2011-03

Study of standards used to screen recruits for assignment to the communications field in the U.S. Marine Corps

Rautio, Leonard J.

Monterey, California. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

STUDY OF STANDARDS USED TO SCREEN RECRUITS FOR ASSIGNMENT TO THE COMMUNICATIONS FIELD IN THE U.S. MARINE CORPS

by

Leonard J. Rautio

March 2011

Thesis Co-Advisors: Elda Pema
Mark J. Eitelberg

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 2011	Master's Thesis

4. TITLE AND SUBTITLE Study of Standards Used to Screen Recruits for Assignment to the Communications Field in the U.S. Marine Corps	5. FUNDING NUMBERS
6. AUTHOR(S) Leonard J. Rautio	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number 0058-IR-EP7-A.

12a. DISTRIBUTION / AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Approved for public release; distribution is unlimited	

13. ABSTRACT (maximum 200 words)

This thesis examines the relationship between ASVAB composite scores and success at the 06 Occupational Field Schools. The author analyzes Marine Corps personnel data obtained from the Total Force Data Warehouse. The range of the data studied covers a period from fiscal year 2006 through fiscal year 2009, including 9,921 Marines. Several multivariate regression models are estimated to determine the effects of ASVAB composites and other measures of performance on success at the Communications Schools. Results indicate that the Electronic aptitude test composite has a significant positive effect on success at the Communications Schools. Additional variables that have a positive effect on the probability of success are being married, Hispanic, American Indian, the Clerical aptitude test composite score, enlisting in fiscal year 2007 (compared to 2009), and attending 0612 or 0651 MOS schools (when compared to 0621). Factors that had a negative effect on success include being female, having fewer than 12 years of education, and attending 0613, 0614, 0622, 0623, 0628, or 0656 MOS schools (when compared to 0621). Further research is recommended to examine additional factors and to refine the variable for years of education.

14. SUBJECT TERMS Marine Corps, Communications, ASVAB, EL, Selection, Attrition, MOS, PMOS, Regression, Probit, dProbit, Stata, Statistics	15. NUMBER OF PAGES 87
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

STUDY OF STANDARDS USED TO SCREEN RECRUITS FOR ASSIGNMENT TO THE COMMUNICATIONS FIELD IN THE U.S. MARINE CORPS

Leonard J. Rautio
Captain, United States Marine Corps
B.B.A., University of Wisconsin Madison, 2003

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 2011

Author: Leonard J. Rautio

Approved by: Elda Pema
Thesis Co-Advisor

Mark J. Eitelberg
Thesis Co-Advisor

William Gates
Dean, Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

This thesis examines the relationship between ASVAB composite scores and success at the 06 Occupational Field Schools. The author analyzes Marine Corps personnel data obtained from the Total Force Data Warehouse. The range of the data studied covers a period from fiscal year 2006 through fiscal year 2009, including 9,921 Marines. Several multivariate regression models are estimated to determine the effects of ASVAB composites and other measures of performance on success at the Communications Schools. Results indicate that the Electronics aptitude test composite has a significant positive effect on success at the Communications Schools. Additional variables that have a positive effect on the probability of success are being married, Hispanic, American Indian, the Clerical aptitude test composite score, enlisting in fiscal year 2007 (compared to 2009), and attending 0612 or 0651 MOS schools (when compared to 0621). Factors that had a negative effect on success include being female, having fewer than 12 years of education, and attending 0613, 0614, 0622, 0623, 0628, or 0656 MOS schools (when compared to 0621). Further research is recommended to examine additional factors and to refine the variable for years of education.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

MCO	Marine Corps Order
MOS	Military Occupational Specialty
ASVAB	Armed Services Vocational Aptitude Battery
EL	Electronic
PMOS	Primary Military Occupational Specialty
TFDW	Total Forces Data Warehouse
FY	Fiscal Year
OccFld	Occupational Field
GT	General Technical
CL	Clerical
KSA	Knowledge, Skills, and Abilities
MCRD	Marine Corps Recruit Depot
PEF	Program Enlisted For
MCRC	Marine Corps Recruiting Command
DoD	Department of Defense
MEPS	Military Entrance Processing Station
CEP	Career Exploration Program
AFQT	Armed Forces Qualification Test
PC	Paragraph Comprehension
WK	Word Knowledge
MK	Mechanical Knowledge
AR	Arithmetic Reasoning
MM	Mechanical Maintenance
AS	Auto and Shop Information
MC	Mechanical Comprehension
EI	Electronic Information
AO	Assembling Objects
VE	Verbal Expression
MARDET	Marine Detachment
SATCOM	Satellite Communications

SHF	Super High Frequency
EHF	Extremely High Frequency
CCNA	CISCO Certified Network Associate
CNA	Center for Naval Analyses
JPM	Job Performance Measurement
FCG	Final Course Grade
DMDC	Defense Manpower Data Center
AMERIND	American Indian

ACKNOWLEDGMENTS

I would like thank Dr. Mark J. Eitelberg and Dr. Elda Pema for their wisdom and guidance on helping me finish this thesis. I would also like to extend my gratitude to the other professors and faculty at GSBPP for teaching me more than I ever planned on learning.

Finally, I would like to thank my wife and daughter for their patience, understanding, love and support.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. BACKGROUND

Each of the Armed Services uses very specific standards in assigning recruits to occupational training. Prerequisites for jobs in the Marine Corps are outlined in the Marine Corps Order (MCO) 1200.17A, *Military Occupational Field Manual* (Short title: MOS Manual) (2009). Military Occupational Specialty (MOS) Schools' curricula frequently are updated, improved, and reorganized, based on new technologies, training techniques, testing methods, and job requirements. The corresponding prerequisites for these MOSs are not always updated at an equal pace, however. This can cause increased attrition at MOS schools.

Over the past few years, the 06 Occupational Field (Communications) has implemented numerous new systems and capabilities, leading to increased technical requirements for each MOS within the Field. Entry requirements for the 06 MOS have changed little, however. Recent data indicate that entry-level students are not performing to expectations at the 06 MOS-producing schools. This lower performance has raised questions concerning the requirements for entry into the 06 MOSs.

The most important single factor in the MOS-screening process is the recruits' scores on relevant subtests of the Armed Services Vocational Aptitude Battery (ASVAB). Screening for the 06 Occupational Field is based on the Electronics (EL) subtest of the ASVAB. If the EL requirement for the 06 Occupational Field is not set at the optimal level, it may not be predicting the correct training success rates for new recruits.

B. PURPOSE

The purpose of this thesis is to examine quantitatively the relationship between ASVAB test scores and success at the 06 Occupational Field Schools. The data analysis also includes an assessment of other correlates of success or failure in 06 MOS training.

C. RESEARCH QUESTIONS

1. Primary Research Question

How effective are current ASVAB composite score standards for the 06xx Occupation Field at predicting success in the 06xx PMOS School?

2. Secondary Research Questions

Are factors other than the ASVAB scores predictive of recruit performance in the 06xx PMOS School?

D. SCOPE AND LIMITATIONS

This thesis examines the relationship between ASVAB composite scores (particularly the EL score) and success at the 06 Occupational Field Schools. The author analyzes Marine personnel data obtained from the Total Force Data Warehouse (TFDW). The range of the data studied covers a period from fiscal year (FY) 2006 through FY 2009. FY 2010 data were not included because personnel arriving late in the fiscal year may not have had the chance to complete a Communications School course if they were set back in the course.

E. ORGANIZATION OF THE STUDY

This thesis is organized into six chapters. Following this introduction, Chapter II provides further details about the Marine Corps Military Occupational System, the ASVAB, and the Marine Corps Communications School. Chapter III describes the methodology, techniques, and key findings used in previous studies. Chapter IV presents the results of preliminary analysis using data collected. Chapter V describes the research methodology for the regression models and presents the results for each of the regression models. Chapter VI summarizes the study results, and closes with conclusions and recommendations.

THIS PAGE INTENTIONALLY LEFT BLANK

II. AN OVERVIEW OF THE MARINE CORPS MILITARY OCCUPATIONAL SYSTEM, THE ARMED FORCES VOCATIONAL APTITUDE BATTERY, AND THE MARINE CORPS COMMUNICATION SCHOOL

A. PURPOSE

This chapter briefly describes the Marine Corps Military Occupational System, the ASVAB, the Marine Corps Communication School, and the Communications MOSs. First, the chapter provides background on how jobs are designated in the Marine Corps and a brief background of the ASVAB and how it is applied to job placement in the Marine Corps. The chapter then gives a short description of each Communications MOS and the prerequisites applied in screening recruits for assignment.

B. MARINE CORPS MILITARY OCCUPATIONAL SYSTEM

The Marine Corps Occupational System for assigning Marines to jobs is outlined in the MOS Manual. The MOS Manual is based on the operating principle that "similar skill and knowledge requirements are grouped in functional areas, known as occupational fields (OccFld), which provide for the most efficient and effective classification, assignment, promotion, and utilization of Marine Corps personnel."[1] The OccFld is a group of related MOSs identified by the first two digits of the four-digit MOS. The MOS is a set of duties and tasks that extends over one or more grades. The last two digits of the four-digit MOS code identify the promotional channel and job specialty within the OccFld.

Each OccFld contains a basic MOS that represents entry-level knowledge of the Marine in the OccFld. Its two-digit OccFld number, followed by two zeros, identifies the basic MOS (e.g., MOS 0600, Communications). When Marines

[1] Marine Corps Order 1200.17A, *Military Occupational Field Manual* (Short title: MOS Manual), p. v. Version alpha was used instead of bravo due to the preliminary status of bravo.

successfully graduate from an OccFld specialty school, they are assigned a Primary MOS (PMOS). The final two digits are designated according to this specialty (e.g., MOS 0621, Field Radio Operator).

A PMOS has certain requirements for qualification, as defined by the MOS Manual (e.g., minimum General Technical [GT] score of 100 or minimum Clerical [CL] score of 110 or must be a U.S. citizen). Recruits who are brought into each PMOS must meet these requirements to enter the corresponding PMOS school. The OccFld sponsor and other organizations that play a part in assigning individuals to the PMOS (schoolhouse, monitors, etc.) vet the requirements defined in the MOS Manual. The OccFld sponsors base their critical review on whichever Knowledge, Skills, and Abilities (KSAs) are considered necessary for success in each PMOS.

Recruits from Marine Corps Recruit Depots (MCRDs) fill each PMOS. The recruit slots at MCRDs are filled as Marine Corps Recruiting Command accomplishes its accession mission. The accession mission is based on programs enlisted for (PEF), which are groupings of similar MOSs related to the KSAs. Marine Corps Recruiting Command (MCRC) recruits individuals into the OccFld, not the individual PMOS. It is difficult for MCRC to "sell" an individual PMOS to a high school graduate, so recruiters normally use a skill set, such as the 06 Communications occupational field. Toward the end of the recruit's time at recruit training, the school they will be attending for the PMOS is determined. The recruit's test scores, MOS entry guarantees, needs of the Marine Corps, and other background information (such as citizenship, eligibility for a security clearance, etc.) all factor into this determination. Once recruits graduate from the PMOS school, they are assigned the last two digits of their PMOS designation.

C. ARMED SERVICES VOCATIONAL APTITUDE BATTERY

The United States military has been screening for aptitude since World War I. Before the 1970s, each service used its own version of aptitude tests. In January 1976, the Department of Defense (DoD) began using the Armed

Services Vocational Aptitude Battery, which was already in use by the Air Force and the Marine Corps since 1968, as the "Defense-wide aptitude test of enlistment eligibility."[2] Although modified over the years, the ASVAB remains the military's premier tool for enlistment screening and job placement.[3]

The ASVAB is administered to most military applicants at a regional Military Entrance Processing Station (MEPS). These applicants take a computerized version of the test, called the CAT-ASVAB (CAT stands for Computerized Adaptive Testing). A paper-and-pencil version of the ASVAB is also available for applicants who need to be tested at remote sites. The CAT-ASVAB contains nine subtests that are timed separately. These subtests are shown and described in Table 1.[4]

Screening for the military is accomplished by calculating a composite score from selected subtests of the ASVAB. For example, the Armed Forces Qualification Test (AFQT), the military's enlistment test, is a composite score of four ASVAB subtests: Paragraph Comprehension (PC), Word Knowledge (WK), Mathematics Knowlege (MK), and Arithmetic Reasoning (AR). The AFQT score usually is espressed as a percentile score based on youth population norms for men and women aged 18 to 23. Thus, an AFQT percentile score of 50 is the mean or dividing point between above-average and below-average scores for young adults in the general population. For high school graduates, the minimum AFQT score allowed by the Marine Corps is 32.

---

[2] Mark J. Eitelberg, *Manpower for Military Occupations* (Alexandria, VA: Human Research Resources Organization, 1988), 18–23.

[3] Ibid., 23.

[4] "The ASVAB is also offered to high school and post-secondary students as part of the ASVAB Career Exploration Program (CEP). The program provides tools to help students learn more about career exploration and planning, in both the civilian and military worlds of work." It should be noted that the paper-and-pencil version of the ASVAB is used in the high school testing program (http://asvabprogram.com, last accessed 12 January 2011).

Table 1. Armed Services Vocational Aptitude Battery Subtest Descriptions

Subtest	**Content**
General Science (GS)	Knowledge of or about physical, chemical, and biological properties
Arthmetic Reasoning (AR)	Reasoning required to perform arithmetic processes
Word Knowledge (WK)	The meanings of selected words
Paragraph Comprehension (PC)	Understanding of written material from brief paragraphs
*Auto and Shop Information (AS)	Knowledge of and familiarity with tools, shop practices, maintenance, and repair of automobiles
Mathematic Knowledge (MK)	Application of learned mathematics principles
Mechanical Comprehension (MC)	Understanding and application of various mechanical principles
Electronics Information (EI)	Identification or application of simple electrical or electronic knowledge
Assembling Objects (AO)	(New as of 2002) Ability to determine how an object will look when its parts are put together.

***(Auto and Shop tests are seperate on the written version of the test).**
Source: After Office of the Secretary of Defense, "Understanding the ASVAB," *Official Site of the ASVAB,* last accessed 12 January 2011, www.official-asvab.com/understand_coun.htm.

Composite scores need to be calculated to assign recruits to jobs in the Marine Corps. To do that, subtest scores are converted to standard scores with a mean of 50 and a standard deviation of 10.[5] These standard scores are then used to calculate an applicant's nonstandardized composite score. According to research done by Robert J. Schaffer, "the composites are then converted to standardized Marine Corps composites with a mean of 100 and a standard deviation of 20."[6] These Marine Corps composites are used to assign an applicant to a job training course, taking into consideration the desires of the applicant and the needs of the Marine Corps.[7]

The composite scores are listed in Table 2 along with the equation used to derive them. As seen here, the Marine Corps uses four composites: The Mechanical Maintenance (MM) composite, the CL composite, the EL composite and the GT composite. The EL composite is composed of the AR, MK, EI and GS subtests. The EL composite score is used to determine eligibility for assignment to training in the Communications MOS.

Table 2. Marine Corps Armed Services Vocational Aptitude Battery Composites

Composite Name	**Definition**
Mechanical Maintenance (MM)	AR + EI + MC + AS
Clerical (CL)	VE (WK + PC)+ MK
Electronics (EL)	AR + MK + EI + GS
General Technical (GT)	VE (WK + PC) + AR + MC

Source: From Marine Corps Order 1230.5B, Classification Testing (11 Sep 2009), 4.2.

[5] Office of the Secretary of Defense, "Understanding the ASVAB," *Official Site of the ASVAB*, last accessed 12 January 2011, www.official-asvab.com/understand_coun.htm.

[6] Robert J. Schaffer III, "Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance" (Master's thesis, Naval Postgraduate School, 1996), 3–5.

[7] Ibid.

Marines may receive their assignment to one of the Communication MOSs at various times during the initial screening and training process. Once a prospective Marine receives the necessary composite score from taking the ASVAB, either at the MEPS, remotely, or during the CEP, he can be guaranteed the 06 Occupational Field via contract. Otherwise, a Marine can enter recruit training with an open contract (not assigned any particular MOS) and later be assigned an 06 MOS because of screening done at Boot Camp. Assigning Marines with open contracts to the 06 Occupational Field is a way to fill vacant Communications School requirements as a result of attrition from Boot Camp or Marine Combat Training.

D. COMMUNICATIONS SCHOOL AND MOS DESCRIPTIONS

1. The Marine Corps Communication and Electronics School (MCCES)

MCCES is located in Twentynine Palms, California, and has a Marine Detachment (MARDET) at Fort Gordon, Georgia. MCCES at Twentynine Palms is divided into three Companies; Alpha Company, Bravo Company, and Charlie Company. Marines are assigned to a company based on PMOS School as follows:

- Marines who attend the Communication-Electronics Maintenance School are located in Alpha Company. Marines who graduate from this school typically receive an MOS in the 2800 Occupational Field.
- Marines who attend the Tactical Communication Training School are located in Bravo Company. Marines who graduate from this school receive the 0612-0658 MOSs.
- Marines who attend the Air School are located in Charlie Company. Marines who graduate from this school receive MOSs in the 7200 Occupational Field.

- Marines receiving the 0627 and 0628 MOS attend the Satellite Communication (SATCOM) Operator Course, the Ground Mobile Forces SATCOM Operator Course, the Phoenix Satellite Terminal Operators Course and the Lightweight Multi-band Satellite Terminal Operator-Maintainer Course located at Fort Gordon, Georgia.

2. MOS Descriptions and Prerequisites

The MOS Manual describes the Communications field as follows:

> The communications occupational field includes the design, installation, interconnection, and operation of communication networks and information systems used to transmit information and data. Marines in this field operate and perform preventive maintenance on both hardware and software systems; including telephone, teletype, switching, radio, cryptographic, and computer systems, which are essential links in the overall functions of communication.[8]

The following Communication MOSs are entry-level MOSs to which Marines graduating from bootcamp can be assigned.

a. MOS 0612, Tactical Switching Operator

> The primary role of personnel in this MOS is to install, operate, and maintain wire and cable networks to link units with reliable paths for facsimile, telephone and data services. Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 90 or higher; (3) must have normal color vision; and (4) must have a confidential security clearance and be eligible for a secret security clearance.[9]

b. MOS 0613, Construction Wireman

> Typical duties include integrating tactical telephone systems with host nation telephone systems, operating unique items of equipment for pole line construction (pole line trucks/series

[8] MOS Manual, 3.90.

[9] Ibid.

ditcher), mounting commercial hardware, and emplacing conduit systems/commercial cable. Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 100 or higher; (3) must have normal color vision; and (4) must have a confidential security clearance and be eligible for a secret security clearance.[10]

c. MOS 0614, Unit-Level Circuit Switch Maintainer

"This MOS is merged with MOS 0612 and is deleted."[11]

d. MOS 0621, Field Radio Operator

Typical duties include the set-up and tuning of radio equipment, including antennas and power sources; establishing contact with distant stations; processing and logging of messages; making changes to frequencies or cryptographic codes; and maintaining equipment at the first echelon. Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 90 or higher; (3) must possess a valid state driver's license; and (4) must have a confidential security clearance and be eligible for a secret security clearance.[12]

e. MOS 0622, Digital (Multi-Channel) Wideband Transmission Equipment Operator

The digital (multi-channel) Wideband transmission equipment operator are Marines qualified to install, operate, and maintain, at the first echelon, the multichannel media equipment and AN/MRC-142. Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 100 or higher; (3) must possess a valid state driver's license; and (4) must have a confidential security clearance and be eligible for a secret security clearance.[13]

---

[10] MOS Manual, 3.90.

[11] Ibid., 3.91.

[12] Ibid., 3.92.

[13] MOS Manual, 3.93–3.94.

f. MOS 0623, Tropospheric Scatter Radio Multi-Channel Equipment Operator

The tropospheric scatter radio multi-channel equipment operator MOS identifies Marines who are qualified to install, operate, and maintain, at the first echelon, multi-channel media equipment. Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 100 or higher; (3) must possess a valid state driver's license; and (4) must have a confidential security clearance and be eligible for a secret security clearance.[14]

g. MOS 0627, Super High Frequency (SHF) Satellite Communications Operator-Maintainer

The SHF satellite communications operator-maintainer PMOS identifies Marines who emplace, interconnect, energize, and verify the operation of SHF satellite terminal equipment. Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 100 or higher; and (3) must have a confidential security clearance and be eligible for a secret security clearance.[15]

h. MOS 0628, Extremely High Frequency (EHF) Satellite Communications Operator-Maintainer

The EHF satellite communications operator-maintainer MOS identifies Marines who emplace, interconnect, energize, and verify the operation of EHF satellite terminal equipment (currently the SMART-T satellite system). Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 100 or higher; (3) must possess a valid state driver's license; and (4) must have a confidential security clearance and be eligible for a secret security clearance.[16]

[14] MOS Manual, 3.94.

[15] Ibid., 3.94–3.95.

[16] MOS Manual, 3.95.

i. MOS 0651, Data Systems Technician

> Data Network Technicians are responsible for the installation, configuring, and management of data network systems in both stand-alone and client-server environments, including Microsoft-based curriculum on Microsoft Exchange/Server, CISCO Certified Network Associate (CCNA) modules 1, 2, and 3, as well as other authorized data network systems. Prerequisites include: (1) must be a U.S. citizen; (2) must have an EL score of 110 or higher; and (3) must have a confidential security clearance and be eligible for a secret security clearance.[17]

j. MOS 0656, Tactical Network Specialist

> "This MOS is merged with MOS 0652 and is deleted."[18]

E. CHAPTER SUMMARY

In summary, the Marine Corps Military Occupational System attempts to assign the right Marines to the right jobs by using various prerequisites outlined in the MOS Manual. The EL portion of the ASVAB is the primary determinant and is examined in the present study of Marines assigned to Communications MOSs. Marines assigned to the Communication field attend initial MOS training at MCCES Twentynine Palms, California, or Fort Gordon, Georgia. The Communications Field MOSs are highly technical and require an EL score ranging from 90 to 110. Further details on MOS descriptions can be found in the MOS Manual.[19]

The validity of ASVAB composites in predicting performance at initial training schools is examined frequently. The current study looks at the relationship between the ASVAB composite scores on success, but due to the limitations of resources and time, does not attempt to establish the validity of the

[17] MOS Manual, 3.97.

[18] Ibid., 3.99.

[19] Ibid., 3.90–3.99.

composites. Many ASVAB validity studies are related to the current study, however. The next chapter examines several of the most relevant studies.

THIS PAGE INTENTIONALLY LEFT BLANK

III. LITERATURE REVIEW

A. INTRODUCTION

Numerous ASVAB validation studies have been conducted over the past 30 years. According to Bill Sims and Catherine Hiatt of the Center for Naval Analyses (CNA), in March there are several instances when an ASVAB validation study is conducted for the Marine Corps: "(1) an ASVAB validation usually takes place every 5 to 10 years; (2) a validation is initiated when there is a complaint from the field; or (3) when new ASVAB subtests are introduced."[20] Unlike previous studies involving ASVAB scores as a predictor of initial training performance, the current study does not attempt to validate ASVAB scores as a predictor of performance. The current study examines how effective current ASVAB composite score standards for the 06xx Occupation Field are at predicting success in the 06xx PMOS school. It is important to examine literature that establishes this validation for the purposes of the current study, however.

This chapter briefly examines the history of the Job Performance Measurement (JPM) Project, presents the methodology and results from ASVAB validation research, presents the methodology and results of similar studies to the current study, and examines attrition research relevant to the current study.

B. JOB PERFORMANCE MEASUREMENT PROJECT

CNA analysts discovered a normalization error in the ASVAB in 1979.[21] This misnorming "resulted in a significant number of unqualified and low aptitude

[20] William H. Sims and Catherine M. Hiatt, *Marine Corps Selection and Classification* (Alexandria, VA: CNA, 2001), 3.

[21] William H. Sims and Ann Truss, *A Reexamination of the Normalization of the Armed Services Vocational Aptitude Battery (ASVAB) Forms 6, 7, 6E, and 7E* (Alexandria, VA: CNA, 1980), 1–2.

personnel entering each of the services in the late 1970's."[22] According to Carey and Ramirez, "across the four services, a total of about 360,000 persons would have been declared ineligible for service if the test scores had been correct."[23] In 1981, Congress mandated that each service test the validity of ASVAB scores on predicting on-the-job performance as well as training school performance. Additionally, the services were to "establish enlistment standards against these job performance criterions."[24]

The Marine Corps JPM was a long-term project to study the relationship between the ASVAB and Marine job performance.[25] Out of this project, the validity of the ASVAB was established in predicting job performance.[26] The following sections summarize relevant studies that were a result of the JPM Project.

1. Job Performance Tests

Using hands-on and written proficiency evaluations, in addition to training school grades, CNA analysts Milton H. Maier and Catherine M. Hiatt examined the "feasibility of validating ASVAB enlistment standards against job performance."[27] In the study, Maier and Hiatt developed the hands-on and written tests for three Marine Corps MOSs: Ground Radio Repair, Automotive

---

[22] Neil Carey and Janet L. E. Ramirez, *The Marine Corps job Performance Measurement (JPM) Project: A Bibliography* (Alexandria, VA: CNA, 1993), 1.

[23] Ibid.

[24] Ibid.

[25] Paul W. Mayberry, *Validity Results for the Job Performance Measurement Project* (Alexandria, VA: CNA, 1989), 1.

[26] Ibid.

[27] Milton H. Maier and Catherine M. Hiatt, *An Evaluation of using Job Performance Tests to Validate ASVAB Qualification Standards* (Alexandria, VA: CNA, 1984), i.

Mechanic, and Infantry Rifleman.[28] These three MOSs represent high-to-low technical skills and, therefore, cover an adequate range of technical complexity for the purposes of their study.[29]

Results of the study show that all three evaluation types are adequate measures of performance. Milton and Hiatt conclude, "validating ASVAB enlistment standards against job performance appears to be feasible."[30] Due to the high cost of developing and administering job performance tests, they determine that the traditional training course grades can be used as a proxy.[31]

2. Establishing ASVAB Composites

In 1985, Milton H. Maier and Ann R. Truss of CNA conducted an ASVAB validation study for the Department of the Navy. The study had these two main objectives:

- Validate ASVAB forms 8, 9, and 10 "as a predictor of performance in Marine Corps occupational specialty training courses."[32]
- "Develop and evaluate ASVAB composites for ASVAB forms 11, 12, and 13."[33]

The study uses ASVAB scores from "automated Marine Corps files,"[34] and final grades from the Marine Corps training schools. Unlike the current study, Maier and Truss did not include observations where the individual dropped out of the course for nonacademic reasons.

---

[28] Maier and Hiatt, *Job Performance Tests*, i.

[29] Ibid., 9.

[30] Ibid., i.

[31] Ibid.

[32] Milton H. Maier and Ann R. Truss, *Validity of the Armed Services Vocational Aptitude Battery Forms 8, 9, and 10 with Applications to Forms 11, 12, 13, and 14* (Alexandria, VA: CNA, 1985), iii.

[33] Ibid.

[34] Ibid., 5.

As a result of the study, four composites (the current EL, GT, CL, and MM) were developed for use in assigning Marines into occupational specialties. Additionally, the study confirmed the ASVAB as a "valid predictor of performance in occupational training courses, and it can continue to be used in making personnel decisions about selecting recruits and assigning them to occupational specialties."[35]

3. Validity of ASVAB Composites in Predicting Performance

Since Maier and Truss developed the ASVAB Composites, CNA conducted several studies as part of the JPM project on the validity of ASVAB composite scores in predicting training school performance. The following studies pertain to the current research.

In 1990, Neil B. Carey of CNA conducted a study to determine if changes made to the AFQT composite in 1989 had decreased the number of eligible Marines and whether composites other than the GT composite could be used to increase the number of eligible Marines.[36]

Carey used test scores from all high school graduates who took the ASVAB from November 1987 through February 1988. Carey's findings show that the AFQT composite developed in 1989 has a nearly identical qualification percentage as did the old version. In addition, the GT composite qualifies the most applicants for service in the Marine Corps, and using the other three composites (EL, CL, or MM) increases the total applicant pool by only 2 percent.[37] Because the other three composites have more stringent requirements for individual MOSs,[38] it was determined that the GT score

---

[35] Maier and Truss, *Validity of the ASVAB*, viii.

[36] Neil B. Carey, *Effect of the GT Composite Requirement on Qualification Rates* (Alexandria, VA: CNA, 1990), v.

[37] Ibid.

[38] At the time of the study, entry into the Marine Corps required the applicant to be in at least the 21st percentile on the AFQT and have a GT score of at least 80. Qualification for an MOS may have other requirements for the other composites. For example, the communication MOSs require an EL score of 90 through 115, depending on the specialty within the 06 PMOS field.

remained the best alternative for initial qualification for entry into the Marine Corps. Similarly, the current study examines the relationship of all four composites on success at the Communications Schools.

In 1992, Divgi, Mayberry, and Carey of CNA conducted a study to determine the fairness of the MM composite across racial/ethnic groups. The researchers evaluated MM composite scores for 118 blacks and 632 whites to estimate the results of "hands-on performance tests for the Automotive Mechanic specialty (MOS 3521),"[39] developed during the JPM project. They found that "Marine Corps JPM results for the Automotive Mechanic specialty, using the hands-on performance test as the criterion, show that the Mechanical Maintenance composite is equally sensitive for blacks and whites."[40] The current study further examines the effects of race (and other demographic variables) on training school performance, to determine if there are similar findings for the Communications MOS.

In 1993, Carey and Hiatt conducted a study in support of the JPM project to "analyze the relationship between the Marine Corps (EL) ASVAB composite and success in electronics courses for Ground Radio Repair (MOS 2841)."[41] Carey and Hiatt use final course grades, number of failures, number of setbacks, demographic information, and high school records of 435 Marines who successfully completed the Ground Radio Repair course for one data set and 430 Marines who included 107 Marines who dropped out of the course for a second data set. The results of the study "indicate that the Marine Corps EL composite is valid for predicting electronics course performance."[42]

---

[39] D.R. Divgi, Paul W. Mayberry, and Neil B. Carey, *Sensitivity and Fairness of the Marine Corps Mechanical Maintenance Composite* (Alexandria, VA: CNA, 1992), v.

[40] Ibid., 5.

[41] Neil B. Carey and Catherine M. Hiatt, *Validity of the Marine Corps Electronics Composite for Predicting Success in Electronics Training School* (Alexandria, VA: CNA, 1993), iii.

[42] Carey and Hiatt, *Electronic Composite*, iii.

C. METHODOLOGY OF SIMILAR STUDIES

As stated in the introduction to this chapter, periodic studies are conducted to validate ASVAB scores in predicting job performance. Although the current research does not attempt to validate ASVAB scores, two recent studies have similar applications. The following studies examine the relationship of the EL score to training school performance in the Communications occupational field.

In 1996, Robert J. Schaffer III analyzed the validity of ASVAB subtest scores on performance at initial MOS schools for the Marine Corps. One of the MOS schools studied was the Field Radio Operator Course (0621) at Twentynine Palms, California. Then, in 2005, Catherine M. Hiatt performed an ASVAB validation study for CNA. The study analyzes the EL ASVAB composite score and its predictive power on success in the Field Radio Operator MOS (0621).

1. Data and Variables

Hiatt and Schaffer used similar methods to collect data. The data for Schaffer's study were collected by CNA. Out of 54 courses examined, Schaffer chose to study eight based on composite requirements. Each of the ASVAB composites (EL, GT, CL, and MM) was represented by two MOSs.[43] For each individual in the sample selected, Schaffer collected data on Final Course Grade, ASVAB subtest scores, Marine Corps composite scores, an attrition variable, a completion code, armed forces active-duty base date, and final course completion date.[44] Other factors that may affect attrition or completion of initial training courses (ability, behavior, demographics, etc.) were not included in the study.

[43] Schaffer III, *Relating ASVAB to Job Performance*, 6–7.

[44] Ibid., 7.

In the Schaffer study, Final Course Grades (FCGs) were used as the criterion measure to determine these predictive validity coefficients.[45] Schaffer found that, due to instructional techniques, there was little variance in FCGs.[46] This tight distribution made it difficult to determine job performance differentiation of the sample. To remedy this problem, Schaffer combined the FCG with a completion variable that further differentiates FCGs by including how they completed the course. Table 3 presents a summary of the completion code variable Schaffer developed.

Table 3. Completion Code Variable Used in Study by Shafer

If ATTRITE = 0 (a graduate) then
COMPLETION CODE = 1 is a regular pass
COMPLETION CODE = 2 is an academic recycle
COMPLETION CODE = 3 is a non-academic recycle
If ATTRITE = 1 (attrited from course) then
COMPLETION CODE = 1 is an academic attrite
COMPLETION CODE = 2 is a non-academic attrite

Source: From Schaffer III, Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance, 9.

Based on these definitions, FCGs were adjusted to provide for easier interpretation. The FCGs were taken as is unless the observation passed (ATTRITE = 0) but was an academic recycle (COMPLETION CODE = 2) or the observation failed (ATTRITE = 1) but for nonacademic reasons (COMPLETION CODE = 2). If the individual passed but was an academic recycle or they failed but for nonacademic reasons, they were given a minimum passing grade.[47] This method differs from the current study in this regard. Because the current study has a secondary question of determining if factors other than the ASVAB scores

[45] Schaffer III, *Relating ASVAB to Job Performance,* 13.

[46] Ibid., 9.

[47] Ibid.

are predictive of recruit performance, the author includes dropouts due to nonacademic reasons as course failures. In addition, due to resource limitations, the current study does not include course grades.

Hiatt used a slightly different approach. After dropping observations due to missing information and outliers, the Hiatt study analyzed 1,160 out of 1,519 observations.[48] For each final observation, final course grades were collected from the Marine Corps training school for Field Radio Operators in Twentynine Palms, California. The Defense Manpower Data Center (DMDC) provided ASVAB scores, composites, and demographic information.[49] Variables for ability or behavior were not included. Hiatt does not use a completion variable to adjust for a tight distribution of final course grades.

2. Methodology

a. Validity Coefficients

To assign a value to the predictive power of ASVAB scores and on how accurate they are at forecasting performance at initial MOS schools, Schaffer and Hiatt use different methods in developing predictive validity coefficients. It is important to emphasize the current study is not a validation study per se, so does not develop validity coefficients. That being the case, the variables used in the current study do not attempt to generalize results for an entire population so they do not need to correction for range restrictions. In examining the Schaffer and Hiatt study it is useful to mention how and why they develop the validity coefficients.

Schaffer calculates the validity coefficient by using the formula in Table 4. In this formula, "the explicit variable refers to the ASVAB composite and

[48] Catherine M. Hiatt, *The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators* (Alexandra, VA: CNA, 2005), 6–9.

[49] Ibid., 6.

the indirect variable refers to the adjusted FCG."[50] Due to the nature of restricting individuals from taking a course because of their ASVAB scores, the population validity coefficient is underestimated. Removing individuals who do not meet the minimum requirements for an MOS reduces the validity coefficient. This formula attempts to correct for the range of the validity coefficient.[51]

Table 4. Adjusted Validity Coefficient Formula Used by Schaffer

$$R_{XY} = \sqrt{1-\left(1-r_{xy}^2\right)\frac{S_y^2}{S_Y^2}},$$

where x is the sample explicit variable from the selected group,
y is the sample indirect variable from the selected group,
X is the corrected for range restriction explicit variable,
Y is the corrected for range restriction indirect variable,
r_{xy} is the sample correlation between x and y,
s_y^2 is the variance of sample y,
S_Y^2 is the variance of reference population Y.

Source: From Schaffer III, Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance (1996), 16.

Similar to the Schaffer study, Hiatt adjusts the coefficients to account for the restriction of range of the validities to the selection method (only including recruits with an EL of at least 90).

b. Statistical Analyses

Schaffer uses two methods in his statistical analysis. First, Schaffer uses a linear multiple discriminant analysis method to identify groups by their ASVAB scores.[52] Each individual is then assigned a course based on his highest score. Marine Corps composite scores use different combinations of the

[50] Schaffer III, *Relating the ASVAB to Marine Job Performance,* 15.

[51] Ibid, 16.

[52] Ibid, 19.

same nine subject area tests; therefore, they contain areas from each subject. In addition, MOS prerequisites are the same for many MOSs. This being the case, many individuals qualify for more than one MOS and would perform equally well at either. Because of this, the needs of the Marine Corps and individual preference are taken into consideration when assigning an MOS. Table 5 shows the discriminant analysis formula used by Schaffer in his study to develop groups by ASVAB score. Needs of the Marine Corps and individual preferences are not calculated in this formula.

Table 5. Discriminant Analysis Formula Used in Study Used by Schaffer

$$S_i^j = (\mu_i^T \Sigma^{-1}) U_i^j - \frac{1}{2}\left(\mu_i^T \Sigma^{-1} \mu_i\right) + \log(\pi_i) \qquad \forall i$$

where i = total number of courses considered
j = an individual
μ_i = vector of mean predictor values
Σ^{-1} = inverse of the dispersion matrix
U_i^j = vector of an individual's predictor values
π_i = percentage of individuals assigned to course i

Source: From Schaffer III, Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance (1996), 20.

Finally, Schaffer uses a tree-based regression method to determine if the use of additional ASVAB sub scores (i.e., using EL in addition to GT scores instead of just EL) to screen recruits may increase final course grades. Each course is tested separately, and all four composites are used.

The Hiatt study uses a different statistical approach. To ensure that the EL composite was the best alternative, Hiatt performed a stepwise regression by systematically comparing different combinations of subtests. The first step of this procedure was to add additional subtests to the regression and compare the multiple R^2. Hiatt then analyzed the composite validities based on these stepwise regression results. To determine fairness of the EL composite, Hiatt ran regressions on each racial and gender subgroup and compared slopes,

intercepts, and standard errors of measurement.[53] In the regressions, Hiatt used both observed scores for the ASVAB subtests and she calculated true score estimates to account for measurement errors in the subtests.[54]

D. RESULTS OF SIMILAR STUDIES

a. Validity Coefficient Results

After adjusting for selection bias on the validity coefficients by applying the formula in Table 4, Schaffer found that "all population validity coefficients to be positive, have moderate estimated values, and have different values for each ASVAB subtest. These latter two properties make the values sufficient for assignment and selection purposes."[55] Hiatt also found that all the subtests have a high validity.[56]

b. Statistical Analyses Results

Schaffer found that the majority of those originally assigned to an MOS course based on ASVAB composite scores were placed in the same course or a similar course based on the discriminant method results. In all cases, more were assigned to the original MOS course than any other course. Schaffer also found that individuals with higher ASVAB composite scores, regardless of course, tend to outperform individuals with lower scores.[57] The study also shows that by including additional composite scores in results show minor improvements to FCG.

---

[53] Hiatt, *ASVAB and Training School Performance*, 15.

[54] Ibid.

[55] Schaffer III, *Relating the ASVAB to Job Performance,* 25.

[56] Hiatt, *ASVAB and Training School Performance,* 10.

[57] Schaffer III, *Relating the ASVAB to Job Performance,* 29.

Hiatt's regression analysis (results in Table 6) show that "that performance in the course is influenced by math (AR and MK) and technical (EI and AS) abilities as measured by the indicated subtests."[58]

Table 6. Stepwise Regression by Subtest in Study by Hiatt

Subtests	Multiple R^2
AR	0.37
AR + EI	0.41
AR + EI + MK	0.43
AR + EI + MK + AS	0.44
AR + EI + MK + AS + VE	0.45

Source: From Hiatt, The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators (2005), 12.

Hiatt then included the composite validities based on the stepwise regression results shown in Table 6. Table 7 shows the validities for the composites are quite similar.

Table 7. Composite Definitions

Composite definition	Validity
AR + EI	0.63
AR + EI + MK	0.66
AR + EI + MK + AS	0.66
AR + EI + MK + GS*	0.66
* This is the current EL composite	

Source: From Hiatt, The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators (2005), 14.

[58] Hiatt, *ASVAB and Training School Performance,* 12.

In her regressions to determine fairness of the EL composite, Hiatt found that the slopes and intercepts for all subgroups (true and observed scores) were significantly insignificant. This shows that the EL composite predicts performance equally for all subgroups tested.[59] Table 8 shows a summary of the findings.

Table 8. Subgroup Analysis Results of Study by Hiatt

Score type	Subgroup	Slope F value	Intercept F value
True score estimate	Race	0.20	0.01
	Gender	0.03	0.60
Observed score	Race	0.16	0.89
	Gender	0.00	1.47

Source: From Hiatt, The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators (2005), 16.

E. COMPARISONS AND CONCLUSIONS OF SIMILAR STUDIES

While the Schaffer study tests the validity of ASVAB subtest scores and shows that by including additional composites in screening may improve FCGs, it does not include other possible correlates that may influence attrition or success. In the current study, the author controls for these correlates to find a more accurate predictive power of the EL composite.

The Hiatt study results indicate that the EL composite remains the best predictor of success for Field Radio Operators. The study does not test the other Communications MOSs and does not control for other possible correlates of attrition or success like ability or behavior, however.

[59] Hiatt, *ASVAB and Training School Performance,* 16.

F. ATTRITION STUDIES

To determine variables used in analyzing correlates of success at the Communications Schools, the author examines several attrition studies. Christopher Distifeno finds that, in examining 180 and 365-day attrition rates, men and minorities (Black, Hispanic, and other) are less likely to attrite than women and Whites, while married soldiers and soldiers with dependents are more likely to attrite from the Army.[60]

Richard A. Huth finds that men and minorities (Black, Asian, and Hispanic) have a lower rate of first-term attrition from the Navy.[61] Huth also finds that education has a positive effect on the success of recruits.[62]

In 2004, Joseph K. Knapik, Bruce H. Jones, Keith Hauret, Salima Darakjy, and Eugene Psikator found similar results in their study.[63] The study was robust, analyzing over 20 years of attrition research for all four services. The authors determined that "risk factors for attrition include lower educational attainment, female gender, white ethnicity, (and) lower Armed Forces Qualification Test scores."[64]

The current study builds upon the findings of previous attrition research and controls for variables found to increase the likelihood of first-term attrition from the military.

---

[60] Christopher Distifeno, "Effects of Moral Conduct Waivers on First-term Attrition of U.S. Army Soldiers" (Master's thesis, Naval Postgraduate School, 2008), 36–40.

[61] Richard A. Huth, "The Effect of Moral Waivers on Success of Navy Recruits" (Master's thesis, Naval Postgraduate School, 2007), 36.

[62] Ibid.

[63] Joseph K. Knapik, Bruce H. Jones, Keith Hauret, Salima Darakjy, and Eugene Psikator, *A Review of the Literature on Attrition from the Military Services: Risk Factors for Attrition and Strategies to Reduce Attrition* (Fort Knox, KY: Center For Accessions Research, 2004), i.

[64] Ibid.

G. CHAPTER SUMMARY

Based on the literature reviewed, ASVAB sub-scores have high validity in predicting success at initial training schools. In addition, previous studies show that the EL composite score is a good predictor of performance for Field Radio Operators. The present study uses more recent data and additional correlates of success to determine if the EL composite remains a good predictor of performance. The study also controls for correlates of attrition. The following chapter provides background on the data sources and variables used in the analysis.

THIS PAGE INTENTIONALLY LEFT BLANK

IV. DATA SOURCES, VARIABLE DESCRIPTIONS, AND SUMMARY STATISTICS

The purpose of this chapter is to provide background information on the data sources used in the analysis. In addition, this chapter describes the dependent and independent variables used and explains why they were chosen. Finally, the chapter provides an overview of the data used by presenting variable tabulations and descriptive statistics.

A. DATA SOURCES

1. Total Forces Data Warehouse

Data for this study were provided by the Marine Corps Total Forces Data Warehouse (TFDW). TFDW is the official system of record for the Manpower Plans and Policy Division of Headquarters Marine Corps. It is a database containing information on all active and reserve Marines. Data include demographics, commissioning and enlistment information, and MOS information. The TFDW was used to pull MOS and demographic data on all Marines assigned the 0600 MOS from 01 October 2005 through 30 September 2009.

The data are provided in sequence on all Marines each month. Each sequence contains a snapshot of data on each Marine at that exact time. The sample was restricted to active-duty Marines initially entering the Marine Corps at the pay grade of E1-E4. Table 9 gives details on the sample used in the study. As shown here, the initial sample drawn from TFDW included 10,533 Marines. Of these, 612 observations were deleted because of missing or inaccurate data, leaving 9,921 observations for study.

Table 9. Marines Entering in FY2006–2009 for the 0600 MOS

Details	**Number of Observations**
Initial Sample	10,533
Missing or Deleted	612
Final Sample	9,921

Source: Total Forces Data Warehouse.

Table 10 gives further details of the observations dropped. Marines were dropped from the sample if they had no recorded proficiency and conduct marks, an AFQT score of less than 32, or an EL score under 90. It is believed that anyone outside that range had errors in reporting.

Table 10. Restrictions Details for Observations Dropped

Observations Dropped	Number Removed	Explanation
AFQT < 32	394	The minimum AFQT score for entrance into the Marine Corps is 32.
Proficiency Mark of 0	205	A Proficiency mark of 0 is reserved for those on Deserter status and will skew the results of the regression.
Conduct Mark of 0	(Same 205 as Proficiency Mark drops)	A Conduct mark of 0 is reserved for those on Deserter Status and will skew the results of the regression.
EL < 90	13	All 06xx MOS require an EL score of at least 90.

Source: Total Forces Data Warehouse.

2. Communications School

Data on aggregate graduation numbers were obtained from MCCES Twentynine Palms, California.

B. VARIABLE DESCRIPTIONS

The following subsections contain descriptions of the variables used in the study. The author included all available variables that may be correlated with success or attrition.

1. Success Dependent Variable

The dependent variable is a dummy variable that identifies whether the Marine in observation was successful at an 06 primary MOS school. The variable takes a value of one if successful or a value of zero if not successful.

Data were collected by examining each sequence in a fiscal year on all Marines entering with an MOS of 0600 (meaning they were assigned to the 06 Occupational Field but had not graduated from initial PMOS training). When the 0600 MOS changes to a Primary MOS in the 06 Occupational Field (0612, 0621, 0651, etc.), we consider the Marine as successfully completing an 06 Primary MOS school. These Marines are assigned a one. If the Marine's MOS changes to something other than 06xx (03xx, 28xx, etc.), or if the Marine drops out of TFDW, we consider this nonsuccess. A limitation of this process is that we cannot determine the reason for nonsuccess of those dropping out of TFDW.

The reasons for nonsuccess in these cases may be related to factors other than failure at the schoolhouse (medical, personal, behavioral, etc.). Marines are typically given numerous times to retake a course at the Communications School (this is considered being "rolled" or set back). Marines who are "rolled" back, but later complete the course are considered a success and assigned a one. This process varies from previous research conducted. As

shown in Chapter III, Hiatt used adjusted final course grades and an adjustment variable in his study. Final course grades were not obtained for the current study because of limited resources.

2. Demographic Independent Variables

Demographic variables were used in the study based on the attrition literature reviewed.[65] Prior literature indicates that these variables may be contributing factors to attrition in the military. This study attempts to control for any variable that may affect attrition.

a. Gender

The Female variable takes a value of one if the observation is female and a zero if the observation is male. Prior studies show that women are more likely than men to attrite from the military.[66]

b. Race/Ethnicity

This information was captured by a series of dummy variables (**WHITE**, **BLACK**, **HISPANIC**, **ASIAN, AMERIND** (American Indian)**,** and **OTHER**) indicating the race of the Marine. Distifeno observes that various studies in this area have found varying results for the effect of race on attrition.[67] The variables were included to determine whether race has an effect on the success rate of Marines attending an 06 Primary MOS School.

The **Other** variable is a combination of Marines selecting other as a race/ethnicity or did not choose a particular race/ethnicity.

---

[65] See Chapter III.

[66] Ibid.

[67] Distifeno, *Moral Conduct Waivers,* 17.

c. Marital Status

The Married dummy variable represents the entrant's marital status. A value of one represents married while zero represents single, widowed, divorced, or annulled. Knapik et al. found that individuals with families have higher attrition rates than those without during the first term of enlistment.[68]

d. Number of Dependents

This variable lists the number of dependents a Marine has claimed. Findings on dependents were similar to those of marital status.[69]

3. Service and Other Independent Variables

a. Primary MOS

Difficulty of course material and other differences in MOSs have an effect on success at the PMOS school. Knapik et al. found that different MOSs have varying attrition rates.[70] The MOS dummy variable in the fifth regression model is included to control for differences in the PMOS school. MOS 0614 and 0656 were combined with MOS 0612 and MOS 0651, respectively.

b. Fiscal Year

The Fiscal Year (FY) variables (**fy06**, **fy07**, **fy08**, **fy09**) are variables that take the value of one if the Marine has an armed forces active duty base date (AFADBD) during that fiscal year. FY dummy variables were used to capture the effect of the economy or service during that FY that may account for attrition. This variable also captures possible changes in the schoolhouse over

[68] Knapik et al., *Attrition Literature,* 8.

[69] Ibid., 9.

[70] Ibid., 33.

time. For example, if testing methods (going from open book tests to closed book tests) differ from one year to the next these variables will capture this difference.

c. AFQT Score

AFQT score is used as a proxy for the ability of the Marine. Eitelberg (1988) refers to numerous studies showing that AFQT scores are a good indicator of trainability, and higher AFQT scores equate to higher scores at training schools.[71] Knapik et al. find that research analyzed in their study shows that "higher AFQT scores are associated to lower attrition, but the effect is not a strong one."[72]

d. ASVAB Composite Scores

The key composite score of note for this study is the EL score. The other composite scores were included to control for their effect on the dependent variable. See Chapter II for composite score definitions and calculations.

e. Education

The education variables are dummy variables representing years of education. TFDW has incomplete information on degree information so number of years of school was used in the study. The **HSG** variable takes a value of one for those Marines with 12 years of education. The **NHG** variable takes a value of one for those Marines with fewer than 12 years of education (those with a GED may have fewer than 12 years of education so these individuals are included in the **NHG** variable). The **MT_HSG** variable takes a value of one if the Marine has more than 12 years of education.

---

[71] Eitelberg, *Manpower for Military Occupations,* 30.

[72] Knapik et al., *Attrition Literature,* 10.

f. Proficiency

The average proficiency marks in service are used as a proxy for behavior along with the average conduct marks in service (described in paragraph f.). Enlisted Marines of pay grades E1–E4 (Private through Corporal) are assigned proficiency marks every 6 months and on special occasions.[73] In assigning duty proficiency marks, a scale of zero through five is used. See Table 11 for a marking summary. The mark should indicate how well a Marine performed their primary duties during the marking period. Technical skills, specialized knowledge relating to the duty, and other attributes are taken into account.[74]

[73] See Marine Corps Order P1070.12K, *Marine Corps Individual Records Administration Manual* (Short Title: IRAM), 2000, 4.35–4.47 for special occasions in assigning proficiency marks

[74] Ibid., 4.42.

Table 11. Proficiency Mark Explanations

Mark	Corresponding Adjective Rating	Standards of Conduct
0.0 to 1.9	Unacceptable	Does unacceptable work in most duties, generally undependable; needs considerable assistance and close supervision on even the simplest assignment.
2.0 to 2.9	Unsatisfactory	Does acceptable work in some of the duties but cannot be depended upon. Needs assistance and close supervision on all but the simplest assignments.
3.0 to 3.9	Below Average	Handles routine matters acceptably but needs close supervision when performing duties not of a routine nature.
4.0 to 4.4	Average	Can be depended upon to discharge regular duties thoroughly and competently but usually needs assistance in dealing with problems not of a routine nature.
4.5 to 4.8	Excellent	Does excellent work in all regular duties, but needs assistance in dealing with extremely difficult or unusual assignments.
4.9 to 5.0	Outstanding	Does superior work in all duties. Even extremely difficult or unusual assignments can be given with full confidence that they will be handled in a thoroughly competent manner.

Source: From Marine Corps Order P1070.12K Marine corps Individual Records Administration Manual (Short Title: IRAM). 2000, 4.42.

g. Conduct Score

The average conduct marks in service are used as a proxy for behavior. Enlisted Marines of pay grades E1-E4 (Private through Corporal) are assigned conduct marks every 6 months and on special occasions. In assigning conduct marks, a scale of zero through five is used. See Table 12 for marking summary. The mark should indicate how well the Marine observed "the letter of law and regulations."[75] As stated in the IRAM, "general bearing, attitude, interest, reliability, courtesy, cooperation, obedience, adaptability, influence on others, moral fitness, physical fitness as effected by clean and temperate habits, and participation in unit activities not related directly to unit mission, are all factors of conduct and should be considered in evaluating the Marine."[76]

[75] *IRAM*, 3.39.

Table 12. Conduct Mark Explanations

Mark	Corresponding Adjective Rating	Standards of Conduct
0.0 to 1.9	Unacceptable	Habitual offender. Conviction by general, special or more than one summary court-martial. Give a mark of "0: upon declaration of desertion. Ordered to confinement pursuant to sentence of court-martial. Two or more punitive reductions in grade.
2.0 to 2.9	Unsatisfactory	No special court-martial. Not more than one summary court-martial. Not more than two nonjudicial punishments. Punitive reduction in grade.
3.0 to 3.9	Below Average	No court-martial. Not more than one nonjudicial punishment. Failure to make satisfactory progress while assigned to the weight control or military appearance program. Conduct such as not to impair appreciably one's usefulness or the efficiency of the command, but conduct not sufficient to merit an honorable discharge.
4.0 to 4.4	Average	No offenses. No unfavorable impressions as to attitude, interests, cooperation, obedience, after-effects of intemperance, courtesy and consideration, and observance of regulations
4.5 to 4.8	Excellent	No offenses. Positive impressions of above qualities. Demonstrates reliability, good influence, sobriety, obedience, and industry.
4.9 to 5.0	Outstanding	No offenses. Exhibits to an outstanding degree the qualities listed above. Observes spirit as well as letter of orders and regulations. Demonstrates positive effect on others by example and persuasion.

Source: From Marine Corps Order P1070.12 Marine corps Individual Records Administration Manual (Short Title: IRAM), 2000, 3.39.

[76] Ibid.

C. DESCRIPTIVE STATISTICS

1. Summary Statistics of All Variables

Table 13 contains a summary of the descriptive statistics for all variables used. The table shows that the demographic information is keeping with historical accession data. White single males are the dominant group in the observation.

Table 13. Descriptive Statistics

Variable	Mean	Standard Deviation	Range
Success	.93	.25	1 = Success 0 = Otherwise
EL	108.13	11.22	90 - 153
GT	107.29	12.42	79 - 155
CL	102.29	24.72	0 - 148
MM	106.49	13.66	69 - 166
DEPENDENTS	.29	.69	0 - 6
AFQT	59.73	18.35	32 - 99
HISPANIC	.12	.33	1 = Hispanic 0 = Otherwise
WHITE	.70	.50	1 = White 0 = Otherwise
BLACK	.11	.32	1 = Black 0 = Otherwise
ASIAN	.03	.16	1 = Asian 0 = Otherwise
AMERIND	.01	.11	1 = American Indian 0 = Otherwise
OTHER	.03	.16	1 = Other or failed to respond 0 = Otherwise

Female	.09	.30	1 = Female 0 = Otherwise
Male	.91	.30	1 = Male 0 = Otherwise
Married	.22	.42	1 = Married 2 = Otherwise
Single	.76	.42	1 = Single 0 = Otherwise
CONDUCT	4.27	.27	1 – 4.9
PROFICIENCY	4.31	.19	1 – 4.9
NHG	.03	.18	1 = Fewer than 12 years of school 0 = Otherwise
HSG	.94	.24	1 = 12 years of school 0 = Otherwise
MT_HSG	.03	.17	1 = More than 12 years of school 0 = Otherwise
fy06	.22	.41	1 = AFADBD in FY 2006 0 = Otherwise
fy07	.25	.43	1 = AFADBD in FY 2007 0 = Otherwise
fy08	.28	.45	1 = AFADBD in FY 2008 0 = Otherwise
fy09	.25	.43	1 = AFADBD in FY 2009 0 = Otherwise
MOS0612	.13	.34	1 = Attended 0612 PMOS school 0= Otherwise
MOS0614	.02	.16	1 = Attended 0614 PMOS school 0= Otherwise
MOS0621	.43	.50	1 = Attended 0621 PMOS school 0= Otherwise
MOS0622	.07	.26	1 = Attended 0622 PMOS school 0= Otherwise

MOS0623	.03	.16	1 = Attended 0623 PMOS school 0= Otherwise
MOS0627	.02	.15	1 = Attended 0627 PMOS school 0= Otherwise
MOS0628	.01	.12	1 = Attended 0628 PMOS school 0= Otherwise
MOS0651	.16	.40	1 = Attended 0651 PMOS school 0= Otherwise
MOS0656	.10	.29	1 = Attended 0656 PMOS school 0= Otherwise

Source: TFDW data manipulated with STATA statistical software.

2. Cross Tabulation of Key Variables by Success

The following tables show success rate by demographic characteristics. These tables show a preliminary analysis that aims to replicate prior findings on attrition.

Table 14 shows a summary of success by gender. Results show that women have a lower success rate than men, and are similar to prior attrition studies showing women are more likely than men to attrite.

Table 14. Success by Gender

Gender	Frequency	Success Rate %
Male	9,020	93.48
Female	906	91.39

Source: TFDW data manipulated in STATA statistical software.

Table 15 shows a summary of success by race. The race differences are minimal and show that minorities are more successful than Whites are.

Table 15. Success by Race

Race	Frequency	Success Rate %
WHITE	6,924	92.4
BLACK	1,141	92.46
HISPANIC	1,209	95.86
ASIAN	274	94.89
AMERIND	120	95.83
OTHER	258	91.47

Source: TFDW data manipulated in STATA statistical software.

Table 16 shows success by marital status. As seen in the table, unlike previous research by Knapik et al., the statistical results show that the success rate for married Marines is higher than for single Marines.

Table 16. Success by Marital Status

Marital Status	Frequency	Success Rate %
Single	7,698	92.2
Married	2,223	97.2

Source: TFDW data manipulated in STATA statistical software.

Table 17 shows very high success rates of Marines with dependents. These results are similar to marital status and differ from previous research by Knapik et al.

Table 17. Success by Dependents

Number of Dependents	Frequency	Success Rate %
0	7,874	92.4
1	1,435	96.9
2	482	97.1
3	101	97.0
4	18	94.4
5	6	100
6	4	100

Source: TFDW data manipulated in STATA statistical software.

Table 18 shows success rate by fiscal year. The success rates are consistent over the fiscal years. Actual graduation rates from the schoolhouse only vary slightly from data obtained from TFDW. One possible variation could be due to the schoolhouse not counting "rollbacks" as a success for that graduating class. Another possibility is that the schoolhouse includes reserves and prior service students.

Table 18. Success Rate by Fiscal Year

Fiscal Year	Frequency	Success Rate %	Schoolhouse %
FY06	2,190	93.11	Not Available
FY07	2,482	94.24	97.36
FY08	2,754	92.01	97.36
FY09	2,500	93.92	92.36

Source: TFDW data manipulated in STATA statistical software.

In this study, it is important to determine which PMOS producing courses have lower than expected attrition rates. Table 19 shows the success percentage of each MOS. A 90-percent success rate typically indicates the cutoff for an acceptable rate. PMOS 0613, 0622, 0623, 0628 and 0656 all have success rates below 90 percent.

Table 19. Success Rate by MOS

MOS	Frequency	Success Rate%
0612	1,286	99.9
0613	253	45.45
0614	151	92.05
0621	4,268	99.53
0622	695	70.50
0623	261	87.36
0627	238	97.48
0628	134	89.55
0651	1,622	99.69
0656	952	84.03

Source: TFDW data manipulated in STATA statistical software.

The following tables (Table 20–23) compares the MOSs that have lower than 90 percent success rate with the individuals EL score. It is interesting to see where the higher success rates are by EL score. MOS 0656 is not included in this analysis because it has recently been merged with MOS 0652. As shown in the tables, on average, success rates are lowest for the EL score range of 90-99. The frequency for this range is very small because the current minimum requirement for these MOSs is an EL of 100. The author was not able to obtain

data that indicated when the current prerequisite was set to an EL of 100, so those admitted to the schoolhouse with a 90–99 may have been before the current standards were set.

Table 20. MOS 0613 by EL Score

EL Score	Frequency	Success Rate %
90-99	74	5.4
100-109	122	64.7
110-119	39	51.3
120-129	12	50
130-138	5	80

Source: TFDW Data manipulated by STATA statistical software.

Table 21. MOS 0622 by EL Score

EL Score	Frequency	Success Rate %
90-99	106	9.4
100-109	378	85.5
110-119	130	69.2
120-129	64	82.8
130-142	17	82.4%

Source: TFDW Data manipulated by STATA statistical software.

Table 22. MOS 0623 by EL Score

EL Score	Frequency	Success Rate %
90-99	5	100
100-109	150	86.7
110-119	62	85.5
120-129	33	93.9
130-150	11	81.8

Source: TFDW Data manipulated by STATA statistical software.

Table 23. MOS 0628 by EL Score

EL Score	Frequency	Success Rate %
90-99	9	88.8
100-109	69	86.9
110-119	36	91.7
120-129	17	94.1
130-140	3	100

Source: TFDW Data manipulated by STATA statistical software.

D. SUMMARY

This chapter describes the data sources and variables used in the analysis. Variables were chosen based on previous studies and research on attrition. Variables were then summarized using statistical software, and variable tabulations were presented to examine success rates by key variables. The next chapter discusses the methodology used in the study and the regression results.

V. MODEL DEVELOPMENT, REGRESSION RESULTS, AND ANALYSIS

To examine the relationship between key correlates of performance on success at the Communications Schools, the analysis uses probit regression models. Each model incrementally adds variables that may affect success at initial training schools based on the literature reviewed.

Probit regression models were used because of the binary nature of the dependent variable. A probit model is a "binary response model, (where) interest lies primarily with the response probability."[77] This study focuses on estimating P(**success** = 1| **x**), where **x** indicates the full set of independent variables used for the various models. All regressions were estimated using Stata statistical software package.

A. MODEL DEVELOPMENT

As stated above, each model incrementally adds variables that may affect success at the initial training school. The base case for all models is a single white male that enlisted in fiscal year 2009.

1. Model #1: Effects of Demographics on Success

Model #1 is the simplest of all the models used. It includes only demographics and fiscal year dummies (which control for economic conditions, variation in cohort characteristics, etc.). Below, Φ refers to the standard normal cumulative density function.

$$P(\mathbf{success} = 1|\ \mathbf{x}) = \Phi(\beta_0 + \beta_1\mathbf{HISPANIC} + \beta_2\mathbf{BLACK} + \beta_3\mathbf{ASIAN} + \beta_4\mathbf{AMERIND} + \beta_5\mathbf{OTHER} + \beta_6\mathbf{Female} + \beta_7\mathbf{Married} + \beta_8\mathbf{DEPENDENTS} + \beta_9\mathbf{fy06} + \beta_{10}\mathbf{fy07} + \beta_{11}\mathbf{fy08})$$

[77] Jeffery M. Wooldridge, *Introductory Econometrics: A Modern Approach* (Mason, OH: South-Western Cengage Learning, 2009), 575.

2. Model #2: Effects of Ability and Education on Success

To test the effect of ability on success, Model #2 adds the variable **AFQT**. As stated in the Chapter IV, AFQT is used as proxy for ability. In addition, this model tests the effect of education on success. After adding the education variables, the base case for the models is now a single white male with 12 years of education who enlisted in fiscal year 2009.

$$P(\mathbf{success} = 1 | \mathbf{x}) = \Phi(\beta_0 + \beta_1\mathbf{HISPANIC} + \beta_2\mathbf{BLACK} + \beta_3\mathbf{ASIAN} + \beta_4\mathbf{AMERIND} + \beta_5\mathbf{OTHER} + \beta_6\mathbf{Female} + \beta_7\mathbf{Married} + \beta_8\mathbf{DEPENDENTS} + \beta_9\mathbf{fy06} + \beta_{10}\mathbf{fy07} + \beta_{11}\mathbf{fy08} + \beta_{12}\mathbf{NHG} + \beta_{13}\mathbf{MT\_HSG} + \beta_{14}\mathbf{AFQT})$$

3. Model #3: Effects of Composite Score on Success

Model #3 tests the effects of the composite scores on the dependent variable.

$$P(\mathbf{success} = 1 | \mathbf{x}) = \Phi(\beta_0 + \beta_1\mathbf{HISPANIC} + \beta_2\mathbf{BLACK} + \beta_3\mathbf{ASIAN} + \beta_4\mathbf{AMERIND} + \beta_5\mathbf{OTHER} + \beta_6\mathbf{Female} + \beta_7\mathbf{Married} + \beta_8\mathbf{DEPENDENTS} + \beta_9\mathbf{fy06} + \beta_{10}\mathbf{fy07} + \beta_{11}\mathbf{fy08} + \beta_{12}\mathbf{NHG} + \beta_{13}\mathbf{MT\_HSG} + \beta_{14}\mathbf{AFQT} + \beta_{15}\mathbf{EL} + \beta_{16}\mathbf{MM} + \beta_{17}\mathbf{CL} + \beta_{18}\mathbf{GT})$$

4. Model #4: Effects of Behavior on Success

To determine if behavior is a correlate of success, the variables CONDUCT and PROFIENCY were added. As discussed in Chapter IV, the CONDUCT and PROFICIENCY variables are used as a proxy for behavior.

$$P(\mathbf{success} = 1 | \mathbf{x}) = \Phi(\beta_0 + \beta_1\mathbf{HISPANIC} + \beta_2\mathbf{BLACK} + \beta_3\mathbf{ASIAN} + \beta_4\mathbf{AMERIND} + \beta_5\mathbf{OTHER} + \beta_6\mathbf{Female} + \beta_7\mathbf{Married} + \beta_8\mathbf{DEPENDENTS} + \beta_9\mathbf{fy06} + \beta_{10}\mathbf{fy07} + \beta_{11}\mathbf{fy08} + \beta_{12}\mathbf{NHG} + \beta_{13}\mathbf{MT\_HSG} + \beta_{14}\mathbf{AFQT} + \beta_{15}\mathbf{EL} + \beta_{16}\mathbf{MM} + \beta_{17}\mathbf{CL} + \beta_{18}\mathbf{GT} + \beta_{19}\mathbf{CONDUCT} + \beta_{20}\mathbf{PROFICIENCY})$$

5. Model #5: Effects of MOS on Success

The final model controls for any effect the various Communication MOSs may have on the dependent variable. Difficulty, length, or instruction method may all be correlated with how well a Marine does in the course. The base case for this model is a single white male with 12 years of education who enlisted in fiscal year 2009 for the 0621 MOS.

$$P(\mathbf{success} = 1 | \mathbf{x}) = \Phi(\beta_0 + \beta_1\mathbf{HISPANIC} + \beta_2\mathbf{BLACK} + \beta_3\mathbf{ASIAN} + \beta_4\mathbf{AMERIND} + \beta_5\mathbf{OTHER} + \beta_6\mathbf{Female} + \beta_7\mathbf{Married} + \beta_8\mathbf{DEPENDENTS} + \beta_9\mathbf{fy06} + \beta_{10}\mathbf{fy07} + \beta_{11}\mathbf{fy08} + \beta_{12}\mathbf{NHG} + \beta_{13}\mathbf{MT\_HSG} + \beta_{14}\mathbf{AFQT} + \beta_{15}\mathbf{EL} + \beta_{16}\mathbf{MM} + \beta_{17}\mathbf{CL} + \beta_{18}\mathbf{GT} + \beta_{19}\mathbf{CONDUCT} + \beta_{20}\mathbf{PROFICIENCY} + \beta_{21}\mathbf{MOS0612} + \beta_{22}\mathbf{MOS0613} + \beta_{23}\mathbf{MOS0614} + \beta_{24}\mathbf{MOS0622} + \beta_{25}\mathbf{MOS0623} + \beta_{26}\mathbf{MOS0627} + \beta_{27}\mathbf{MOS0628} + \beta_{28}\mathbf{MOS0651} + \beta_{29}\mathbf{MOS0656})$$

B. REGRESSION RESULTS AND ANALYSIS

1. Model #1 Results

Tables 24 and 25 gives a summary of the probit results and the estimated partial effects. Model #1 shows that being married, Hispanic, or American Indian increases the probability of success at the Communication Schools when compared with single white Marines. When compared with males, females are 0.02 percentage points less likely to graduate. Chapter IV showed that FY08 had the lowest percentage of success at the Communication Schools (92.01 percent). The results of the regression confirm this by showing that a Marine who enlisted in FY08 is approximately 0.02 percentage points less likely to graduate than a Marine who enlisted in FY09.

2. Model #2 Results

The results for demographics and fiscal year are similar to Model #1. The effect of education confirms findings in prior studies. When compared to Marines

with 12 years of education, Marines with fewer than 12 years of education are 0.04 percentage points less likely to succeed.

3. Model #3 Results

Model #3 results show similar effects for most variables. While EL is statistically significant at the 0.1 level, the small increase in the probability of success seems practically insignificant. This, however, is due to the scale of the EL variable. A one standard deviation increase in the EL score equals a 1.2 percent improvement in the probability of success.[78] The model also shows that a higher CL score increases the probability of success. One standard deviation increase in the CL score equals a .51 percent improvement in the probability of success.

4. Model #4 Results

Model #4 shows similar results as Model #2. The added Conduct and Proficiency mark variables are significantly significant at the .01 level. A one point increase in Conduct and Proficiency mark will increase the probability of success by 0.08 and 0.05 percentage points, respectively.

5. Model #5 Results

In Model #5, MOS variables are added to control for difficulty of course material, and differences in instructors or instruction. The results show that all MOS variables are statistically significant, except the 0627 MOS, when compared to the 0621 MOS. The similarities in course material or difficulty may account for this lack of significance in the variable.

[78] Measured as (standard deviation change * marginal effect)/observed probability of success (11.22*0.000995/.93).

In this model, Gender, Hispanic ethnicity, American Indian ethnicity, marital status, non-high school degree status, Proficiency, Conduct, CL, and EL retain their statistical significance. In model five, one standard deviation increase in EL score equals a .61 percent improvement in the probability of success. The improvement in this model is lower than model three but the significance increases to the .05 level.

Table 24. Probit Results

VARIABLES	Model #1 success	Model #2 success	Model #3 success	Model #4 success	Model #5 success
HISPANIC	0.242***	0.233***	0.225***	0.193***	0.159*
	(0.0695)	(0.0699)	(0.0705)	(0.0738)	(0.0935)
BLACK	-0.0149	-0.0258	-0.0374	-0.0418	0.0118
	(0.0605)	(0.0611)	(0.0633)	(0.0663)	(0.0825)
ASIAN	0.183	0.187	0.170	0.168	0.201
	(0.129)	(0.129)	(0.130)	(0.136)	(0.169)
AMERIND	0.304	0.292	0.283	0.224	0.383
	(0.209)	(0.209)	(0.209)	(0.214)	(0.268)
OTHER	-0.113	-0.122	-0.129	-0.110	-0.163
	(0.115)	(0.115)	(0.116)	(0.123)	(0.149)
Female	-0.180***	-0.193***	-0.203***	-0.257***	-0.229**
	(0.0646)	(0.0649)	(0.0686)	(0.0708)	(0.0887)
Married	0.526***	0.526***	0.525***	0.452***	0.447***
	(0.0963)	(0.0962)	(0.0964)	(0.101)	(0.126)
DEPENDENTS	-0.0339	-0.0321	-0.0239	0.0366	0.0965
	(0.0628)	(0.0628)	(0.0631)	(0.0692)	(0.0877)
fy06	-0.0405	-0.0329	-0.0371	-0.0510	0.0958
	(0.0581)	(0.0583)	(0.0586)	(0.0612)	(0.0765)
fy07	0.0392	0.0431	0.0420	0.0397	0.205***
	(0.0576)	(0.0577)	(0.0579)	(0.0608)	(0.0761)
fy08	-0.139***	-0.135**	-0.137**	-0.147***	-0.108
	(0.0536)	(0.0536)	(0.0538)	(0.0560)	(0.0717)
NHG		-0.271***	-0.252**	-0.192*	-0.299**
		(0.0995)	(0.0997)	(0.106)	(0.124)
MT_HSG		0.0668	0.0588	-0.0215	0.0303
		(0.125)	(0.125)	(0.130)	(0.156)
AFQT		-0.00134	-0.00267	-0.00440	-0.00541
		(0.00109)	(0.00344)	(0.00359)	(0.00436)
EL			0.00821*	0.00829*	0.0127**
			(0.00468)	(0.00489)	(0.00589)
MM			-0.00270	-0.00366	-0.00186
			(0.00416)	(0.00435)	(0.00525)
CL			0.00159**	0.00123	0.00217**
			(0.000789)	(0.000827)	(0.000984)
GT			-0.00411	-0.00417	-0.0116
			(0.00587)	(0.00613)	(0.00747)
CONDUCT				0.762***	0.728***

				(0.0882)	(0.110)
PROFICIENCY				0.550***	0.576***
				(0.133)	(0.162)
MOS0612					1.255***
					(0.318)
MOS0613					-2.112***
					(0.0953)
MOS0614					-0.668***
					(0.169)
MOS0622					-1.472***
					(0.0705)
MOS0623					-0.913***
					(0.114)
MOS0627					-0.0712
					(0.190)
MOS0628					-0.866***
					(0.160)
MOS0651					0.863***
					(0.164)
MOS0656					-0.989***
					(0.0771)
Constant	1.451***	1.540***	1.304***	-4.000***	-3.453***
	(0.0436)	(0.0809)	(0.402)	(0.545)	(0.646)
Observations	9,920	9,920	9,920	9,920	9,920

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: TFDW Data manipulated by STATA statistical software

Table 25. Marginal Effects

VARIABLES	Model #1 success	Model #2 success	Model #3 success	Model #4 success	Model #5 success
HISPANIC	0.0257***	0.0247***	0.0239***	0.0186***	0.00569*
	(0.00631)	(0.00640)	(0.00649)	(0.00626)	(0.00296)
BLACK	-0.00183	-0.00318	-0.00464	-0.00465	0.000475
	(0.00751)	(0.00767)	(0.00801)	(0.00757)	(0.00328)
ASIAN	0.0195	0.0198*	0.0182	0.0160	0.00665
	(0.0119)	(0.0118)	(0.0121)	(0.0113)	(0.00456)
AMERIND	0.0294*	0.0284*	0.0276*	0.0203	0.0105**
	(0.0155)	(0.0158)	(0.0160)	(0.0159)	(0.00473)
OTHER	-0.0149	-0.0162	-0.0172	-0.0130	-0.00781
	(0.0165)	(0.0167)	(0.0169)	(0.0157)	(0.00836)
Female	-0.0246**	-0.0265***	-0.0279***	-0.0329***	-0.0113**
	(0.00979)	(0.00995)	(0.0106)	(0.0105)	(0.00540)
Married	0.0519***	0.0517***	0.0514***	0.0404***	0.0143***
	(0.00751)	(0.00749)	(0.00748)	(0.00737)	(0.00352)
DEPENDENTS	-0.00414	-0.00391	-0.00290	0.00397	0.00391
	(0.00767)	(0.00764)	(0.00764)	(0.00749)	(0.00357)
fy06	-0.00503	-0.00407	-0.00457	-0.00566	0.00367
	(0.00735)	(0.00729)	(0.00733)	(0.00694)	(0.00280)
fy07	0.00472	0.00516	0.00501	0.00423	0.00747***
	(0.00683)	(0.00679)	(0.00679)	(0.00638)	(0.00264)
fy08	-0.0179**	-0.0172**	-0.0174**	-0.0168**	-0.00462
	(0.00719)	(0.00715)	(0.00715)	(0.00674)	(0.00325)
NHG		-0.0399**	-0.0364**	-0.0240	-0.0164*
		(0.0173)	(0.0169)	(0.0151)	(0.00893)
MT_HSG		0.00775	0.00683	-0.00237	0.00119
		(0.0138)	(0.0139)	(0.0146)	(0.00594)
AFQT		-0.000163	-0.000323	-0.000477	-0.000219
		(0.000133)	(0.000416)	(0.000389)	(0.000178)
EL			0.000995*	0.000899*	0.000515**
			(0.000567)	(0.000530)	(0.000245)
MM			-0.000328	-0.000397	-7.53e-05
			(0.000504)	(0.000471)	(0.000213)
CL			0.000192**	0.000134	8.78e-05**
			(9.56e-05)	(8.96e-05)	(4.08e-05)
GT			-0.000498	-0.000452	-0.000471
			(0.000711)	(0.000664)	(0.000306)
CONDUCT				0.0826***	0.0295***
				(0.00984)	(0.00553)
PROFICIENCY				0.0597***	0.0234***
				(0.0144)	(0.00693)
MOS0612					0.0235***
					(0.00234)
MOS0613					-0.454***
					(0.0391)
MOS0614					-0.0535**
					(0.0225)
MOS0622					-0.208***
					(0.0218)

MOS0623					-0.0904***
					(0.0211)
MOS0627					-0.00310
					(0.00890)
MOS0628					-0.0837***
					(0.0281)
MOS0651					0.0208***
					(0.00284)
MOS0656					-0.0939***
					(0.0145)
Observations	9,920	9,920	9,920	9,920	9,920

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: TFDW Data manipulated by STATA statistical software

C. CHAPTER SUMMARY

The results of the regressions are consistent with previous research. Probability of success increases as the EL score increases. Also, in conjunction with EL score, it is important to look at the MOS results. The results show that MOSs with a higher EL prerequisite have a negative effect on success when compared to the 0621 MOS, which has the lowest required EL score of 90. This may suggest that the higher difficulty of the courses compared with 0621 is the cause of the lower success rate, and a higher EL prerequisite may be warranted for these MOSs.

VI. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

This study examines the relationship between ASVAB composites and other performance measures on success at the Marine Corps Communications School. The data for the study were obtained from the Marine Corps Total Forces Data Warehouse (TFDW). The sample population includes all persons who entered the Marine Corps in fiscal years 2006 through 2009 for the Communications Occupational Field. To determine the effects of ASVAB composite scores on success at the Marine Corps Communications School, five probit models were constructed using TFDW data. The probit models incrementally tested the effects of various correlates of success or attrition on the dependent variable.

The models tested demographic characteristics, effects of the fiscal year, education, ability, proficiency, conduct, the ASVAB composites, and MOS effects on the dependent variable "success." The models indicate that being married, Hispanic, American Indian, EL and CL score, enlisting in fiscal year 2007 (compared to 2009), attending 0612 or 0651 MOS schools (when compared to 0621) all have a positive effect on the probability of success. Factors that had a negative effect on success include being female, having fewer than 12 years of education, and attending 0613, 0614, 0622, 0623, 0628, or 0656 MOS schools (when compared to 0621).

B. CONCLUSIONS

The results of the study are consistent with previous research, indicating the EL score is a good predictor of success at the Marine Corps Communications School. In particular, one standard deviation change in EL score equals a 1.2 percent improvement in the probability of success. Difficulty of course material (represented by the MOS variables) and certain demographic factors also have

an impact on success rates. Data for the current study indicate that 0612, 0621, and 0651 have the highest success rates out of the MOSs. The 0651 MOS has the highest EL prerequisite of 110, while 0612 and 0621 have the lowest requirement with an EL score of 90. This range in EL score may indicate that the method of instruction or level of difficulty in training has more of an impact than does the prerequisite. Or, more simply, the prerequisite may be set at the optimal level.

Examining the EL scores of students in MOSs who had a success rate of under 90 percent can assist in determining optimal score requirements. Success rates also vary by fiscal year. Determining what changes may have caused lower or higher rates between fiscal years can help determine the best instruction method to achieve higher success rates. For example, modifying testing methods (e.g., changing from open-book to closed-book tests) or adding a new technology may require more instruction or time in explaining new procedures to ensure student success.

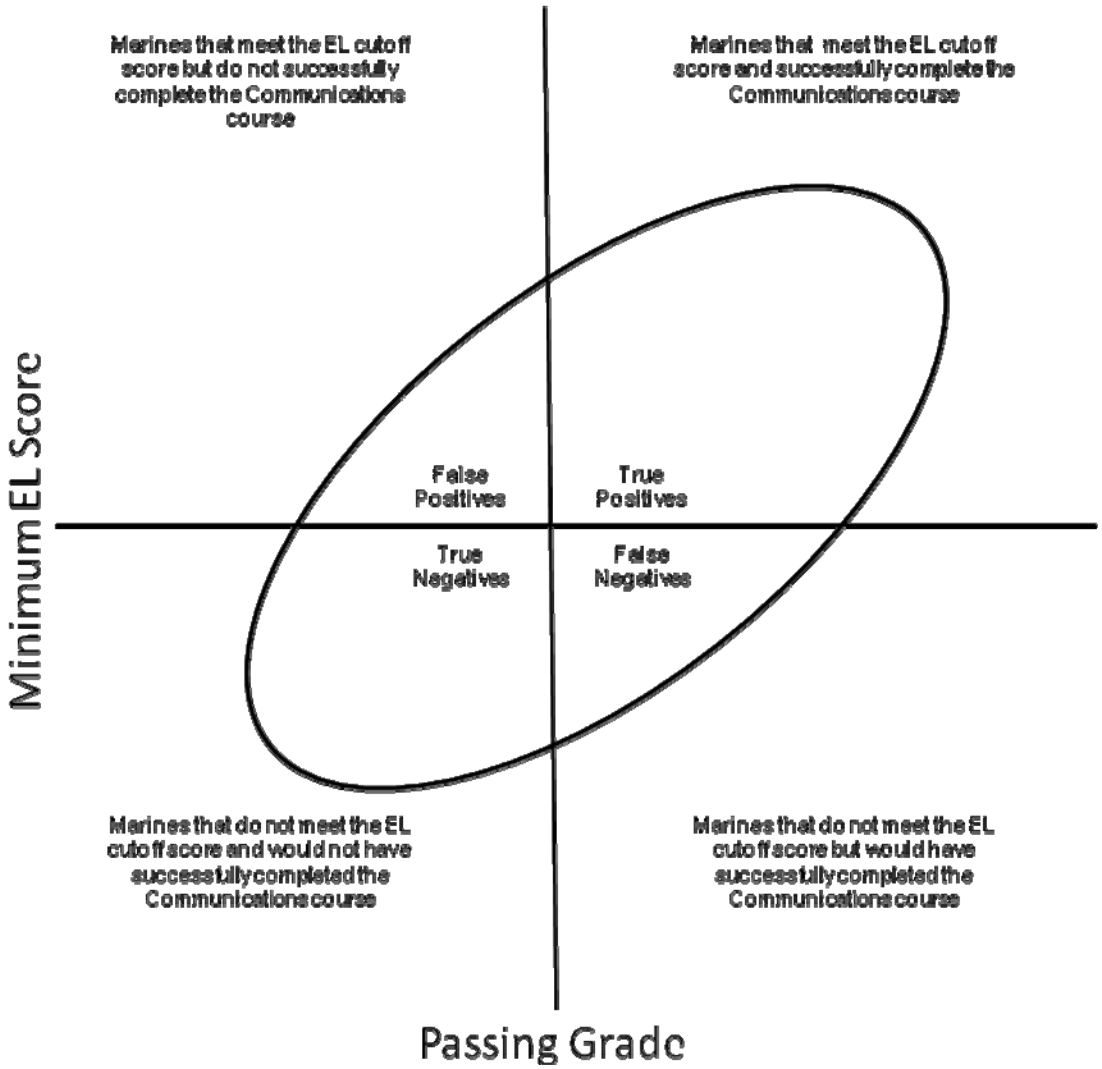
It is important for recruiters and monitors to recognize variables over which they have some control. For instance, having fewer than 12 years of education is a variable that has a negative impact on success at the Communications School. By requiring additional prerequisites when screening persons who do not have at least 12 years of education, monitors can reduce the likelihood that a Marine will fail at the Communications School. An option, in this case, would be to counterbalance the increased risk of failure by requiring that the person possess some characteristic or qualification strongly associated with success, such as a higher EL score.

C. RECOMMENDATIONS

It is difficult to determine prerequisites that maximize the number of individuals who will pass an initial training course in the military. The findings of this study show that other factors besides an aptitude composite score may need to be factored in when determining prerequisites. Figure 1 presents a graphical

representation of selection criteria. The horizontal line is the EL cutoff for selection into Communications School. This line will range from an EL score of 90 to 110, depending on the MOS. The portion of the graph above the EL cutoff score line depicts Marines who scored at or above this minimum EL prerequisite. Below the line are Marines who did not score above the line. The vertical line indicates the minimum passing score to successfully complete a course at the Communications School. Marines who fall to the right of this line are those who would successfully receive a passing grade. At the same time, Marines who fall to the left of the line are those who would not receive a passing grade.

Dividing the graph into four sections, the upper left quadrant indicates Marines who would qualify for a course at the Communications School but would not successfully complete the course. Marines who fall into this quadrant are considered false positives. The upper right quadrant indicates Marines who meet the minimum requirement to attend a course at the Communications School and would successfully complete the course. These Marines are considered true positives. The lower left quadrant indicates true negatives: Marines who do not meet the EL prerequisite and would not successfully complete a course at the Communications School. Marines who fall into the lower right quadrant are those who do not meet the EL prerequisites, but given the chance, would successfully complete a course at the Communications School. These Marines are considered false negatives.



Source: After illustrations from Paul M. Muchinsky, Psychology Applied to Work: 9th Edition (Kansas City, KS: Hypergraphic Press, 2008), 204.

Figure 1. Selection Cutoff Diagram for Marine Corps Communications School.

The goal of policy makers should be to maximize the number of individuals who fall into the true positive category in the upper right quadrant of the graph shown in Figure 1. The main difficulty of this task is determining which individuals fall into the false negative category. By setting the EL prerequisite too high, the Marine Corps could eliminate many people who would successfully complete a course. Alternatively, by setting it too low, many Marines may fail the courses.

Due to limitations of time and scope in the present study, the author was unable to include final course grades or explore the reasons why a student failed to complete a course. Additional research including final course grades and failure/dropout reasons (due to academics, behavior, medical, etc.) would be beneficial in determining prerequisites. Because having fewer than 12 years of education is such a strong predictor of failure (decreases the probability of success by 1.64 percentage points), further research should focus on this factor. In this study, the fewer than 12 years of education variable (NHG) includes Marines with GEDs, those who were home schooled, persons with alternative credentials, and high school dropouts. Separating these component categories from years of education would further refine this variable and assist in understanding its effect on success.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

Carey, Neil B. and Catherine M. Hiatt. *Validity of the Marine Corps Electronics Composite for Predicting Success in Electronics Training School*. Alexandria, VA: Center for Naval Analyses, 1993.

Carey, Neil and Janet L. E. Ramirez, *The Marine Corps Job Performance Measurement (JPM) Project: A Bibliography.* Alexandria, VA: Center for Naval Analyses, 1993.

Distifeno, Christopher. "Effects of Moral Conduct Waivers on First-term Attrition of U.S. Army Soldiers." Master's thesis, Naval Postgraduate School, 2008.

Divgi, D. R., Paul W. Mayberry, and Neil B. Carey, *Sensitivity and Fairness of the Marine Corps Mechanical Maintenance Composite*. Alexandria, VA: Center for Naval Analyses, 1992.

Eitelberg, Mark J. *Manpower for Military Occupations.* Alexandria, VA: Human Research Resources Organization, 1988.

Hiatt, Catherine M. *The Relationship between ASVAB and Training School Performance for USMC Field Radio Operators.* Alexandra, VA: Center for Naval Analyses, 2005.

Huth, Richard A. "The Effect of Moral Waivers on Success of Navy Recruits." Master's thesis, Naval Postgraduate School, 2007.

Knapik, Joseph K., Bruce H. Jones, Keith Hauret, Salima Darakjy, and Eugene Psikator. *A Review of the Literature on Attrition from the Military Services: Risk Factors for Attrition and Strategies to Reduce Attrition*. Fort Knox, KY: Center For Accessions Research, 2004.

Maier, Milton H. and Catherine M. Hiatt, *An Evaluation of using Job Performance Tests to Validate ASVAB Qualification Standards.* Alexandria, VA: Center for Naval Analyses, 1984.

Maier, Milton H. and Ann R. Truss, *Validity of the Armed Services Vocational Aptitude Battery Forms 8, 9, and 10 with Applications to Forms 11, 12, 13, and 14.* Alexandria, VA: Center for Naval Analyses, 1985.

Marine Corps Order 1200.17A, Military Occupational Field Manual (Short title: MOS Manual), 2009.

Marine Corps Order P1070.12K, Marine corps Individual Records Administration Manual (Short Title: IRAM), 2000.

Mayberry, Paul W. *Validity Results for the Job Performance Measurement Project*. Alexandria, VA: Center for Naval Analyses, 1989.

Muchinsky, Paul M. Psychology Applied to Work: 9th Edition. Kansas City, KS: Hypergraphic Press, 2008.

Office of the Secretary of Defense, "Understanding the ASVAB." *Official Site of the ASVAB.* last accessed 12 January, 2011. http://www.official-asvab.com/understand_coun.htm

Schaffer III, Robert J. "Relating the Armed Services Vocational Aptitude Battery to Marine Job Performance." Master's thesis, Naval Postgraduate School, 1996.

Sims, William H. and Ann Truss, *A Reexamination of the Normalization of the Armed Services Vocational Aptitude Battery (ASVAB) Forms 6, 7, 6E, and 7E*. Alexandria, VA: Center for Naval Analyses, 1980.

Sims, William H. and Catherine M. Hiatt, *Marine Corps Selection and Classification*. Alexandria, VA: Center for Naval Analyses, 2001.

U.S. Department of Defense, *ASVAB Career Exploration Program*. last accessed 12 January, 2011. http://asvabprogram.com.

Wooldridge, Jeffery M. *Introductory Econometrics: A Modern Approach*. Mason, OH: South-Western Cengage Learning, 2009.

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California

3. Marine Corps Representative
   Naval Postgraduate School
   Monterey, California

4. Director, Training and Education, MCCDC, Code C46
   Quantico, Virginia

5. Director, Marine Corps Research Center, MCCDC, Code C40RC
   Quantico, Virginia

6. Marine Corps Tactical Systems Support Activity (Attn: Operations Officer)
   Camp Pendleton, California

7. Elda Pema
   Graduate School of Business and Public Policy
   Naval Postgraduate School
   Monterey, California

8. Mark J. Eitelberg
   Graduate School of Business and Public Policy
   Naval Postgraduate School
   Monterey, California