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Air traffic control is a highly technical occupation that requires emotional stability, considerable aptitude, and lengthy training. Identifying those individuals with the greatest potential to capitalize on training is a major interest of air traffic organizations around the world, particularly when considering limited resources. This paper compares and contrasts several selection systems, to include their development, continuing validation, and in one case, demise. In the erstwhile, two-stage US Federal Aviation Administration (FAA) selection process, applicants completed the written Office of Personnel Management (OPM) test battery and a nine-week screening program at the FAA Academy in Oklahoma City, OK. The eventual replacement to this system, the Air Traffic Selection and Training (AT-SAT) computerized test battery, is now used to assess aptitude for air traffic control duties. The US Navy and Air Force's use of composites from the Armed Services Vocational Aptitude Battery (ASVAB) is next explored. The computerized battery employed by EUROCONTROL, termed the First European Air traffic Selection Test (FEAST), is then considered. FEAST is used by many European countries to complement their existing selection methods. To the delight of researchers worldwide, users are required to agree to assist in the continuing validation of FEAST. Finally, the approach used by SHL Canada to recruit and select trainees for NAV CANADA Air Traffic Control positions using a variety of cognitive ability and personality measures is described, including the associations found between cognitive measures, ability tests, and performance in both initial and on-the-job training.

Worldwide, air traffic control organizations are interested in the development and validation of selection instruments. Staffing the air traffic control (management) occupation typically requires a sizeable number of applicants from which to select the most promising candidates for training. Valid selection techniques play a critical role in reducing costs associated with attrition from training programs. Validation ensures that those who are hired have (or are likely to develop) the necessary knowledge, skills, and abilities to perform successfully on the job.

The interest of the Federal Aviation Administration (FAA) in longitudinal research to improve controller selection dates back to before the establishment of the institution currently charged with this task (Brokaw, 1959, Trites, 1961), today's Civil Aerospace Medical Institute. The FAA has refined its air traffic control specialist (ATCS) selection process to improve its ability to select (select-in) candidates with the right aptitude and motivation to control air traffic and to identify (select-out) candidates possessing a potential medical risk to successful occupational functioning. The FAA developed the Air Traffic Selection and Training (AT-SAT) aptitude battery to replace a two-stage selection process in which ATCS applicants completed a written Office of Personnel Management (OPM) test battery, which included the Multiplex Controller Aptitude Test (MCAT), the Abstract Reasoning Test, and the Occupational Knowledge Test (OKT), and a nine-week performance-based screening program at the FAA Academy in Oklahoma City, OK.

Hiring Surges

There was an urgent need to recruit, screen, and hire large groups of applicants to train to control air traffic after President Ronald Reagan fired 10,438 striking FAA ATCSs (out of a workforce of about 15,000) in 1981. It cost about $200 per person to administer the OPM test; and about another $10,000 for the screening program. While this selection procedure was relatively expensive, it was very effective at reducing the training time before failure occurred. Previously, 38% of ATCS hires left the FAA between 2-3 years into field training (Manning, Kegg, & Collins, 1989). After the screening program was implemented (but before the 1981 strike), the total loss rate was still 38%, but 30% occurred at the Academy and only 8% during training. After the strike, total losses increased to about 50% with 40% occurring at the Academy and only 10% in field training. The FAA's cost for providing three years of ATC training was about $100,000. Thus, while the overall financial cost of this selection procedure was relatively high, it was lower than paying to train candidates who were ultimately unsuccessful.

Facing a sudden shortage of controllers, the 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. As these ATCSs are now completing their careers and preparing to retire, there is again a need to recruit, screen, select, and train thousands of ATCSs over the course of a decade. AT-SAT is the tool that will be used to select the majority of these new ATCSs.

Air Traffic Selection and Training (AT-SAT)

AT-SAT was developed based on the results of the Separation and Control Hiring Assessment (SACHA; Nickles, Bobko, Blair, Sands, & Tartak, 1995) job analysis of the duties of the ATCS options. The SACHA job analysis reviewed the existing ATCS job analysis literature. After reviewing and summarizing existing job analysis information, the SACHA project staff visited sites to observe controllers at en route and terminal facilities. Subject-matter experts (SMEs) also were questioned about the qualities they considered necessary for effective job performance. The worker requirements determined necessary for the ATCS job were then used to design a series of self-administering computerized tests to assess the ability of applicants to perform these tasks.

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 an overall constant added) for an overall score. 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 was to gauge 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 can only be administered via computer. The remaining four are static, similar to pencil-and-paper tests, but are administered via computer in AT-SAT.

Applicant Pools

AT-SAT is used to assess the aptitude of College Training Initiative applicants and those who are being assessed after they respond to a job announcement. There are several applicant categories whose members do not have to take and pass AT-SAT to be considered for employment. Military controllers and Department of Defense civilian controllers are included in this category as well as former PATCO controllers who are eligible for rehire since President Clinton lifted the ban on their employment on August 12, 1993. These applicants are by no means automatically hired; they are just exempt from having to take AT-SAT. The process the US military services use for entry into the air traffic control career field will be described in a subsequent section of this paper. All applicants must pass medical screening after receiving a conditional offer of employment, to include clearing a psychological assessment. That assessment, which is evolving from the 16 Personality Factor test (16 PF, as outlined in King, Retzlaff, Detwiler, Schroeder, & Broach, 2003) to the Minnesota Multiphasic Personality Inventory-2 (MMPI-2) will not be described here.

ATCS Career Field Options

As alluded to above, there are two options in the ATCS occupational series: terminal and en route. Terminal controllers can be further divided into two groups: tower cab and TRACON. Currently, AT-SAT is not used for placement decisions; scores are not used to assign successful applicants to en route centers or terminal facilities. There is growing interest in determining if AT-SAT can be effective in placing new hires into options as well as deciding what level facility (indicating the degree of complexity of the air traffic environment) in which an applicant can most effectively be placed. Such decisions may not be solely based on overall AT-SAT scores, rather subtest scores may be considered.

Future Directions in FAA Research

Other future research plans include a longitudinal validation: comparing performance on the AT-SAT with success in training and on the job. The ultimate goal of research with AT-SAT is to ensure that those selected to enter the ATCS career field possess (or will develop) the necessary knowledge, skills, and abilities to ensure that air traffic moves in a safe and expeditious manner.

US Military ATC Selection

Applicants for US military enlistment and job classification are required to take the Armed Services Vocational Aptitude Battery (ASVAB). The ASVAB consists of nine subtests that assess verbal, math, and spatial ability as well as job knowledge. The subtests are General Science (GS), Arithmetic Reasoning (AR), Word Knowledge (WK), Paragraph Comprehension (PC), Auto and Shop Information (A/S), Mathematics Knowledge (MK), Mechanical Comprehension (MC), Electronics Information (EI), and Assembling Objects (AO). The subtests are not used separately, but rather are combined into aptitude composites. The Armed Forces Qualification Test (AFQT = AR + 2WK + 2PC + MK) score is used for entry into all branches of the US military regardless of job specialty. The minimum qualifying AFQT percentile score for enlistment qualification varies by service. For the US Air Force (USAF) the minimum AFQT percentile score is 36.

Each US military service develops its own aptitude composites for their job specialties. The USAF groups its enlisted jobs into four broad categories (Mechanical, Administrative, General, and Electronics or MAGE). Enlisted ATC candidates must qualify on the General (G) composite

Entry into the USAF ATC career field requires passing a flight physical and a Reading Aloud Test, vision correctable to 20/20, and a minimum percentile score of 53 on the ASVAB General (G) composite (G = WK + PC + AR).

Upon completion of basic military training, USAF ATC students attend an apprentice training course at Keesler AFB, MS. The course includes instruction in air traffic controller fundamentals, control tower operations, radar approach control operations, and control tower operation certification. The fourth block consists of administration of the FAA ATC certification test that must be passed successfully to graduate from apprentice-level training (Department of the Air Force, 1996).

Carretta and Siem (1999) examined the predictive validity of the ASVAB composites versus enlisted USAF ATC training performance. The sample consisted of 1,069 USAF enlisted personnel who entered ATC training between 1990-1995. The training criteria included a dichotomous pass/fail score and final school grade. The graduation rate was 75.2%. After correction for range restriction (Lawley, 1943), the correlation between the ASVAB General composite and pass/fail training and final school grade were .391 and .569, respectively. When all four USAF composites were used (M, A, G, and E), the multiple correlations with pass/fail and final school grade were .465 and .595 after correction for range restriction.

Similar results have been obtained with US Navy enlisted ATC students (Held, 2006; Held & Johns, 2002). The US Navy allows ATC applicants to qualify for training on either of two composites, the Air Traffic Control composite (WK + PC + MK + MC + CS[1]) or the Nuclear composite (WK + PC + AR + MK + MC). In a

[1] Coding Speed (CS) was an ASVAB subtest on an earlier form that is no longer in operational use. The US Navy administers CS as a special test.

sample of 269 US Navy ATC students, Held (2006) reported validities of .72 and .74 for the Nuclear and Air Traffic control composites versus final school grade after correction for range restriction.

The USAF and US Navy are conducting a validation of the FAA AT-SAT battery for enlisted ATC training. About 1,000 enlistees were tested on the AT-SAT prior to entering training. The USAF currently is collecting training performance data, but the US Navy has completed its data collection and validation effort. The US Navy validation sample consisted of 79 trainees with final school grades. Results indicated that the validity of the AT-SAT Air Traffic Scenario Test (ATST) subtest r = .520) was comparable to the US Navy ASVAB ATC composite (r = .476) and incremented the validity of the ASVA by .048. Despite its incremental validity, the length of the AT-SAT ATST subtest may preclude its operational use as an adjunct to the ASVAB (J. D. Held, personal communication, 15 September 2006). Additional analyses will be conducted once the USAF training criteria data have been collected.

EUROCONTROL

The computerized battery employed by EUROCONTROL, termed the First European Air traffic Selection Test (FEAST) is then considered. FEAST is used by many European countries to complement their existing selection methods. To the delight of researchers worldwide, users are required to agree to assist in the continuing validation of FEAST.

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Conclusion

Research into the effectiveness of selection methods for entry into air traffic control training continues to evolve, both in the U.S. and around the world. Despite the seeming dissimilarities across selection systems, psychologists and operational personnel worldwide recognize that validated selection instruments are valuable tools. Organizations differ in the emphasis they place on personality measures at the expense of cognitive measures. What is valid for one setting may or may not translate to another setting. Continuing validation of selection instruments and methods, is therefore an ongoing process. While the methods of practice across organizations and nations may vary, the goals are identical: enhanced efficiency and safety.

Research into the comparative effectiveness of the selection tools for entry into air traffic control training is currently on the threshold of a major collaborative effort: the comparison of FAA selection methods to those used by the U.S. military services. A major goal of the current paper and panel discussion is an effort to extend this collaborative effort across international boundaries. There is growing interest in the U.S. to determine if the personality measures used by NavCanada would fare well with the selection process used in the U.S. Another example is if EUROCONTROL's FEAST could prove itself to be a potentially useful tool for the selection of U.S. ATCSs. Such a project would represent a major research effort due to the need re-norm FEAST on successful U.S. incumbent ATCSs. This panel may serve as the first step in that journey.

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