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Operational Use of the Air Traffic Selection and Training Battery

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16. Abstract

The Federal Aviation Administration (FAA) is commencing a massive hiring of air traffic control specialists using a new selection procedure, the Air Traffic Selection and Training (AT-SAT) computerized test battery. Before AT-SAT could be used for hiring purposes, however, the issue of its potential for adverse impact (potential unfair discrimination) had to be addressed. A previous project (Wise, Tsacoumis, Waugh, Putka, & Hom, 2001) reweighted the subtests and adjusted the overall constant to mitigate potential group differences that could result in adverse impact, without unduly compromising validity. A subsequent study (Dattel & King, 2006) used research participants and found that this effort appeared to have achieved its goal of mitigating group differences that could result in adverse impact. The present study endeavors to: 1) describe how AT-SAT functions as an operational selection method with respect to the several applicant pools, and 2) determine how the reweighting effort fares with actual applicants in the goal of reducing/eliminating group differences that could result in adverse impact. Of the 854 applicants who have taken AT-SAT as part of a job application process (rather than as according to a research protocol), 219 applicants (25.64%) voluntarily disclosed their race; gender was known for 253 (29.63%). The results suggest that the reweighting effort is paying dividends as group differences that could result in adverse impact are not in evidence. While the initial numbers reported here are relatively small, the issue of group differences that could result in adverse impact will be continually monitored. Longitudinal validation, comparing AT-SAT results to training and on-the-job performance, is a research priority due to concerns about the overall passing rate of 93.33%, which is higher than the expected passing rate of 67%.

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Operational Use of the Air Traffic Selection and Training Battery

A Plan for the Future: The FAA's 10-Year Strategy for the Air Traffic Control Workforce was submitted to the U.S. Congress in December 2004. This report, generally referred to as the *Controller Workforce Plan* (FAA, 2004), provides the outline to mitigate anticipated controller retirements and contemplates strategies to achieve appropriate staffing levels, including hiring 12,500 controllers over the next decade. The present paper focuses on the current status of the recently[1] implemented Air Traffic Selection and Training (AT-SAT) selection test battery, focusing specifically on the functioning of the reweighted AT-SAT and the potential for group differences that could result in adverse impact.[2] The data in this paper represent the first time operational (collected for selection purposes rather than research) AT-SAT data are being reported.

How did the staffing situation become so urgent? As detailed in the *Controller Workforce Plan*, a majority of the air traffic controller workforce went on strike on August 3, 1981, when President Ronald Reagan ordered the striking controllers to return to duty within 48 hours. When 10,438 (out of a workforce of approximately 15,000) striking controllers did not return to work by the deadline, President Reagan fired them. Facing a sudden shortage of controllers, the Federal Aviation Administration (FAA) hired 3,416 individuals in 1982 and another 1,720 in 1983. From 1982 through 1991, the FAA hired an average of 1,527 individuals per year. The majority of entrants met the 18 to 30 years-of-age entry requirement.

The post-strike hiring wave created the potential for a large portion of the controller workforce to reach retirement age at roughly the same time, particularly due to the FAA policy requiring retirement from controlling air traffic by age 56. Based on current projections, 73% of the agency's 15,000 controllers will become eligible to retire within ten years. Total losses are expected to reach nearly 11,000 (FAA, 2005). This amount of attrition means that the FAA must use effective recruitment, selection, and training procedures to ensure that its staffing needs are met. The AT-SAT battery, now the official Civil Service test used to select FAA air traffic control specialists (ATCSs) without previous operational air traffic control experience, will thus become an instrument of increasing importance.

The development and validation of AT-SAT plays a critical role in reducing costs associated with attrition from air traffic control training. Using a valid selection test also ensures that those who are hired have (or have the potential to develop) the necessary knowledge, skills, and abilities to be successful. The duties of ATCSs make them individually responsible for more lives than the practitioners of any other occupation in the United States (Biggs, 1979). The FAA developed the AT-SAT battery to replace a two-stage selection process in which ATCS applicants completed an Office of Personnel Management (OPM) test battery and a nine-week screening program at the FAA Academy in Oklahoma City, OK. This previous selection process proved to be expensive (Ramos, Heil, & Manning, 2001a). AT-SAT was developed based on the results of the Separation and Control Hiring Assessment (SACHA; Nickles, Bobko, Blair, Sands, & Tartak, 1995) job task analysis, which drew heavily from previous work done by Ammerman, Becker, Jones, Tobey, and Phillips (1987). Additional development and validation efforts for AT-SAT were described by Ramos, Heil, and Manning (2001a & 2001b) in their two-volume report.

AT-SAT is a select-in procedure; select-out (medical) issues will not be addressed in this paper. Readers interested in select-out issues are referred to King, Retzlaff, Detwiler, Schroeder, and Broach (2003). AT-SAT is a computerized test battery comprised of eight subtests based on 22 individual scores that, when weighted (forming "part scores") and combined, are totaled (with a constant added) for a single overall score. As delineated in Table 1, AT-SAT is comprised of the following subtests: *Air Traffic Scenarios Test*, *ATST; Analogies*, *AY*; *Angles*, *AN*; *Applied Math*, *AM*; *Dials*, *DI*; *Experiences Questionnaire*, *EQ*; *Letter Factory*, *LF; and Scan*, *SC*. AT-SAT is an aptitude test and not a test of air traffic control knowledge. The goal of AT-SAT is to predict the likelihood of success in air traffic control training and, more importantly, subsequently on the job. Seven of the eight subtests assess aspects of cognitive ability, while one, *EQ,* assesses issues in the personal history/personality realm. Four (*ATST*, *AY, LF, SC*) of the subtests are dynamic; they are interactive and

[1]AT-SAT was approved as the official ATCS selection test for those applicants without previous air traffic control experience on May 13, 2002, with June 2002 marking the first time the test was used operationally.

[2]Adverse Impact – "A selection rate for any race, sex, or ethnic group which is less than 4/5 (80%) of the rate for the group with the highest rate." (Uniform Guidelines on Employee Selection Procedures, 1978, Sec 4D.)

Table 1. The eight AT-SAT subtests.

Subtest	Description
Dials (DI)	Scan and interpret readings from a cluster of analog instruments
Applied Math (AM)	Solve basic math problems as applied to distance, rate, and time
Scan (SC)	Scan dynamic digital displays to detect targets that regularly change
Angles (AN)	Determine the angle of intersecting lines
Letter Factory (LF)	Participate in an interactive dynamic exercise that requires categorization skills, decision making, prioritization, working memory (incidental learning), and situation awareness
Air Traffic Scenarios (ATST)	Control traffic in interactive, dynamic low-fidelity simulations of air traffic situations requiring prioritization
Analogies (AY)	Solve verbal and nonverbal analogies that require working memory and the ability to conceptualize relationships
Experience Questionnaire (EQ)	Respond to Likert scale questionnaire about life experiences

can only be administered via computer. The remaining four are static, similar to pencil-and-paper tests, but are administered via computer.

During the development of AT-SAT, subtests were weighted to yield the maximum validity, according to their relationship to the job, as suggested by the job task analysis. An individual's performance on each subtest is multiplied by the weight developed for that subtest, and a constant is subtracted to ensure that each subtest has a floor of zero. The net result is a "part score." Part scores are then summed and combined with an additional, overall constant (composed of a summation of the inverse of the individual constants and a calibrating constant) to yield the overall AT-SAT score (which is truncated to have a maximum score of 100). Veteran's preference points (either five or ten points) are *subsequently* added. This overall score is the only one that enters into the hiring decision when AT-SAT is used in an operational fashion. Subtest weights are not disclosed in this paper as they could be used as part of a coaching strategy to artificially inflate AT-SAT scores in an effort to gain a competitive advantage.

Before operational use of AT-SAT was approved for hiring purposes, FAA employees that were members of minority groups raised concerns over potential adverse impact. Recall that adverse impact is a selection rate for any race, sex, or ethnic group that is less than 4/5 (80%) of the rate for the group with the highest rate. To calculate this ratio, the pass rate of the group of interest serves as the numerator, while the pass rate of the group with the highest pass rate serves as the denominator. Eighty percent serves as the bright line; a quotient below 80% suggests a potential for adverse impact, while one equal to or greater than 80% argues against it. The concern about the potential for adverse impact against African Americans seemed well founded, as only three out of every 100 black applicants were predicted to achieve a score of at least 70 (the minimum passing score – termed a "qualifying score") on AT-SAT. Nevertheless, as the predictive validity was .69, a case could be made for "business necessity." Business necessity is a defense available when the employer has a criterion for selection that is facially neutral but excludes members of one sex, race, or national origin at a substantially higher rate than members of other groups (thus creating adverse impact). The employer must then prove that its selection requirement having the adverse impact is job-related, typically as demonstrated by a job analysis.

To appreciate the wider context, the reader needs to understand that the issue went beyond pass rates for minority applicants. By original design, 38% of fully certified incumbent FAA controllers would not pass AT-SAT under the original scoring scheme. The original passing score of 70 had been calibrated, using the overall constant, so that only 62% of incumbent fully certified controllers would achieve an AT-SAT score of 70 or more, in an effort to minimize FAA Academy failures and compensate for the need for ATCSs to perform

potentially more difficult duties in the future. The goal was to at least preserve and strive to improve the level of functioning in the workforce (Waugh, 2001).

In response to concerns about group differences that could result in adverse impact, FAA officials requested that scientists review the options to mitigate these differences. Meanwhile, they emphasized maintaining the overall validity of the AT-SAT battery. Additionally, FAA management made the case that the cut score should be set at the point where most fully qualified, incumbent controllers would pass FAA's entry-level aptitude test. Consequently, the AT-SAT subtests were re-weighted, and the overall constant was adjusted. The new weights were developed as a trade-off between their validity and their contribution to group differences that could lead to adverse impact. The content of the subtests themselves was not changed; rather, the subtests were weighted differently. The goal was to retain adequate validity while reducing potential adverse impact. Test validity (job-relatedness) is determined by the strength of the correlation between the overall AT-SAT score and en route controller job performance measures (which, in the AT-SAT validation study, consisted of a computerized situational judgment test assessing maximum performance, plus peer and supervisor ratings of typical performance). After reweighting, the correlation between AT-SAT and a job performance composite measure was reduced slightly, from .69 to .60 (Wise, Tsacoumis, Waugh, et al., 2001). Compared with most validation coefficients, this is still a strong correlation with job performance. As indicated above, the relationship with job performance is especially important in this context; any remaining adverse impact can be justified by business necessity, as previously defined above.

Using data from the original validation studies, Wise et al. (2001) found that, by reweighting the subtests and adjusting the overall constant (as described above), they eliminated group differences that could result in potential adverse impact for women and Hispanics and greatly reduced it for African Americans. Wise, et al. concluded their report with a cautionary statement about the uncertainty of how the reweighting might function with actual applicants, to include the impact on overall pass rates. A primary purpose of the present paper is to examine how this reweighting functioned operationally to eliminate group differences that could result in adverse impact.

To further address the potential problem of adverse impact, FAA officials decided to abandon a strict "top-down" approach to hiring and, instead, use a category ranking method. This approach is a form of "score banding" that can be justified on the basis of ignoring score differences that are due to an estimate of the applicant's true ability. Score banding, although somewhat controversial among selection scientists, "will almost always produce less adverse impact than strict rank ordering" (Biddle, 2005, p. 103) as it ignores score differences likely to be statistically insignificant. Under this scheme, job fair applicants who achieve a qualifying minimum score are divided into two groups: those scoring 85 and above (termed "well qualified") and those scoring from 70 to 84.9 (termed "qualified"). Those in the "well-qualified" group will be offered employment before anyone in the "qualified" group. AT-SAT data in this paper are therefore reported according to these categories.

Dattel and King (2006) applied the weights and additive constant developed to address potential adverse impact to the scores of 724 developmental ATCSs, hired by a previous method, who volunteered to take AT-SAT. An average increase of 4.86 points was found with the new scoring method; the notional passing rate, based on achieving an AT-SAT score of 70 or more, changed from 58.8% to 80%. American Indian/Alaskan Native, Hispanic, and black participants (categories are as defined on the Race and National Origin Form) showed the greatest average increase in overall scores: 6.97, 6.98, and 7.02 respectively, representing increases in pass rates of 22.2% (77.8% to 100%), 35.1% (51.9% to 87%), and 35.2% (37% to 72.2%), respectively.

While this analysis of data collected from research participants was encouraging, the real standard is to determine how a selection instrument functions with actual applicants. That opportunity has presented itself with the commencement of increased hiring and universal use of AT-SAT to hire candidates without previous air traffic control experience.

Sources of ATCS Applicants without Previous Controlling Experience

The Air Traffic - Collegiate Training Initiative (AT - CTI) program and job fairs are two authorities used to hire personnel without previous experience controlling air traffic. The AT - CTI program is a partnership between the FAA and 14 aviation colleges/universities to provide the academic preparation necessary for students interested in ATCS careers. Enrollment in, and even completion of, a AT - CTI program in no way obligates the FAA to hire the student, and the FAA typically does not test these students until near the completion of their studies. AT - CTI school officials decide whether to recommend a student to the FAA for AT-SAT testing, and hence, hiring consideration.

Not all job fair applicants are permitted to take the AT-SAT due to the time required (a full day) and the cost (about $800) of administering it. Selection for AT-SAT testing was previously based on a random selection process but is now based on responses to a biographical

questionnaire. Job fair applicants compete with each other in order to be hired at a specific facility. Not every job fair applicant who achieves a qualifying score will be offered employment. Consequently, it is possible that a job fair applicant who scores only in the "qualified" range will not be offered employment. Similarly, AT - CTI applicants who score in the "well qualified" range are referred for positions before applicants who score in the "qualified" range.

The third pool of applicants also did not have previous air traffic control experience but were unique in that they took both the paper and pencil Office of Personnel Management (OPM) test and AT-SAT. Members of this group had passed the OPM test several years previously but were not admitted into the nine-week screening program due to reduced staffing requirements at the time. Since hiring was reduced after they passed the OPM test, but before they could complete the screening program, they had to take AT-SAT at a later time and could not be hired without a passing AT-SAT score (≥70). This group is also unique due to the amount of time that had elapsed before they were finally considered to be hired and their two tiers of testing.

Other Applicant Pools

There are other applicant pools for ATCS positions, including former military and Department of Defense civilian controllers. These groups will not be described in detail in this paper as they do not have to take AT-SAT and are considered for employment based on their previous operational experience controlling air traffic.

METHOD

Operational results (i.e., AT-SAT scores collected from applicants who competed on the basis of taking AT-SAT) were analyzed in terms of race, ethnic, and gender group membership, considered by hiring authority.

Participants

From June 2002 to June 2006, 854 applicants took AT-SAT as part of their job application process. Applicants either 1) responded to a job fair announcement (soliciting applicants for a specific position), 2) were nearing completion of one of the 14 AT - CTI programs, or 3) had previously passed the OPM test and had to achieve a passing score on AT-SAT before they were admitted into training at the FAA Academy. All applicants were requested to voluntarily complete the Race and National Origin (RNO) form (OPM Form 1468 until October 2005, FAA Form 3330-64 thereafter) to ascertain their racial/ethnic group membership. Self-identification of gender was new to FAA Form 3330-64; previously, that information was solicited through a variety of means. Of 854 job applicants, gender was known for 253 (29.63%). RNO data are discussed in the Results section, as they derive directly from the self-report forms.

RESULTS

Of the 854 job applicants, 219 (25.64%) disclosed their race on the form in use at the time of their application. Total counts for race/national origin groups and gender are depicted in Table 2.

Table 2. RNO Results.

RNO	Count
1.) American Indian or Alaska Native	1
2.) Asian (Asian or Pacific Islander previous to Oct 2005)	12
3.) Black or African American (Black, not of Hispanic Origin previous to Oct 05)	23
4.) Hispanic or Latino (Hispanic previous to Oct 05)	8
5.) Native Hawaiian or Other Pacific Islander (Was represented under #2 previous to Oct 05)	1
6.) White	174
Gender	
Male	212
Female	41

Table 3 displays AT-SAT pass rates (those who achieved a score ≥ 70) with respect to self-reported RNO group membership, segmented by hiring authority.

Collapsing across applicant pools, the sole American Indian/Alaska Native applicant passed and the sole Native Hawaiian/Other Pacific Islander passed; 11 of 12 (91.67%) Asian applicants passed; 18 of 23 (78.26%) black applicants passed; 7 of 8 (87.5%) Hispanic applicants passed; and 169 of 174 (97.13%) white applicants passed. Ignoring the two smallest groups (due to their extremely small *n*), the ratio of the group with the lowest passing rate (black/African American) compared to the group with the highest passing rate is 80.57 (78.26/97.13), just above the 80% threshold, suggesting that AT-SAT did not, as yet, exhibit group differences that could result in adverse impact.

As the concept of adverse impact is also concerned with gender differences, the data were also examined by gender, again according to hiring authority. Table 4 displays AT-SAT pass rates (those who achieved a score ≥ 70) with respect to gender, segmented by hiring authority.

Collapsing applicant pools, 203 of 212 men (95.75%) passed and 38 of 41 women (92.68%) passed. The ratio here is 96.79 (92.68/95.75) suggesting that AT-SAT did not exhibit a gender difference with a potential for adverse impact.

Table 5 delineates the results of the overall population of 854, by hiring source. The overall pass rate of 93.3% rate is higher than the 67% predicted in the *Controller Workforce Plan* (FAA, 2004).

Table 3. RNO Group AT-SAT differences, considered by hiring source.

Self-reported RNO Membership	Applicant Pool	Failed - scored below 70		Qualified - scored 70-85		Well Qualified - scored > 85		Total Passing – ≥ 70	
		Count	Row %	Count	Row %	Count	Row %	Count	Row %
1.) American Indian or Alaska Native	OPM/ATSAT					1	100.0%	1	100.0%
2.) Asian (Asian or Pacific Islander previous to Oct 2005)	CTI			2	66.7%	1	33.3%	3	100.0%
	Job Fair	1	14.3%	3	42.9%	3	42.9%	6	85.7%
	OPM/ATSAT					2	100.0%	2	100.0%
3.) Black or African American (Black, not of Hispanic Origin previous to Oct 05)	CTI	2	14.3%	6	42.9%	6	42.9%	12	85.7%
	Job Fair	3	42.9%	4	57.1%			4	57.1%
	OPM/ATSAT			2	100.0%			2	100.0%
4.) Hispanic or Latino (Hispanic previous to Oct 05)	CTI	1	20.0%	4	80.0%			4	80.0%
	Job Fair			1	33.3%	2	66.7%	3	100.0%
5.) Native Hawaiian or Other Pacific Islander (Was represented under #2 previous to Oct 05)	Job Fair					1	100.0%	1	100.0%
6.) White	CTI	3	3.9%	20	26.0%	54	70.1%	74	96.1%
	Job Fair			14	41.2%	20	58.8%	34	100.0%
	OPM/ATSAT	2	3.2%	20	31.7%	41	65.1%	61	96.8%
Total		12	5.5%	76	34.7%	131	59.8%	207	94.5%

Table 4. Gender AT-SAT differences, considered by hiring source.

Gender	Applicant Pool	Failed - scored below 70		Qualified – scored 70-85		Well Qualified - scored > 85		Total Passing - ≥ 70	
		Count	Row %	Count	Row %	Count	Row %	Count	Row %
Male	CTI	4	4.5%	30	34.1%	54	61.4%	84	95.5%
	Job Fair	2	4.8%	16	38.1%	24	57.1%	40	95.2%
	OPM/ATSAT	3	3.7%	19	23.2%	60	73.2%	79	96.3%
Female	CTI	3	13.6%	6	27.3%	13	59.1%	19	86.4%
	Job Fair			3	75.0%	1	25.0%	4	100.0%
	OPM/ATSAT			7	46.7%	8	53.3%	15	100.0%
Total		12	4.7%	81	32.0%	160	63.3%	241	95.3%

Table 5. Overall AT-SAT results, considered by hiring source.

Applicant Pool	Failed - scored below 70		Qualified – scored 70-85		Well Qualified – scored > 85		Total Passing - ≥ 70	
	Count	Row %	Count	Row %	Count	Row %	Count	Row %
CTI	34	6.9%	178	35.9%	284	57.3%	462	93.1%
Job Fair	20	7.7%	109	41.8%	132	50.6%	241	92.3%
OPM/ATSAT	3	3.2%	26	26.8%	68	70.1%	94	96.9%
Total	57	6.7%	313	36.7%	484	56.7%	797	93.3%

DISCUSSION AND CONCLUSION

After years of validation efforts (Ramos, Heil, & Manning, 2001a & 2001b), AT-SAT is finally being used as an operational selection tool for ATCSs, coinciding with the increased hiring that has already begun. This study focused primarily on AT-SAT's performance in selecting applicants of various racial/ethnic backgrounds. The outcome found in this study is very different than the 3% passing rate predicted under the original weighting scheme for black applicants, for example. There was also no evidence of any potential adverse impact with respect to gender. Therefore, while AT-SAT appears to be functioning as projected by Wise et al. (2001) in terms of reduced group differences that could result in adverse impact, the higher than expected pass rates may be of concern. The next step is to conduct longitudinal validation to determine how well AT-SAT predicts success in training and on-the-job performance.

The increased ATCS hiring will serve to populate the RNO and gender cells if applicants voluntarily provide the data. Group differences that could result in adverse impact will be continually monitored. The value of considering the data by hiring source is to suggest strategies to mitigate group differences, should they arise. Recall that AT-SAT scores are used differently depending on the hiring authority under which an applicant applies. Therefore, even though the present study is more realistic than previous efforts that used research data, a more thorough understanding could be afforded by an examination of applicants who are actually offered employment. In an effort to increase the voluntary participation rate, future applicants should be encouraged to complete their RNO forms so that a more accurate picture of the applicants can be achieved and group differences can be more readily detected. It will also be necessary to assess the potential for adverse impact of subsequent selection procedures, to include considering who is actually offered employment.

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