATCSs, which might have been used for this study, were not gathered for those hired based on prior experience. Data were only gathered on prospective ATCSs hired from the general public, most of whom would have had little prior experience.

Besides being the best available data for use in this study, there is also some evidence to suggest that prospective ATCSs hired between 1986 and 1992 are similar in some respects to those hired more recently. For example, all ATCS applicants must be U.S. citizens. The vast majority of applicants then and now must be initially appointed before reaching the age of 31, with the only exception being retired military controllers. In addition, Cannon and Broach (2011) found that controllers hired in 2009 responded much like controllers hired between 1986 and 1992 regarding factors that influenced their choice of the controller occupation. In follow-on research, Cannon and Broach (personal communication, December 19, 2011) compared the extent to which controllers hired between 1986 and 1992 reported having had similar prior experiences as those hired in 2009. Preliminary results indicate that the numbers of new hires with experience in the areas investigated in the current study are similar, except for experience as a private and/or commercial pilot. More of the 2009 hires reported having experience as a private and/or commercial pilot than those hired from 1986-1992.

Regarding the data gathered between 1986 and 1992, 16% reported having prior experience in ATC or as a pilot, and approximately 73% provided information on questions of interest to this study. The exact number of responses varied by the question selected. The number of respondents per question ranged from 9,333 to 9,354. Those responding to the questions of interest were similar in characteristics to the larger sample. Therefore, demographic information is only reported for the larger sample. The majority of those in the sample were male (80%) and white (89%). Their average age at entry into the FAA Academy was 25.81 ($sd = 2.89$). Most had some college experience (89%), with the rest having graduated from high school (11%).

Measures

Biographical Questionnaire. The FAA routinely uses a biographical questionnaire (BQ) to collect biographical information from prospective ATCSs. This information is usually collected after the prospective ATCSs are selected and report to training. Items on the original version of the BQ (VanDeventer, Taylor, Collins, & Boone, 1983) were primarily designed to gather information on education and prior experience of the prospective ATCSs. The BQ has been revised multiple times for research purposes and to support human resources initiatives in recruitment, selection, and training (Farmer, 2002). Farmer (2002) provides an overview of the development and use of the BQ to predict performance and attrition of ATCSs.

We identified items on the BQ that were judged to be related, either directly or indirectly to Alternate Requirements 1-5 (see Table 1). There were no BQ items found to be related to Alternate Requirements 6 or 7, which will be addressed in Study 2 of this report. Responses to all relevant BQ items were grouped into two categories, indicating that the respondent either did or did not have the relevant experience. Responses to these items were then analyzed to determine if there was a relationship between the types of experience identified in the alternate requirements and FAA Academy training performance.

FAA Academy Training Performance. The criterion for our analysis was FAA Academy training performance. Prospective ATCSs were grouped into two categories. They either passed or did not pass Academy training. Those who did not pass Academy training either withdrew prior to completion of training or failed training.

Procedures

Reported in Table 2 are the BQ items selected for analysis and the number of participants responding to each BQ item, along with the relevant alternate requirement. For the first alternate requirement, three BQ items judged to be related to the requirement were selected for

Table 2. Alternate Requirements and Related BQ Items

	Alternate Requirement	BQ Items
1.	Hold or have held an appropriate facility rating and have actively controlled air traffic in civilian or military ATC terminals or centers;	BQ33 – Do you have a prior Control Tower Operator Rating? (n= 9,354)
		BQ34 – Do you have a prior Air Traffic Control Specialist (ATCS) rating? (n=9,333)
		BQ35 – Do you have prior Instrument Flight Rules (IFR) operations experience? (n = 9,349)
2.	Hold or have held an FAA certificate as a dispatcher for an air carrier;	BQ 70 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Dispatch-air carrier. (n=9,339)
3.	Hold or have held an instrument flight rating;	BQ 65 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Instrument. (n=9,334)
4.	Hold or have held an FAA certificate as a navigator or have been fully qualified as a Navigator/Bombardier in the Armed Forces;	BQ 71 – Indicate whether or not you currently, or have ever, possessed any of the ratings/certificates/licenses: Navigator/Bombardier. (n=9,340)
5.	Have 350 hours of flight time as a copilot or higher and hold or have held a private certificate or equivalent Armed Forces rating;	BQ 56 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Private Pilot. (n=9,340)
		BQ 57 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Commercial Pilot. (n=9,339)

analysis. For Alternate Requirements 2-4, one BQ item per alternate requirement was selected for analysis. There were two relevant BQ items for Alternate Requirement 5.

Analyses

Independent chi-square analyses (Field, 2009) were performed to assess the extent to which the selected BQ items, operating as surrogates for the alternate requirements, were related to Academy training. The 2 X 2 contingency tables used in the chi-square analyses were based on prospective ATCSs indicating that they had or did not have the relevant experience and passed or did not pass the FAA Academy training. Not passing Academy training included either withdrawing before the end of training or failing training. Both withdrawing and failing the Academy were considered to be unsuccessful training outcomes. A binary logistic regression was also computed to develop a model of the BQ items best suited for predicting Academy training.

RESULTS

The results are presented by alternate requirement. The number of BQ items selected to assess each alternate requirement varies based on the number of relevant items available for analysis.

Alternate Requirement 1: Hold or have held an appropriate facility rating and have actively controlled air traffic in civilian or military ATC terminals or centers.

There were three items selected from the BQ as relating to Alternate Requirement 1. Each item reflects prior experience in a civilian or military ATC facility. Results are presented by BQ item.

Do you have a prior Control Tower Operator (CTO) Rating? Of the 9,354 respondents to this question, 8,408 did not have a CTO rating and 946 indicated that they had a CTO rating. The number of those who did not have a CTO rating and passed Academy training was 4,414 (52.5%), with 3,994 (47.5%) withdrawing or failing. The number of those who had a CTO rating and passed Academy training was 579 (61.2%), with 367 (38.8%) withdrawing or failing the Academy. The assumption for this and all other chi-square analyses reported in this study were met in that all frequencies, observed and expected, were greater than 5 (see Appendix A).
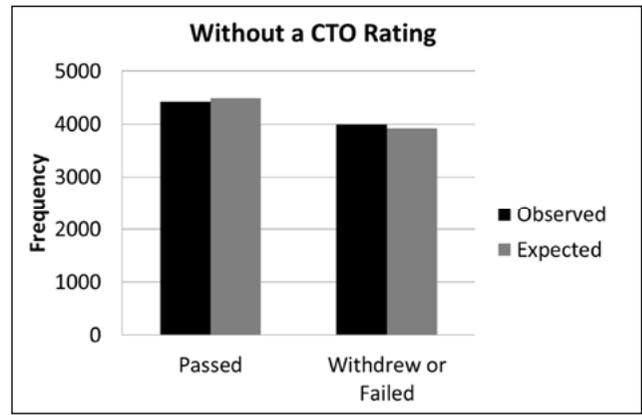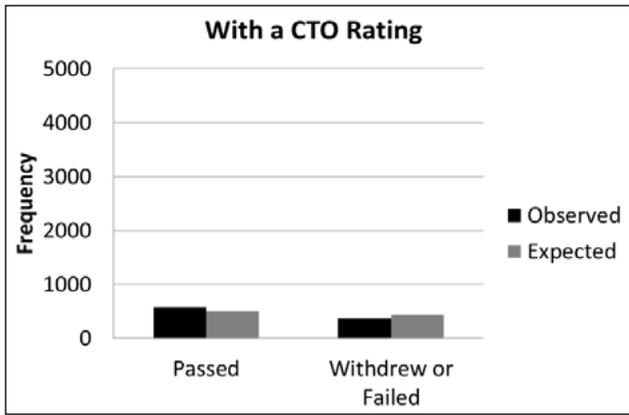
Figure 2. Observed and Expected Academy Training Performance With or Without a CTO Rating

The chi-square analysis indicated that there was a significant relationship between CTO rating and Academy training performance (χ^2 = 25.91, df = 1, Sig (p=.000)). As shown in Figure 2, respondents with a prior CTO rating passed more often than would be expected (579/505)and withdrew or failed less often than would be expected (367/441). The relationship was reversed for respondents without a prior CTO rating. They passed less often than would be expected (4,414/4,488) and withdrew or failed more often than would be expected (3,994/3,920).

Because these are categorical data, the effect size can be determined by calculating an odds ratio (Field, 2009). The steps in calculating an odds ratio are described below.

First, the odds that a person with a CTO rating would pass Academy training were determined by dividing the number of people with a CTO rating who passed Academy training by the number with a CTO rating who withdrew or failed. In this case, 579 people holding a CTO rating passed training, while 367 people holding a CTO rating withdrew or failed. Thus, the odds that a person with a CTO rating would pass Academy training were 1.58 to 1 (Eq. 1).

$$\text{Odds}_{\text{(Passing Academy Training with a CTO Rating)}} = \frac{\text{Number with a CTO rating who passed}}{\text{Number with a CTO rating who withdrew or failed}}$$
$$= \frac{579}{367}$$
$$= 1.58 \qquad\qquad \text{Eq. 1}$$

The next step is to calculate the odds that a person without (w/o) a CTO rating has of passing Academy training. This is done by dividing the number of people who did not have a CTO rating and passed by the number who did not have a CTO rating and withdrew or failed (4414/3994 = 1.11) . The odds that a person without a CTO rating will pass Academy training are 1.11 (Eq. 2).

$$\text{Odds}_{\text{(Passing Academy Training w/o a CTO Rating)}} = \frac{\text{Number w/o a CTO rating who passed}}{\text{Number w/o a CTO rating who withdrew or failed}}$$
$$= \frac{4414}{3994}$$
$$= 1.11 \qquad\qquad \text{Eq. 2}$$

The odds ratio is then calculated by dividing the odds of passing if one has a CTO rating by the odds of passing if one does not have a CTO rating (1.58/1.11 = 1.42; Eq. 3).

$$\text{Odds Ratio} = \frac{\text{Odds}_{\text{(Passing Academy Training with a CTO Rating)}}}{\text{Odds}_{\text{(Passing Academy Training w/o a CTO Rating)}}}$$
$$= \frac{1.58}{1.11}$$
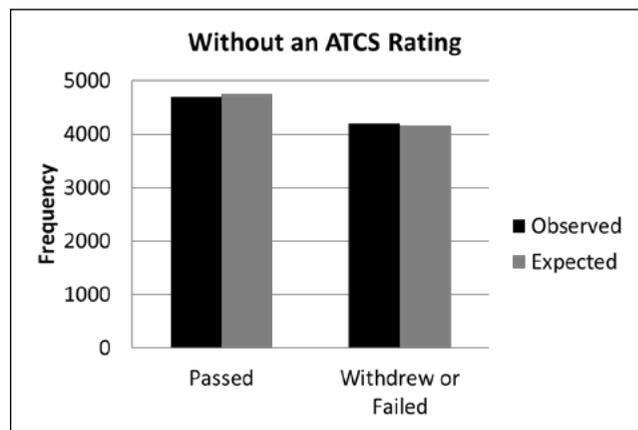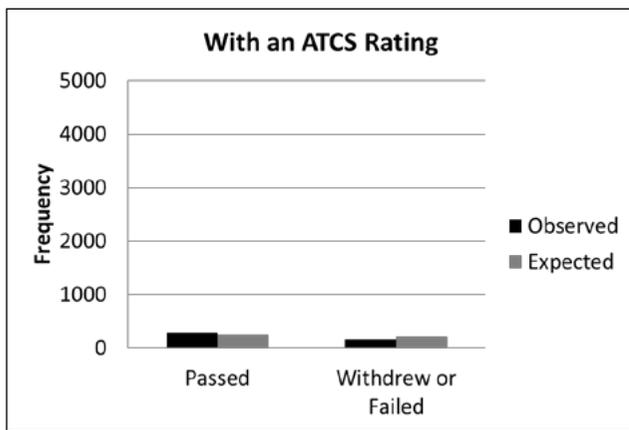$$= 1.42 \qquad\qquad \text{Eq. 3}$$

Figure 3. Observed and Expected Academy Training Performance With or Without an ATCS Rating
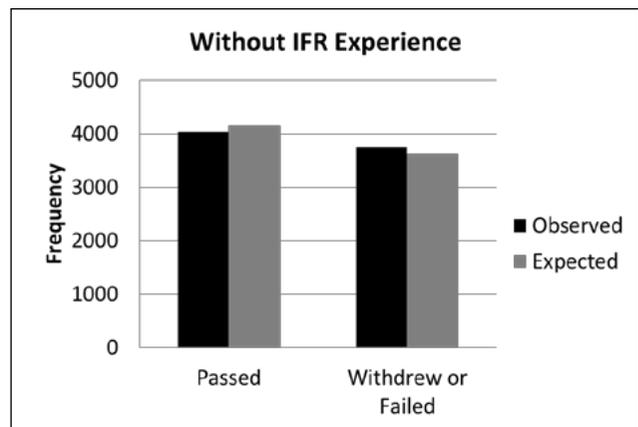

Figure 4. Observed and Expected Academy Training Performance With or Without IFR Experience

Thus, the odds that person with a CTO rating would pass Academy training was 1.42 times higher than if they had attended the Academy and did not have a CTO rating. This approach for calculating the effect size is used in all subsequent analyses in this study.

Do you have a prior Air Traffic Control Specialist (ATCS) rating? Of the 9,333 respondents to this question, 8,892 (95.3%) did not have a prior ATCS rating, and 441 (4.7%) indicated that they had a prior ATCS rating. The number of those who did not have a prior ATCS rating and passed Academy training was 4,696 (52.8%), with 4,196 (47.2%) withdrawing or failing. The number of those who passed Academy training with an ATC rating was 282 (63.9%), with 159 (36.1%) withdrawing or failing (see Appendix B).

The chi-square analysis indicated that there was a significant relationship between ATCS rating and Academy training performance ($\chi^2 = 20.93$, df = 1, Sig (p=.000)). As shown in Figure 3, respondents with a prior ATCS rating passed more than would be expected (282/235.2) and withdrew or failed less than would be expected (159/205.8). The relationship was reversed for respondents with no prior ATCS rating. They passed less

than would be expected (4,696/4,742.8) and withdrew or failed more than would be expected (4,196/4,149.2).

The odds that a person with a prior ATCS rating would pass Academy training were 1.58 times higher than if they had attended the Academy and did not have a prior ATCS rating.

Do you have prior IFR (Instrument Flight Rules) Operations experience? Of the 9,349 respondents to this question, 7,774 (83.2%) did not have IFR operations experience and 1,575 (16.8%) indicated that they had prior experience in IFR operations. The number of those who did not have IFR operations and passed Academy training was 4,031 (51.9%), with 3,743 (48.1%) withdrawing or failing. The number of those who had IFR operations experience and passed Academy training was 960 (61.0%), with 615 (39%) withdrawing or failing (see Appendix C).

The chi-square analysis indicated that there was a significant relationship between IFR operations experience and Academy training performance ($\chi^2 = 43.58$, df = 1, Sig (p=.000)). As can be seen in Figure 4, respondents with experience in IFR operations passed Academy training more than would be expected (960/840.8) and withdrew
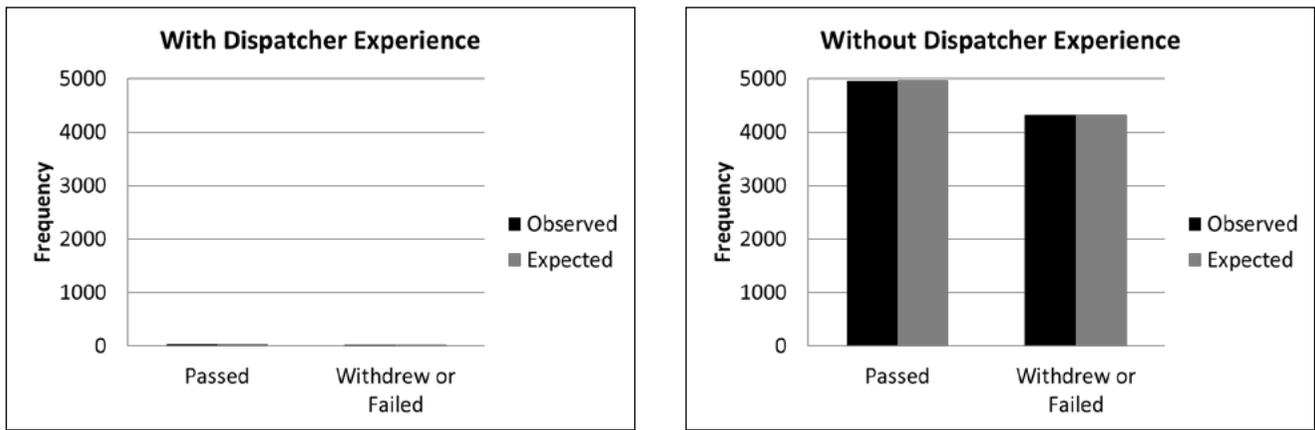
Figure 5. Observed and Expected Academy Training Performance With or Without Dispatcher Experience

or failed less than would be expected (615/734.2). The relationship was reversed for respondents with no experience in IFR operations. They passed Academy training less than would be expected (4,031/4,150.2) and withdrew or failed more than would be expected (3,743/3,623.8).

The odds that a person with IFR experience would pass Academy training were 1.44 times higher than if they had attended the Academy and did not have IFR experience.

Alternate Requirement 2. Hold or have held an FAA certificate as a dispatcher for an air carrier.

A single item on the BQ was found to reflect the second alternate requirement.

Indicate whether or not you currently, or have ever, possessed any of the ratings/certificates/licenses: Dispatch-air carrier. Of the 9,339 respondents to this question, 9,288 (99.5%) did not have a rating, certificate or license as a dispatch-air carrier and 51 (.5%) indicated that they currently had or had previously possessed a rating, certificate or license as a dispatcher for an air carrier. The number of those without a dispatch-air carrier rating, certificate or license and passed Academy training was 4,958 (53.4%), with 4,330 (46.6%) withdrawing or failing. The number of those with dispatch-air carrier experience who passed Academy training was 32 (62.7%), with 19 (37.3%) withdrawing or failing (see Appendix D).

The chi-square analysis did not show a significant relationship between having a rating, certificate or license as a dispatch-air carrier and Academy training performance (χ^2 = 1.79, df = 1, NS (p= .181)). Although difficult to see due to the small number of respondents with experience as a dispatch-air carrier, the pattern of responses

was similar to the pattern seen previously (see Figure 5). Respondents with a current or prior rating, certificate or license as a dispatch-air carrier passed slightly more often than would be expected (32/27.3) and withdrew or failed slightly less often than would be expected (19/23.7). The relationship was reversed for respondents with no rating, certificate or license as a dispatch-air carrier. They passed Academy training slightly less often than would be expected (4,958/4,962.7) and withdrew or failed Academy training slightly more often than would be expected (4,330/4,325.3). However, as stated previously, there was no significant relationship between having a rating, certificate or license as a dispatch-air carrier and Academy training performance.

Because the chi-square analysis was not significant, the odds ratio was not computed.

Alternate Requirement 3. Hold or have held an Instrument flight rating.

A single item on the BQ was found to reflect Alternate Requirement 3.

Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Instrument. Of the 9,334 respondents to this question, 8,919 (95.6%) did not have an Instrument rating, and 415 (4.4%) indicated that they currently had or previously had possessed an Instrument rating, certificate or license. The number of those who did not have an Instrument rating and passed Academy training was 4,732 (53.1%), with 4,187 (46.9%) withdrawing or failing the Academy. The number of those who had an Instrument rating and passed Academy training was 256 (61.7%), with 159 (38.3%) withdrawing or failing (see Appendix E).
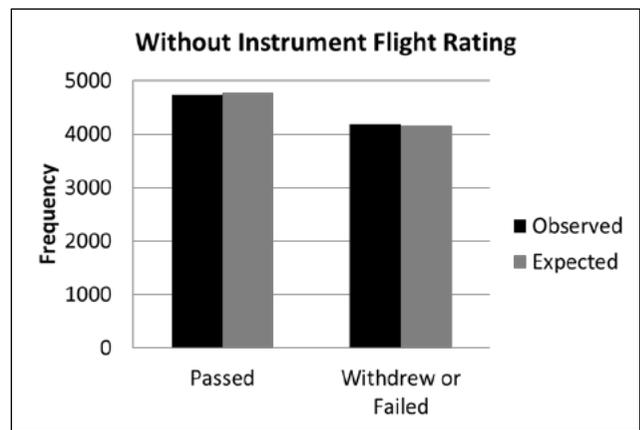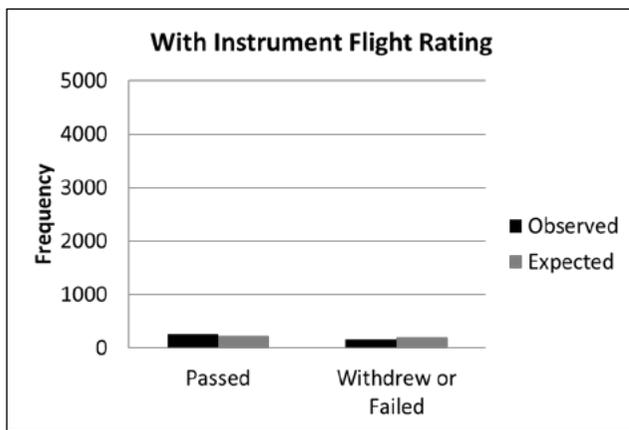
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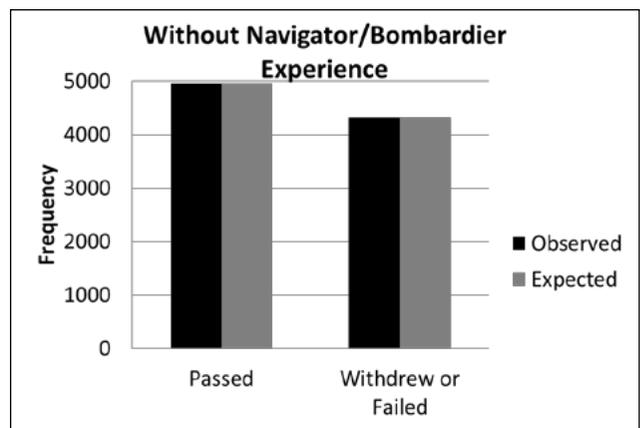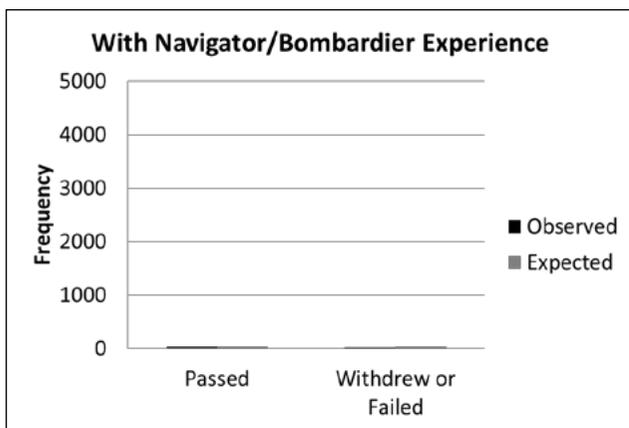Figure 6. Observed and Expected Academy Training Performance With or Without an Instrument Flight Rating

Figure 7. Observed and Expected Academy Training Performance With or Without Navigator/Bombardier Experience

The chi-square analysis indicated that there was a significant relationship between Instrument rating and Academy training performance (χ^2 = 11.87, df = 1, Sig (p=.001)). As can be seen in Figure 6, respondents with a current or prior Instrument rating passed more than would be expected (256/221.8) and withdrew or failed less than would be expected (159/193.2). The relationship was reversed for respondents with no current or prior Instrument rating. They passed less often than would be expected (4,732/4,766.2) and withdrew or failed more often than would be expected (4,187/4,152.8).

The odds that a person with a current or prior Instrument rating would pass Academy training were 1.42 times higher than if they had attended the Academy and did not have an Instrument flight rating.

Alternate Requirement 4. Hold or have held an FAA certificate as a navigator or have been fully qualified as a navigator/bombardier in the Armed Forces.

A single item on the BQ was found to reflect the fourth alternate requirement.

Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: navigator/bombardier. Of the 9,340 respondents to this question, 9,283 (99.4%) did not have a current or prior rating, certificate or license

as a navigator/bombardier, while only 57 (.6%) indicated that they currently had or had ever had a rating, certificate or license as a navigator/bombardier. Of those, the number who did not have a rating, certificate or license as a navigator/bombardier and passed Academy training was 4,955 (53.4%), with 4,328 (43.6%) withdrawing or failing. The number of those who had a current or prior rating, certificate or license as a navigator/bombardier and passed Academy training was 32 (56.1%), with 25 (43.9%) withdrawing or failing (see Appendix F).

The chi-square analysis did not show a significant relationship between having a current or prior rating, certificate or license as a navigator/bombardier and Academy training performance (χ^2 = .174, df = 1, NS (p= .677)). Although difficult to see due to the small number of respondents with experience as a navigator/bombardier, the pattern of responses was similar to the pattern seen previously (see Figure 7). Respondents with a rating, certificate or license as a navigator/bombardier passed slightly more often than would be expected (32/30.4) and withdrew or failed slightly less often than would be expected (25/26.6). The relationship was reversed for respondents without a rating, certificate or license as a navigator/bombardier. They passed slightly less often than would be expected (4955/4956.6)
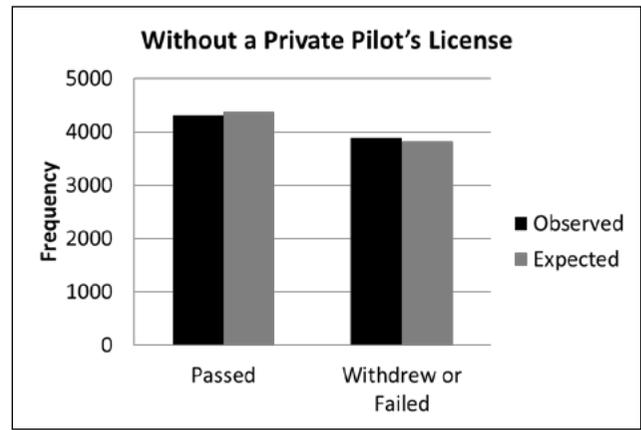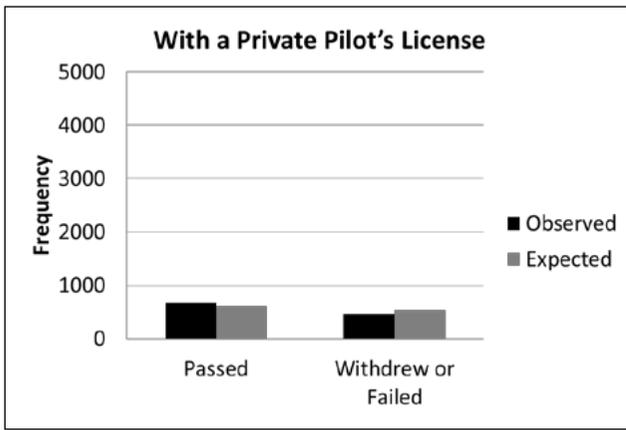
8

Figure 8. Observed and Expected Academy Training Performance With or Without a Private Pilot's Rating, Certificate or License

and withdrew or failed slightly more often than would be expected (4,328/4,326.4). However, as stated previously, there was no significant relationship between having a rating, certificate or license as navigator/bombardier and Academy training performance.

Because the chi-square analysis was not significant, the odds ratio was not computed.

Alternate Requirement 5. Have 350 hours of flight time as a copilot or higher and hold or have held a private certificate or equivalent Armed Forces rating.

Several items on the BQ could be used to assess Alternate Requirement 5. The BQ items of relevance asked if the prospective ATCS had a rating, certificate or license as a pilot for multiple types of platforms. Although number of hours flown was not addressed in the BQ item, for our purposes, we selected two items. The first addressed having a private pilot's rating, certificate or license. The second addressed having a commercial pilot's rating, certificate or license. The minimum flight time requirements for pilots are defined under Part 61, Title 14 of the Code of Federal Regulations (Electronic Code of Federal Regulations, 2011). For a private pilot, the minimum requirement is 40 hours of flight time; and for a commercial pilot, the minimum requirement is 250 hours.

Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Private Pilot. Of the 9,340 respondents to this question, 8,196 (87.8%) did not have a private pilot's license and 1,144 (12.2%) indicated that they currently or had previously possessed a rating, certificate or license as a private pilot. The number of those who did not have a private pilot's license and passed Academy training was 4,307 (52.6%), with 3,889 (47.4%)

withdrawing or failing. The number of those who had a private pilot's license and passed Academy training was 682 (59.6%), with 462 (40.4%) withdrawing or failing (see Appendix G).

The chi-square analysis indicated that there was a significant relationship between a private pilot's rating, certificate or license and Academy training performance (χ^2 = 20.14, df = 1, Sig (p=.000)). Figure 8 shows that respondents with a private pilot's rating, certificate or license passed more than would be expected (682/611.1) and withdrew or failed less than would be expected (462/532.9). The relationship was reversed for respondents without a private pilot's rating, certificate or license. They passed Academy training less than would be expected (4,307/4,377.9) and withdrew or failed more than would be expected (3,889/3,818.1).

The odds that a person with a private pilot's rating, certificate or license would pass Academy training were 1.33 times higher than if they did not have a private pilot's rating, certificate or license.

Indicate whether or not you currently or have ever possessed any of the ratings/certificates/licenses: Commercial Pilot. Of the 9,339 respondents to this question, 9,009 (96.5%) did not have a commercial pilot's license and 330 (3.5%) indicated that they currently or had previously possessed a rating, certificate or license as a commercial pilot. The number of those who did not have a commercial license and passed Academy training was 4,787 (53.1%), with 4,222 (46.9%) withdrawing or failing. The number of those who had a commercial pilot's license and passed Academy training was 201 (60.9%), with 129 (39.1%) withdrawing or failing the Academy (see Appendix H).
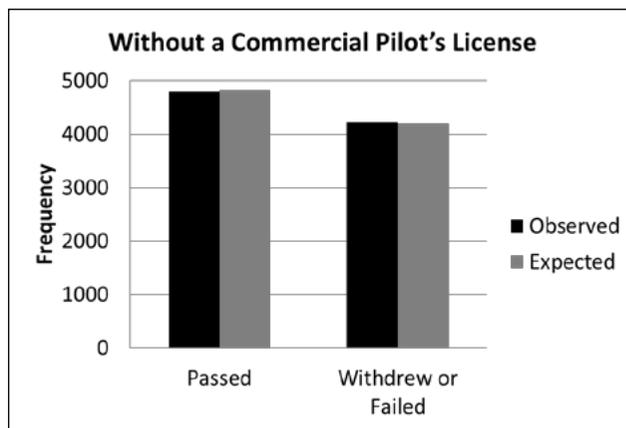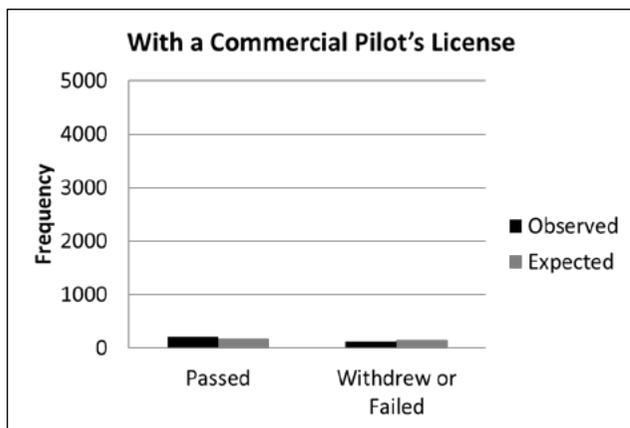
Figure 9. Observed and Expected Academy Training Performance With or Without a Commercial Pilot's Rating, Certificate or License

The chi-square analysis indicated that there was a significant relationship between having a commercial pilots rating, certificate or license and Academy training performance (χ^2 = 7.73, df = 1, Sig (p=.005)). As can be seen in Figure 9, respondents with a commercial pilot's rating, certificate or license passed Academy training more than would be expected (201/176.3) and withdrew or failed less than would be expected (129/153.7). The relationship was reversed for respondents without a commercial pilot's rating, certificate or license. They passed Academy training less than would be expected (4,787/4,811.7) and withdrew or failed more than would be expected (4,222/4,197.3).

The odds that a person with a commercial pilot's rating, certificate or license would pass Academy training were 1.38 times higher than if they had attended the Academy and did not have a commercial pilot's rating, certificate or license.

Logistic Regression

A logistic regression analysis was run to determine the relative weight of each of the BQ items in predicting Academy training performance. The eight items selected from the BQ as representing OPM alternate requirements for ATCS selection were entered into a logistic regression model using a forward stepwise (likelihood ratio) strategy. This method of entering the items into the model was selected because no theory exists regarding the relative merits of the experiences represented in the BQ items for predicting Academy training performance. Rather, our aim was to develop a prediction model using the best predictors from among the selected BQ items.

The same dataset used in the chi-square analyses was used in the logistic regression. There were 12,858 cases in the dataset, 9,273 (72.1%) included in the analysis. The initial model in the forward stepwise logistic regression was derived using only the constant in the regression equation. The initial model maximizes the prediction of Academy training performance based on the observed data. In our dataset, 4,956 prospective ATCSs passed and

4,317 withdrew or failed Academy training. Since more prospective ATCSs passed than withdrew or failed, the initial model predicted that all prospective ATCSs would pass Academy training. This model would correctly classify Academy training performance 53% of the time. At this stage in our analysis, none of the BQ items had been entered into the model. However, the residual chi-square statistic for the BQ items was 68.07 (p < .000), indicating that one or more of the BQ items, if added to the baseline model, would significantly affect the predictive power of the model (see Table 3).

The Rao's efficient score statistic (Score) for each of the BQ items is listed in Table 3. This statistic is used by SPSS to examine the significance of the potential predictors not in the model and to select the item that will be entered first into the model. As can be seen, all types of experience except experience as a dispatcher for an air carrier or as a navigator/bombardier had a significant Rao's efficient score statistic and could potentially make a contribution to the model. Having IFR operations experience had the highest Rao's efficient score statistic and was entered first into the model. Other items for inclusion in the model were selected based on their relative contribution given the other variables still not in the model and the contribution they could make, given the variables that had already been entered into the model.

Running the logistic regression using a forward stepwise (likelihood ratio) entry method resulted in a model with three variables. Shown in Table 4 is the log-likelihood statistic for each iteration of the model. The log-likelihood statistic of the model with only the constant was 12,811.039. As expected, the log-likelihood statistic decreased with each iteration of the model as the unexplained variance in the model decreased. However, the final log-likelihood statistic was still fairly large, indicating that even after fitting the best model possible from the data, there was a great deal of unexplained variance. This can also be seen by the relatively small amount the predictor variables contributed to the prediction of Academy training

Table 3. Step 0 – Variables Not in the Equation

Experience	Score	Degrees of Freedom	Significance
Dispatcher-Air Carrier	1.294	1	.255
IFR Operations	42.383	1	.000
Navigator/Bombardier	.310	1	.578
Private Pilot's License	20.996	1	.000
Commercial Pilot's License	7.218	1	.007
Instrument Rating	12.171	1	.000
CTO Rating	24.358	1	.000
ATCS	22.427	1	.000
Overall Statistics	68.071	8	.000

Table 4. Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1 IFR Operations	12,768.276[a]	.005	.006
2 Private Pilot's License	12,754.017[a]	.006	.008
3 ATCS Experience	12,746.806[a]	.007	.009

Table 5. Variables in the Equation

	B	S.E.	Wald	Degrees of Freedom	Significance	Exp(B)
Step 1						
IFR Operations	.370	.057	42.097	1	.000	1.447
Constant	.078	.023	11.634	1	.001	1.081
Step 2						
IFR Operations	.342	.057	35.384	1	.000	1.408
Private Pilot's	.246	.065	14.123	1	.000	1.279
License	.053	.024	4.970	1	.026	1.054
Constant						
Step 3	.274	.063	19.164	1	.000	1.315
IFR Operations	.260	.066	15.622	1	.000	1.296
Private Pilot's	.298	.112	7.100	1	.008	1.347
License	.049	.024	4.222	1	.040	1.050
ATCS						
Constant						

performance. Even the best model improved prediction over the constant by only .007 using the Cox & Snell R Square and .009, based on the Nagelkerke R Square.

The three significant predictors were IFR Operations experience, having a private pilot's license, and experience as an ATCS (see Table 5). The Wald statistics, which measures the extent to which the b coefficients were significantly different from 0, were significant for all three predictors, so we assume that all three are making a significant contribution to the prediction of who will pass Academy training (Table 5). Also shown in Table 5 is the odds ratio (Exp(B)) for each variable. All values were greater than 1, indicating that as the likelihood increased of the prospective ATCS having experience in IFR operations, a private pilot's license, or ATCS experience, the odds of passing Academy training also increased.

In Table 6, the 95% confidence interval (CI) for the odds ratios for each of the predictors in the model is presented. Limits of the CI for all predictors were greater than 1, indicating that if prospective ATCSs have experience in IFR operations, as a private pilot, or as an ATCS, they will be more likely to pass Academy training than if they have not had those experiences.

The remaining items did not make a significant improvement in predicting Academy training performance and were not included in the model.

Table 6. 95% Confidence Intervals (CI) for the Odds Ratio

	B(SE)	Lower	Odds Ratio	Upper
Included				
Constant	.049 (.024)			
IFR Operations Experience	.274 (.063)	1.163	1.315	1.487
Private Pilot's License	.260 (.066)	1.140	1.296	1.474
ATCS Experience	.298 (.112)	1.082	1.347	1.677

STUDY 2
METHOD

This study was conducted to assess the degree to which OPM Alternate Requirements 6-7 (see Table 1 for a complete listing of the OPM alternate requirements) listed in the OPM qualification standard for ATC Series 2152 were related to Academy training performance. Alternate Requirement 6 referred to having experience as a rated Aerospace Defense Command Intercept Director, but no BQ item could be identified as relating directly or indirectly to such experience. Similarly for Alternate Requirement 7, which referred to a pay schedule that is no longer used for ATCSs and a written test no longer taken by ATCS applicants, there were no objective data available to assess this requirement. Therefore, a qualitative approach based on interview data and a review of pertinent documents was used to assess these alternative requirements.

Participants

Military subject matter experts (SMEs) from the U.S. Air Force, U.S. Army, U.S. Navy, and U.S. Marine Corps with expertise in military ATC were interviewed to assess Alternate Requirement 6. Specialists in FAA human resources were also interviewed to assess Alternate Requirement 7.

Procedures

The military SMEs were asked to describe the selection, training, placement, and assessment of military air traffic controllers. They were also asked to identify any jobs within the military that required similar knowledge, skills, and abilities as an air traffic controller. FAA human resources personnel were interviewed and asked to describe the FAA ATCS applicant qualification process. Supporting military and civilian documentation was also reviewed.

RESULTS

Alternate Requirement 6

Have served as a rated Aerospace Defense Command Intercept Director. The Aerospace Defense Command Intercept Director was a previous job title within the U.S. Air Force, but the title of the job was changed to Aerospace Control and Warning Systems on 30 April 2007 and then on 01 December 2009 to the current title, Command and Control Battle Management Operations. The Air Force Specialty Code (AFSC) for this job is 1C5X1. AFSCs are a combination of numbers and letters used to identify a job specialty within the USAF. AFSC 1C5X1 is a classification code for an enlisted airman (AFECD, 2011).

Each position in the AFSC represents an identifier of the job with the combination of numbers and letters identifying a unique job within the USAF. A breakdown of the 1C5X1 AFSC is shown in Table 7. The first number identifies the career group. The 1 in the first position is for operations. The second position is the career field. The 1C indicates that this job is in the command and control systems operations career field. The third number combined with the first two characters of the AFSC indicates the career field subdivision. The fourth character, a number, identifies the skill level. An X is used to designate all skill levels. The fifth character, also numeric, combined with the other four numbers and letters, identifies the specific AFSC. AFSCs may also include a prefix or suffix (called a Shredout) to identify additional specialty information. For example, a senior airman with an AFSC of 1C5X1 who has received specialized training as a weapons director has the D suffix added to his or her specialty code (AFSC 1C5X1D). Each USAF job has both a title and an AFSC (Air Force Instruction 36-2101, 2010, June 14).

Detailed information on the duties and responsibilities of AFSC 1C5X1 as well as the required personnel qualifications are provided in the Air Force Enlisted Classification Directory (AFECD, 2011). The current AFECD (2011) is the official guide to the USAF enlisted classification code and is primarily used by USAF personnel officials and agencies engaged in procurement, classification, and training. The classification system used in the AFECD is detailed in Air Force Instruction 36-2101 (2010).

The AFSC 1C5X1 summary, duties and responsibilities, and qualifications have been updated with each title change, but basically the job has remained the same. AFSC 1C5X1 and 1C5X1D airmen are trained to work with deployed units to control air traffic during times of war

Table 7. Air Force Specialty Code Explained

Character	Identifiers	Example 1C5X1D
First Position (Numeric)	Career Group 1-Operations, 2-Logistics, 3-Support, 4-Medical or Dental, 5-Legal or Chaplain, 6-Acquisition or Finance, 7-Special Investigation, 8-Special Duty Identifier, 9-Reporting Identifier	1 Operations
Second Position Combined with First Character (Alpha)	Career Field	1C Command and Control Systems Operations
Third Position Combined with First and Second Character (Numeric)	Career Field Subdivision	1C5 Command and Control Battle Management Operations
Fourth (Numeric)	Skill Level of AFSC 1-Helper 3-Apprentice 5-Journeyman 7-Craftsman 9-Superintendent 0-Chief Enlisted Manager	1C5X X Represents All Skill Levels
Fifth Combined with Other Four Characters (Numeric)	Specific AFSC	1C5X1
Alpha Prefix or Suffix (Shredout)	Positions Associated With Particular Equipment or Functions Within a Single Specialty	1C5X1D Completion of Weapons Director Training

(J. Kirk, personal communication, August 24, 2010). In their role as wartime air traffic controllers, the airmen in Command and Control Battle Management Operations (1C5X1) control fighters, tankers, and bombers using both radar and procedural processes; they oversee air traffic during air-to-air combat and combat air refueling operations, and they keep track of aircraft during forced marshalling operations in which there are no pre-defined flight plans (D. Ennis, personal communication, January 18, 2011).

AFSC 1C5X1 is for enlisted airmen. However, there are also officers in this career field. Officer positions are identified with a separate AFSC (Air Force Instruction 36-2101, 2010). These positions include authorized codes, title, summary, duties and responsibilities, qualifications, and shredouts (if applicable) and are contained in the Air Force Officer Classification Directory (AFOCD, 2011). The officer AFSC – associated with the job title Command and Control Battle Management Operations is AFSC 13BX. Officers in Command and Control Battle Management Operations perform similar tasks as the enlisted personnel in AFSC 1C5X1, especially as company-grade

officers (first lieutenant, second lieutenant, and captain). They perform these duties from both ground and airborne platforms. However, as these officers are promoted to field grade (major, lieutenant colonel, and colonel), their jobs will likely shift from hands-on control to supervision and leadership (J. Kirk, personal communication, August, 24, 2010).

Military SMEs in ATC and Command and Control Battle Management Operations identified AFSC's 1C5X1, 1C5X1D, and 13BX as having similar training and skill requirements as the USAF ATC career field (1C1X1). Currently, there are no objective data to determine the relationship between having experience in Command and Control Battle Management Operations and civilian ATC performance, but the similarity of the jobs suggests that collecting additional data using the updated title for the career field to assess the relationship is warranted. Therefore, we recommend that an item be added to the BQ to assess the extent to which applicants with experience in Command and Control Battle Management Operations perform well in Academy training.

The Aerospace Defense Command Intercept Director was not a military position within any of the other services, and no other military jobs were identified by the military SMEs as having knowledge, skills, and abilities similar to those of an air traffic controller.

Alternate Requirement 7

Meet the requirements for GS-5 and pass the written test with an appropriately higher score. Alternate Requirement 7 was made irrelevant by changes to both the FAA pay scale for prospective ATCSs and testing requirements. The General Schedule (GS) pay scale system is no longer used to classify ATCSs. Prospective ATCSs are selected based on the vacancy announcement to which they apply. Each vacancy announcement details the criteria for selection, training requirements, and anticipated compensation level (R. Mitchell, personal communication, n.d.). While in training at the FAA Academy, all prospective ATCSs are placed on temporary excepted appointments and paid accordingly. Once training is completed, their salaries are determined based on the current ATC bargaining unit agreement, which reflects the previous experience of the new ATCS and the facility level to which the new hires are assigned.

The OPM written test is no longer used to qualify applicants under any ATCS hiring authority. Rather, some prospective ATCSs are now required to take and pass the Air Traffic–Selection and Training (AT-SAT) test to qualify for an ATCS position. Major sources for recruiting prospective ATCSs include the general public, graduates of an Air Traffic-Collegiate Training Initiative program, retired military controllers, Department of Defense civilian controllers, former FAA controllers seeking reinstatement, and VRA military controllers (Air Traffic Controller Occupational Handbook, 2003; Federal Aviation Administration, 2011). Vacancy announcements are written to target these populations or hiring sources. Of these potential hiring sources, applicants from the general public and AT-CTI graduates are required to take and pass the AT-SAT test. VRA and RMC applicants and former FAA and DOD controllers generally do not take AT-SAT or any other test for selection.

DISCUSSION

Revisions to the OPM qualification standard for the ATC Series 2152 occupation are required because the current qualification standard does not reflect changes that have been made in FAA practices and policies or military job classifications. There is also a need to assess the qualification standard as a predictor of ATCS performance in FAA Academy training: Do prospective ATCSs having the experiences covered by the qualification standard pass Academy training at a higher rate than those who have not had those experiences? This report addressed both requirements using a multi-method approach.

Alternate Requirements 1-5 were addressed by analyzing biographical data gathered from prospective ATCSs attending the FAA Academy from 1986-1992. Alternate Requirements 6 and 7 were assessed based on interviews with FAA human resources specialists and military subject matter experts and a review of personnel documents. A summary of the results are presented in Table 8. Recommendations for revising, retaining, or eliminating the OPM qualification standard for the ATC Series 2152 are presented below, by alternate requirement.

RECOMMENDATIONS

Alternate Requirement 1. Three items from the BQ were selected for use in determining the extent to which holding or having held an appropriate facility rating and having actively controlled air traffic in civilian or military ATC terminals or centers would predict performance of prospective ATCSs attending ATC training at the FAA Academy. All three items selected as representing Alternate Requirement 1 were found to be related to Academy training performance. Prospective ATCSs who indicated that they had or had held a CTO or ATCS rating or had IFR operations experience passed Academy training more than would be expected and withdrew or failed less than would be expected. In addition, two of the items – having an ATCS rating and experience in IFR operations – contributed significantly to the logistic regression model predicting Academy training performance. These results are supported by previous research, in which a consistent, significant relationship between ATC experience and Academy training performance (e.g., Collins, Nye, & Manning, 1990; VanDeventer et al., 1983) has been found. Based on these results, it is recommended that Alternate Requirement 1 be retained as an OPM alternate requirement and qualifying standard for ATCSs.

Alternate Requirement 2. One item from the BQ was selected for use in determining the extent to which holding or having held a FAA certificate as a dispatcher for an air carrier would predict Academy training performance. No relationship was found, although the trend was the same as seen for ATC experiences having a significant relationship. It is likely that the small number of respondents indicating that they had this type of experience influenced the result. Less than 1% of the 9339 respondents indicated that they had experience as a dispatcher for an air carrier in our sample of prospective ATCSs hired from 1986-1992. Thus there was no basis for making a clear recommendation for retaining, revising, or eliminating Alternate Requirement 2. In a review of current biographical data captured from a sample of prospective ATCSs, hired from 2003-2007, the number indicating that they have had experience as a dispatcher for an air carrier was 51 out of 1,308 respondents, or approximately 4%. Given the trend in the 1986-1992 dataset and the number of prospective ATCSs in a more recent dataset indicating that they have had experience as a dispatcher for an air carrier, it is recommended that Alternate Requirement 2 be retained as written in the OPM qualification standard.

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Table 8. Summary of Results

	Alternate Requirement	BQ Items	Results
1.	Hold or have held an appropriate facility rating and have actively controlled air traffic in civilian or military ATC terminals or centers; *Recommendation:* *Retain*	BQ33 – Do you have a prior Control Tower Operator Rating? (n= 9,354)	χ^2 = 25.91, df = 1, Sig (p=.000) Effect Size = 1.42
		BQ34 – Do you have a prior Air Traffic Control Specialist (ATCS) rating? (n=9,333)	χ^2 = 20.93, df = 1, Sig (p=.000) Effect Size = 1.58 Logistic Regression Model Predictor 3
		BQ35 – Do you have prior IFR operations experience? (n = 9,349)	χ^2 = 43.58, df = 1, Sig (p=.000) Effect Size = 1.44 Logistic Regression Model Predictor 1
2.	Hold or have held an FAA certificate as a dispatcher for an air carrier; *Recommendation:* *Retain*	BQ 70 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Dispatch-air carrier. (n=9,339)	χ^2 = 1.79, df = 1, NS (p= .181)
3.	Hold or have held an instrument flight rating; *Recommendation:* *Retain*	BQ 65 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Instrument. (n=9,334)	χ^2 = 11.87, df = 1, Sig (p=.001) Effect Size = 1.42
4.	Hold or have held an FAA certificate as a navigator or have been fully qualified as a Navigator/Bombardier in the Armed Forces; *Recommendation:* *Eliminate*	BQ 71 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Navigator/Bombardier (n=9,340)	χ^2 = .174, df = 1, NS (p= .677)
5.	Have 350 hours of flight time as a copilot or higher and hold or have held a private certificate or equivalent Armed Forces rating; *Recommendation:* *Revise/Retain*	BQ 56 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Private Pilot. (n=9,340)	χ^2 = 20.14, df = 1, Sig (p=.000) Effect Size = 1.33 Logistic Regression Model Predictor 2
		BQ 57 – Indicate whether or not you currently, or have ever possessed any of the ratings/certificates/licenses: Commercial Pilot. (n=9,339)	χ^2 = 7.73, df = 1, Sig (p=.005) Effect Size = 1.38
6.	Have served as a rated Aerospace Defense Command Intercept Director; *Recommendation:* *Revise/Retain*	No BQ items of relevance were identified.	Air Force Specialty Code Change to Command and Control Battle Management Operations
7.	Meet the requirements for GS-5 and pass the written test with an appropriately higher score. *Recommendation:* *Eliminate*	No BQ items of relevance were identified.	Hired as temporary excepted appointments, converted to ATCS pay scale at first duty station. OPM written test no longer required.

Alternate Requirement 3. Holding or having held an instrument flight rating was found to be related to Academy training performance based on an assessment of responses to one question on the BQ. More prospective ATCSs endorsing this BQ item passed Academy training than would be expected and withdrew or failed less than would be expected. Again, this finding is supported by previous research in which a significant relationship between prior ATC experience and Academy training performance was found consistently (e.g., Collins et al., 1990; VanDeventer et al., 1983). It is recommended that Alternate Requirement 3 be retained as an OPM alternate requirement and qualifying standard for ATCS.

Alternate Requirement 4. No significant relationship was found between holding or having held an FAA certificate as a navigator or having been fully qualified as a navigator/bombardier in the Armed Forces and Academy training performance, as assessed by a single item on the BQ. Again, the trend was the same as seen previously in that prospective ATCSs who indicated that they had experience as a navigator/bombardier passed Academy training more than would be expected and withdrew or failed less than would be expected. The number of respondents indicating that they had this experience, however, was very low, less than 1% of 9,349. In a review of a 2003-2007 dataset, this trend continued with only 6 of the 1,308 prospective ATCSs (again, less than 1%) indicating that they had experience as a navigator/bombardier. This item was subsequently dropped from later versions of the BQ. Deletion of the item was most likely due to the small number of respondents endorsing the item and, because as new items were added to the BQ, there was a need to delete other items to manage the length of the BQ (personal communication Dana Broach, July 5, 2011).

It is likely that advances in navigation and bomb guidance technology have significantly changed the job of navigator and navigator/bombardier, making this alternate requirement obsolete. At one time, the role of the military navigator/bombardier was to guide the airplane to a bombing target and release the aircraft's bomb load. However, the term navigator/bombardier is no longer used in military job classification of enlisted servicemen. The enlisted military job title that seems to be most closely aligned with the navigator/bombardier position is the aerial gunner (W. Melton, personal communication, 12 July, 2011). The USAF aerial gunner specialty code is the 1A7X1 and, as described in the AFECD (2011), the aerial gunner inspects, maintains in-flight, and operates airborne weapon systems. The aerial gunner performs aerial gunner functions based on the aircraft and mission type during integrated air or ground operations. Another example of a military aerial gunner is the U.S. Marine Corps military occupational specialty (MOS) 6199, enlisted aircrew/aerial observer gunner (Department of the Navy, Headquarters of the Marine Corps, Marine Corps Order 1200.17A, 2009). The MOS 6199 crewmembers act as aerial observers/gunners for U.S. Marine Corps helicopters and tilt-rotor

aircraft. There are no data to suggest, however, that the skills required to be an aerial gunner in today's military are the same as those required to be a navigator/bombardier.

Also, regardless of service, the aerial gunner does not act as a navigator. Job positions of military navigator that seem to be most closely related to the navigator/bombardier are performed by military officers. In the USAF and as described in the AFOCD (2011), navigation is performed by the combat systems officers within the operations career field and naval flight officers within the U.S. Navy and Marine Corps (Department of the Navy, 2009). For example, the USAF bomber combat systems officer (12BX) is an aircraft crewmember whose duties include navigating the aircraft and operating navigation systems to accomplish assigned missions. As described in the AFOCD (2011), the bomber combat systems officer must know flight theory, air navigation, meteorology, flying directives, aircraft operation procedures, and mission tactics. The U.S. Marine Corps manual of MOSs describes the naval flight officer as a member of an aircraft crew with the responsibility to assist in the employment of the aircraft's offensive and defensive weapons (Department of the Navy, 2009). Both the combat systems officer and the naval flight officer support aviation operations. No similar positions were found in the other services. Again, however, there are no data to suggest that the skills required today to be a combat systems officer or naval flight officer are the same skills required by navigator/bombardiers.

Given the small number of prospective ATCSs who had experience as a navigator or navigator/bombardier in two samples (1986-1992 and 2003-2007) and changes to the military classification of navigator/bombardier, it is recommended that Alternate Requirement 4 be eliminated as an OPM alternate requirement and qualifying standard for ATCSs. If retained, however, it is recommended that Alternate Requirement 4 be revised to eliminate the term bombardier. It is also recommended that if Alternate Requirement 4 is revised and retained, a question be added to the BQ regarding experience as a navigator. Response rates to the BQ question should be monitored to reassess the relationship between experience as a navigator and Academy training performance.

Alternate Requirement 5. Two items from the BQ were used to assess Alternate Requirement 5. The items addressed having a private or commercial pilot's license but did not specify number of hours of flight time. Since both items were significantly related to Academy training performance, it is recommended that Alternate Requirement 5 be revised to eliminate the need for 350 hours of flight time and then retained. This recommendation is consistent with previous findings in which level of pilot rating or number of hours flown were not related to Academy attrition (Cobb & Nelson, 1974). If Alternate Requirement 5 is retained to include the 350 hours of flight time, it is recommended that an item be added to the BQ to reassess the relationship between number of hours of flight time and Academy training performance.

Alternate Requirement 6. There were no objective data to assess the relationship between Academy training performance and having served as a rated Aerospace Defense Command Intercept Director. It is recommended, based on discussions with USAF subject matter experts (D. Ennis, personal communication, August 24, 2010, 2011; J. Kirk, personal communication) and a review of job classification descriptions, that alternate requirement 6 be revised and retained. Further, it is recommended that an item be added to the BQ to assess experience in wartime ATC and that the relationship with Academy training performance be analyzed.

Alternate Requirement 7. It is recommended that Alternate Requirement 7 be eliminated. Changes in pay schedules and testing procedures have made this alternate requirement obsolete.

Limitations. A possible limitation of this research was the data used were gathered more than 20 years ago. As mentioned previously, there is some evidence to suggest that prospective ATCSs hired between 1986 and 1992 are similar to those hired today (Cannon & Broach, 2011). However, there were also differences in how the participants used in this research and current ATCS candidates were trained. During the 1986-1992 timeframe, training was used as a screening process to identify and eliminate ATCS candidates who did not have the potential to become fully certified ATCSs (Della Rocco, 1998). Assignment to a facility was made only after the candidates successfully completed the screening process. Today, ATCS candidates are assigned to a facility before they enter the Academy. Candidates with no experience in ATC attend a course in the basics, followed by an initial course specific to their assigned option of terminal, en-route, or terminal radar control (TRACON). Experienced candidates and graduates of an accredited AT-CTI program do not attend the basics course, but rather begin Academy training with the initial course. It is unclear what impact the differences in training may have had on our results. Additional research may be warranted to validate the results of this study.

Additional research might be possible over the next few years because the number of prospective ATCSs being hired is increasing as those ATCSs hired after the PATCO strike become retirement eligible. The FAA hired 998 new controllers in 2010 and is projected to hire more than 20,000 new controllers between 2011 and 2020 (FAA, 2011). There is an opportunity, with many new ATCSs entering the workforce, to collect biographical data to both reevaluate the recommendations made in this research, as well as to identify other predictors of Academy training performance. These predictors may also include personality dimensions. As noted by Schroeder et al. (1998), there will be an increased emphasis on coordination and shared decision making in future ATC systems, which may result in personality dimensions such as teamwork emerging as a significant predictor of ATCS performance.

Another limitation is the use of Academy training performance as the criterion in our analyses. Civil Aerospace Medical Institute (CAMI) researchers are working to develop outcome criteria based on on-the-job training and later job performance. Current research efforts are underway to identify and collect data from ATCSs as they advance through the stages of on-the-job training and become certified professional controllers. Although it is important to select ATCSs who can pass FAA Academy training, our ultimate aim is to select ATCSs who will be successful on the job.

Conclusion. The OPM qualification standard for the ATC Series 2152 was reviewed and recommendations made to retain, revise and retain, or eliminate each of the seven alternate requirements. Where possible, recommendations were made based on an analysis of data gathered from students attending ATC training at the FAA Academy between 1986 and 1992. If no data were available, recommendations were made based on interviews with subject matter experts or review of pertinent documents.

Alternate Requirements 1-3 were recommended for retention as written in the OPM qualification standard. Two recommendations were made for Alternate Requirement 4. First, it was recommended for elimination, but if retained, it should be revised to reflect an accurate military job title. Alternate Requirements 5-6 were recommended for revision and retention. Alternate Requirement 7 was recommended for elimination.

A final recommendation is that a longitudinal study be initiated to investigate the revisions made to the OPM qualification standard for the ATC Series 2152 and to identify additional biographical and personality predictors of successful performance in ATC training at the FAA Academy and for on-the-job training and performance. This research is needed to identify both the most useful predictors and the most relevant criteria to influence personnel selection decisions. This recommendation is also consistent with recommendations made by the FAA's Independent Review Panel (IRP) on air traffic controller selection, assignment, and training (Barr, Brady, Koleszar, New, Pounds, 2011). The IRP, which was convened by the FAA Administrator in 2011, reviewed selection, assignment, and training of ATCSs and made a number of recommendations for use as a roadmap to improve workforce effectiveness. In their recommendations, the IRP recognized the importance of tracking selectees by hiring source from selection through full qualification as certified professional controllers. Thus, the use of longitudinal studies to review and revise selection processes will continue to be an integral component of the FAA's process for selecting and qualifying ATCS candidates.

REFERENCES

Air Force Enlisted Classification Directory (AFECD) (2011, April 30). The official guide to the Air Force enlisted classification codes. HQ AFPC/DPSIDC.

Air Force Officer Classification Directory (AFOCD) (2011, April 30). The official guide to the Air Force officer classification codes. HQ AFPC/DPSIDC.

Air Force Instruction 36-2101 (2010, June 14). Personnel, Classifying Military Personnel (Officer and Enlisted). Retrieved from http://www.e-publishing. af.mil/

Air Traffic Controller Occupational Handbook (2003, July). *Personnel policies and guidance.* Prepared by: Office of the Assistant Administrator for Human Resource Management (AHR). Washington, DC: Federal Aviation Administration.

Aul, J.C. (1998). Current FAA controller workforce demographics future requirements, and research questions. In D. Broach (Ed.), *Recovery of the FAA air traffic control specialist workforce, 1981-1992* (pp. 3-6). (Report No. DOT/FAA/AM-98/23). Washington, DC: FAA Office of Aviation Medicine.

Barr, M., Brady, T., Koleszar, G., New, M., & Pounds, J. (2011). FAA Independent Review Panel on the Selection, Assignment and Training of Air Traffic Control Specialists, Final Report. Washington, DC: Federal Aviation Administration.

Cannon, M.M., & Broach, D. (2011). *Studies of next generation air traffic control specialists: Why be an air traffic controller?* (Report No. FAA-AM-11-12). Washington, DC: FAA Office of Aerospace Medicine.

Cobb, G.G., & Nelson, P.L. (1974). *Aircraft-pilot and other pre-employment experience as factors in the selection of air traffic controller trainees* (Report No. FAA-AM-74-8). Washington, DC: FAA Office of Aviation Medicine.

Collins, W.E., Nye, L.G., & Manning, C.A. (1990). *Studies of post strike air traffic control specialist trainees: III. Changes in demographic characteristics of Academy entrants and biodemographic predictors of success in air traffic controller selection and Academy screening* (Report No. DOT-FAA-AM-90-4). Washington, DC: FAA Office of Aviation Medicine.

Della Rocco, P. (1998). FAA Academy air traffic control specialist: screening programs and strike recovery. In D. Broach (Ed.), *Recovery of the FAA air traffic control specialist workforce, 1981-1992* (pp. 43-51). (Report No. DOT/FAA/AM-98/23). Washington, 0DC: FAA Office of Aviation Medicine.

Department of the Navy Headquarters United States Marine Corps (2009, June 4). Marine Corps Order 1200.17A, Military occupational specialties manual. Washington, DC: U.S. Government Printing Office.

Electronic Code of Federal Regulations (e-CFR). Part 61 Certification: Pilots, Flight Instructors, and Ground Instructors, Subpart F Commercial Pilots. US Code of Federal Regulations, Federal Aviation Regulations. Retrieved from http://ecfr.gpoaccess.gov/cgi/t/text/ text-idx?c=ecfr&sid=40760189a03dfea0b501608f3 3820a45&rgn=div5&view=text&node=14:2.0.1.1 .2&idno=14#14:2.0.1.1.2.6

Farmer, W.L. (2002). *Characteristics of biodata keys as function of scaling method, sample size, and criterion.* (Unpublished doctoral dissertation). Norman, OK: University of Oklahoma.

Federal Aviation Administration (2011). A plan for the future: 10-year strategy for the air traffic control workforce 2011-2020. Retrieved from http://www. faa.gov/air_traffic/publications/controller_staffing/ media/CWP_2011.pdf

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). London: SAGE.

Manning, C.A., & Aul, J.C. (1992). *Evaluation of an alternate method for hiring air traffic control specialists with prior military experience* (Report No. DOT/ FAA/AM-92/5). Washington, DC: FAA Office of Aviation Medicine.

Office of Personnel Management (2009, August). Introduction to the Position Classification Standards, TS-134 July 1995, TS-107 August 1991, Revised August 2009. Retrieved from www.opm.gov/fedclass/gsintro.pdf

Schroeder, D.J., Broach, D., & Farmer, W.L. (1998). Current FAA controller workforce demographics, future requirements, and research questions. In D. Broach (Ed.), *Recovery of the FAA air traffic control specialist workforce, 1981-1992* (pp. 43-51). (Report No. DOT/FAA/AM-98/23). Washington, DC: FAA Office of Aviation Medicine.

United States Code (2006). Title 10, Chapter 139, Sec. 2366a. Washington, DC: US Government Printing Office.

VanDeventer, A.D., Taylor, D.K., Collins, W.E., & Boone, J.O. (1983). *Three studies of biographical factors associated with success in air traffic control specialist screening/training at the FAA Academy* (Report No. DOT/FAA/AM-83/6). Washington, DC: FAA Office of Aviation Medicine.

			CTO Rating		Total
			No	Yes	
Academy Status	Withdrew or Failed	Count	3994	367	4361
		Expected Count	3920.0	441.0	4361.0
		% within Academy			
		Status F/P	91.6%	8.4%	100.0%
		% within CTO Rating	47.5%	38.8%	46.6%
		% of Total	42.7%	3.9%	46.6%
		Std. Residual	1.2	-3.5	
	Passed	Count	4414	579	4993
		Expected Count	4488.0	505.0	4993.0
		% within Academy			
		Status F/P	88.4%	11.6%	100.0%
		% within CTO Rating	52.5%	61.2%	53.4%
		% of Total	47.2%	6.2%	53.4%
		Std. Residual	-1.1	3.3	
Total		Count	8408	946	9354
		Expected Count	8408.0	946.0	9354.0
		% within Academy			
		Status F/P	89.9%	10.1%	100.0%
		% within CTO Rating	100.0%	100.0%	100.0%
		% of Total	89.9%	10.1%	100.0%

| | | | ATCS Rating | | |
			No	Yes	Total
Academy Status	Withdrew or Failed	Count	4196	159	4355
		Expected Count	4149.2	205.8	4355.0
		% within Academy			
		Status F/P	96.3%	3.7%	100.0%
		% within ATCS Rating	47.2%	36.1%	46.7%
		% of Total	45.0%	1.7%	46.7%
		Std. Residual	.7	-3.3	
	Passed	Count	4696	282	4978
		Expected Count	4742.8	235.2	4978.0
		% within Academy			
		Status F/P	94.3%	5.7%	100.0%
		% within ATCS Rating	52.8%	63.9%	53.3%
		% of Total	50.3%	3.0%	53.3%
		Std. Residual	-.7	3.1	
Total		Count	8892	441	9333
		Expected Count	8892.0	441.0	9333.0
		% within Academy			
		Status F/P	95.3%	4.7%	100.0%
		% within ATCS Rating	100.0%	100.0%	100.0%
		% of Total	89.9%	10.1%	100.0%

			IFR Ops		Total
			No	Yes	
Academy Status	Withdrew or Failed	Count	3743	615	4358
		Expected Count	3623.8	734.2	4358.0
		% within Academy			
		Status F/P	85.9%	14.1%	100.0%
		% within IFR Operations	48.1%	39.0%	46.6%
		% of Total	40.0%	6.6%	46.6%
		Std. Residual	2.0	-4.4	
	Passed	Count	4031	960	4991
		Expected Count	4150.2	840.8	4991.0
		% within Academy			
		Status F/P	80.8%	19.2%	100.0%
		% within IFR Operations	51.9%	61.0%	53.4%
		% of Total	43.1%	10.3%	53.4%
		Std. Residual	-1.8	4.1	
Total		Count	7774	1575	9349
		Expected Count	7774.0	1575.0	9349.0
		% within Academy			
		Status F/P	83.2%	16.8%	100.0%
		% within IFR Operations	100.0%	100.0%	100.0%
		% of Total	83.2%	16.8%	100.0%

			Dispatch-Air Carrier		Total
			No	Yes	
Academy Status	Withdrew or Failed	Count	4330	19	4349
		Expected Count	4325.3	23.7	4349.0
		% within Academy Status F/P	99.6%	.41%	100.0%
		% within Dispatch-Air Carrier	46.6%	37.3%	46.6%
		% of Total	46.4%	.2%	46.6%
		Std. Residual	.1	-1.0	
	Passed	Count	4958	32	4990
		Expected Count	4962.7	27.3	4990.0
		% within Academy Status F/P	99.4%	.6%	100.0%
		% within Dispatch-Air Carrier	53.4%	62.7%	53.4%
		% of Total	53.1%	.3%	53.4%
		Std. Residual	-.1	.9	
Total		Count	9288	51	9339
		Expected Count	9288.0	51.0	9339.0
		% within Academy Status F/P	99.5%	.5%	100.0%
		% within Dispatch-Air Carrier	100.0%	100.0%	100.0%
		% of Total	99.5%	.5%	100.0%

| | | | Instrument Rating | | Total |
			No	Yes	
Academy Status	Withdrew or Failed	Count	4187	159	4346
		Expected Count	4152.8	193.2	4346.0
		% within Academy			
		Status F/P	96.3%	3.7%	100.0%
		% within Instrument Rating	46.9%	38.3%	46.6%
		% of Total	444.9%	1.7%	46.6%
		Std. Residual	.5	-2.5	
	Passed	Count	4732	256	4988
		Expected Count	4766.2	221.8	4988.0
		% within Academy			
		Status F/P	94.9%	5.1%	100.0%
		% within Instrument Rating	53.1%	61.7%	53.4%
		% of Total	50.7%	2.7%	53.4%
		Std. Residual	.5	2.3	
Total		Count	8919	415	9334
		Expected Count	8919.0	415.0	9334.0
		% within Academy			
		Status F/P	95.6%	4.4%	100.0%
		% within Instrument Rating	100.0%	100.0%	100.0%
		% of Total	95.6%	4.4%	100.0%

			IFR Ops		
			No	Yes	Total
Academy Status	Withdrew or Failed	Count	4328	25	4358
		Expected Count	4326.4	26.62	4358.0
		% within Academy Status F/P	99.4%	.6%	100.0%
		% within Navigator/Bombardier	46.6%	43.9%	46.6%
		% of Total	46.3%	.3%	46.6%
		Std. Residual	.0	-.3	
	Passed	Count	4955	32	4991
		Expected Count	4956.6	30.4	4991.0
		% within Academy Status F/P	99.4%	.6%	100.0%
		% within Navigator/Bombardier	53.4%	56.1%	53.4%
		% of Total	53.1%	.3%	53.4%
		Std. Residual	.0	.3	
Total		Count	9283	57	9349
		Expected Count	9283.0	57.0	9349.0
		% within Academy Status F/P	99.4%	.6%	100.0%
		% within Navigator/Bombardier	100.0%	100.0%	100.0%
		% of Total	99.4%	.6%	100.0%

			IFR Ops		
			No	Yes	Total
Academy Status	Withdrew or Failed	Count	3889	462	4351
		Expected Count	3818.1	532.9	4351.0
		% within Academy			
		Status F/P	89.4%	10.6%	100.0%
		% within Private Pilot	47.4%	40.4%	46.6%
		% of Total	41.6%	4.9%	46.6%
		Std. Residual	1.1	-3.1	
	Passed	Count	4307	682	4989
		Expected Count	4377.9	611.1	4989.0
		% within Academy			
		Status F/P	86.3%	13.7%	100.0%
		% within Private Pilot	52.6%	59.6%	53.4%
		% of Total	46.1%	7.3%	53.4%
		Std. Residual	-1.1	2.9	
Total		Count	8196	1144	9340
		Expected Count	8196.0	1144.0	9340.0
		% within Academy			
		Status F/P	87.8%	12.2%	100.0%
		% within Private Pilot	100.0%	100.0%	100.0%
		% of Total	87.8%	12.2%	100.0%

			IFR Ops		
			No	Yes	Total
Academy Status	Withdrew or Failed	Count	4222	129	4351
		Expected Count	4197.3	153.7	4351.0
		% within Academy Status F/P	97.0%	3.0%	100.0%
		% within Commercial Pilot	46.9%	39.1%	46.6%
		% of Total	45.2%	1.4%	46.6%
		Std. Residual	.4	-2.0	
	Passed	Count	4787	201	4988
		Expected Count	4811.7	176.3	4988.0
		% within Academy Status F/P	96.0%	4.0%	100.0%
		% within Commercial Pilot	53.1%	60.9%	53.4%
		% of Total	41.3%	2.2%	53.4%
		Std. Residual	-.4	1.9	
Total		Count	9009	330	9339
		Expected Count	9009.0	330.0	9339.0
		% within Academy Status F/P	96.5%	3.5%	100.0%
		% within Commercial Pilot	100.0%	100.0%	100.0%
		% of Total	96.5%	3.5%	100.0%