

NPRST



Navy Personnel Research, Studies, and Technology
5720 Integrity Drive • Millington, Tennessee 38055-1000 • www.nprst.navy.mil

research at work

NPRST-TN-13-2

June 2013

Suitability Screening Test for Marine Corps Air Traffic Controllers Phase II

Karen M. Walker, Ph.D.
William L. Farmer, Ph.D.
Rebecca C. Roberts, MS

Navy Personnel Research, Studies, and Technology



Approved for public release; distribution is unlimited.

Suitability Screening Test for Marine Corps Air Traffic Controllers Phase II

Karen M. Walker, Ph.D.
William L. Farmer, Ph.D.
Rebecca C. Roberts, MS
Navy Personnel Research, Studies, and Technology

Reviewed by
Tanja Blackstone, Ph.D.

Approved and released by
D. M. Cashbaugh
Assistant Chief
Navy Personnel Research, Studies and Technology

Approved for public release; distribution is unlimited.

Navy Personnel Research, Studies, and Technology
Navy Personnel Command
5720 Integrity Drive
Millington, TN 38055-1400
www.nprst.navy.mil

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 10-06-2013		2. REPORT TYPE Technical Report		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Suitability Screening Test for Marine Corps Air Traffic Controllers Phase II Technical Report				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Karen M. Walker, PhD William L. Farmer, PhD Rebecca C. Roberts, MS				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Navy Personnel Research Studies and Technology (NPRST/BUPERS-1) Bureau of Naval Personnel 5720 Integrity Drive Millington, TN 38055-1000				8. PERFORMING ORGANIZATION REPORT NUMBER NPRST-TR-13-2	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Dr. Michael Bailey, Technical Director Operations Analysis Division, MCCDC 3300 Russell Road Quantico, VA 22134				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Unlimited Distribution to include Operations Analysis Division (OAD) MCCDC					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The objective of this research effort is to assist in the selection and screening process of Marines for ATC duty through the development and validation of non-cognitive profiles of successful US Marine Corps Air Traffic Controllers (ATC) in both the Operating Force and the ATC Schoolhouse. A previous technical report detailed the validation process in the Operating Forces; the current phase of the project aims to validate the Marine Air Traffic Controller - Suitability Test (MATC-ST) in predicting success at the ATC Schoolhouse. Hierarchical regression analyses suggests that two variations of the MATC-ST accounts for 29% and 24% of the variance, respectively, in schoolhouse cumulative GPA and provides incremental validity above and beyond the use of the ASVAB scores in selection for success in the ATC Military Occupational Specialty (MOS) school. A suitability profile which can predict success at the ATC MOS school greatly increases the efficiency of the personnel pipeline and relieves the burden of unproductive training by providing early detection of Marines who are and are not likely to graduate or perform satisfactorily as ATCs. MATC-ST implementation can improve the Marine ATC screening process through better schoolhouse performance, better operating forces performance, and increased diversity through fair, valid screening improvements.					
15. SUBJECT TERMS Non-Cognitive measurement, Air Traffic Control, NCAPS, NPRST, Marine Corps, Validation, Personality, suitability test, profiles,					
16. SECURITY CLASSIFICATION OF: UNCLASSIFIED			17. LIMITATION OF ABSTRACT UNLIMITED	18. NUMBER OF PAGES 30	19a. NAME OF RESPONSIBLE PERSON Wendy Douglas
a. REPORT UNCLASSIFIED	b. ABSTRACT UNCLASSIFIED	c. THIS PAGE UNCLASSIFIED			19b. TELEPHONE NUMBER (include area code) 901-874-2218 DSN 882

Foreword

This effort was funded by the Operations Analysis Division (OAD) under program HQMC AVN APX. The overarching objective of this research effort is to develop a non-cognitive profile of successful US Marine Corps Air Traffic Controllers (ATC) to assist in the selection and screening process of Marines for ATC duty. This aim was realized by a three-phase process, as discussed in the previous technical report titled *Suitability Screening Test for Marine Corps Air Traffic Controllers Technical Report (NPRST-TR-13-1)*. The current report concerns the implementation of Phase II: the development and validation of a suitability profile of success in the Marine ATC Schoolhouse. Derived from scores on the Navy Computerized Personality Scales (NCAPS), the suitability profile was used to predict success using Schoolhouse performance data. Utilizing this type of non-cognitive profile can greatly increase the efficiency of the Marine Corps ATC personnel pipeline and relieve the burden of unproductive training through detection of Marines who are and are not likely to graduate or perform satisfactorily as ATCs.

The authors wish to thank the funding sponsor, and project officers for their assistance in this project. A number of Marine Corps Air Traffic Control instructors at the ATC-School provided invaluable assistance in the collection of questionnaire and academic data, and their accessibility greatly enhanced the development of the validation program undertaken in the present study.

D. M. CASHBAUGH
Assistant Chief
Navy Personnel Research, Studies and Technology

Summary

Problem

Entry into military occupational specialty (MOS) training schools requires a minimum score requirement on the Armed Services Vocational Aptitude Battery (ASVAB), a test battery that assesses cognitive abilities through performance in reading, mathematics, general science, as well as basic knowledge about electronics, mechanical systems, and automotive-shop. The ASVAB was designed to increase the effectiveness and efficiency of the selection procedure, and determines that incumbents have the necessary cognitive skills to handle the technical aspects of training and job performance. However, the current Marine Corps Air Traffic Control selection process using the ASVAB has resulted in cognitively proficient applicants, who are, nevertheless, classified as “unsuited” for ATC duty during post-training performance. The inclusion of individuals into the ATC MOS who will ultimately be unfit for this position is an inefficient use of time and resources. Building on the first phase of the research effort, which developed and validated a Marine Air Traffic Control Suitability Screening Test (MATC-ST) on Operational Force performance metrics (Walker, Farmer, & Roberts, 2012), Phase II discusses findings from validity analysis utilizing Marine ATC Schoolhouse data. Making such a suitability profile will greatly increase the efficiency of the Marine Corps ATC personnel pipeline and reduce the burden of unproductive training by providing early detection of Marines who are and are not likely to perform satisfactorily as ATCs.

Objective or Purpose

Individuals possess a variety of abilities, preferences, interests, and personal characteristics that should be useful in predicting who will be best suited for different types of military jobs or duties. The overarching objective of this project is to capitalize on these individual differences by developing a non-cognitive profile of successful air traffic controllers to be used in the selection procedures for Marine Corps ATC duty. To reach this objective, test scores on measures of non-cognitive traits have been used to develop and validate a profile (MATC-ST) for successful ATC performance in the operating forces. The current phase of this project seeks to validate a non-cognitive profile in ATC performance in the schoolhouse. Validation based on schoolhouse performance data seeks to minimize ATC academically-related training failures and to further emphasize the utility of considering non-cognitive traits in conjunction with ASVAB standards when selecting for ATC duty.

Approach or Method

Using a multifaceted adaptive personality measure, the Navy Computer Adaptive Personality Scales (NCAPS), the authors assessed ATCs in the supporting establishment operating forces (7257, 7252, 7253, 7254 MOS) and Marine ATC students (7251 MOS) on 19 different individual traits. Through both concurrent and predictive validity designs, scores on the NCAPS were correlated with measures of schoolhouse academic

performance, and statistically significant traits were identified. The resulting hierarchical regression analyses produced a subset of relevant NCAPS traits, and two profile algorithms were created to significantly predict schoolhouse performance. These profiles were referred to as the Marine Air Traffic Control Suitability Screening Test A (MATC-ST A) and the Marine Air Traffic Control Suitability Screening Test B (MATC-ST B).

Findings or Results

The subset of NCAPS traits that demonstrated statistically significant prediction for ATC schoolhouse performance and were included the Marine Air Traffic Controller - Suitability Screening Test algorithms were: *Achievement Motivation, Initiative, Perceptiveness, Social Orientation, and Self-Reliance*. Hierarchical regression analyses suggest that the non-cognitive suitability measure adds incremental validity above and beyond the ASVAB score, and accounts for 29% of the variance of ATC schoolhouse performance ($R^2=.208$, $\beta = .541$, $t = 4.646$, $p < .000$). Given a MATC-ST score, one can predict the expected level of success an individual Marine is likely to exhibit in the ATC schoolhouse and can make subsequently valid ATC duty selection decisions.

Conclusions

The Marine ATC Suitability Screening Test is a valid algorithm derived from dimensions of NCAPS and has been shown to be predictive of success for Marine ATCs in the Schoolhouse. Those with higher suitability scores performed better on knowledge and simulation exams, and graduated at a higher rate than those with low suitability scores. Further data collection and analysis following the ATC schoolhouse graduation to 7257 qualification will provide confirmation of the MATC-ST's predictive validity, both for training performance and ATC job performance. Further analysis to derive conservative cut-scores from the combined results of the concurrent and predictive validation from the ATC Schoolhouse is recommended. If the MATC-ST is to be utilized for selection/classification it is recommended that it be used only in addition to the ASVAB, and implemented at the Military Entrance Processing Station (MEPS) prior to a Marine ATC MOS designation. This will reduce attrition/revocation and increase the quality of Marines selected for the ATC MOS. MATC-ST implementation can improve the Marine ATC screening process through better schoolhouse performance, better operating forces performance, and increased diversity through fair, valid screening improvements.

Table of Contents

Introduction	1
Background	1
Method	2
Data Collection	2
ATC Schoolhouse	3
Validity Analysis	4
Performance Measures	4
Results	5
Background and demographics	5
NCAPS Data Summary	6
ATC Schoolhouse Performance Data Summary	7
Marine ATC Suitability Test Score and Validity Analysis	8
Recommendations	16
Limitations	17
Conclusion	17
References	18
Distribution List	20

List of Figures

1. GT Score and Cumulative GPA	10
2. MATC-ST A and Cumulative GPA	11
3. MATC-ST B and Cumulative GPA	12
4. GT Score and MATC-ST A Composite and Cumulative GPA	13
5. GT Score and MATC-ST B Composite and Cumulative GPA	14
6. Top 100 GT Score and Diversity	15
7. Top 100 GT Score & MATC-ST A and Diversity	15
8. Top 100 GT Score & MATC-ST B and Diversity	16

List of Tables

1. ATC Schoolhouse Demographics	6
2. Operating Forces Performance Descriptive Statistics	7
3. Predictor Test Scores and Performance Intercorrelations	8
4. ATC Schoolhouse Hierarchical Regression Validity Analysis	9

Introduction

The previous technical report titled *Suitability Screening Test for Marine Corps Air Traffic Controllers Technical Report* (Walker, Farmer, & Roberts, 2012), gave a complete introduction of the research involved for this study. As a review, the current Air Traffic Control selection process utilized by the US Marine Corps is being reviewed as a result of an unacceptable number of Marine Air Traffic Controllers (ATCs) being classified as “unsuited” for ATC duty as defined by performance and behavioral expectations. The first, most important step in creating a more efficient force is to improve the Air Traffic Controller (ATC) screening/selection process. This research effort focused on developing a non-cognitive Air Traffic Controller profile that could be incorporated into a model for their selection. Such a profile would allow the Marine Corps to identify those Marines who are likely to be successful as Air Traffic Controllers, those who need a greater depth of screening, and those who are likely to fail.

During Phase I of this research study the focus was on data collection and analysis from Marine ATCs in the operating forces and within the ATC schoolhouse. Phase I results reported significant findings within the Operating Forces, and recommended further predictive validity analysis from the ATC schoolhouse data. This report will discuss Phase II of the study and includes the predictive validity analysis from the ATC schoolhouse data.

Background

Phase I of this study was a concurrent validity study utilizing data collection and analysis from Marine ATCs in the operating forces. The subset of NCAPS traits that demonstrated statistically significant prediction for ATC (operating forces) performance and were included the Marine Air Traffic Controller - Suitability Screening Test (MATC-ST) algorithms were: *Adaptability/Flexibility, Vigilance, Empathy, and Self-Reliance*. Hierarchical regression analyses suggest that the non-cognitive suitability measure adds incremental validity above and beyond the ASVAB score, and accounts for 14% of the variance of ATC job performance ($R^2=.141$, $\beta=.375$, $t=5.804$, $p<.000$). Given a MATC-ST score, one can predict the expected level of success an individual Marine is likely to exhibit on the job and can make subsequently valid selection decisions.

At the completion of Phase I, data collection and analysis from the Marine ATC schoolhouse was still in progress. Phase II of this study will discuss findings from validity analysis utilizing Marine ATC schoolhouse data. This effort considers the Armed Services Vocational Aptitude Battery (ASVAB) standard that is established to minimize ATC academically related training failures in conjunction with the suitability screening test to replicate Phase I findings.

Method

In personnel selection and classification it is customary to develop measures that predict job performance and/or job tenure. Measures given to job applicants need to assess the knowledge, skills, and abilities necessary for successful performance in a particular job, ideally without producing adverse impact (large mean differences) for racial, ethnic, or gender groups. This study relied on a mix of predictive and concurrent validity designs using NCAPS and Marine ATC performance measures. A concurrent validity design is when the predictor is administered to participants close in time to when the criterion (performance measure) is collected (e.g., on the job). NCAPS was administered in such a concurrent validity design. A predictive validity design is when the predictor is administered long in advance to all applicants who have yet to be selected for the job, and thus represents a more realistic setting in which the instrument will ultimately be used. The ASVAB, to be compared with NCAPS, was administered in a predictive validity design.

The validation approach chosen for this project was a criterion-related strategy. This is traditionally accomplished by obtaining the test scores of job applicants as predictors and then collecting measures of these same individuals' job performance, the criterion (or criteria if more than one type of measure is collected). The predictor test scores are then related statistically to how well individuals perform on the job and, if successful, can be used to identify the most qualified candidates for the position by predicting how individuals with particular test scores will likely perform. This validation methodology is one of three validation strategies presented in the *Uniform Guidelines on Employee Selection Procedures* (1978, EEOC), the *Standards for Educational and Psychological Testing*, and the Society for Industrial/ Organizational Psychology's (SIOP) *Principles for the Validation and Use of Personnel Selection Procedures* (1987).

In order to statistically perform this validation for Phase II, measurements of job performance and NCAPS scores were provided for Marines currently training at the Marine ATC Schoolhouse (both concurrent and predictive data). This included Marine ATCs already attending the ATC schoolhouse and any new Marine ATC arrivals at the schoolhouse.

Data Collection

Data were collected from Marine ATC students (7251 MOS) at the Air Traffic Controller Schoolhouse in Pensacola, Florida. Data collection consisted of interviews, observations, performance measurements, and NCAPS scores. The following data collection section is provided as a review from Phase I: Suitability Screening Test for Marine Corps Air Traffic Controllers Technical Report (Walker, Farmer, & Roberts, 2012).

ATC Schoolhouse

The 14-week school consists of three blocks of training that have knowledge based written tests and performance based assessments. Block One training is six weeks long, entirely knowledge based, and concludes with the FAA qualification written exam. Block Two consists of local control, ground control, and flight data performance based assessments. Block Three consists of basic radar, ASR, PAR, and Arrival written tests and performance based assessments.

The schoolhouse requires a 70% or higher grade to pass, however in the operating forces an 80% or higher is required to receive qualifications. ATC officials view ATC school as preliminary and expect that more extensive learning occurs with On-the-Job-Training (OJT), the platform MOS, and other required operating force qualifications to maintain qualified controller status.

Schoolhouse Instructor/Staff Interviews

NPRST researchers met with school officials to discuss the study objectives and methods, and the aptitude strengths and weaknesses of incoming trainees. Researchers were given tours of the classrooms; the tower simulator and other computer based classroom training, and allowed individual time to interview key instructors in this process. Arrangements were also made for collection of performance measures for students.

- Marine Corps has an ASVAB GT (VE, Verbal + AR, Arithmetic Reasoning + MC, Mechanical Comprehension) score of 110 as a minimum qualifier. A Marine recruit is then designated into Aviation and disseminated between ATC, Weather, and UAV. Instructors also confirmed that this process leads to motivational concerns as to whether Marines selected for ATC School have the motivation to be there.
- According to instructor/Staff interviews, trends were reported in higher Block One student failures of the: General Tower, ATC Terminal Procedures, and Emergency/Non-Radar Exams; higher Block Two student failures of the: Local Control Exam; and no trends reported for Block Three student failures.
- For performance based evolutions (Blocks Two and Three) students are evaluated with critique sheets that are filled out for each evolution that include instructor comments. The Critique/Evaluation sheets are based on the position being evaluated (Local Control, Arrival, etc.) and students are given three scores: (S) satisfactory, (N) needs improvement, (U) unsatisfactory. Instructors give recommendations for improvement on these critique sheets. A student's performance folder is collected upon graduation/drop and destroyed after two years.

Other comments concerning motivation for Marine 7251s from instructors and staff were:

- The instructors commented on attributes besides intelligence that make successful 7251s. Some mentioned skills like ***multitasking***, such as “being a

bartender”, is comparable to being an ATC. Others commented that skills like **achievement motivation** and **perseverance** count the most in getting through the ATC School successfully.

- “Students don’t fear authority.”
- “They don’t see a problem with quitting. If I put a bell on the quarterdeck, they would ring it here!”
- “They don’t see a problem with failing. They treat it like a video game. They make a mistake and they want to push reset and start over.”
- Remediation and re-test is guaranteed to students who have failed an exam. Instructors noted that those students that reach out for help, use labs outside of class time and that ask questions, or take initiatives to approach instructors after class are the most successful at successfully completing ATC School.

Schoolhouse Performance Measures

In order to measure performance at the ATC schoolhouse we collected Grade Point Averages (GPA) for each Marine student at each block of training. In the context of this report, GPA is a composite score consisting of the mean average for each block of training. GPAs were collected at the end of Block One, Block Two, and Block Three for each Marine ATC student (7251).

NCAPS at Schoolhouse

The Navy Computer Adaptive Personality Scales (NCAPS) is a web-based non-cognitive measurement tool consisting of 19 dimensions. NCAPS was administered to incoming and current 7251s.

Validity Analysis

Validity refers to the correlation between a predictor of success (such as the ASVAB GT Score, or NCAPS) and an objective performance measure (such as school grades or graduation status, or time to 7257 qualification). The ASVAB (GT Score) has demonstrated validity for predicting job performance, but is most predictive of academic performance. NCAPS has demonstrated validity for predicting job performance. The two predictors generally do not correlate, but it depends upon the constructs being measured by the specific criterion.

Performance Measures

Job performance is a multifaceted construct that can be measured in a variety of ways (peer ratings, supervisor ratings, customer ratings, output, qualifications, absence of errors, etc.). For Phase II, a variety of proxies for job performance were considered, but the following provided the most significant results.

Schoolhouse performance measures

GPA scores for Block One, Block Two, Block Three, and Blocks One through Three (1-3) Cumulative GPA were collected and standardized. ASVAB (GT Scores) were also collected.

Results

The resulting data from the ATC schoolhouse were cleaned and subjected to various analyses including validity analysis. This section describes the data obtained and analyses with the results reported up front. Validity analysis determined:

- NCAPS scores are a valid predictor of success for Marine Air Traffic Controllers in the schoolhouse. Success in the schoolhouse is determined by Block 1-3 Cumulative GPA.
- ASVAB GT Scores correlated significantly with GPA for the schoolhouse as did NCAPS measures.
- Regression analyses clearly indicate that non-cognitive measures, especially those assessed with the Marine Air Traffic Control Suitability Test A and B (MATC-ST A and B), add incremental validity above the ASVAB GT Score.

Background and demographics

This section describes the sample of participants who took part in the study, as well as the characteristics of the performance measures collected from those participants. Table 1 presents background and demographic information for 209 Marine Corps ATC Schoolhouse (7251) participants. The majority of the sample was male (92.3%), White (67%), with less than 4 years of service (91.87%). Most of the sample was Private First Class (PFC; E2 paygrade), (70.8%).

Table 1
ATC Schoolhouse Demographics

		Frequency	Percent	Cumulative Percent
Gender	Male	193	92.3	92.3
	Female	16	7.7	100.0
Ethnicity	White	140	67.0	67.0
	Hispanic	30	14.4	81.4
	Black	19	9.1	90.5
	Asian or Pacific Islander	8	3.8	94.3
	American Indian	2	1.0	95.3
	Other	10	4.8	100.0
Rank	E1 (PVT)	21	10.0	10.0
	E2 (PFC)	148	70.8	80.9
	E3 (LCPL)	8	3.8	84.7
	E4 (CPL)	19	9.1	93.8
	E5 (SGT)	13	6.2	100.0
YoS	>4	192	91.87	91.87
	5-10	17	8.13	100.0

NCAPS Data Summary

At the time of this report, complete data was obtained from the NCAPS measure for 209 Marine Corps ATC Schoolhouse (7251 MOS) participants.

NCAPS is a computerized adaptive personality measure consisting of 19 components, four of which were related to attributes relevant to the current research effort. For each NCAPS component, the data consist of a theta value that describes the participants standing on the construct being measured, and a PSD or posterior standard deviation, which is an index of algorithm convergence. A theta value is defined as an individual's standing on a construct being measured using adaptive testing, or item response theory, where items are presented to individuals based on their responses to prior items. This process continues until the algorithm closes in on that individual's standing on the construct, which is represented by the value of theta.

There were seven relevant NCAPS dimensions for the ATC schoolhouse performance. These NCAPS dimensions were used to develop the algorithms for the Marine Air Traffic Control Suitability Test (MATC-ST). There are two relevant algorithms for the ATC schoolhouse performance. These will be referred to as the Marine Air Traffic Control Suitability Test Alpha (MATC-ST A) and the Marine Air Traffic Control Suitability Test Bravo (MATC-ST B). The Marine Air Traffic Control Suitability Test Alpha dimensions were: Achievement Motivation, Initiative, Perceptiveness/Depth of thought, Social Orientation, and Self-Reliance. The Marine Air Traffic Control Suitability Test Bravo dimensions were: Achievement Motivation, Empathy, Perceptiveness/Depth of Thought, Self-Reliance, and Vigilance. The MATC-ST B has been included in this report because it incorporated dimensions that overlap in

content to the significant predictors for operational performance developed in Phase I of this research project. The degree of relevance, or relatedness (validity) was derived through regression analyses, which identified these dimensions (or traits) as statistically significant predictors of ATC performance at the Schoolhouse.

ATC Schoolhouse Performance Data Summary

The ATC Schoolhouse performance data summary in Table 2 includes the minimums, maximums, means, modes, and standard deviations of GT Score, 7251 Block 1 GPA, 7251 Block 2 GPA, 7251 Block 3 GPA, and 7251 Cumulative Block 1-3 GPA. GT Scores were collected for 208 ATC schoolhouse Marines, with a minimum GT Score of 107, a maximum GT Score of 139, a mean GT Score of 118.23, the mode GT Score was 114, and the standard deviation for GT Score was 7.55.

The 7251 Block 1 GPA was collected for 140 ATC schoolhouse Marines, with a minimum Block 1 GPA of 73.80%, a maximum Block 1 GPA of 95.29%, a mean Block 1 GPA of 84.93%, the mode Block 1 GPA was 78.35% and the standard deviation for Block 1 GPA was 4.99%. The 7251 Block 2 GPA was collected for 119 ATC schoolhouse Marines, with a minimum Block 2 GPA of 77.08%, a maximum Block 2 GPA of 95.04%, a mean Block 2 GPA of 85.86%, the mode Block 2 GPA was 82.40% and the standard deviation for Block 2 GPA was 4.15%. The 7251 Block 3 GPA was collected for 100 ATC schoolhouse Marines, with a minimum Block 3 GPA of 77.98%, a maximum Block 3 GPA of 95.95%, a mean Block 3 GPA of 87.95%, the mode Block 3 GPA was 90.00% and the standard deviation for Block 3 GPA was 3.70%. The 7251 Block 1-3 Cumulative GPA was collected for 100 ATC schoolhouse Marines, with a minimum Block 1-3 Cumulative GPA of 77.28%, a maximum Block 1-3 Cumulative GPA of 94.57%, a mean Block 1-3 Cumulative GPA of 86.26%, the mode Block 1-3 Cumulative GPA was 83.99% and the standard deviation for Block 1-3 Cumulative GPA was 3.94%.

Table 2
Operating Forces Performance Descriptive Statistics

	N	Minimum	Maximum	Mean	Mode	Std. Deviation
GT Score	208	107	139	118.23	114	7.55
Block 1 GPA	140	73.80%	95.29%	84.93%	78.35%	4.99%
Block 2 GPA	119	77.08%	95.04%	85.86%	82.40%	4.15%
Block 3 GPA	100	77.98%	95.95%	87.95%	90.00%	3.70%
Block 1-3 Cumulative GPA	100	77.28%	94.57%	86.26%	83.99%	3.94%

Marine ATC Suitability Test Score and Validity Analysis

The Marine ATC Suitability Test (MATC-ST) Alpha and Bravo score for the ATC schoolhouse population is calculated from dimensions of NCAPS that were submitted in regression analysis with the ATC schoolhouse Block 1-3 Cumulative GPA as the performance criterion. This section describes the correlation and regression analyses.

Table 3 presents the intercorrelations of the predictor test scores, (MATC-ST A), (MATC-ST B), ASVAB GT, and the criterion, ATC schoolhouse Block 1 GPA, Block 2 GPA, Block 3 GPA, and Block1-3 Cumulative GPA.

Table 3
Predictor Test Scores and Performance Intercorrelations

	MATC -ST A	MATC -ST B	GT Score	Block 1 GPA	Block 2 GPA	Block 3 GPA	Cum GPA
MATC-ST A	1						
MATC-ST B	.755**	1					
GT Score	.129*	.157*	1				
Block 1 GPA	.368**	.293**	.341**	1			
Block 2 GPA	.331**	.277**	.271**	.858**	1		
Block 3 GPA	.399**	.353**	.328**	.753**	.860**	1	
Block 1-3 Cumulative GPA	.456**	.373**	.368**	.939**	.959**	.912**	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 3 shows the intercorrelations between GT Score, the MATC-ST A and MATC-ST B, and the Schoolhouse performance metrics. All GPA scores were significantly correlated with one another, with both Suitability algorithms, and with GT Score at the $p < .01$ level. GT Score was also significantly correlated to MATC-ST A and MATC-ST B at the $p < .05$ level. For completeness, the data were used in a hierarchical regression.

Through hierarchical regression, the prediction of the MATC-ST A and B score on performance outcomes may be isolated and compared to the prediction of other factors, such as the ASVAB score, as well as the prediction of composites of multiple factors at once. This technique uses comparisons of successive regression models and determines the significance that each one has above and beyond the others. Three models were tested and compared: (1) the ASVAB GT scores' prediction of Cumulative GPA scores, (2) the MATC- Suitability Test scores' prediction of Cumulative GPA scores, and (3) regression weighted composite scores' (made up of ASVAB GT and MATC-ST) of Cumulative GPA scores.

The Marines currently use the ASVAB as a selection screening tool to gain access to the ATC School; therefore, GT Score was the first variable entered (model 1), followed by the MATC-ST A score (model 2), and the resulting composite (model 3). The same

model process was conducted for MATC-ST B score (model 2a) and the resulting composite (model 3a). Results of the regression analysis are presented in Table 4 (weights are standardized beta (β) weights and thus represent correlations).

Table 4
ATC Schoolhouse Hierarchical Regression Validity Analysis

Measure	Standardized Regression Coefficient	R ²	F	t
GT Score	.368	.135	15.237*	3.914*
MATC-ST A	.456	.208	25.696*	5.066*
GT Score & MATC-ST A	.296 .403	.293	21.611*	3.416* 4.649*
MATC-ST B	.373	.139	15.856*	3.979*
GT Score & MATC-ST B	.316 .323	.237	12.895*	3.519* 3.591*

a. Dependent Variable: Block 1-3 Cumulative GPA; *Statistically significant at the $p < .001$ probability level.

The Table 4 results showed that, as expected from the results in table 3, GT Score alone (Model 1) predicts Schoolhouse performance at a statistically significant level (Model 1; $\beta = .368$, $R^2 = .135$, $F = 15.237$, $t = 3.914$, $p < .000$), accounting for 13.5% of the variance in performance. When the MATC-ST A was added into the next step (Step 2) of the hierarchical regression analysis, the results were also statistically significant (Model 2; $\beta = .456$, $R^2 = .208$, $F = 25.696$, $t = 5.066$, $p < .000$). Together, the MATC-ST A and GT Score account for 29.2% of the variance in performance.

A composite of the two variables entered in the third model (Step 3) improved the prediction over MATC-ST A alone (Model 3; $\beta = .541$, $R^2 = .293$, $F = 21.611$, $t = 4.646$, $p < .000$). Given that GT Score and the Suitability Alpha test score were significantly correlated ($R^2 = .293$), this finding suggests that the predictive validity of the components work together additively to increase the validity of the prediction with regard to Schoolhouse performance.

In Table 4 results showed that, the MATC-ST B predicts Schoolhouse performance at a statistically significant level (Model 2a; $\beta = .373$, $R^2 = .139$, $F = 15.856$, $t = 3.979$, $p < .000$), accounting for 14% of the variance in performance. When the GT Score and MATC-ST B were hierarchically regressed onto Schoolhouse performance, the results were also statistically significant (Model 3a; $\beta = .487$, $R^2 = .237$, $F = 12.895$, $t = 3.588$, $p < .000$).

Together, the MATC-ST B and GT Score account for 23.6% of the variance in Schoolhouse performance. Given that GT Score and the MATC-ST B score were significantly correlated ($R^2 = .237$), this finding suggests that the predictive validity of the components work together additively to increase the validity of the prediction with regard to Schoolhouse performance.

Figure 1 provides a graphical representation of the predictive relationship between GT Score and Cumulative GPA score ($R^2=.135$). Figure 2 provides a graphical representation of the predictive relationship between MATC Suitability Test A score and Cumulative GPA score ($R^2=.208$). Figure 3 provides a graphical representation of the predictive relationship between MATC Suitability Test B score and Cumulative GPA score ($R^2=.139$).

Figure 4 applies to the combined GT and MATC-Suitability Test A as the predictor ($R^2=.293$). Figure 5 applies to the combined GT and MATC-Suitability Test B as the predictor ($R^2=.237$). R^2 (variance overlap) is shown on each graph and is the proportion of the Cumulative GPA score that is accounted for by the predictor. The square root of this value is the correlation.

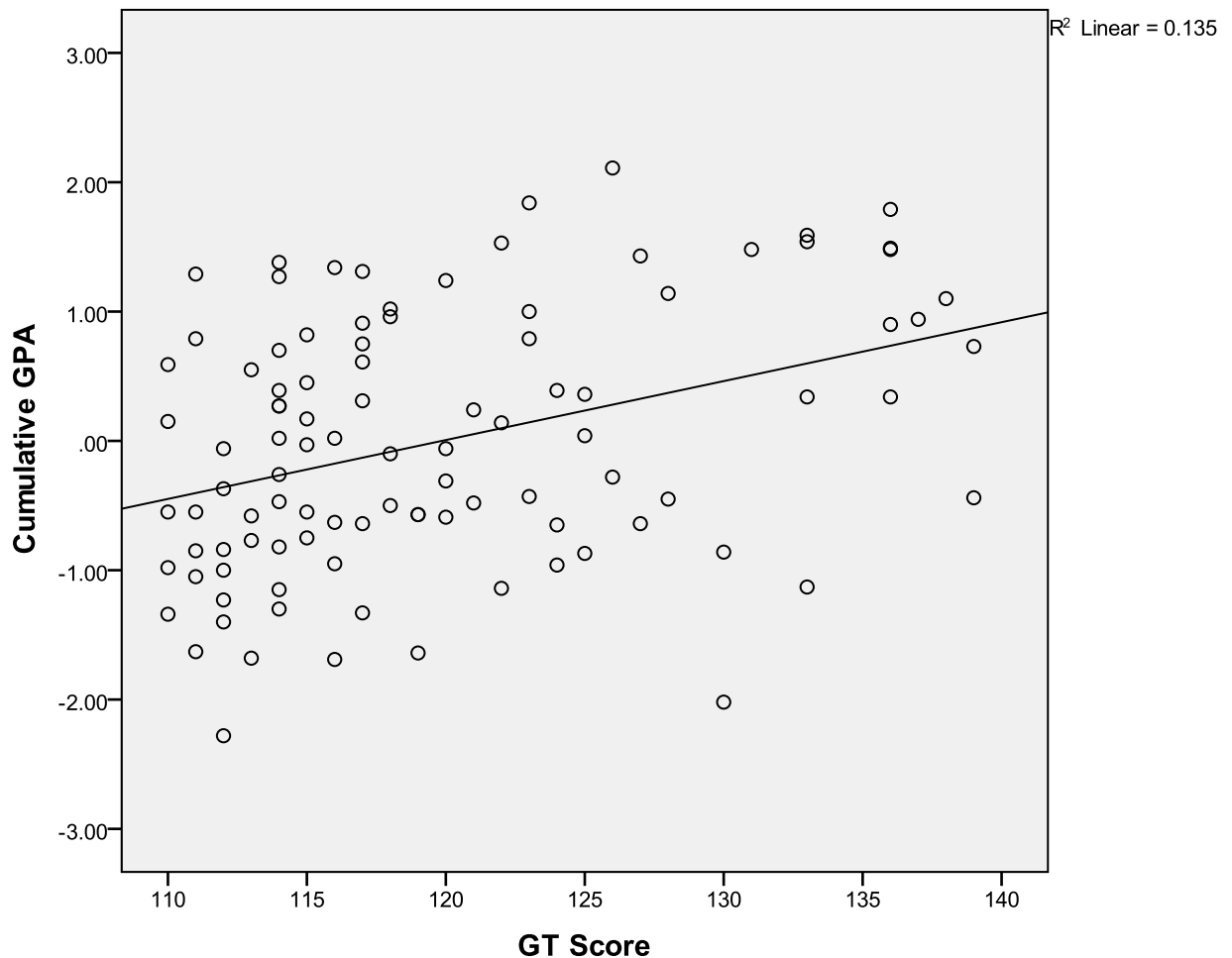


Figure 1. GT Score and Cumulative GPA

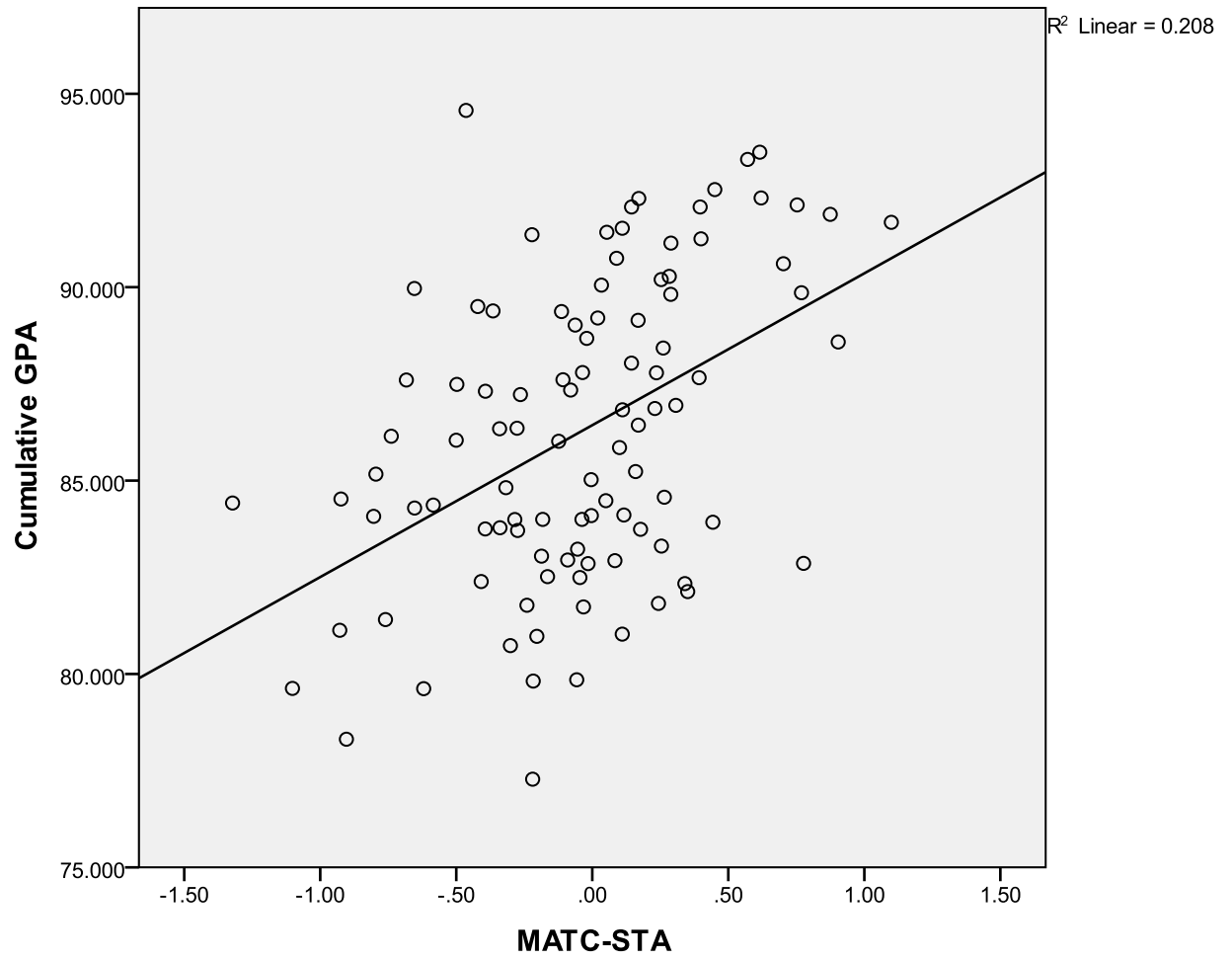


Figure 2. MATC-ST A and Cumulative GPA

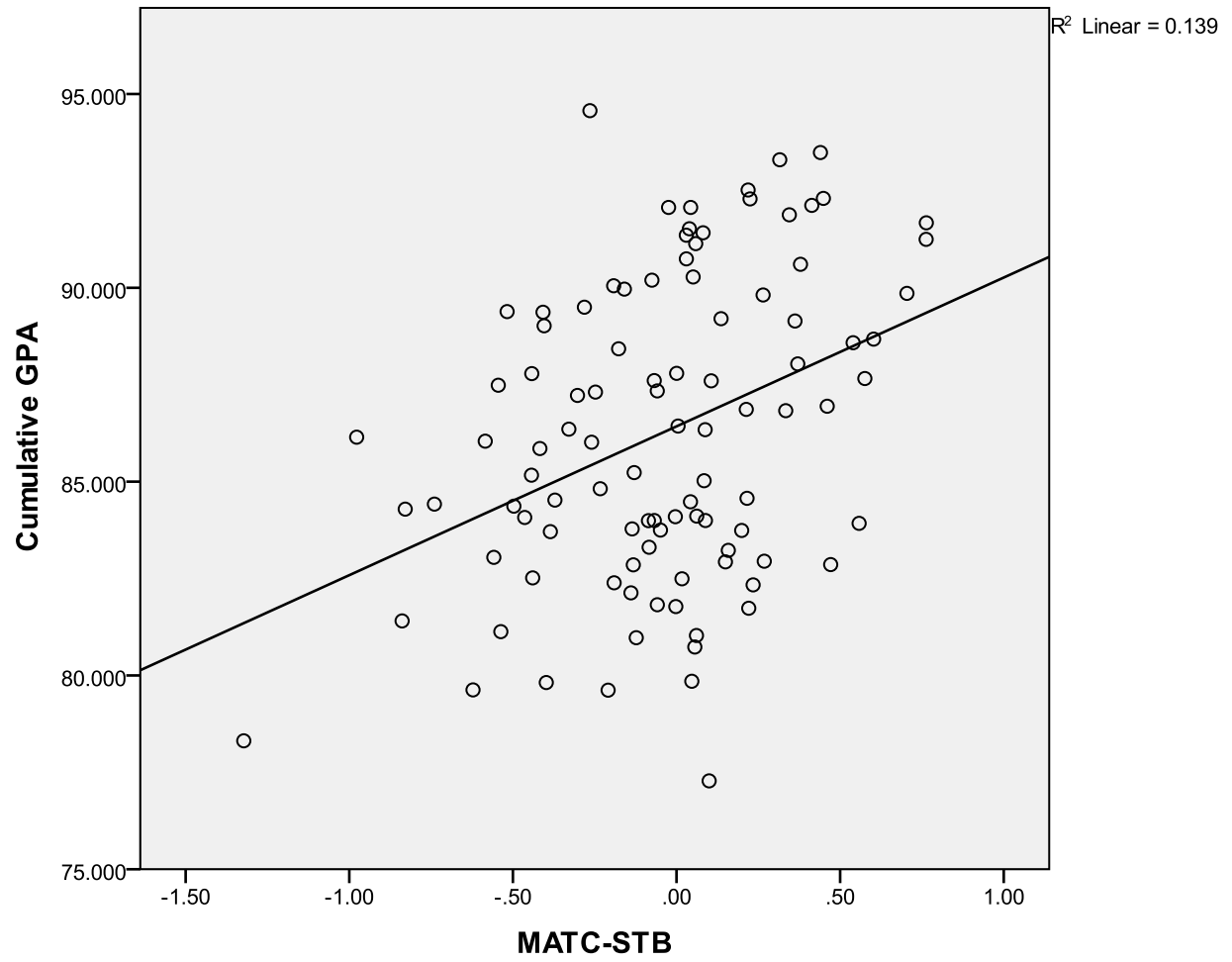


Figure 3. MATC-ST B and Cumulative GPA

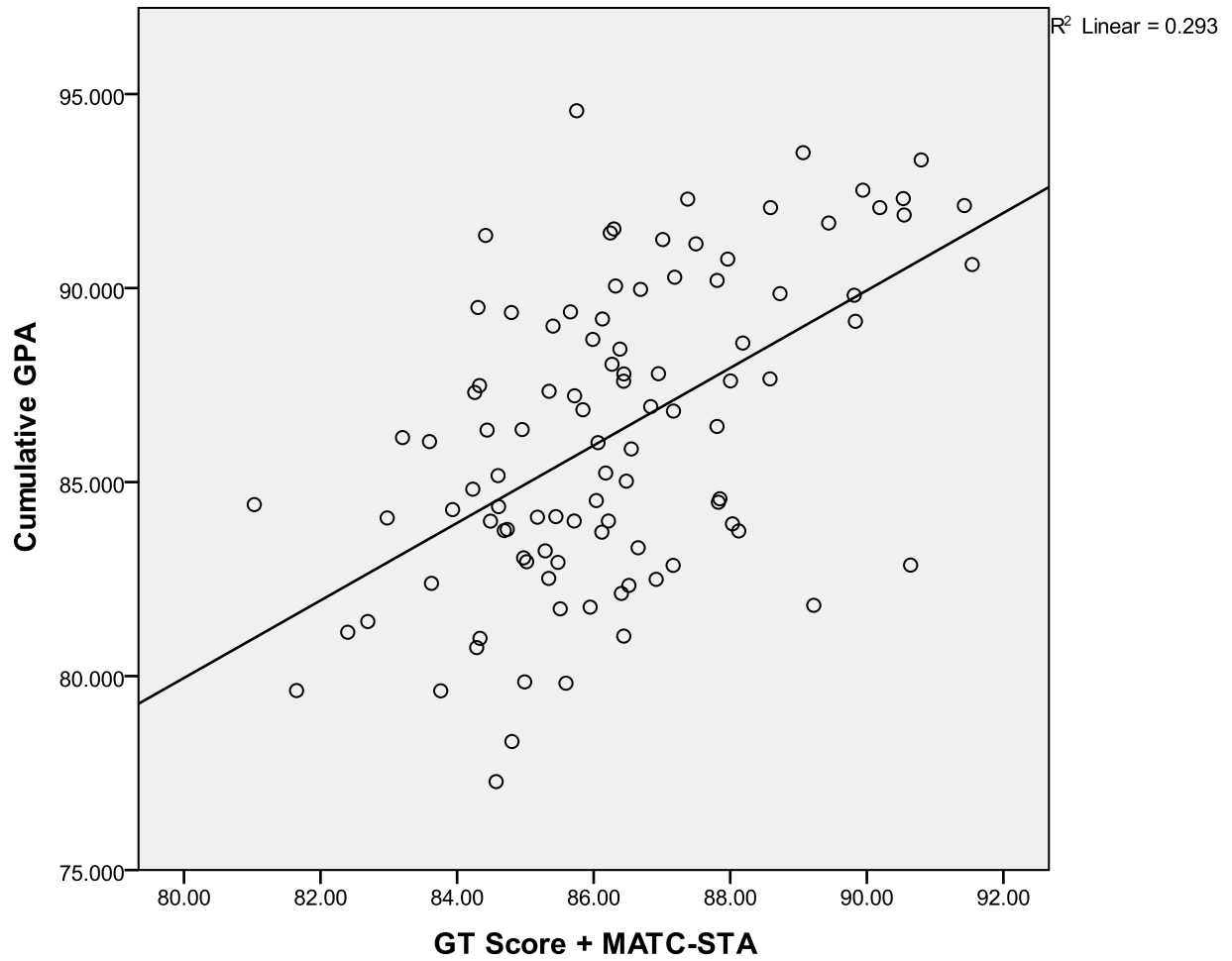


Figure 4. GT Score and MATC-ST A Composite and Cumulative GPA

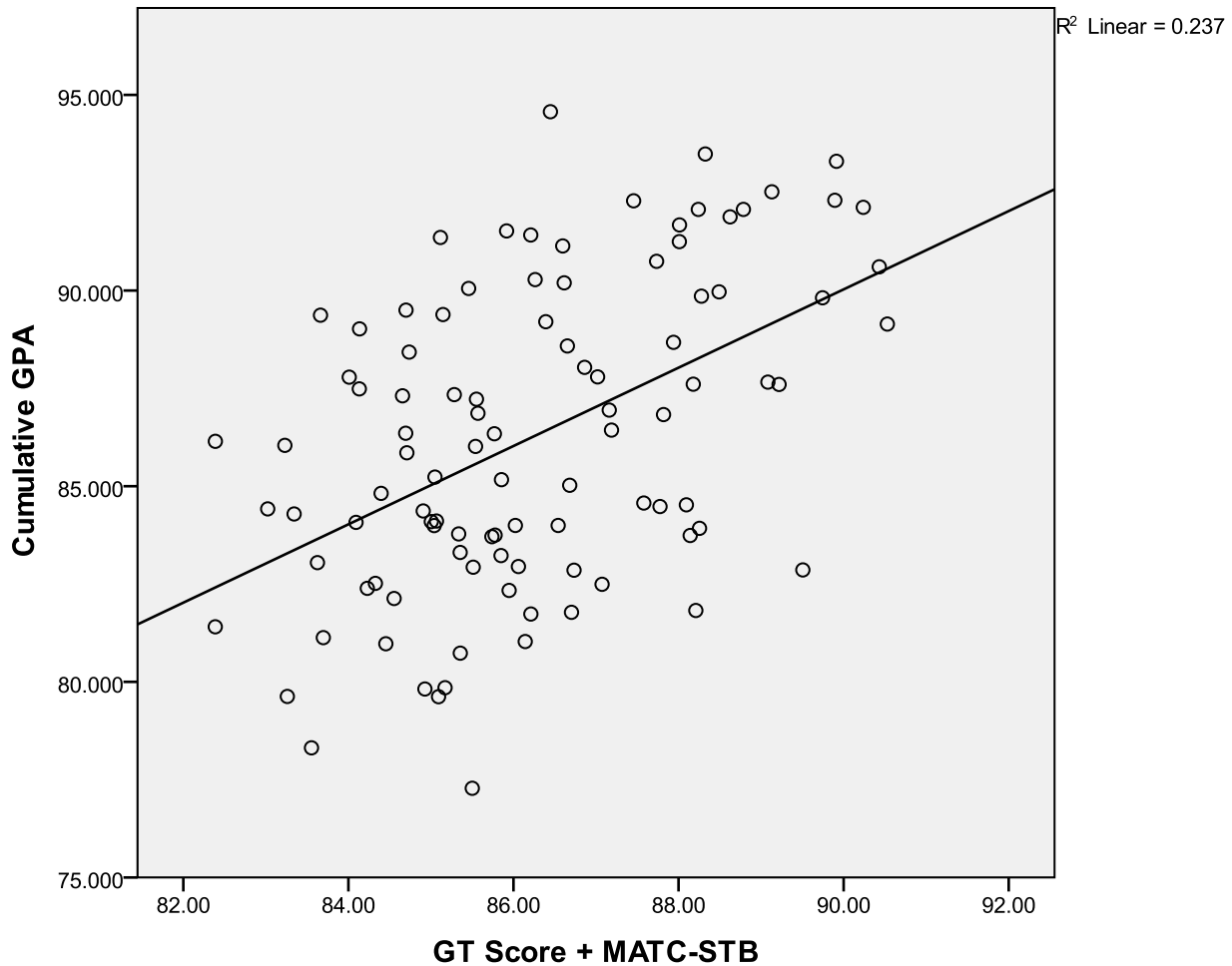


Figure 5. GT Score and MATC-ST B Composite and Cumulative GPA

Together, GT Score and MATC- Suitability Screening Test score account for 29.2% of the variance in schoolhouse performance. The “variance accounted for” metric interpretation of a correlation provides meaningful insights into the value of a selection & classification instrument. That is, predictor test developers strive for 100% performance variability accounted for by the predictor (a correlation of 1.0). However, to set a cutscore for an operational selection standard, the correlation coefficient (validity coefficient) is required. Setting relevant cutscores will be further analyzed in Phase III when the data from the next cohort going from the ATC schoolhouse to 7257 qualification (Phase III) can be analyzed.

The MATC-ST A and B has been shown to be predictive of success for Marine ATCs in the schoolhouse. Success is determined by Block 1-3 Cumulative GPA, therefore the higher the MATC-ST score the higher the Cumulative GPA of the ATC schoolhouse graduate (7251). The expectation is that the relationship will hold up for future ATC Marines at the schoolhouse, and that a near term goal would be to evaluate the positive effects of an operational cutscore.

An additional topic of interest is the positive impact that the MATC-ST had on diversity. From the ATC schoolhouse sample (n=209), we sorted GT Scores from highest

to lowest and we selected the top 100 GT scorers. The diversity picture is illustrated in Figure 6 and annotated here: White (75%) and Non-white (25%); Male (95%) and Female (5%).

We then sorted the GT & MATC-ST A scores highest to lowest and we selected the top 100 scorers. The diversity picture is illustrated in Figure 7 and annotated here: White (70%) and Non-white (30%); Male (96%) and Female (4%). We also sorted the GT & MATC-ST B scores highest to lowest and we selected the top 100 scorers. The diversity picture is illustrated in Figure 8 and annotated here: White (60%) and Non-white (40%); Male (91%) and Female (9%).

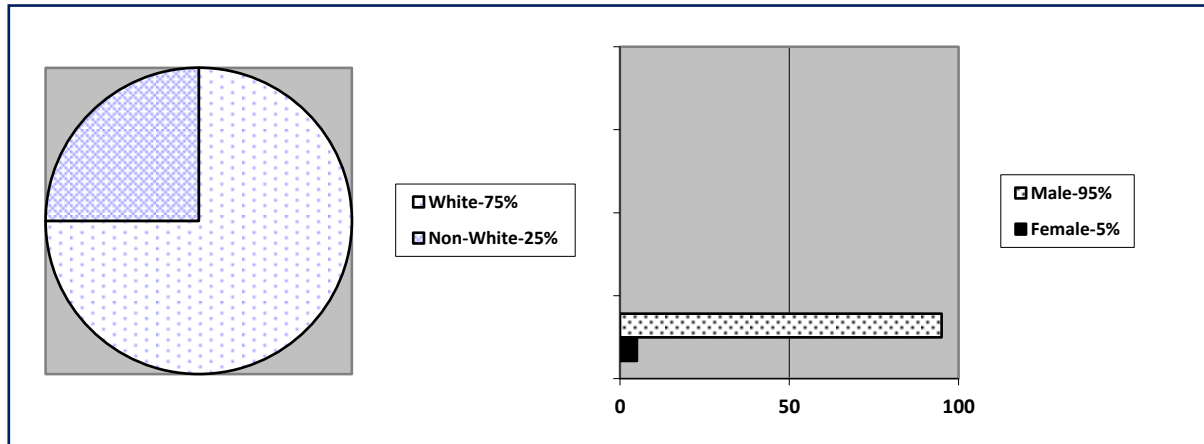


Figure 6. Top 100 GT Score and Diversity

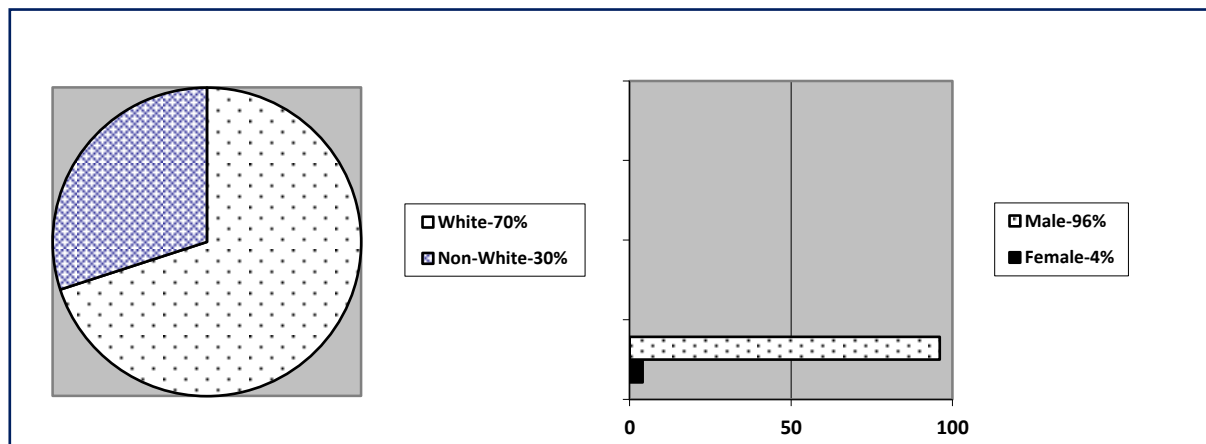


Figure 7. Top 100 GT Score & MATC-ST A and Diversity

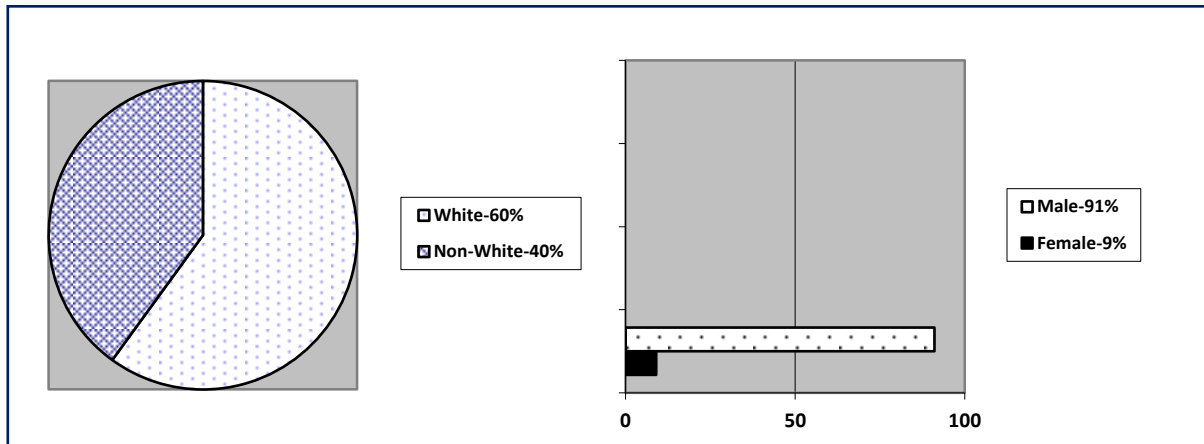


Figure 8. Top 100 GT Score & MATC-ST B and Diversity

The addition of the MATC-ST can improve the ATC screening process through fair, valid screening improvements that not only predict high performance in the operating forces (Walker, Farmer, & Roberts, 2012) and schoolhouse, but also increase diversity within the Air Traffic Control field.

Recommendations

At the time of this report the Marine ATC Suitability Screening Test (MATC-ST) is shown to be predictive of success for Marine ATCs in the operating forces (Phase I results) and the ATC schoolhouse (Phase II results). The Marine ATC Suitability Test (MATC-ST) score is a valid algorithm derived from dimensions of NCAPS. Further data collection and analysis following the ATC schoolhouse graduation to 7257 qualification will provide confirmation of the MATC-ST's predictive validity, both for training performance and ATC job performance. It is best practice to combine concurrent validity with predictive validity from the ATC Schoolhouse in order to recommend any conservative cutscores and/or implementation into the Marine Corps Air Traffic Control selection and classification process. (This recommendation has been submitted as a Phase III proposal and is pending at the time of this report).

As of the date of this report Phase I and Phase II results were pending to be briefed to project officers. It is important to note that Phase I results were from operating forces and Phase II results were from the schoolhouse. Phase III will look at the best overall MATC-ST algorithm for predicting Marine ATC performance as defined by project officers (e.g. time to qualify, GPA, behaviorally anchored rating scales, etc.).

If the MATC-ST is to be utilized for selection/classification it is recommended that it be used only in addition to the ASVAB (GT), and implemented at the Military Entrance Processing Station (MEPS) prior to a Marine ATC MOS designation/assignment. This will reduce attrition and increase the quality of Marines selected for the ATC MOS.

Limitations

The length of this study was approximately one year, however an extension was granted for more data collection at the schoolhouse. A hindering factor was that data collection at the schoolhouse started about six months later than the operating forces. The timing difference did not have an impact on results other than delaying Phase II analysis six months in order to allow enough time for performance measures to be collected. Although, NCAPS allowed for maximum participation among Marine Air Traffic Controllers in the schoolhouse because it was web enabled and administered at the beginning of training; the performance data collection took much more time to collect. It was necessary for an adequate amount of time to pass to collect Block One, Block Two, Block Three, and Block One through Three (1-3) Cumulative GPA data from the ATC schoolhouse.

Another limitation at the time of this report is that the ATC schoolhouse data and analysis includes cumulative GPAs, thus failures are excluded. Further analysis will need to be performed, as recommended for Phase III to allow for a larger sample size and any range restriction. An additional report would need to be produced at the time of Phase III MATC-ST data analysis completion.

Conclusion

This report further concluded findings from the ATC operating forces study (Phase I) that NCAPS dimensions calculated specifically for the Marine Air Traffic Control community can predict success in training as well as on the job. Phase II of the Marine Air Traffic Control Suitability Screening Test (MATC-ST) project focused on performance at the ATC schoolhouse, predicting higher Cumulative GPAs in ATC schoolhouse graduates (7251). Recommendations were made for Phase III to continue validation of MATC-ST. The expectation is that the relationship will hold up for future ATC Marines, and that a near term goal would be to evaluate the positive effects of an operational cutscore.

MATC-ST implementation can improve the Marine ATC screening process through better schoolhouse performance, better operating forces performance, and increased diversity through fair, valid screening improvements. As with any test, it is important to continue to validate these tools considering changes in curriculum and additions of simulation based training in order to see if the ASVAB composites and MATC-ST cutscores are adequate for producing a job ready Marine.

References

- Batram, D. (1993). Emerging trends in computer-assisted assessment. In H. Schuler, J.L. Farr, & M. Smith (Eds.), *Personnel selection and assessment: Individual and organizational perspectives* (Chapter 17, p. 267-288).
- Equal Employment Opportunity Commission. (1978). Uniform Guidelines on Employee Selection Procedures. Department of Labor and Department of Justice. Washington, D.C.
- McBride, T.M. (2012). Study of personnel attrition and revocation within U.S. Marine Corps Air Traffic Control specialties. (Unpublished master's thesis). Embry-Riddle Aeronautical University, Daytona Beach FL.
- Principles for the Validation and use of personnel selection procedures. (1987, 3rd ed). Society for Industrial and Organizational Psychology. College Park, MD.
- Walker, K.M., Farmer, W.L., and Roberts, R.C. (2012). Suitability Screening Test for Marine Corps Air Traffic Controllers Technical Report (Technical Report No. 13-1). Millington, TN: Navy Personnel Research Studies and Technology.

Distribution List

AIR UNIVERSITY LIBRARY

ARMY RESEARCH INSTITUTE LIBRARY

ARMY WAR COLLEGE LIBRARY

CENTER FOR NAVAL ANALYSES LIBRARY

HUMAN RESOURCES DIRECTORATE TECHNICAL LIBRARY

JOINT FORCES STAFF COLLEGE LIBRARY

MARINE CORPS UNIVERSITY LIBRARIES

MARINE CORPS COMBAT DEVELOPMENT COMMAND, TRAINING AND
EDUCATION COMMAND (TECOM)

MARINE CORPS COMBAT DEVELOPMENT COMMAND, OPERATIONS ANALYSIS
DIVISION (OAD)

NATIONAL DEFENSE UNIVERSITY LIBRARY

NAVAL HEALTH RESEARCH CENTER

NAVAL POSTGRADUATE SCHOOL DUDLEY KNOX LIBRARY

NAVAL RESEARCH LABORATORY RUTH HOOKER RESEARCH LIBRARY

NAVAL WAR COLLEGE LIBRARY

NAVY PERSONNEL RESEARCH, STUDIES, AND TECHNOLOGY SPISHOCK
LIBRARY

OFFICE OF NAVAL RESEARCH (CODE 34)

PENTAGON LIBRARY

USAF ACADEMY LIBRARY

US COAST GUARD ACADEMY LIBRARY

US MERCHANT MARINE ACADEMY BLAND LIBRARY

US MILITARY ACADEMY AT WEST POINT LIBRARY

US NAVAL ACADEMY NIMITZ LIBRARY