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THESIS

MEDICAL SEPARATION AMONG CAREERISTS

by

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March 2013

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The last 10 years have presented the Marine Corps with the challenge of continuous deployments to hostile environments at an unprecedented rate. This study examines the correlation between deployment tempo and medical separation rates for Marines who have shown an intention to remain in the Service by reenlisting past their first term. It does so by comparing the probability of medical separation for careerists relative to other causes of separation. The data comes from the Marine Corps Total Data Force Warehouse. Interaction effects were measured using a Linear Probability Model and probit estimations. Key variables in my study are gender, a 9/11 partition, and the number of deployments. Medical separations are defined as acute sources, such as loss of limb, degenerative sources such as back pain and other long-term ailments, and medical retirements.

Among those separated, I find that the increased deployment tempo in the post-9/11 era leads to decreases in medical separation rates, particularly among those with two or more deployments. There is also a notable additional decrease in medical separation for female Marines who have deployed.

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MEDICAL SEPARATION AMONG CAREERISTS

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LIST OF ACRONYMS AND ABBREVIATIONS

ACE	Aviation Combat Element
CGO	Company Grade Officer
FGO	Field Grade Officer
GCE	Ground Combat Element
GO	General Officer
LCE	Logistics Combat Element
LDO	Limited Duty Officer
LPM	Linear Probability Model
MLR	Multiple Linear Regression
MOS	Military Occupational Specialty
NCO	Noncommissioned Officer
TFDW	Total Force Data Warehouse
WO	Warrant Officer

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Simply put, this thesis would not have happened without the daily support and constant focusing efforts of my husband, Alec. Thank you for the encouragement and guidance, as well as being an amazing dad and taking on the not-so-simple task of caring for our wonderful sons. You are truly my keystone.

To my past mentors and current advisors, thank you for your passive and active motivation. Without the influence of Col Matthew Cicchinelli and LtCol Patrick Kirchner, I'd be unable to clearly articulate my preference for the Oxford comma to my peers as we lounge about in mufti. In regard to econometric theory, Dr. Yu-Chu Shen and Dr. Jesse Cunha were instrumental in guiding me from classroom learning toward real-world application. Thank you for all the patient direction and advice, and quick, meaningful reviews and edits. Tim Johnson at the Total Data Force Warehouse was instrumental in extracting the relevant and necessary data for this thesis, and I'm sure he'll regret it as I'm passing his name to every manpower student I can find.

For my dad. (May 21, 1951–May 13, 2012)

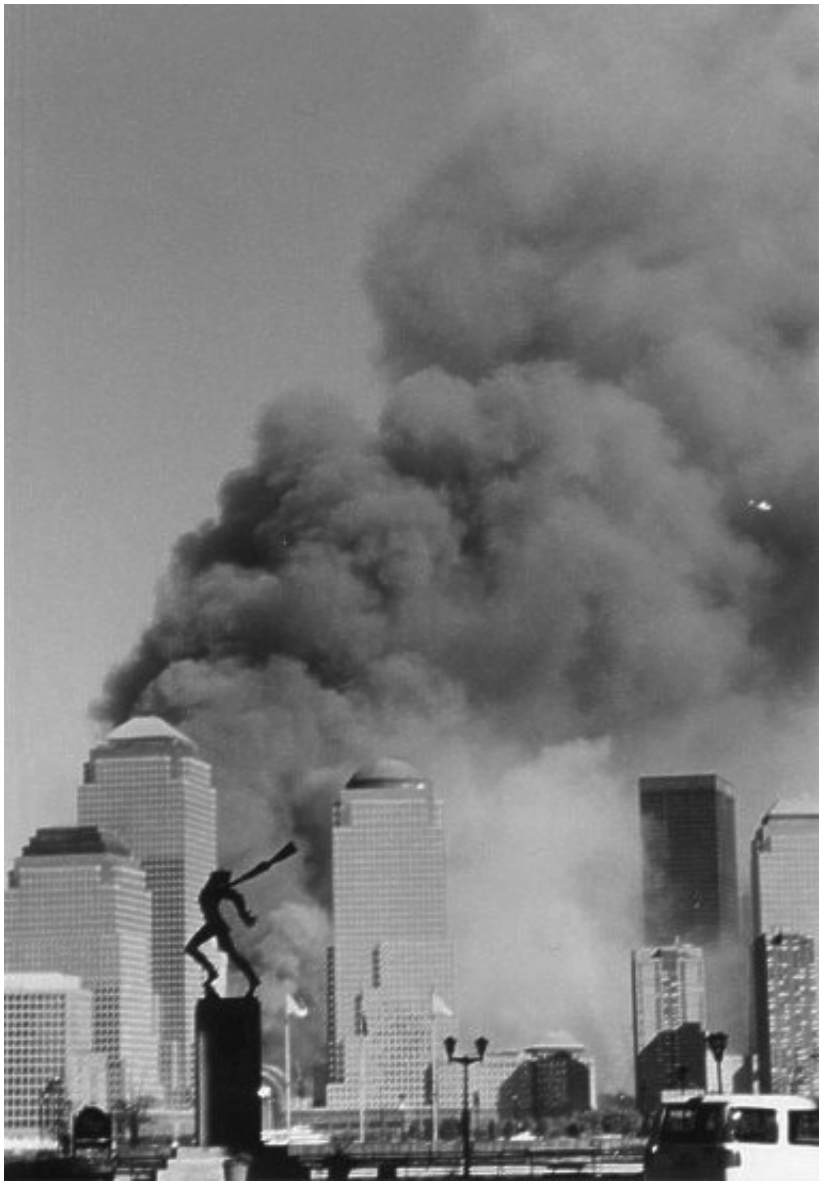

Figure 1. September 11, 2001, as seen from Hoboken, NJ. (Photo provided by Sara Kirstein, 2001)

I. INTRODUCTION

A. BACKGROUND

Perceptions are easy to establish and maintain when there is no quantifiable data to prove them accurate or incorrect. The analysis of data to determine trends and isolate factors of significance can go a long way towards truly understanding the nature of our force. Sometimes this analysis will support these perceptions and assist in their definition, and sometimes it will force a re-assessment of them. By analyzing Marine Corps separation data, I provide trends and significant factors that will prove useful to decision-makers, manpower planners, and those engaged in national conversations concerning a variety of topics such as deployment effects, gender effects, and the impact of 9/11/2001.

The research is centered on the segment of the fleet known as careerists, or those who are generally choosing to stay beyond their initial term of service. The Marine Corps uses two main categories to define the retainment status of Marines, first-term and subsequent-term. The first-term reenlistment process is a powerful force-shaping tool, as the Marine Corps can increase or decrease the exact number of personnel that will be allowed to reenlist on a yearly basis. These terms of enlistment generally come in four-year contracts, although occasionally extensions of up to one year are allowed. In times of drawdown, first-term reenlistments can get extremely competitive, particularly in high-capacity military occupational specialties (MOSs). Once a Marine has been selected for first-term

reenlistment, subsequent-term reenlistments are much easier to obtain as their "boat space" has been reserved, although it is important to note that the Marine is only obligated to complete the current four-year contract. Only detrimental actions from the Marine or times of extreme drawdown will make subsequent-term reenlistments difficult to get. This policy puts the focus on the initial reenlistment as the indicator for extended future service.

The officer contract process is quite different from the enlisted contract process. There is an initial service requirement, which is generally four years. Longer requirements for high-skill jobs such as pilot can be up to eight years. If selected for a career path, officers can serve until they choose to resign or are forced to resign their commission (separate) due to legal or severe performance issues. In the initial term of service, junior Marine officers are vetted for selection for career opportunities. Until 2009, this process was called augmentation, wherein individuals competed within their MOS to augment to the career fleet. These selection rates could drop as low as 10% (Lamothe, 2009). Starting in 2009, the program changed to Career Designation, which divided the officer corps into five competitive categories: combat arms, combat support, aviation support, aviation, and law. Each category has a set selection rate. These processes are very important force-shaping tools as the number selected can change every year to meet the predicted need for officers. As a reenlistment and renewed contract every four years are not required, officers have more flexibility concerning how long they serve.

One way that a Marine may get involuntarily separated or forced to take retirement is for medical reasons. As expected, the military has certain physical requirements that must be met. If Marines are unable to do their jobs or complete physical and combat fitness tests for an extended period of time, they may be subject to a physical evaluation board. Informally called a *med board*, this process may take up to two years to complete, as the Marine is given time to either get in shape or recuperate from injury. Conducted by senior Navy medical personnel, the board must prove that the individual is either unable to recover fully enough to meet the standards, or that recovery will take such an extensive amount of time as to hinder the Marine's ability to serve his or her term. Certain allowances are made for extreme circumstances on an individual basis, such as Marines nearing retirement, or those who request exemption, such as amputees who desire to continue service. The desires of the individual do play a role in these medical boards, although they may or may not affect the result. A desire to stay in the Service will generally increase the amount of time allowed by the board for the individual to correct this physical deficiency.

The lifestyle of a Marine is a physically demanding one. Aside from meeting basic fitness requirements, physical demands include marching with loads, conducting field exercises, and defensive training such as martial arts. These practices wear down the body even in a garrison-training environment. In the combat environment, underlying or obvious threats increase the impact of mental stresses, as well as require a greater amount of protective gear. There is often an increased amount of nonstandard

work such as set up and teardown of fortifications, working environments, and living environments. Much of this is done outside, by hand, over long hours, and on limited sleep. This constant level of high exertion will take a toll on any individual, even if the person is a Marine. It would stand to reason that, in times of increased deployment activity, such levels of physical activity would increase wear on the body and therefore cause a greater number of issues that may lead to medical separation.

B. PURPOSE

1. Objectives

The objective of this study is to establish a quantitative evaluation of the impact of the increased deployment tempo on the overall health of the Marine Corps and the long-term health impacts of women with combat deployments. I have also developed additional information such as the relationship between MOS and medical separation, the prevalence of various separation categories, and the overall impact that these have on the senior makeup of the Marine Corps.

It is important to note that the objective of this study is not to add to or detract from the political and sociological debate concerning women in the armed forces and their role in combat zones, although the results are a basis for discussion on this topic.

2. Primary Research Question

What is the cause of medical separations for Marines who otherwise show intent to remain in the Service?

3. Secondary Research Questions

a. How does gender affect medical separations? Do women leave the Marines more quickly, at a younger age, and at a higher rate than their male counterparts due to medical reasons?

b. What is the effect of the increased deployment tempo caused by 9/11 on medical separations in the Marines? Does this effect vary by gender?

c. Do separation causes vary by rank?

C. SCOPE AND ORGANIZATION

1. Scope

The scope of this study is all Marines, including officers and enlisted with greater than four years of service or following their first-term reenlistment who have separated from the Marine Corps between January 1, 1990 and December 31, 2011. The data set represents all Marines service members that met the study criteria, and is not a sample set. It does not include individuals still on active service, or those pending separation. It does include separated Selected Marine Corps Reservists and those who have moved to the Individual Ready Reserve, as they have a separation code. Many studies have been done to analyze the causes of attrition and success among first-term service members, but this study is focused on those who have actively selected to remain in the Marine Corps past their first term. I review the data from many angles. The pre- and post-9/11 angle directly addresses the increased deployment tempo following the September 11th attacks.

Further breakdown includes analysis of gender, MOS as it applies to Marine Corps major combat elements, and rank.

2. Assumptions

My primary assumption is that Marines with more than four years of service intend to stay at least 10 years, or would stay if they remained healthy, maintained standards, and did not have legal issues. This is based on the fact that 75% of Marines do not reenlist past the first term, and there is competition for first-term enlistments. (Wetzel, 2012) Those who choose to compete show their intent to remain.

Another assumption is that a majority of medical discharges are either an acute result of military activity, or a cumulative result of physical wear over time due to the Marine Corps lifestyle. This level of physical wear is greater than would occur in a traditional civilian job and carries a great deal of personal risk. Contrarily, medical problems caused by actions not in the line of duty and due to a member's misconduct are generally not the separation cause, because the legal separation code will take precedence

3. Organization

In the introduction and background, I provide the framework and establish the goal of the analysis. In the literature review in Chapter II, I highlight similar studies and establish the context for this study. In Chapter III, I provide the initial organized review of the body of data for this thesis. These summary statistics are shown from the angle of each research question. In Chapter

IV, I present the regression and estimation models and analyses, as well as a detailed discussion of each independent variable's effect on the outcome. Regressions and probability estimations detail various interaction effects beyond the scope of summary statistics, and the results undergo a thorough analysis, both quantitative and qualitative. In Chapter V, I conclude the paper with a discussion of the findings and recommend areas for further research. I provide supporting information in the Appendices.

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II. LITERATURE REVIEW

A. OVERVIEW

There is a great deal of literature and research concerning attrition and separation causes, as well as women in the service. However, almost all attrition reports focus on the first four years of service and are designed to assist with entry-level recruiting. Studies concerning women in the Service are often physiological or philosophical dissections as to why women should or shouldn't participate in the armed services or fulfill combat roles. While this thesis is not aimed specifically at either of these topics, they are of relevance.

Many of the works reviewed in preparation for this study are fellow Naval Postgraduate School (NPS) theses. I have reviewed them in order to help develop a methodology, but for the most part, the comparisons presented are not parallel. Regardless, much of the literature listed here lays the groundwork for the cultural military background of this study. The primary work listed here is Capt Katie Petronio's (2012) article, as found in the *Marine Corps Gazette*, as it presents the basis for the questions I have answered with my analysis.

B. ATTRITION AND SEPARATION

1. *A Study of Promotion and Attrition of Mid-Grade Officers in the U.S. Marine Corps: Are Assignments a Key Factor?* (Morgan, 2005)

This NPS master's thesis by Marine Major Jerry R. Morgan (2005) was a study of promotion and attrition of mid-grade officers in the U.S. Marine Corps. The focus was

on the ratio of time spent in one's primary MOS vice alternate billets, and how that ratio affected the chances of promotion to major as well as the inclination to stay in the Corps that long at all. He used survival analysis to further evaluate a Marine's predilection to stay and the length of time they remain in the Service.

Morgan's (2005) study does provide some interesting information, but it only addressed completion of contract separations with a mention of unsatisfactory performance separations. He did not address medical or legal concerns, although this is not an unreasonable omission given the small percentage of mid-grade officers with these types of separations. He also only addressed mid-grade male officers—a limitation that served his purposes well but has little adaptability to this study.

2. *Forecasting Marine Corps Enlisted Attrition Through Parametric Modeling* (Hall, 2009)

Marine Captain Jeremy Hall wrote this quantitative NPS master's thesis in 2009 to improve on the Marine Corps' attrition forecasting. Rather than maintain the status quo by generating a yearly forecast, he attempted to create a way to provide a monthly snapshot for manpower planners via a detailed survival analysis. However, his termination point for the purposes of survival analysis was very non-specific. All non-End of Active Service losses were grouped together instead of specified, such as legal or medical. Enlisted ranks with less than 12.5 years of service were analyzed.

While this study provides an interesting analysis of hazard models, the author concluded that the results were

too detailed and time consuming to be of practical use. He was able to provide excellent survivability rates, but for very small subgroups of personnel within the whole scope of the data. Unfortunately, he did not provide data that could be used for comparison for the results found in this study.

3. *How Does Deployment Affect Retention of Military Personnel?* (Fricker, 2003)

Ronald D. Fricker is a RAND analyst who participated in a series of analyses starting in 2000 about the relationship between deployments and retention. While this brief was written in 2003, the data used was all pre-9/11. The most in-depth of these studies focused on mid-grade officers of all branches, but he provided a comprehensive review of his results for both enlisted and officer in this research brief. The hypothesis was that increased deployments would reduce overall retention. This was based on exit interviews with service members and popular assumption. However, the data for both enlisted and officer showed a positive relationship between deployments and retention. Further analysis broke down the deployment factor to hostile and non-hostile deployments. Hostile deployments showed a much smaller positive correlation, and began to show a small negative correlation as the number of deployments increased.

Fricker (2003) recommended that more in-depth studies be done concerning deployment duration and location, as the data used for his studies were generic in this regard. He mentioned family separation information as well. One aspect that is most intriguing was the quality of those who remained in the Service after deployment. He made no overt

implications but, rather, suggested that it be a point of future consideration: did those who remained do so out of sense of duty and job satisfaction, or because of a lack of options?

This study provides a very interesting look at the big picture concerning deployments and retention rates in the armed services. The data were somewhat generic, which was necessary for the intended scope.

4. *Study by Patterns of Marine Corps Reserve Continuation Behavior: Pre- and Post-9/11* (Lizzaraga, 2011)

Marine Corps Major Joseph Lizzaraga (2011) discussed pre- and post-9/11 behavior in the Selected Marine Corps Reserve in his recent NPS master's thesis. As his focus was on reservists' decisions to continue attending drill weekends after their six-year initial contracts, he was able to easily split the data into three main groups: pre-, overlap-, and post-9/11, based on where two key milestones fell, enlistment and continuation decision. His methodology included utility models, organizational behavior, and probit logistic regressions.

The summary of this thesis indicated that reserve mobilizations increased the likelihood of continuation rates, implying that job satisfaction played a significant role in the decision to remain in the reserves. While Lizzaraga (2011) did not address any non-standard separations or breeches of contract, his findings of increased retention are very important to help understand the differences in the pre- and post-9/11 armed forces, particularly self-selection factors.

5. *Success of First-Term Soldiers* (Buddin, 2005)

This RAND study by Richard Buddin (2005) focused on Army recruitment and retention practices, and provided a detailed report on the effects of gender on first-term attrition. In the results of a number of logistic regressions, he found that women were 20% more likely to attrite during the Delayed Entry Program, 34% more likely to attrite during Basic Combat Training, and 51% more likely to not complete their first term. Figure 2 provides a comprehensive overview.

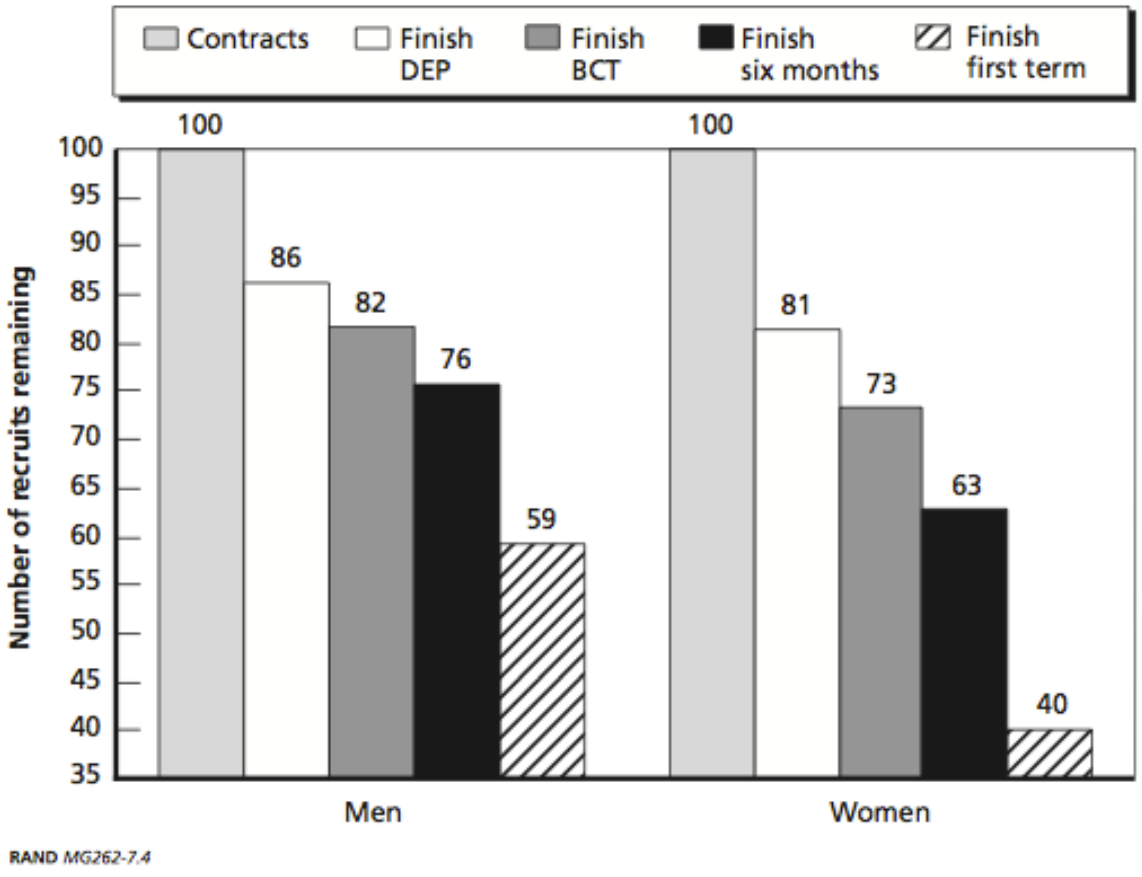

Figure 2. Comparison of the Loss Profile for Men and Women (From Buddin, 2005)

Buddin (2005) did a great deal of comparative analysis at every level of observation but did little in-depth elaboration about potential physiological causes or specific reasons for the attritions, such as medical or legal reasons. The results, however, were very clear: women attrite at a much higher rate than men during their initial term of enlistment.

C. GENDER

1. *Get Over It! We Are Not All Created Equal* (Petronio, 2012)

A recent article by Capt Katie Petronio (2012) in the *Marine Corps Gazette* titled *"Get Over It! We Are Not All Created Equal"* is more editorial than research report. Petronio is an engineering officer with two combat tours, to include a combat action ribbon, and presented an argument against allowing women in combat specialties due to unchangeable physical differences. Officer Candidate School injury attrition rates were mentioned, which were 14% for women and 4% for men. Beyond that, she highlighted her personal experience and related injuries, among them restless legs, muscular atrophy, and skeletal atrophy, which are degenerative issues that affect anyone in a demanding, persistent, and highly kinetic environment, such as on deployment. However, she noted that over her combat tours, the rate of degeneration and atrophy appeared to be far more rapid than that of her male counterparts.

While Capt Petronio was able to complete her tours successfully, the focus of the article is the potential long-term effects on females should they increase their time in combat roles. She stated, "I am confident that

should the Marine Corps attempt to fully integrate women into the infantry, we as an institution are going to experience a colossal increase in crippling and career-ending medical conditions for females" (Petronio, 2012).

Finding quantitative data to either confirm or deny this statement is the impetus of this thesis. Capt Petronio (2012) didn't deny the ability of women to be successful in combat environments, but used her personal experience as a warning against attempting to make the combat arms MOS' gender inclusive. However, this was based on single, personal experiences and training attrition rates, rather than a data analysis of the long-term consequences. This article was designed to provoke conversation, and it has done so at all levels of the military.

2. *The Decision to Allow Military Women into Combat Positions: A Study in Policy and Politics* (Culler, 2000)

This NPS master's thesis by Navy Lieutenant and Naval Aviator Kristen Culler is a direct examination of the repeal of exclusionary laws against women in combat aviation. Much of this study focused on political and social aspects of women in the military, but there is information more pertinent to my thesis concerning female physiology. The author summarized many different sources rather than presenting original material, although she did provide commentary and organization. She presented physical fitness data with a general trend of women performing at reduced strength and endurance levels, given equal requirements. However, this study did not address the long-term medical concerns of women. It did address career

ceilings and related social elements such as sexism and tokenism, but these were not specifically applied to separations.

3. *Women Serving in Combat Would Strengthen America's Defense* (Roush, 1991)

Following the Gulf War of 1990, a new surge of national conversations about women in combat emerged. This article in particular presented an interesting angle on the debate concerning time lost from work due to pregnancy and medical issues. Naval Academy professor and retired Marine Colonel Paul E. Roush (1991) commented,

> It is true, of course, that lost time is an important aspect of the capabilities discussion. When we go beyond perceptions and dwell on data, however, an interesting pattern emerges. ... A 1984 study calculated lost time for men and women for each year of their first enlistment. Lost time events hospitalization, confinement in a brig, and desertion or other unauthorized absence. During the first year, days of lost time for each 100 men was 2.5 times that for each 100 women. During the second, third and fourth years, lost time rates for men exceeded rates for women by factors of 5.0, 4.1, and 3.5, respectively. (p. 59)

He went on to describe differences in leadership styles between men and women and combat effectiveness of women in other militaries, and picked apart a number of smaller arguments, such as interpersonal bonding. As a Naval Academy graduate himself, he spoke of a time when there was one black man in his 1,300-member class, and of when fellow black teammates ate on the bus while their white counterparts sat inside the restaurant for football team dinners. He was emphasizing that time alters

perceptions, particularly when they are based on a "tradition" of bigotry (Roush, 1991).

Analyzing aspects of time lost from work and the underlying social implications regarding perceptions of such for different social groups is an interesting angle that rarely enters the discussion. The original data from Roush's study was from 1984; it would be a welcome challenge to recreate the effort and analyze the results.

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III. DATA AND PRELIMINARY ANALYSIS

A. DATA

The data for this study is a universal set of all Marines with at least four years of service, and a separation date between January 1, 1990 and December 31, 2011. It was consolidated from a single source, directly from the Marine Corps Total Data Force Warehouse (TDFW), Manpower and Reserve Affairs, Headquarters Marine Corps. There is a single observation for each individual, and it is a universal data set in that each observation is measured at the time of the Marine's separation from active service, and every Marine who separated is represented. Those still serving on active duty are not represented in this data. This information is unclassified and does not contain the individuals' social security numbers. TFDW provided a unique identifier code for each Marine officer in compliance with the Privacy Act of 1974.

The original data came in two sets (1993-2001 and 2001-2011) with matching variables. Prior to cleaning and coding, the raw data had 95,175 observations and 21 variables. The only additional variable I created prior to creating analysis variables was a time dummy, to generate the ability to analyze the difference in data for those who separated before Sept 11, 2001, and after. I excluded just 9.8% of observations due to incomplete data, leaving 85,864 viable observations. The post-9/11 observations comprise 57.6% of the total. Table 1 provides a detailed variable description.

Variable	Description	Type
Key		
Female	Positive if female	Binary
Regular Separation	Completion of contract; retirement	Binary
Medical Separation	Service-related medical disability/condition	Binary
Substandard Performance	Unable to maintain military standards; training failures	Binary
Legal Separation	Legal/Misconduct/Fraudulent entry	Binary
Other Separation	Administrative/Reduction-in-force; Combat loss	Binary
No deployments	No major deployments	Binary
One deployment	One major deployment	Binary
Two or more deployments	Two or more deployments; top of the range is four	Binary
Post-9/11	Positive if separated after 11 September 2001	Binary
Demographic		
Married	Positive if married	Binary
Number of dependents	Actual # of dependents	Continuous
White	Caucasian	Binary
Black	African-American	Binary
Hispanic	Hispanic	Binary
Other	Asian, Hawai'ian, Native American, Alaskan, Other	Binary
Protestant	All Protestant Christian denominations	Binary
Catholic	All Catholic denominations	Binary
Other religion	Jewish, Muslim, Hindu, Buddhist, Atheist/Agnostic, Other	Binary
High School	High School diploma or GED equivalent	Binary
Some college	1-4 years of college, no Bachelors	Binary
Bachelors Degree	Bachelors degree awarded	Binary
Postgraduate Degree	Masters or Doctorate awarded	Binary
Military		
NonNCO	Private, Pvt First Class, Lance Corporal (E1-E3)	Binary
NonCommissioned Officer	Corporal, Sergeant (E4-E5)	Binary
Staff NCO	Staff Sergeant, Gunnery Sergeant (E6-E7)	Binary
Technical Staff NCO	Master Sergeant, Master Gunnery Sergeant. Technical specialty. (E8-E9)	Binary
Admin Staff NCO	First Sergeant, Sergeant Major. Admin/leadership specialty. (E8-E9)	Binary
Warrant Officer	All Warrant Officers (W1-W5)	Binary
Company Grade Officer	2nd and 1st Lieutenant (O1/O2), Captain (O3)	Binary
Field Grade Officer	Major (O4), Lieutenant Colonel (O5), Captain (O6)	Binary
General Officer	All General Officers (O7-O10)	Binary
Ground Combat Element (GCE)	Infantry, artillery, and armored vehicles	Binary
Logistics Combat Element (LCE)	All other support jobs	Binary
Air Combat Element (ACE)	Pilots and other specialities directed at aviation	Binary
Age at separation	Age at the time of separation	Continuous
Years of service	Years of completed service	Continuous
GCT score	General Classification Test score	Continuous

Table 1. Variable Descriptions

1. Deployments and Separations

Deployments are a key variable in this study. Due to changes in reporting requirements and lack of a universal reporting structure for short-term training deployments, a deployment is defined as participation in a major action that also incurs hazardous duty pay. The length of deployments is nonstandard, but many of the physical demands involved in deployments take place in the actual movement to and from the deployment area, making length of deployment less significant for the purposes of this study. An ideal study would identify deployment time by months or even days, but I believe that enough deployments, particularly post-9/11, are of a standard enough length to mitigate any bias due to deployment length. Shipboard deployments not specifically tied to a major operation are not tabulated for any observation in this sample. Typically, these are six-month rotations in a Navy fleet deployment undertaken by infantry, pilots, and a small number of support personnel. Other training deployments are also not included, particularly those in Southeast Asia where units may take up to six one-month deployments in a given year.

There are 287 separation codes utilized in this study. Some of this can be attributed to identical separation reasons having been given multiple codes as administration practices developed over the time spread of the study. I have grouped them into nine minor categories, and further segmented them into five major categories for regression and estimation purposes (see Table 2).

Minor Category	N	Percent	Major Category	N	Percent
Medical	14,575	16.97%	Medical	14,575	16.97%
Contract Completion	41,848	48.74%	Regular	53,960	62.84%
Retirement	12,112	14.11%			
Unsat Performance	4,013	4.67%	Substandard Performance	4,516	5.26%
Training Failure	503	0.59%			
Legal/Fradulent Entry	8,753	10.19%	Legal	8,753	10.19%
Medical/Combat	84	0.10%	Other/Administrative/ Force Shaping	4,060	4.73%
Homosexual Conduct	109	0.13%			
Other Causes	3,867	4.50%			
Total	85,864	100%		85,864	100%

Table 2. Separation Codes

The medical separation variable does not distinguish between severe or lesser disabilities, or mental or physical disabilities. Not only would this data be difficult to procure and display without violations of privacy, it is unnecessary for the goals of this study. Any Marine who is unable to serve due to a disability is a loss, regardless of the nature of the injury. My intent with this analysis is to examine the overall physical and mental degradation effects caused by the comprehensive hazards of military service in the Marine Corps. For this reason, retirement separations that are classified as either voluntary or involuntary and medically based are included. An involuntary medical retirement at 20 years is an indicator of physical degradation that prohibited a Marine from serving, but the Marine was able to remain long enough to retire vice separate on a purely medical basis.

Without reviewing cases on an individual level, there is no way for me to specifically isolate a disability-based separation and relate it to a deployment. Medical separations are typically involuntary, but several codes

are voluntary. Voluntary codes account for a very small number of medical separation observations.

Regular separations are voluntary and include completion of enlisted contract obligations, resignations of officers having completed all obligated service time, and retirements. Legal separations are involuntary and a direct result of judicial or non-judicial action, to include court-martial sentences and non-judicial misconduct results. Non-judicial actions are disciplinary measures exclusive to the military, and come with no civilian legal record entries other than a discharge rated below *Honorable*. Sub-standard performance such as fitness failures and failure to promote within a prescribed timeframe make up the *substandard performance* category, as well as irreconcilable training failures. The final separations category includes all other codes, including involuntary reduction-in-force force shaping methods, hardship discharges, homosexual conduct discharges, and many other categories. This includes post-Desert Storm involuntary troop drawdowns. Several of these codes have less than five observations. For the purposes of this study, I have included combat-related deaths as *other*, in order to eliminate bias in the medical separations category.

The post-9/11 variable was generated to separate the data into two distinct eras. The date of separation chosen was September 11, 2001, even though the largest number of deployments did not begin until 2003. This is because I believe that the anticipation and build-up to war would still have an effect on Marines, physically and emotionally.

2. Demographics and Education

My analysis uses a standard set of demographic information, including gender, race, ethnicity, and family structure. Female represents gender, because it is expected to be the variant from the norm. It is also the focus of a secondary question. Number of dependents is a snapshot of how many dependents a service member has at the time of separation. Dummy variables are generated to represent race, with the largest category, white, being the control. Black represents all African-Americans. Asian, Hawaiian, Alaskan, and American Indian are grouped into one category due to the small numbers in these categories. Hispanic is listed as an ethnic category vice race, but over half of those marking Hispanic ethnicity were in the *declined to respond* race category, and a majority of the rest listed race as white. These race categories were superseded by the ethnicity, and I replaced them with a Hispanic race category.

Education is a proxy for individual drive, so much so that a high school diploma or equivalent is a requirement for almost all enlistment programs. As personal drive is relatively intangible and therefore difficult to measure, an individual's pursuit of education past the minimum requirement of high school indicates their motivation to advance in comparison to peers. The education variables are high school, some college, bachelors, and postgraduate, which include master's degrees and doctorates (see Figure 3). In the regression analysis of the enlisted population, the control will be high school diploma. For the officer population analysis, the bachelor's is the control, as it

is a requirement for a standard commission. Warrant officers are not required to have a degree, and that accounts for high school and partial-college observations.

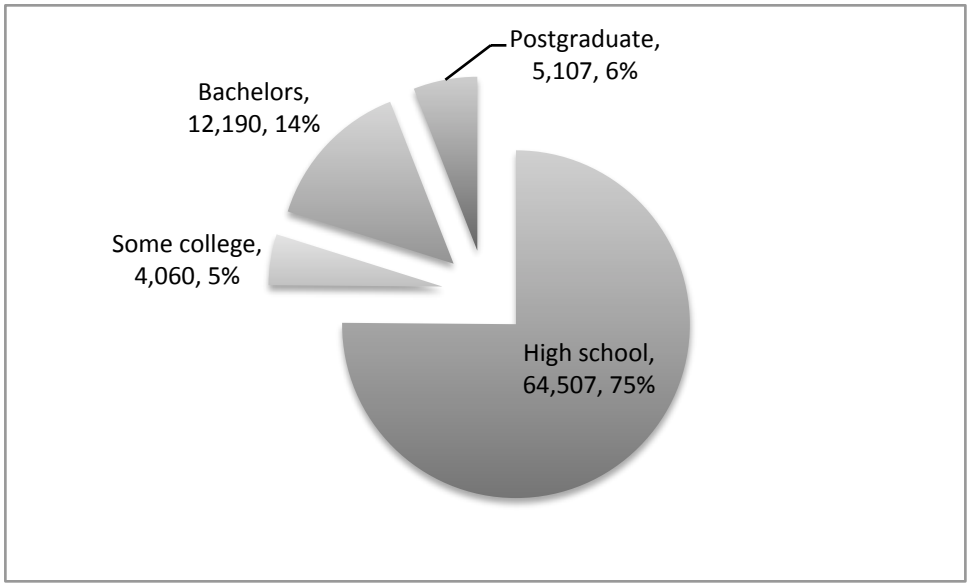

Figure 3. Educational Spread

The final category, *religion*, is included to control for any potential differences in the desire to stay in the military due to different religious affiliation. I did not expect it to have an active effect on the results in this study, as opposed to studies that concern primarily moral issues such as gay personnel serving in the military.

3. Rank and Military

NCOs are the most common enlisted category in this study, comprised of corporals and sergeants. After four years of service, almost any Marine with no major non-judicial or judicial problems will have achieved the rank of NCO. The individuals who are non-NCOs in this study, that is, Privates, Privates First Class and Lance

Corporals, account for 65.35% of the legal separations, and they have been punitively demoted to this rank. In the fleet Marine Corps, SNCO comprises all senior enlisted ranks. For the purposes of this study, the SNCO variable is only staff sergeant and gunnery sergeant.

The two senior ranks of staff NCO, E-8 and E-9, have divergent career paths. Technical specialists, master sergeants and master gunnery sergeants, focus on their MOS (MOS) and are considered to be subject-matter experts in this area. First sergeants and sergeants major are administrative and legal specialists who are selected to serve as senior enlisted advisors to commanding officers and generals.

Warrant Officers are exclusively from the enlisted ranks. After eight years of service, a Marine can apply for a warrant to become a Limited Duty Officer (LDO) within their specialty. These Marines are considered to be duty experts in their fields. While this is a very competitive program, no degree is required. Some warrant officers become LDOs, who start at the rank of O-3E captains, and cap out at lieutenant colonel. LDOs are treated the same as regular commissioned officers for the purposes of this study; however, their years of service are likely to be much greater than their non-LDO peers.

Company grade officers (CGOs) are 2nd lieutenants, 1st lieutenants, and captains. CGOs are more likely to be physically involved in their jobs and with their troops. Field grade officers (FGOs) are majors, lieutenant colonels, and colonels. General grade officers are rather limited in the Marine Corps, and this category includes all four general ranks. Table 3 provides an overview of rank spread.

Rank	N	Percentage
General Officer	153	0.18%
Field Grade Officer	10,647	12.40%
Company Grade Officer	4,965	5.78%
Warrant Officer	2,549	2.97%
1stSgt/SgtMaj	713	0.83%
MSgt/MGySgt	1,791	2.09%
SNCO	15,284	17.80%
NCO	39,887	46.45%
Non NCO	9,875	11.50%
Total	85,864	
Enlisted	67,550	78.67%
Officer	18,314	21.33%
Total	85,864	100%

Table 3. Rank Distribution

The following military-specific demographics are helpful for understanding the type of individual who is separating, and why they do so. Age at separation is the age when the individual leaves active duty. The years of service variable shows the number of complete, satisfactory years served. This is over four years for every observation in this study, since the focus is on careerists. Only 25% of Marines elect to reenlist following their first tour, and 15% of those remain through retirement (Wetzel, 2012). The General Classification Test score is used to measure mental aptitude and the intellectual health of the fleet. It is adapted from the General Technical score of the Armed Services Vocational Ability test. Less than 1% of the observations had clearly miscoded GCT scores; these scores were replaced with the median score in order to retain those observations.

Military specialties could very well affect the type of separations, since certain occupational fields will

cause a greater physical drain than others. The Marine Corps divides itself into three major job categories. The Ground Combat Element (GCE) includes infantry, artillery, tanks, engineers, and other direct combat jobs. This is very male-dominated as most MOSs in this category are male-only. The only women in this category are combat engineers; this MOS is open to women, but is very limited as to the units to which they may be attached. The Aviation Combat Element (ACE) is aviation. This includes pilots and aircrew, air traffic control, expeditionary airfield units, and aircraft maintenance. The Logistics Combat Element (LCE) is often identified as combat service support, and contains all other MOS' required to maintain the fleet, such as administration, finance, and motor transport. Appendix A provides a detailed picture of this breakdown of these three job categories.

B. SUMMARY DATA STATISTICS

Prior to developing econometric models, reviewing the data in summary tables provides some interesting information. This section details those summaries. I present a more in-depth analysis in Chapter IV.

1. Grouping the Data—Pre- and Post-9/11

Ideologies and strategic-level narratives aside, the events of September 11th had a profound impact on the armed forces. The knowledge of an almost certain war deployment shifted the type of individual who would not only join the Service, but remain in the Service. On top of that, increased deployment tempos mean a greater stress on the individual Marine and their families. The physical demands

of deployments include traveling and living under austere conditions and carrying the increased weight loads needed for set up and teardown of working and living areas. Daily activity in a combat deployment requires an average combat load of approximately 63 lbs, the estimate for ground troops serving in Afghanistan in 2004 (U.S. Army Soldier Systems Center, 2004).

The pre-9/11 decade, from 1990-2001 and including Desert Shield/Desert Storm, had an average of 0.298 deployments per Marine, with only 27.64% having at least one deployment. The Long War in Iraq and Afghanistan, represented in this study by the years 2001-2011, produced an average 1.259 deployments per Marine, with 56.42% of Marines having at least one deployment. Pre-9/11 had only 713 Marines with two or more deployments, whereas post-9/11, 21,333 Marines have two or more (see Table 4).

The dramatic increase in deployment tempo marked by a single event provides us with an unprecedented opportunity to understand the effects of increased deployments. Intuitively, an increase in such physically demanding rotations would be matched with a relative increase in medical separations. However, the data paints a different picture.

	Overall	Pre 9/11	Post 9/11
Average deployments per Marine	0.84	0.30	1.26
Deployments			
No deployments	55.79%	72.36%	43.57%
One deployment	18.54%	25.68%	13.27%
Two or more deployments	25.68%	1.96%	43.15%
Separation Cause			
Contract Separation	62.84%	57.56%	66.74%
Medical Separation	16.97%	19.27%	15.28%
Performance-based Separation	5.26%	6.35%	4.46%
Legal Separation	10.19%	10.91%	9.67%
Other Separations	4.73%	5.92%	3.85%
Personal Status			
Female	6.53%	6.31%	6.69%
Married	71.33%	71.22%	71.41%
# of dependents	1.78	1.83	1.74
Religion			
Protestant Christian	53.43%	55.11%	52.19%
Catholic	28.10%	28.61%	27.72%
Other religion	18.47%	16.28%	20.08%
Race			
Caucasian	72.58%	74.00%	71.54%
African-American	16.14%	18.72%	14.24%
Hispanic	8.65%	5.80%	10.75%
Asian or Native American	2.63%	1.47%	3.48%
Education			
High School	75.13%	78.78%	72.44%
Some college	4.73%	4.52%	4.88%
Bachelor's Degree	14.20%	12.11%	15.74%
Masters or Doctorate	5.95%	4.58%	6.95%
Rank			
All enlisted	78.67%	82.04%	76.19%
All officers	21.33%	17.96%	23.81%
Job Category			
Ground Combat Element	27.17%	25.16%	28.65%
Logistics Combat Element	49.89%	50.40%	49.51%
Air Combat Element	22.94%	24.44%	21.84%
Military Demographics			
Years of service	11.41	11.05	11.68
GCT score	110.92	111.08	110.79
Age at separation	31.17	30.82	31.43
Observations	85,864	36,427	49,437

Table 4. Pre- and Post-9/11 Descriptive Statistics

2. Dependent Variable: Medical Separation

The primary dependent variable for this study is whether an individual has a medical separation code. Medical disability can be the result of a single catastrophic injury or a series of smaller injuries over time. I have selected the independent variables that address probable reasons for these separations, as well as provide a picture of the type of service member that medically separates. The descriptive statistics shown in Table 5 provide a summary of these factors.

To interpret this table, note that each category represents a percentage of the total. For instance, females are 8.61% of all medical separations. Looking at the deployments category, we see that those with no deployments are 59.99% of medical separations, those with one deployment are 18.01%, and those with two or more deployments are 22.00%. Surprisingly, those having two deployments or more contribute less to medical separations than they do to non-medical separations. The detailed analysis and regression in Chapter IV offers a closer look at this data, specifically.

	Medically Separated	Not Medically Separated
Deployments		
No deployments	59.99%	54.93%
One deployment	18.01%	18.64%
Two or more deployments	22.00%	26.43%
Personal Status		
Female	8.61%	6.10%
Married	68.25%	71.96%
# of dependents	1.5995	1.82
Religion		
Protestant Christian	55.01%	53.11%
Catholic	24.99%	28.74%
Other religion	20.00%	18.15%
Race		
Caucasian	74.33%	72.23%
African-American	15.99%	16.17%
Hispanic	7.32%	8.92%
Asian/Native American/Hawai'ian/Alaskan	2.35%	2.68%
Education		
High School	90.00%	72.09%
Some college	5.09%	4.65%
Bachelor's or higher	4.91%	23.26%
Rank		
Enlisted	96.19%	75.08%
Officer	3.81%	24.90%
Job Category		
Ground Combat Element	33.48%	25.88%
Logistics Combat Element	45.34%	50.39%
Air Combat Element	21.17%	23.74%
Military Demographics		
Years of service	8.36	111.47
GCT score	103.17	12.02
Age at separation	28.71	31.73
Observations	14,575	71,289

Table 5. Medical Separation Descriptive Statistics

3. The Gender Variable

The impetus for this thesis was an article in the July 2012 *Marine Corps Gazette* written by Capt Katie Petronio, a peer and classmate.

> In the end, my main concern is not whether women are capable of conducting combat operations, as we have already proven that we can hold our own in some very difficult combat situations; instead, my main concern is a question of longevity. Can women endure the physical and physiological rigors of sustained combat operations, and are we willing to accept the attrition and medical issues that go along with integration?

She noted that the Marine Corps has done little to no research on the long-term effects of increased deployment and combat operations, and stated that she felt that a combat-specific MOS would be greatly detrimental to the already small female population. Several studies have shown that female attrition from recruitment through their first term is much higher overall,[1] but by studying only those who would be defined as careerists, I isolate the effects on female career length. There is validity to the concern that women trend towards leaving the Service earlier; if women are becoming medically separated at a higher rate than men, fewer will push to the essential senior ranks. As women are already an overwhelming minority in the Marine Corps, even a small increase in early separations will have a detrimental impact. While this study does not review the political or social aspects of having women in leadership

[1] A 2005 RAND study showed increased attrition for Army women in the Delayed Entry Program through the first term, with only 40 of 100 women completing the term of service, as opposed to 59 of 100 men, all other things equal. Interestingly, those women that completed the first term had a slightly higher reenlistment rate than men (Buddin, 2005).

roles, there is legitimate cause to analyze the potential reasons for such a decline.

Prior to developing the methodology and conducting the regression, I again review the descriptive statistics, this time delineated by the gender variable (see Table 6). For many variables such as GCT score, rank, and age at separation, men and women are strikingly similar. However, variables such as deployments, years of service, and causes of separation show relatively large gender differences. Furthermore, the results indicate that the percentage of deployments for both men and women, both pre- and post-9/11, have increased significantly. Figure 4 demonstrates this visually.

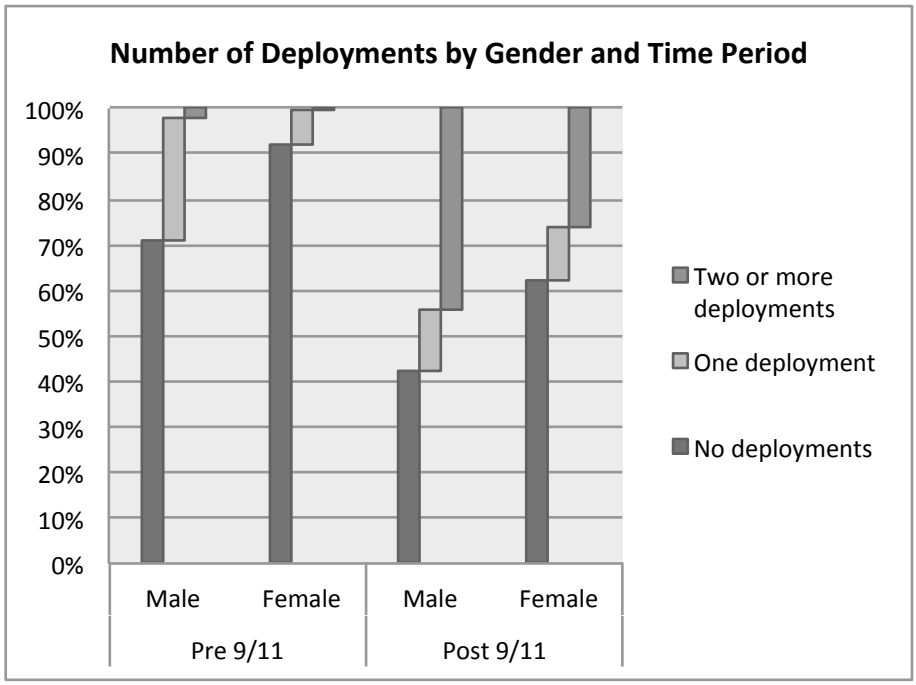

Figure 4. Number of Deployments by Gender and Time Period

	Male	Female
Deployments		
No deployments	54.48%	74.57%
One deployment	19.14%	9.83%
Two or more deployments	26.38%	15.60%
Separation Causes		
Contract Separation	63.30%	56.33%
Medical Separation	16.60%	22.40%
Performance-based Separation	5.12%	7.19%
Legal Separation	10.42%	7.01%
Other Separations	4.57%	7.07%
Family Status		
Married	72.36%	56.58%
# of dependents	1.83	1.09
Religion		
Protestant Christian	53.36%	54.44%
Catholic	28.10%	28.15%
Other religion	18.54%	17.42%
Race		
Caucasian	73.17%	64.18%
African-American	15.71%	22.24%
Hispanic	8.57%	9.80%
Other	2.55%	3.78%
Education		
High School	75.46%	70.41%
Some college	4.47%	8.40%
Bachelor's Degree	14.09%	15.67%
Masters or Doctorate	5.98%	5.51%
Rank		
Enlisted	78.62%	79.37%
Officer	21.38%	20.63%
Job Category		
Ground Combat Element	28.78%	4.09%
Logistics Combat Element	47.99%	77.14%
Air Combat Element	23.23%	18.78%
Military Demographics		
Years of service	11.50	10.12
GCT score	111.08	108.51
Age at separation	31.26	29.87
Observations	80,261	5,603

Table 6. Gender Descriptive Statistics

4. The Rank Variables—Enlisted and Officer

Differences between the officer and enlisted ranks are expected. Officers must have completed a four-year degree to be eligible for a commission at all. A small exception here is the warrant officer, who is an enlisted Marine who serves at least eight years in a specialty before applying for an officer's warrant. While a bachelor's degree gives these Marines an advantage among their peers, it is not required. Physically, officers must have a first-class physical fitness test upon completion of entry-level training, while enlisted may qualify with a first-, second-, or third-class test.

Although the two previous variables are highly quantitative, a less measurable factor is the type of work done by officers. Officers tend to be more focused on organization and paperwork, vice the more physical demands of enlisted jobs. Truly comparing different job quality and difficulty between enlisted and officer workloads is destined for another study entirely; however, it is commonly accepted in the Marine Corps that daily physical demands on the job are, on average, less significant for officers. Due to the factors listed above, as well as demographic differences, I have divided the regression analyses in Chapter IV into officer and enlisted observations. Table 7 provides overall enlisted and officer descriptive statistics. Appendix C provides an additional breakdown by nine rank categories.

	Enlisted	Officer
Deployments		
No deployments	56.32%	53.84%
One deployment	18.84%	17.42%
Two or more deployments	24.85%	28.74%
Separation Causes		
Contract Separation	56.72%	85.43%
Medical Separation	20.75%	3.04%
Performance-failure Separation	5.13%	5.73%
Legal Separation	11.90%	3.92%
Other Separations	5.50%	1.88%
Personal Status		
Female	6.58%	6.31%
Married	68.59%	81.42%
# of dependents	1.65	2.24
Religion		
Protestant	53.43%	53.45%
Catholic	25.82%	36.50%
Other/No religion	20.75%	10.05%
Race		
Caucasian	68.71%	86.89%
African-American	18.59%	7.09%
Hispanic	9.87%	4.16%
Asian or Native American	2.83%	1.87%
Education		
High School	92.67%	10.42%
Some college	4.95%	3.92%
Bachelor's Degree	2.13%	58.72%
Masters or Doctorate	0.25%	26.96%
Job Category		
Ground Combat Element	28.75%	21.32%
Logistics Combat Element	50.11%	49.10%
Air Combat Element	21.14%	29.57%
Military Demographics		
GCT score	107.63	123.04
Years of service	9.43	18.73
Age at separation	28.99	39.22
Observations	67,550	18,314

Table 7. Rank Descriptive Statistics

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IV. METHODOLOGY, RESULTS, AND INTERPRETATION

A. METHODOLOGY

1. Primary Regression Model

The main model for this analysis is the Linear Probability Model (LPM)—a common method used when calculating a binomial dependent variable, such as the medical separations variable. A binomial variable either happens or does not happen, as opposed to a continuous variable. An LPM uses Ordinary Least Squares calculations to estimate the coefficients, which generate a linear curve that represents the relationship between expected and observed data. It does this by minimizing the squares of the deviation between observed and expected. This study utilizes an LPM, vice probit, due to the LPM's ease of calculation and interpretation of the marginal effects in the context of interaction terms. To mitigate concerns about heteroskedasticity, robust standard errors are utilized. Additional concerns with LPM over alternative models will be addressed later in this chapter.

$$\begin{aligned} &Medical\ Separation = \\ &\beta_1 Gender + \beta_2\ One\ Deployment + \beta_3 Two\ or\ More\ Deployments + \\ &\beta_4\ Post\ 911 + \beta_5\ Personal\ Demographics + \beta_6\ Military\ Demographics + \varepsilon \end{aligned} \tag{1}$$

The regression in Equation (1) provides a baseline look at how the independent variables affect those who medically separate. This answers the primary research question of this thesis, "What is the cause of medical separations for Marines who otherwise show intent to remain in the Service?" It also provides a baseline for all

follow-on questions. As stated in Chapter III, the key variables are gender, deployments, and time period. Deployments are divided into three categories: no deployments, one deployment, or two or more deployments. Personal demographics include dummies for race, religion, marital status, and education. Military demographics include rank, job category, GCT score, years of service, and age at separation. All regressions in this study are calculated twice and with distinct groups of data; this is to allow for differences between the enlisted and officer communities. The results section will clearly note these distinctions.

For means of comparison, the medical separation regression is run and shown next to the other major separation categories as dependent variables, *regular*, *substandard performance*, *legal*, and *other*. These results are found in Appendix D.

2. Models Including Interaction Terms

An interaction model is merely a modification of the LPM through the addition of interactive variables as regressors. Multiplicative interaction terms test a conditional hypothesis, defined as a hypothesis in which "a relationship between two or more variables depends on the value of one or more other variables" (Golder, Brambor, & Clark, 2006, p. 4).

In Equation (2), I investigate whether the effects of the Long War on medical separation differ by gender. I add an interaction term for females and time period. The coefficient of the interaction term gives an idea of the specific impact of being a female in the post-9/11 era.

$$
\begin{aligned}
&Medical\ Separation = \\
&\beta_1 Gender + \beta_2\ One\ Deployment\ + \beta_3 Two\ or\ More\ Deployments\ + \\
&\beta_4\ Post\ 911 + \beta_5(Gender * Post911) + \beta_6\ Personal\ Demographics + \\
&\beta_7\ Military\ Demographics + \varepsilon
\end{aligned} \tag{2}
$$

It is important to include the main effects variables as well as the interactive variable, because the coefficients of the constructive terms provide values for those times in which both multiplicative values are not present. For instance, if *Post911* = 0 because the observation is from before 9/11, the interaction term also equals zero. However, the constructive term *gender* still captures the effects of that observation.

In Equation (3), I investigate whether the effects of the number of deployments on medical separation differ by gender. The categorical variable of deployments has been pared down into three dummy variables. These are no deployments, one deployment, and two or more deployments. This allows for a level of specificity without overcomplicating the results.

$$
\begin{aligned}
&Medical\ Separation = \\
&\beta_1 Gender + \beta_2\ One\ Deployment\ + \beta_3 Two\ or\ More\ Deployments\ + \\
&\beta_4\ Post\ 911 + \beta_5(Gender * One\ deployment) + \\
&\beta_6(Gender * Two\ or\ More\ Deployments) + \beta_7\ Personal\ Demographics + \\
&\beta_8\ Military\ Demographics + \varepsilon
\end{aligned} \tag{3}
$$

In Equation (4), I investigate whether the effects of the Long War on medical separation differ by the number of deployments. This isolates the effects of the types of deployments and the constant tempo during the Long War. These deployments are generally of a standard duration,

between six and eight months in the Marine Corps, and to the same operational theatre in the Middle East. For the purposes of this study, it is not necessary to take into account the specific deployment location.

$$\begin{aligned} &Medical\ Separation = \\ &\beta_1 Gender + \beta_2\ One\ Deployment\ + \beta_3 Two\ or\ More\ Deployments\ + \\ &\beta_4\ Post\ 911 + \beta_5(Post911 * One\ deployment) + \\ &\beta_6(Post911 * Two\ or\ More\ Deployments) + \beta_7\ Personal\ Demographics + \\ &\beta_8\ Military\ Demographics + \varepsilon \end{aligned} \tag{4}$$

3. Probit Estimation Model

One major concern with an LPM is that there is a possibility that some of the predicted probabilities will fall outside the unit interval, meaning the result will be outside {0, 1}. In addition, the error term in an LPM suffers from heteroskedasticity, meaning that the variance of the dependent variable is different with any diverse set of independent variable values. Because the value of the error term is dependent on the values of the independent variables, a classical regression assumption is violated. Also, the error term is not normally distributed, which is another assumption violation.

Econometric developments for binary response models have created a different type of regression called a probability unit regression, or probit. A probit model is a nonlinear estimation method and calculates the maximum likelihood of a binary outcome, the dependent variable, given a set of circumstances, that is, independent variables. Traditionally, probit models have been computationally more difficult to implement, but relatively

recent developments in statistical software have eliminated this concern and greatly increased accessibility of the probit model.

All LPM models I have described so far are also estimated using the probit method, for the purpose of comparison. The major advantage of the probit model over the LPM is that the predicted probabilities will not be out of bound. The drawback of this class of nonlinear regression model is that the interpretation of the coefficients on the interaction terms is more difficult compared to the LPM, yet some of the key results of this thesis rely on the interpretation of these interaction terms. However, direction, magnitude, and significance levels of the marginal effects from the main model are expected to be very similar between both types of estimation methods.

$$\Pr\left((\textit{Medical Separation}) = 1|x\right) =$$

$$\Phi((\beta_1 \textit{Gender} + \beta_2\ \textit{One Deployment} + \beta_3 \textit{Two or More Deployments} + \beta_4\ \textit{Post}\,911 + \beta_5\ \textit{Personal Demographics} + \beta_6\ \textit{Military Demographics}) + \varepsilon) \quad (5)$$

B. ENLISTED RESULTS AND INTERPRETATION

Prior to embarking on a series of regressions and estimations, it is important to have the appropriate data for the task at hand. As I mentioned previously, the data is next divided into *enlisted* and *officer*. This is a standard delineation for military personnel studies and is helpful for analysis and application of the results. The background and demographics are very different between

officers and enlisted, as well as job expectations and military contract execution.

The reference observation in the enlisted models is a Caucasian, single, Protestant male with a high school degree or equivalency who is a noncommissioned officer serving in the GCE.

1. Linear Probability Models

As discussed in section A, there are four models; the first has no interaction terms and functions as a base for comparison. Almost every coefficient in this model is statistically significant to the 1% level; however, it is important to note that statistical significance merely implies that the results are not due to random chance. Direction—positive or negative—and magnitude of the coefficients are also key elements in determining the importance of a variable coefficient. For instance, in column (a) of Table 8, the effect of being a female increases the probability of medical separation by 6.86 percentage points,[2] all other things equal. This has statistical significance, a positive effect, and a relatively large magnitude, compared to the baseline medical separation rate of 33.77%.

Relative to all separations in this dataset, medical separations decreased by 4.82 percentage points in the

[2] The term *percentage point* vice *percent* eliminates ambiguity in the results. In this case, the constant is 21.58%, and saying that the effect of being an officer reduces the probability of medical separation by 9.43 *percent* could mean 9.43% of 21.58%, which is 21.58-2.035 = 19.45%. This is an incorrect interpretation, however. The correct interpretation is that the effect of being an officer reduces the probability of medical separation by 9.43 *percentage points*, or 21.58-9.43 = 12.15%.

post-9/11 era compared to the pre-9/11 era. Deployments also have a negative impact on medical separation: those deployed once have a 1.07-percentage points lower probability of being medically separated compared to those with no deployments, and those deployed more than once have a 1.42-percentage points lower probability of being medically discharged than those not deployed. Despite the intense physical nature of deployment, those who are actively deploying have a reduced number of medically based separations. While this might seem counterintuitive at first, this is possibly due to selection bias; those who deploy may be less likely to be medically separated because they are physically fit for deployment in the first place. On the other hand, those who are not physically prepared for deployment are screened out during the pre-deployment screening. Unfortunately, the data at hand does not allow a further inquiry into the extent of this selection bias.

I believe that some of the results are more intuitive as to their cause; for instance, the increased rate of medical separations for the two most senior enlisted ranks (by 28.5 and 35.35 percentage points, relatively) when compared to noncommissioned officers, is likely the result of a long, demanding career in the Marine Corps. A master sergeant or mastery gunnery sergeant has a predicted probability of medical separation of almost 70%.[3] Inversely, being an E1/E2/E3 in this survey has an 11.01-percentage point lower probability of medical separation compared to a noncommissioned officer. But as Appendix D shows, this rank group has a 53.83-percentage point higher probability of

[3] Note that the medical separation variable also includes retirement separations due to temporary or permanent disability.

being legally separated compared to the reference ranks. This accounts for the lower medical separation probability.

Job categories also appear to be significant predictors of medical separation among those separated. Being in the ACE reduces the probability of medical separation by 6.67 percentage points relative to those in the GCE, while the LCE has a 4.98-percentage point reduction. One potential explanation for the lower rate for aviator is the hesitancy of aviation personnel to report medical concerns due to the extremely high standards of physical fitness needed for flight status. Of course, no Marine will deny that the physical demands of the GCE are much higher, an assertion that is verified by this analysis.

I have aligned the four LPMs into Table 8 for ease of comparison. Column (a) is the base model with no interactive terms. The following columns are examined next in detail.

	Medical Separation (a)		Medical Separation (b)		Medical Separation (c)		Medical Separation (d)	
Key Variables								
Female	0.0686***	(0.0069)	0.1007***	(0.0109)	0.0796***	(0.0080)	0.0684***	(0.0069)
Post 9/11	-0.0482***	(0.0036)	-0.0440***	(0.0037)	-0.0484***	(0.0036)	-0.0616***	(0.0042)
One deployment	-0.0107***	(0.0041)	-0.0099**	(0.0041)	-0.0099**	(0.0042)	-0.0308***	(0.0053)
Two or more deployments	-0.0142***	(0.0040)	-0.0152***	(0.0040)	-0.0107***	(0.0041)	-0.0638***	(0.0174)
Interaction Terms								
Female*Post911			-0.0566***	(0.0137)				
Female*One deployment					-0.0026	(0.0230)		
Female*Two or more deployments					-0.0775***	(0.0173)		
Post911*One deployment							0.0491***	(0.0083)
Post911*Two or more deployments							0.0585***	(0.0179)
Family Status								
Married	-0.0016	(0.0043)	-0.0019	(0.0043)	-0.0019	(0.0043)	-0.0013	(0.0043)
# of dependents	0.0043***	(0.0014)	0.0044***	(0.0014)	0.0043***	(0.0014)	0.0043***	(0.0014)
Religion								
Catholic	-0.0123***	(0.0039)	-0.0123***	(0.0039)	-0.0124***	(0.0039)	-0.0124***	(0.0039)
Other/No religion	-0.0154***	(0.0040)	-0.0154***	(0.0040)	-0.0154***	(0.0040)	-0.0156***	(0.0040)
Race								
African-American	-0.0296***	(0.0042)	-0.0299***	(0.0042)	-0.0298***	(0.0042)	-0.0290***	(0.0042)
Hispanic	-0.0562***	(0.0051)	-0.0563***	(0.0051)	-0.0561***	(0.0051)	-0.0563***	(0.0051)
Asian or Native American	-0.0409***	(0.0089)	-0.0406***	(0.0088)	-0.0405***	(0.0089)	-0.0408***	(0.0088)
Education								
Some college	0.0048	(0.0073)	0.0051	(0.0073)	0.0048	(0.0073)	0.0049	(0.0073)
Bachelors or Higher	-0.0439***	(0.0092)	-0.0437***	(0.0092)	-0.0439***	(0.0092)	-0.0443***	(0.0092)
Rank								
E1/E2/E3	-0.1101***	(0.0045)	-0.1105***	(0.0045)	-0.1103***	(0.0045)	-0.1107***	(0.0045)
E6/E7	0.0547***	(0.0039)	0.0548***	(0.0039)	0.0548***	(0.0039)	0.0547***	(0.0039)
E8/E9 1stSgt/SgtMaj	0.2850***	(0.0155)	0.2857***	(0.0155)	0.2849***	(0.0155)	0.2870***	(0.0155)
E8/E9 MSgt/MGySgt	0.3535***	(0.0143)	0.3542***	(0.0143)	0.3538***	(0.0143)	0.3543***	(0.0143)
Job Category								
Logistics Combat Element	-0.0498***	(0.0038)	-0.0497***	(0.0038)	-0.0494***	(0.0038)	-0.0500***	(0.0038)
Air Combat Element	-0.0667***	(0.0045)	-0.0663***	(0.0045)	-0.0662***	(0.0045)	-0.0664***	(0.0045)
Military Demographics								
GCT score	-0.0004***	(0.0001)	-0.0004***	(0.0001)	-0.0004***	(0.0001)	-0.0004***	(0.0001)
Years of service	-0.0305***	(0.0007)	-0.0304***	(0.0007)	-0.0304***	(0.0007)	-0.0304***	(0.0007)
Age at separation	0.0094***	(0.0006)	0.0094***	(0.0006)	0.0094***	(0.0006)	0.0095***	(0.0006)
Constant	0.3377***	(0.0218)	0.3389***	(0.0218)	0.3386***	(0.0218)	0.3380***	(0.0218)
Observations	67,550		67,550		67,550		67,550	
Adjusted R-squared	0.0466		0.0469		0.0468		0.0471	
Robust standard errors in parentheses								
*** p<0.01, ** p<0.05, * p<0.1								

Table 8. Enlisted Linear Probability Models

Because this is an LPM, interaction effects can be calculated through basic arithmetic. The model in column (b) tests whether the effect of post-9/11 on medical separation differs between male and female Marine enlisted. Isolating the interactions in column (b) helps interpret the results. The interaction term between female and post-9/11 era has a negative magnitude and is statistically significant, suggesting that females are less likely to be

medically separated than males in the post-9/11 era, compared to their medical separation rate differences in the pre-9/11 era. Using marginal probabilities, as reported in Table 8, Figure 5 illustrates the differences in predicted probability by era and by gender.

	Gender = 0 (Male)	*Gender* = 1 (Female)
*Post*911 = 0	0.3389	0.3389 + 0.1007 = 0.4396
*Post*911 = 1	0.3389 + -0.0440 = 0.2949	0.3389 + 0.1007 + -0.0440 + -0.0566 = 0.3390

Figure 5. Gender * Post911 Computation Matrix[4]

This 2x2 table shows that in the pre-9/11 era, predicted probability of medical separation is 33.89% for male and 43.96% for female—a 10.07–percentage point difference. In the post-9/11 era, predicted probability of medical separation went down for both genders: 29.49% for male and 33.9% for female, resulting in the rate difference being narrowed to 4.41 percentage points.

The deployment effects in column (c) of Table 8 are a little more involved, since there are two dummies that need to be isolated. Because the variables *one deployment* and *two or more deployments* handle the same type of information and are mutually exclusive, they can be put into the same

[4] Interpretation is based on a subset of coefficients:

model. As done with column (b), I isolate the interaction effects of column (c), shown in Figure 6.

	$Gender = 0$ (Male)	$Gender = 1$ (Female)
$One\ Deployment = 0$	0.3386	0.3386 + 0.0796 = 0.4182
$One\ Deployment = 1$	0.3386 + -0.0099 = 0.3287	0.3386 + 0.0796 + -0.0099 + 0* = 0.4083

Figure 6. Gender * One Deployment Matrix (* Denotes Insignificant Effect)

While the variables *female* and *one deployment* are both significant to at least 5%, the interaction effect is not within 10% statistical significance. This infers that the effect of this interaction is equal to zero, and cannot be interpreted. The next interaction term is shown in Figure 7.

	$Gender = 0$ (Male)	$Gender = 1$ (Female)
$Two\ or\ More\ Deployments = 0$	0.3386	0.3386 + 0.0796 = 0.4182
$Two\ or\ More\ Deployments = 1$	0.3386 + -0.0107 = 0.3279	0.3386 + 0.0697 + -0.0107 + -0.0775 = 0.3201

Figure 7. Gender * Two or More Deployments Matrix

The interaction effects of being a female with two or more deployments are highly statistically significant, have a negative effect on the probability of medical separation, and have a relatively high magnitude. The 2x2 table in Figure 7 shows that with no deployments, predicted probability of medical separation is 33.86% for male and 41.82% for female—an eight-percentage point difference. However, with two or more deployments, predicted probability of medical separation went down slightly for males to 32.79%, but dropped to 32.01% for females. This results in the rate difference being not only narrowed by almost nine percentage points, but showing a reversal in gender for having a higher rate of medical separations relative to all separation causes.

The causes of this shift are possibly the uneven number of males in the GCE, vice the LCE and ACE.[5] Though not directly related to my original research questions, I also consider here whether the interaction effect between combat element and deployment is relevant. Even with a cursory look at the results shown in Table 9, the significance, magnitude, and direction of the interaction variables indicate that medical separations have a much greater probability for GCE Marines in relation to LCE and ACE. Table 9 and Figures 8-10 show the specific interactions between combat elements and deployments.

[5] Actual combat operations are not part of these calculations; however, the purpose of this study is to evaluate the overall impact of the increased deployment tempo on the health of the force, so the impact of this missing data is negligible.

	Medical Separation (e)		Medical Separation (f)		Medical Separation (g)		Medical Separation (h)	
Key Variables								
Female	0.0686***	(0.0069)	0.0663***	(0.0069)	0.0671***	(0.0069)	0.0687***	(0.0069)
Post 9/11	-0.0482***	(0.0036)	-0.0484***	(0.0036)	-0.0483***	(0.0036)	-0.0483***	(0.0036)
One deployment	-0.0107***	(0.0041)	-0.0202***	(0.0047)	-0.0025	(0.0059)	-0.0064	(0.0047)
Two or more deployments	-0.0142***	(0.0040)	-0.0353***	(0.0045)	0.0075	(0.0055)	-0.0109**	(0.0044)
Ground Combat Element (GCE)			0.0399***	-0.0058				
Logistics Combat Element (LCE)	-0.0498***	(0.0038)	0.0171***	-0.0039	-0.0340***	(0.0049)	-0.0492***	(0.0038)
Air Combat Element(ACE)	-0.0667***	(0.0045)			-0.0631***	(0.0045)	-0.0594***	(0.0056)
Interaction Terms								
GCE, One Deployment			0.0369***	(0.0093)				
GCE, Two or More Deployments			0.0643***	(0.0080)				
LCE, One Deployment					-0.0150*	(0.0081)		
LCE, Two or More Deployments					-0.0462***	(0.0071)		
ACE, One Deployment							-0.0200**	(0.0096)
ACE, Two or More Deployments							-0.0158*	(0.0086)
Constant	0.3377***	(0.0218)	0.3179***	(0.0220)	0.3318***	(0.0218)	0.3347***	(0.0219)
Observations	67,550		67,550		67,550		67,550	
Adjusted R-squared	0.0466		0.0475		0.0471		0.0466	
Robust standard errors in parentheses								
*** p<0.01, ** p<0.05, * p<0.1								

Table 9. Enlisted Linear Probability Key Variables With Combat Element and Deployment Interaction Terms

	$GCE = 0$	$GCE = 1$
Two or More Deployments $= 0$	0.3377	0.3377 + 0.0399 = 0.3776
Two or More Deployments $= 1$	0.3377 + -0.0353 = 0.3024	0.3377 + 0.0399 + -0.0353 + 0.0643 = 0.4066

Figure 8. GCE * Two or More Deployments Matrix

The most numerically significant variable seems to be those with *two or more deployments*. An enlisted Marine serving in the GCE with two or more deployments has a 40.66% probability of medically separating relative to members of the GCE with no deployments, an increase of

three percentage points. This is also over 10 percentage points higher relative to Marines who are not in the GCE.

Members of the LCE and ACE have 25.91% and 24.86% probability, respectively, of medical separation over all other separation causes relative to those with no deployments. So overall, GCE Marines with two or more deployments have a 10-percentage point increase in probability of medical separation when compared to those not in the GCE, while LCE and ACE Marines with two or more deployments show a drop of four and three percentage points when compared with those not in their communities.

	$LCE = 0$	$LCE = 1$
Two or More Deployments $= 0$	0.3318	0.3318 + -0.0340 = 0.2978
Two or More Deployments $= 1$	0.3318 + 0.0075 = 0.3393	0.3318 + -0.0340 + 0.0075 + -0.0462 = 0.2591

Figure 9. LCE * Two or More Deployments Matrix

	$ACE = 0$	$ACE = 1$
Two or More Deployments $= 0$	0.3347	0.3347 + -0.0594 = 0.2753
Two or More Deployments $= 1$	0.3347 + -0.0109 = 0.3238	0.3347 + -0.0594 + -0.0109 + -0.0158 = 0.2486

Figure 10. ACE * Two or More Deployments Matrix

The final model in the enlisted results section evaluates the impact of deployments pre- and post-9/11, regardless of gender. The most recent war in the Middle East has created a sustained deployment environment not experienced in recent military history, and certainly not since the advent of the all-volunteer force in 1973. The relative peace of the 1990s followed by a singular event leading to a sustained deployment environment provides an ideal opportunity to study the effects of said deployments on Marines. The data found in column (d) of Table 8 gives us the data to analyze these effects (see Figures 11-12).

	*Post*911 $= 0$	*Post*911 $= 1$
One Deployment $= 0$	0.3380	0.3380 + -0.0616 = 0.2764
One Deployment $= 1$	0.3380 + -0.0308 = 0.3072	0.3380 + -0.0616 + -0.0308 + 0.0491 = 0.2885

Figure 11. Post-9/11 * One Deployment Matrix

	*Post*911 = 0	*Post*911 = 1
Two or More Deployments = 0	0.3380	0.3380 + -0.0616 = 0.2764
Two or More Deployments = 1	0.3380 + -0.0638 = 0.2742	0.3380 + -0.0594 + -0.0638 + 0.0585 = 0.2733

Figure 12. Post-9/11 * Two or More Deployments Matrix

In the pre-9/11 era, enlisted Marines with no deployments have a 33.8% probability of medical separation relative to all separations. Probability drops three percentage points with one deployment, and an additional three for more than one deployment for a total of a six-percentage point drop to 27.33% probability. As deployments increase in the post-9/11 period, medical separations fluctuate from 27.64% with no deployments, up to 28.85% with one, and back down to 27.33% with two. Compared to the pre-9/11 era, there is a six-percentage point drop in medical separation probability when evaluating post-9/11 Marines with no deployments, a two-percentage point drop when comparing those with one deployment, and only a 0.11-percentage point drop when comparing those with two or more deployments, making the difference in probabilities almost even.

2. Probit Estimation Models

There are significant computation hurdles to finding the interaction effects in a nonlinear estimation model such as a maximum-likelihood probit model. A cadre of

econometricians has worked to create a new statistical software model to address these concerns, and it is certainly possible (Norton, Wang, & Ai, 2004, pp. 154-167). However, the depth and scope of my thesis does not require such an extensive process. The LPM provides accessible interaction effects and statistically viable results. It is prudent to verify the significance, direction, and magnitude of the LPMs by comparing them to a probit model. This is due to concerns of inconsistency and bias of the results and marginal effects. My primary point of concern with an LPM is that of boundedness, defined as the necessity for predicted probabilities to reside within [0, 1]. There is no way to constrain the results of an LPM within this parameter as the OLS model mathematically assumes that changes in the independent variables have a constant effect on the dependent variable, whether a unit change is from 0 to 1, or from 103 to 104. While the effects of this lessen with binary dummy variables, inconsistent and biased results are still an issue.

I am not directly interpreting the results of the probit estimation models, but they are shown in Appendix D. The coefficients are the calculated derivative marginal probability effects for the discrete change of dummy variable from 0 to 1, or for a one-unit change in the mean value of a continuous independent variable. The "observed P" in these models is the probability of medical separation at the mean value of all independent variables.

While the magnitude of the coefficients varies between the LPM and the probit models, they are similar. Direction and significance levels are the same. These factors indicate that the LPM is a decent fit to the data, relative to the probit results.

C. OFFICER RESULTS

The control variables for the officer models are Caucasian, single, Protestant, male, bachelor's degree, field grade officer, and serving in the GCE. All officers, with the exception of warrant officers and LDOs, are expected to have at least a bachelor's degree. WOs and LDOs are a very small percentage of the officer cadre—around 3%. For regular commissioned officers, the path to a commission is a long and difficult one relative to enlisting. Either the officers come from the enlisted ranks themselves, or they come from the civilian sector. An intense six-, 10-, or 12-week selection process prior to commissioning attrites physically weaker candidates, particularly because a first-class physical fitness test is required for graduation. Following that initial selection process is six months of classroom and field work, and then basic occupational training. This process demonstrates that the physical and mental benchmark for a basic Marine officer is significantly higher than for the basic Marine enlisted. Other differences between officer and enlisted include higher legal standards of conduct, higher levels of pay, and different work standards. Due in part to these factors, an overwhelming majority of officers separate due to contract completion (85.43%), be it resigning their commissions or retiring from the Service.

1. Linear Probability Models

	Medical Separation (i)		Medical Separation (j)		Medical Separation (k)		Medical Separation (l)	
Key Variables								
Female	-0.0023	(0.0063)	0.0039	(0.0115)	0.0043	(0.0085)	-0.0022	(0.0063)
Post 9/11	0.0110***	(0.0033)	0.0116***	(0.0033)	0.0113***	(0.0033)	0.0151***	(0.0042)
One deployment	-0.0113***	(0.0032)	-0.0112***	(0.0032)	-0.0100***	(0.0033)	-0.0053	(0.0048)
Two or more deployments	-0.0170***	(0.0031)	-0.0170***	(0.0031)	-0.0162***	(0.0032)	-0.0025	(0.0083)
Interaction Terms								
Female/Post911			-0.0092	(0.0134)				
Female/One deployment					-0.0269*	(0.0139)		
Female/Two or more deploymen					-0.0141	(0.0132)		
Post911/One deployment							-0.0117*	(0.0066)
Post911/Two or more deploymer							-0.0170*	(0.0090)
Family Status								
Married	0.0015	(0.0045)	0.0015	(0.0045)	0.0015	(0.0045)	0.0014	(0.0045)
# of dependents	-0.0003	(0.0009)	-0.0003	(0.0009)	-0.0004	(0.0009)	-0.0003	(0.0009)
Religion								
Catholic	-0.0025	(0.0027)	-0.0025	(0.0027)	-0.0025	(0.0027)	-0.0025	(0.0027)
Other/No religion	0.0003	(0.0046)	0.0003	(0.0046)	0.0003	(0.0046)	0.0003	(0.0046)
Race								
African-American	-0.0020	(0.0054)	-0.0019	(0.0054)	-0.0021	(0.0054)	-0.0020	(0.0054)
Hispanic	-0.0056	(0.0064)	-0.0056	(0.0064)	-0.0055	(0.0064)	-0.0055	(0.0064)
Asian or Native American	0.0002	(0.0100)	0.0002	(0.0100)	0.0000	(0.0100)	0.0002	(0.0100)
Education								
HS or some college	0.0021	(0.0048)	0.0021	(0.0048)	0.0022	(0.0048)	0.0020	(0.0048)
Masters or Doctorate	-0.0034	(0.0027)	-0.0035	(0.0027)	-0.0034	(0.0027)	-0.0034	(0.0027)
Rank								
Warrant Officers	0.0178***	(0.0047)	0.0178***	(0.0047)	0.0176***	(0.0047)	0.0177***	(0.0047)
O1/O1E to O3/O3E	0.0268***	(0.0047)	0.0267***	(0.0047)	0.0268***	(0.0047)	0.0272***	(0.0047)
General officers	-0.0011	(0.0039)	-0.0011	(0.0039)	-0.0009	(0.0040)	-0.0019	(0.0041)
Job Category								
Logistics Combat Element	0.0041	(0.0035)	0.0040	(0.0035)	0.0040	(0.0035)	0.0040	(0.0035)
Air Combat Element	0.0057	(0.0037)	0.0057	(0.0037)	0.0058	(0.0037)	0.0057	(0.0036)
Military Demographics								
GCT score	-0.0003***	(0.0001)	-0.0003***	(0.0001)	-0.0003***	(0.0001)	-0.0003***	(0.0001)
Years of service	-0.0045***	(0.0005)	-0.0046***	(0.0005)	-0.0045***	(0.0005)	-0.0045***	(0.0005)
Age at separation	0.0026***	(0.0004)	0.0026***	(0.0004)	0.0026***	(0.0004)	0.0026***	(0.0004)
Constant	0.0376**	(0.0186)	0.0372**	(0.0186)	0.0373**	(0.0186)	0.0370**	(0.0186)
Observations	18,314		18,314		18,314		18,314	
Adjusted R-squared	0.0210		0.0210		0.0211		0.0212	
Robust standard errors in parentheses								
*** p<0.01, ** p<0.05, * p<0.1								

Table 10. Officer Linear Probability Models

As shown in Table 10, there are far fewer significant variables identifying the reasons that officers medically separate. In the base model shown in column (i), of those factors that are significant, such as years of service and age at separation, the magnitude is far smaller than in the enlisted models. They are, however, in the same direction.

The factors with the highest magnitude are tied to rank. Warrant officers have at least eight years of enlisted service, which is a reasonable explanation for their increased probability of medical separation. Company grade officers are generally the most physically active officers, as their job billets tend to be in smaller units that require a very high level of participation and interaction with the Marines. In the key variables, gender is not even statistically significant. I take the significant interaction coefficients and calculate their effect. These calculations are shown in Figures 13-15.

	$Gender = 0$ (Male)	$Gender = 1$ (Female)
$One\ Deployment = 0$	0.0373	0.0373 + 0* = 0.0373
$One\ Deployment = 1$	0.0373 + -0.0100 = 0.0273	0.0373 + 0* + -0.0100 + -0.0269 = 0.0004

Figure 13. Gender * One Deployment Matrix—Officer (* Denotes Insignificant Effect)

	$Post911 = 0$	$Post911 = 1$
$One\ Deployment = 0$	0.0370	0.0370 + 0.0151 = 0.0521
$One\ Deployment = 1$	0.0370 + 0* = 0.0370	0.0370 + 0.0151 + 0* + -0.0117 = 0.0404

Figure 14. Post-9/11 * One Deployment Matrix—Officer (* Denotes Insignificant Effect)

	$Post911 = 0$	$Post911 = 1$
$Two\ or\ More\ Deployments = 0$	0.0370	0.0370 + 0.0151 = 0.0521
$Two\ or\ More\ Deployments = 1$	0.0370 + 0* = 0.0370	0.0370 + 0.0151 + 0* + -0.0170 = 0.0351

Figure 15. Post-9/11 * Two or More Deployments Matrix—Officer (* Denotes Insignificant Effect

The large difference in significant variables between the enlisted and officer data is an interesting factor in itself, as almost all variables that lose significance for the officer models are personal characteristics rather than military ones. While the details are interesting, more intriguing is the vast overall difference in medical separation percentages between enlisted and officers. Some reasons have been discussed already, such as work requirements and higher physical fitness standards. There may be some qualitative reasons that cannot be measured

here, however. Officers do not generally physically train at the group level, and certainly not with the consistency of the enlisted Marines. Training as part of a group means that some enlisted Marines are underworked, and some are overworked and possibly pushed past their limits. If this occurs, it is far more likely that an officer will be granted time to rest without scrutiny. If you ask almost any enlisted Marine, those requesting time to rest, particularly for smaller injuries to heal before they develop into large injuries, are refuted or even looked down upon. I believe that finding a balance between pushing people past their mental barriers and pushing them past their physical limitations is an extremely important piece to this puzzle.

2. Probit Estimation Models

The officer probit estimation model mimics the significance, direction, and magnitude of the LPM, again indicating that the models are a relative fit. The model results are shown in Appendix D.

D. LIMITATIONS

The primary limitation to this study is that those still serving actively are not included. As, by definition, career Marines will serve for 10–30 years, conducting a survey with even a 20-year range cannot be all-inclusive. Veteran's Assistance data is not available, so those separating with non-medical codes that qualify for disability benefits are not included. Also limiting is the bias of self-selection. This is the individual's predilection for service, or the reason they choose to join

and/or stay in the Service. This can be affected by family history, education, positive or negative leadership experiences, personal bias, or anything that impacts a Marine's opinion on service, particularly at the time of accession or reenlistment.

Another limitation of this study is the lack of a combat-action variable, particularly for females. As women in the Marine Corps do not have a combat-specific MOS designator, there is no way to categorize them into a GCE. For this study, I was unable to identify those serving with Female Engagement Teams; I was also unable to identify recipients of a combat action ribbon or Purple Heart, male or female. This is mitigated by the fact that the overall purpose of the research question is to determine the general toll on the individual Marine, rather than the results of an acute set of actions.

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V. SUMMARY, RECOMMENDATIONS, AND CONCLUSION

A. SUMMARY

There are three primary sections of data in this study, all based on a regression analysis of interaction terms. (see Tables 11 and 12).

	Pre-9/11	Post-9/11	No Deployments	One Deployment	Two or more Deployments
Male	33.89%	29.49%	33.86%	32.87%	32.79%
Female	43.96%	33.90%	41.82%	40.83%	32.01%
Pre-9/11			33.80%	30.72%	27.42%
Post-9/11			27.64%	28.85%	27.33%

Table 11. Probability of Medical Separation Among Separated Enlisted

	Pre-9/11	Post-9/11	No Deployments	One Deployment	Two or more Deployments
Male	3.72%*	3.72%*	3.73%	2.73%	3.73%*
Female	3.72%*	3.72%*	3.73%*	0.00%	3.73%*
Pre-9/11			3.7%	3.7%*	3.7%*
Post-9/11			5.21%	4.04%	3.51%

Table 12. Probability of Medical Separation Among Separated Officers (* Denotes Insignificant Result)

As evidenced from the summarized data, there is a notable decrease of almost 10 percentage points in medical

separations for enlisted females with two or more deployments. I also see an overall trend towards decreased medical separations as deployments increase, both before and after 9/11. However, the post-9/11 era has a lower overall percentage of medical separations.

B. ADDITIONAL STUDY RECOMMENDATIONS

1. All Active-Duty

While the sample size in this thesis is universal in that it includes anyone with a separation code, a far more effective study would include everyone who is or has served on active-duty in the Marine Corps. By comparing those who separate with those who do not, one would truly see the effect of medical separations on the strength of the fleet over time. It would also be beneficial to include separations over the next five or 10 years, in order to include those currently battling with injuries as a result of the current conflicts. We will only get a complete picture of the outcome from Operations Iraqi Freedom and Enduring Freedom after those who deployed there have time to work through the lengthy medical boarding process as necessary.

2. Shape of the Force

The intriguing fact that medical separations have fallen with increased deployments may be better answered through an analysis of the makeup of the force. A common way to do this is to analyze predilection for service. For instance, a 2004 study by the Population Reference Bureau showed that certain states had a higher percentage of military recruits, indicating social factors for increased

enlistment (see Figure 16). Finding equivalent data for a pre-9/11 era would allow for a better understanding of that aspect of the desire to serve.

In order to show the effect that socio-economic factors (such as local unemployment rate and local median income) have on willingness to serve, all Marines, both active and separated, need to be observed. Without knowing the shape of the current active force or the active force at any point in time, this sort of socio-economic information is irrelevant. However, with expanded information, it could be a valuable analysis tool.

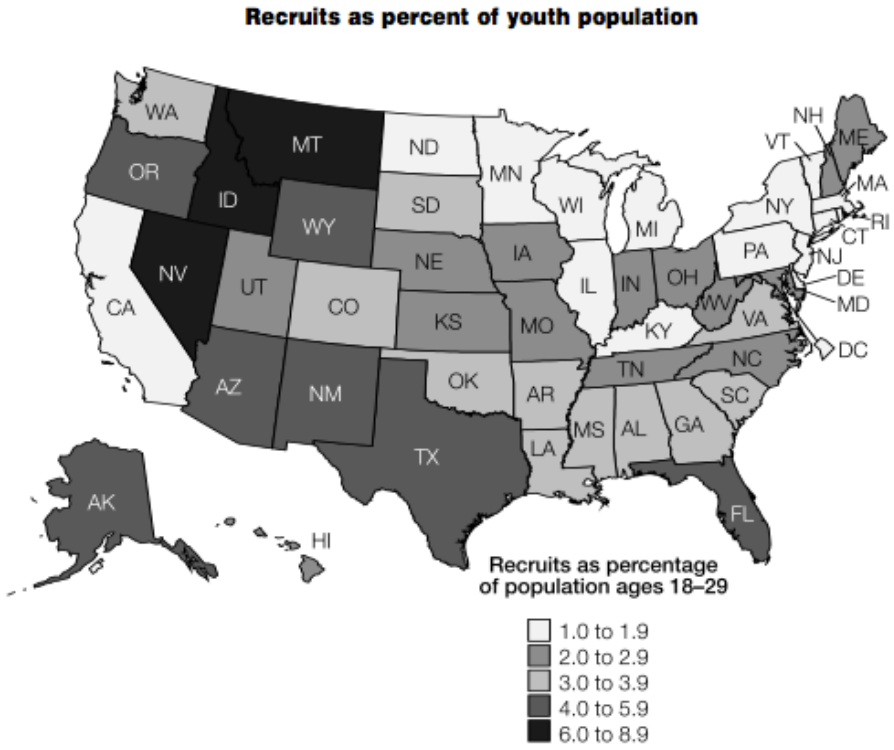

Figure 16. Recruits as Percent of Youth Population (From Segal & Segal, 2004)

3. Increased Data Input

Obviously, any observational study would be improved with more complete data. In studying the trend in medical separation, additional information on combat time and combat missions would be valuable, such as participation in Female Engagement Teams. Given the high magnitude of correlation between increased deployments and reduced medical separation for women, applying the same level of analysis to only those women with combat operation time will be the best way to add to the larger sociological debate over women in combat.

Other useful information would be physical fitness test and combat fitness test scores over time, as well as limited duty status information. Many high-performing Marines at any stage in their careers will be "carried," even with a limited duty status. This will allow them to stay through completion of a contract and separate with an End-of-Active-Service discharge rather than a medical or unsatisfactory performance discharge. Veteran's Affairs disability ratings would also be a highly effective tool for this study.

C. CONCLUSION

The primary research question for this thesis is "What is the cause of medical separations for Marines who otherwise show intent to remain in the Service?" While the data does not point to a single, conclusive indicator, what it shows as *not being* a factor is just as important. Intuitively, increased deployments would be a culprit for increased medical problems. However, my analysis of the data indicates that either the initial presumptions are

flat-out wrong, or there is a great deal of unseen bias that counteracts the effects, such as patriotic motivation or job satisfaction. Overall, the largest factor in medical separations seems to be tied to the senior enlisted ranks. It's an anecdotal truth among Marines that a year in the Marine Corps equals at least three years as a civilian, and the data seems to corroborate that.

A secondary research question concerns whether or not the impact of increased deployment tempo is uniform across gender. The answer to this question seems to be "no," but not for the expected reasons. Women who deploy at all have a reduced tendency for medical separation, implying that many who are destined for medical separations are largely non-deployable to begin with, due to personal choice or physical circumstance. The resulting sociological implications of this are not for this study to determine, but given the correlation between female training standards and decreased medical separations, there is room to develop additional quantitative and policy analyses. Also tied to this is the sheer magnitude of the drop in medical separations between men and women. While both end up around the same place, the difference in separation probability for men and women with no deployments is almost eight percentage points. Men go from approximately 34% of Marines with no deployments having a probability of medical separation down to 33% after two or more deployments, but women drop from 42% to 32%. These results have the highest level of statistical significance, and are extremely important to the gender question. This is a very high indication that there are women strongly capable of intense service.

Initially, the differential gender trend in medical separation between pre- and post-911 periods is significant because of the rapidly changing role of women in the Marine Corps. It wasn't until 1997 that women received equivalent Marine Combat Training after recruit training ("History of the Women Marines," n.d.), and in the mid-1990s, the women's required run increased from one-and-a-half miles to three miles, and the women's crunches requirement also became equivalent to that of men. This disparity in training and employment may account for a higher rate of medical separations in the pre-9/11 era due to lower physical training standards and related expectations.

Rank has a surprising effect concerning medical separations. Several theories for this are proposed in the previous section, but ultimately we cannot deny that officers medically separate at a far lower percentage than enlisted. In fact, according to the data used in this study, over half of officers stay until voluntary retirement, while less than 3% of enlisted retire voluntarily.[6]

As deployments increase in both the pre- and post-9/11 era, the incidences of medical separations decrease. This not only suggests an increased level of personal and professional fulfillment, but also presents a strong correlation between personal morale and physical health. In a 1997 study titled *Intrinsic Motivation and Exercise Adherence*, the authors showed that adherence to exercise programs was associated with enjoyment, competence, and

[6] Voluntary retirement does not include medical retirements in this calculation.

social interaction (Ryan, 1997, p. 335). Extrinsic motivations such as physical appearance have some importance in getting someone to start working out, but sticking with it requires satisfaction of the intrinsic motivators just listed. As Marines deploy and engage in work that increases their motivation and job satisfaction, their intrinsic motivations to exercise increase as well. If Marines are less satisfied with their work, they will gain little enjoyment from required physical training and have a reduced desire to be physically competent. This will increase risk of injury, and the data shows evidence of this trend, as medical separations are inversely correlated to number of deployments.

With the available data and the models we have chosen, the overall decline of medical separations for Marines who otherwise show intent to remain in the Service might be tied to job satisfaction. Factors that cause job satisfaction, called *motivators*, include challenging work, achievement, recognition, responsibility, and the nature of the work itself (Redmond, 2011). Those who chose to join the Marines expect a certain type of work environment. It's no secret that the motto of the Marine Corps is "Every Marine a rifleman," and people expect to be challenged physically and mentally. While this can be done in a peacetime or garrison environment, everything is just training until an actual conflict happens. Putting training to action and conducting real-world missions is a culminating event for Marines.

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APPENDIX A – OCCUPATIONAL FIELDS

	Occupational Field	Description
Ground Combat Element	03XX	Infantry
	08XX	Artillery
	13XX	Engineers
	18XX	Tanks and Assault Amphibious Vehicles
	21XX	Ground Ordnance Maintenance
	23XX	Ammunition and Explosive Ordnance Disposal
Logistics Combat Element	01XX	Personnel & Administration
	02XX	Intelligence
	04XX	Logistics
	05XX	Plans
	06XX/25XX/40XX	Communications
	09XX	Training
	11XX	Utilities
	26XX	Signals Intelligence
	27XX	Linguist
	28XX	Data/Communications Maintenance
	30XX	Supply Administration and Operations
	31XX	Distribution Manager
	33XX	Food Service
	34XX	Financial Management
	35XX	Motor Transport
	41XX	Morale Welfare Recreation
	43XX	Public Affairs
	44XX	Legal Services
	46XX	Combat Camera
	55XX	Music
	57XX	CBRN Defense
	58XX	Military Police and Corrections
	59XX	Electronics Maintenance
Aviation Combat Element	60XX/61XX/62XX	Aircraft Maintenance
	63XX/64XX	Avionics
	65XX	Aviation Ordnance
	66XX	Aviation Logistics
	68XX	Meteorological and Oceanographic
	70XX	Airfield Services
	72XX	Air Control
	73XX	Navigation/Flight Crews
	75XX	Pilot/Naval Flight Officer

Table 13. MOS/Occupational Field Breakdown

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APPENDIX B – SEPARATION CODES

Appendix B lists all separation code descriptions used in this report. The top 20 overall codes are listed with percentages and observations. All codes are then listed with percentage of the total number of separations in the data. There are additional codes not present as there are no corresponding observations. It is also important to note that separation codes themselves are protected for privacy reasons, so these code descriptions are not available for comparison.

TOP 20 SEPARATION CODES			
Separation	**Category**	**% of total**	**N**
VOL DIS (COMPLETION OF REQUIRED ACTIVE	Completed	30.567%	26077
RETD VOL-REQ SER RETM (LESS MAX) (20YRS	Retirement	9.487%	8093
INVOL DIS (PHY DISABL W/SER PAY)	Medical	7.969%	6798
MANDATORY RETIREMENT (DISABILITY TEMPOR	Medical	6.378%	5441
INVOL DIS (NON-RETENTION ON ACDU) NO FU	Completed	2.929%	2499
INVOL DIS (NO BOARD) COMPLETION OF ACTI	Completed	2.848%	2430
RETDVOL MAX SERV (30 YRS ACTIVE SERVICE	Retirement	2.553%	2178
RESIG (INTRADEPT TR) COM SERV REQ	Completed	2.545%	2171
TERM-CORRECTION TO DELETE ERRONEOUS GAI	Legal	2.330%	1988
VOL DIS (COMPL REQSERV) ENTER USMCR	Completed	2.262%	1930
INVOL DIS (NON-RETENTION ON ACDU) HIGH	Completed	2.034%	1735
RESIG (INTRADEPARTMENTAL TR)	Completed	2.030%	1732
INVOL DIS (BOARD WAIVED) (MISCONDUCT) D	Legal	1.764%	1505
INVOL DIS (NON-RETENTION ON ACDU) HIGH	Completed	1.421%	1212
VOL DIS (IN LIEU OF TRAIL BY COURT MART	Legal	1.206%	1029
MANDATORY RETIREMENT (DISABILITY PERMAN	Medical	1.175%	1002
INVOL DIS (BOARD WAIVED) (MISCONDUCT) S	Legal	1.105%	943
INVOL DIS (FAIL SELECT) REAPP/REENL	Standards	0.968%	826
INVOL DIS (BOARD WAIVED) (PATTERN OF MI	Legal	0.914%	780
RESIG (COMPLETION OF REQUIRED ACTIVE SE	Completed	0.896%	764

Table 14. Top 20 Separation Codes

CONTRACT COMPLETION CODES		
Separation	**Category**	**% of total**
VOL DIS (COMPLETION OF REQUIRED ACTIVE	Completed	30.567%
INVOL DIS (NON-RETENTION ON ACDU) NO FU	Completed	2.929%
INVOL DIS (NO BOARD) COMPLETION OF ACTI	Completed	2.848%
RESIG (INTRADEPT TR) COM SERV REQ	Completed	2.545%
VOL DIS (COMPL REQSERV) ENTER USMCR	Completed	2.262%
INVOL DIS (NON-RETENTION ON ACDU) HIGH	Completed	2.034%
RESIG (INTRADEPARTMENTAL TR)	Completed	2.030%
INVOL DIS (NON-RETENTION ON ACDU) HIGH	Completed	1.421%
RESIG (COMPLETION OF REQUIRED ACTIVE SE	Completed	0.896%
VOL DIS (COMPLETION OF REQUIRED ACTIVE	Completed	0.468%
VOL DIS (INSUFF RETAINABILITY) (ECOMONI	Completed	0.117%
FMCR (VOL RECALL) (COMPL OF REQ SERVICE	Completed	0.105%
VOL REL/TR (EXP OF ACTIVE OBL SERV USMC	Completed	0.090%
RESIG (INTERDEPARTMENTAL TRANSFER)	Completed	0.087%
FMCR (INVOL RECALL) (COMPL OF REQ SERVI	Completed	0.028%
VOL REL/TR (COMPL REQ SERV-USMCR-FTS) E	Completed	0.027%
VOL REL/TR (COMP OF REQ ACTIVE SERVICE)	Completed	0.021%
VOL REL/TR (COMPL REQ SERV-RECALL ACDU)	Completed	0.019%
TR TO FMCR (SUFFICIENT SERVICE FOR RETI	Completed	0.015%

Table 15. Contract Completion Separation Codes

RETIREMENT CODES		
Separation	**Category**	**% of total**
RETD VOL-REQ SER RETM (LESS MAX) (20YRS	Retirement	9.487%
RETDVOL MAX SERV (30 YRS ACTIVE SERVICE	Retirement	2.553%
MANDATORY RETIREMENT (NON-SELECTION PER	Retirement	0.758%
REV RECALLED RETIREE (COMPLETION OF ACT	Retirement	0.658%
VOL RET LESS MAX-REQ SERV (30 YRS ACT U	Retirement	0.433%
RETD VOL (LESS THAN MAX) COMPL 20 YRS	Retirement	0.186%
RETIRED MANDATORY MAX SERV	Retirement	0.091%
RETD VOL UNACCEPT CONDUCT (MORAL/PRO DE	Retirement	0.080%
RETD MAND UNACCEPT CONDUCT (MORAL/PRO D	Retirement	0.021%
RETDVOL LESS THAN 20 RES YRS (RETD W/PA	Retirement	0.014%
RETDVOL MAX SERV (REG COMM OFF 30 YRS A	Retirement	0.014%
RETD VOL-MAX SERV-30 YRS ACTIVE SERVICE	Retirement	0.011%
RETIRED VOL MAX SERV	Retirement	0.006%
VOL RETIREMENT (SUBSTANDARD PERFORMANCE	Retirement	0.005%
REQ SERV FOR RET (15 YRS LESS THAN 20 Q	Retirement	0.002%
RETDVOL MAX SERV (REG WO 30 YRS ACTIVE	Retirement	0.002%
VOL RET LESS MAX-REQ SERV (20 YRS FED W	Retirement	0.002%
VOL RET LESS THAN 20 YRS MAX (W/PAY)	Retirement	0.002%
RETD VOL REQ SERV RETM (LESS THAN MAX 2	Retirement	0.001%
RETD VOL-FAIL OF SEL PERM PROM (RETN)	Retirement	0.001%
RETD VOL-REQ SER RETM (LESS MAX) (RETIR	Retirement	0.001%
RETIRED MANDATORY MAX AGE	Retirement	0.001%

Table 16. Retirement Separation Codes

MEDICAL CODES		
Separation	**Category**	**% of total**
INVOL DIS (PHY DISABL W/SER PAY)	Medical	7.969%
MANDATORY RETIREMENT (DISABILITY TEMPOR	Medical	6.378%
MANDATORY RETIREMENT (DISABILITY PERMAN	Medical	1.175%
DIS W/SEV PAY NON-CBT RELATED(ENH-IDES)	Medical	0.458%
DIS W/SEV PAY NON-CBT RELATED(LEGACY-DE	Medical	0.178%
INVOL DIS (DISABLE OTHER) NOT AGGRAVATE	Medical	0.120%
INVOL DIS PHYS (NO BOARD ENT) EPTE (MED	Medical	0.052%
INVOL DIS (DISABILITY) NOT IN LINE OF D	Medical	0.028%
INVOL DIS (PHY DISABL W/SEV PAY) PRIOR	Medical	0.019%
INVOL DIS (DISABLE OTHER) AGGRAVATED	Medical	0.013%
INVOL DIS PHYS (DISABLE AGGRAVATION)	Medical	0.009%
INVOL DIS PHYS (NO BOARD ENT) EPTE (MED	Medical	0.008%
INVOL DIS (PHYS DISABLE) W/PAY PRIOR SE	Medical	0.001%
INVOL DIS PHYS DISABLE EPTE	Medical	0.001%
RETD VOL-PHY DSABL PERM	Medical	0.001%
VOL DIS (DSABL EPTE) (MED BD)	Medical	0.001%

Table 17. Medical Separation Codes

MEDICAL (COMBAT) CODES		
Separation	**Category**	**% of total**
DIS W/SEV PAY CBT RELATED(ENH-DES SIMUL	Medical (Cbt)	0.039%
DIS W/SEV PAY CBT RELATED(ENH-DES ARMED	Medical (Cbt)	0.016%
DIS W/SEV PAY CBT RELATED(LEGACY-DES AR	Medical (Cbt)	0.016%
DIS W/SEV PAY CBT RELATED(LEGACY-DES SI	Medical (Cbt)	0.013%
DIS W/SEV PAY CBT RELATED(ENH-DES INSTRU	Medical (Cbt)	0.006%
DIS W/SEV PAY CBT RELATED(ENH-DES HAZAR	Medical (Cbt)	0.004%
DIS W/SEV PAY CBT RELATED(LEGACY-DES IN	Medical (Cbt)	0.004%
DIS W/SEV PAY CBT RELATED(LEGACY-DES HA	Medical (Cbt)	0.001%

Table 18. Medical Separation Codes (Combat)

LEGAL CODES		
Separation	**Category**	**% of total**
TERM-CORRECTION TO DELETE ERRONEOUS GAI	Legal	2.330%
INVOL DIS (BOARD WAIVED) (MISCONDUCT) D	Legal	1.764%
VOL DIS (IN LIEU OF TRAIL BY COURT MART	Legal	1.206%
INVOL DIS (BOARD WAIVED) (MISCONDUCT) S	Legal	1.105%
INVOL DIS (BOARD WAIVED) (PATTERN OF MI	Legal	0.914%
INVOL DIS (BOARD) (MISCONDUCT) SERIOUS	Legal	0.516%
INVOL DIS (BOARD) (MISCONDUCT) DRUG ABU	Legal	0.505%
INVOL DIS (BOARD) (PATTERN OF MISCONDUC	Legal	0.381%
INVOL DIS (UNACCEPTABLE CONDUCT) (BOARD	Legal	0.209%
INVOL DIS (BOARD WAIVED) (MISCONDUCT) U	Legal	0.196%
RESIG (UNACCEPTABLE CONDUCT)	Legal	0.184%
INVOL DIS-NO BOARD (FRAUDULENT ENTRY IN	Legal	0.176%
INVOL DIS GCM (COURT MARTIAL) CONVICTIO	Legal	0.171%
INVOL DIS (BOARD WAIVED) ERRON ENTRY (O	Legal	0.164%
INVOL DIS (NO BOARD ENT) (ALCOHOL REHAB	Legal	0.151%
INVOL DIS (BOARD WAIVED) (MISCONDUCT) D	Legal	0.115%
INVOL DIS (BOARD WAIVED) (ALCOHOL REHAB	Legal	0.097%
DIS INVOL (NO BOARD ENT) (MISCONDUCT SE	Legal	0.060%
INVOL DIS (ERRONEOUS ALCOHOL ABUSE)	Legal	0.053%
INVOL DIS SPCM (COURT MARTIAL) CONVICTI	Legal	0.050%
INVOL DIS (GCM COURT MARTIAL CONVICTION	Legal	0.049%
INVOL DIS (NO BOARD ENT) (FRAUD ENTRY D	Legal	0.048%
INVOL DIS (BOARD) (ALCOHOL REHAB FAILUR	Legal	0.047%
MISCONDUCT (CIVIL CONVICTION)	Legal	0.039%
ERRON ENL (DID NOT RED PROG/OPT/GDE)	Legal	0.039%
INVOL DIS (BOARD) (MISCONDUCT) MINOR DI	Legal	0.038%
INVOL DIS (PHY DISABLE) (MISCONDUCT)	Legal	0.034%
INVOL DIS (NO BOARD) PATTERN OF MISCOND	Legal	0.034%
DIS INVOL MISCON DRUG ABUSE	Legal	0.034%
INVOL DIS (BOARD) (MISCONDUCT) CONV CIV	Legal	0.032%
TERM-ADMIN SEPARATION TO DELETE RECORD/	Legal	0.025%
INVOL DIS-BOARD WAIVED MISCONDUCT(OTHER	Legal	0.019%
RESIG (IN LIEU OF TRIAL BY COURT MARTIA	Legal	0.016%
INVOL DIS (BOARD WAIVED) FRAUD ENTRY	Legal	0.016%
INVOL DIS (FRAUD ENTRY-DRUGS)	Legal	0.015%
INVOL DIS (NO/BOARD) PRESERV POLICE REC	Legal	0.014%
VOL DIS (DEFECTIVE ENLISTMENT AGREEMENT	Legal	0.013%
INVOL DIS (NO BOARD) PATTERN OF MISCOND	Legal	0.012%
INVOL DIS (SPCM COURT MARTIAL CONVICTIO	Legal	0.011%

LEGAL CODES (cont)		
Separation	**Category**	**% of total**
FRAUD ENTRY INTO THE USMC (PRESERV DRUG	Legal	0.008%
MISCONDUCT (SEXUAL PERVERSION)	Legal	0.007%
INVOL DIS (ERRONEOUS ENTRY) (DRUG ABUSE	Legal	0.007%
INVOL DIS (NO BOARD ENT) (ERRON ENTRY A	Legal	0.006%
INVOL DIS (NO BOARD ENT) (MISCONDUCT) A	Legal	0.006%
ERRON ENL (PREG AT ENL/WO/KNOWLEDGE)	Legal	0.005%
INVOL DIS SPCM (COURT MARTIAL) DESERTIO	Legal	0.005%
SEP DEL OF MOB RES/FAIL SIA	Legal	0.004%
RESIG (MISCONDUCT) DRUG ABUSE	Legal	0.004%
INVOL DIS (MISCONDUCT) SEXUAL PERVERSIO	Legal	0.004%
INVOL DIS-BOARD MISCONDUCT (OTHER)	Legal	0.004%
INVOL DIS (NO BOARD ENT) (FRAUD ENTRY A	Legal	0.004%
RESIG (MISCONDUCT) CONVICTION CIVIL AUT	Legal	0.002%
FRAUDULENT ENTRY	Legal	0.002%
INVOL DIS (NO BOARD ENT)(UNDER AGE)	Legal	0.002%
DIS INVOL (NO BOARD ENT) (MISCONDUCT)	Legal	0.002%
VOL DIS SVC INABILITY TO HONOR CONTRACT	Legal	0.002%
RESIG (MISCONDUCT) MINOR DISP INF	Legal	0.001%
INVOL DIS-BOARD (FRAUDULENT ENTRY INTO	Legal	0.001%
ERRONEOUS ENLISTMENT NOT ALCOHOL OR DRU	Legal	0.001%
INVOL DIS (BOARD WAIVED) (FRAUD ENTRY A	Legal	0.001%
FRAUDULENT ENTRY-PRIOR SERVICE (MCRD US	Legal	0.001%
INVOL DIS (ERRONEOUS ENL) EXCESSIVE DEP	Legal	0.001%
INVOL DIS (ERRONEOUS ENL) JUVENILE REC	Legal	0.001%
INVOL DIS GCM (COURT MARTIAL) DESERTION	Legal	0.001%
DIS INVOL ADMIN SEP OF MBR WHO HAS DESE	Legal	0.001%
INVOL DIS (NO BOARD ENT) (MISCONDUCT) S	Legal	0.001%
MISCONDUCT - REMOVAL OF MBR FROM ROLLS	Legal	0.001%

Table 19. Legal Separation Codes

STANDARDS FAILURE CODES		
Separation	**Category**	**% of total**
INVOL DIS (FAIL SELECT) REAPP/REENL	Standards	0.968%
INVOL DIS (WEIGHT CONTROL FAILURE BOARD	Standards	0.618%
INVOL DIS (NO BOARD) CONDITION NOT A DI	Standards	0.499%
INVOL DIS (PERSONALITY DISORDER)	Standards	0.380%
INVOL DISCHARGE WEIGHT CONTROL FAILURE	Standards	0.327%
INVOL DIS (UNSAT PERF DUTY) (NO/BOARD)	Standards	0.308%
INVOL DIS (UNSAT PERF DUTY) (BOARD WAIV	Standards	0.209%
INVOL DIS-NO BOARD PERSONALITY DISORDER	Standards	0.165%
DIS INVOL (UNSAT PERF DUTY)	Standards	0.151%
INVOL DIS W/BOARD WEIGHT CONTROL FAILUR	Standards	0.134%
INVOL DIS-BOARD WAIVER (PHYSICAL STANDA	Standards	0.093%
INVOL DIS (BOARD WAIVED) CONDITION NOT	Standards	0.093%
INVOL DIS (PHYSICAL STANDARDS DIRECTED)	Standards	0.084%
COG COND NOT PHY CHAR & BEHAV DISORD	Standards	0.081%
INVOL DIS-BOARD ACTION (PHYSICAL STANDA	Standards	0.048%
VOL DIS (RED INGRADE FM SSGT TO SGT)	Standards	0.047%
INVOL DIS (NON-SELECTION PERM PROM) OFF	Standards	0.046%
VOL DIS (TWICE FAILED SELECTION TO SSGT	Standards	0.046%
INVOL DIS (BOARD)(CONDITION NOT DISABIL	Standards	0.038%
INVOL DIS (SUBSTANDARD PERF - W/BD)	Standards	0.021%
INVOL DIS (UNSAT PERF) WEIGHT	Standards	0.015%
INVOL DIS-BOARD PERSONALITY DISORDER	Standards	0.009%
DIS INVOL (UNSAT PERF-UNSANITARY)(W/BOA	Standards	0.008%
COG COND NOT PHYS CHAR & BEHAV DISORD(W	Standards	0.007%
INVOL DIS (TWICE FAILED SELECTION TO SS	Standards	0.006%
RESIG (PERSONALITY DISORDER)	Standards	0.006%
RESIG (WEIGHT CONTROL FAILURE)	Standards	0.006%
INVOL DIS (UNSAT PERF) WEIGHT	Standards	0.006%
INVOL DIS-BOARD WAIVED FAIL TO PARTICIP	Standards	0.005%
DIS INVOL-CON-NON PHY (INTERFS W/DUTY O	Standards	0.004%
INVOL DIS (UNSAT PERF) UNSANITARY (BOAR	Standards	0.004%
INVOL DIS (UNSAT PERFORMANCE)	Standards	0.004%
INVOL DIS-BOARD NON-RETENTION ON ACTIVE	Standards	0.004%
INVOL DIS-BOARD WAVED WEIGHT CONTROL FA	Standards	0.002%
SUBSTANDARD PERFORMANCE	Standards	0.002%
DIS INVOL-CON-NON PHY (PSEUDOFOLLICULIT	Standards	0.001%
INVOL DIS (DRUG ABUSE REHAB FAILURE)	Standards	0.001%
INVOL DIS (UNSAT PERF) UNSATHABITS (B/W	Standards	0.001%
INVOL DIS-REVIEW ACTION (NO BD)	Standards	0.001%
VOL DIS (PERSONALITY DISORDER)	Standards	0.001%

TRAINING FAILURE CODES		
Separation	**Category**	**% of total**
INVOL DIS (ENTRY LEVEL PERFORM/CONDUCT)	Training	0.350%
INVOL DIS (FAILED MEDICAL/PHYSICAL PROC	Training	0.093%
FAILURE TO COMPL COMM/WO PROGRAM	Training	0.090%
COG DISENROLLED FROM OFFICER CANDIDATE	Training	0.054%
INVOL DIS (FAIL TO COM A CRS INST)	Training	0.036%
RESIG (FAILURE TO COMPLETE A COURSE OF	Training	0.019%
FAIL TO ACC REG APPT CONFIRMED BY SENAT	Training	0.016%
ENTRY LEVEL PERFORMANCE	Training	0.004%
INVOL DIS (FAIL TO COM CRS INST)	Training	0.004%
RESIG (FAIL COM CRS ISNT)	Training	0.002%
INVOL DIS (FAIL TO COM CRS INST)	Training	0.001%
COG OFFICER CANDIDATE DISENROLLS	Training	0.001%

Table 20. Training Failure Codes

HOMOSEXUAL CONDUCT CODES		
Separation	**Category**	**% of total**
INVOL DIS (BOARD WAIVED) (HOMOSEXUAL AD	Homosexual	0.088%
INVOL DIS (BOARD WAIVED) (HOMOSEXUAL AC	Homosexual	0.014%
INVOL DIS (HOMOSEXUAL ADMISSION)	Homosexual	0.011%
INVOL DIS (BOARD) (HOMOSEXUAL ACT)	Homosexual	0.005%
INVOL DIS NO BOARD ENT (HOMOSEXUAL MARR	Homosexual	0.004%
HOMOSEXUAL CONDUCT (STATEMENT)	Homosexual	0.002%
INVOL DIS (BOARD WAIVED) (HOMOSEXUAL MA	Homosexual	0.002%
INVOL DIS (NO BOARD ENT) (HOMOSEXUAL AC	Homosexual	0.002%
RESIG (BOARD) (HOMOSEXUAL ACT)	Homosexual	0.001%
INVOL DIS (COURT MARTIAL) HOMOSEXUAL	Homosexual	0.001%

Table 21. Homosexual Conduct Separation Codes

OTHER CODES		
Separation	**Category**	**% of total**
VOL DIS (HARDSHIP)	Other	0.631%
VOL DISCHARGE EARLY REL PGM-SSB	Other	0.448%
REDUCTION IN FORCE	Other	0.339%
VOL DIS (ACC COMM OR WARRANT ANOTHER BR	Other	0.281%
VOL DIS (TO ATTEND SCHOOL)	Other	0.246%
VOL DISCHARGE EARLY REL PGM-VSI	Other	0.240%
DEATH OUTSIDE US BATTLE-KILLED IN ACTIO	Other	0.227%
INVOL DIS (NO BOARD) (DISABLE EXIST PRI	Other	0.197%
VOL DIS (IMM ENLIST OR REENLIST)	Other	0.139%
DEATH INSIDE US-AUTOMOBILE	Other	0.138%
DEATH INSIDE US-OTHER	Other	0.114%
DEATH INSIDE US-GUNSHOT	Other	0.107%
VOL DIS (PREGNANCY OR CHILDBIRTH)	Other	0.086%
DEATH INSIDE US-MOTORCYCLE	Other	0.084%
VOL DIS (EARLY) (IMM ENLIST OR REENLIST	Other	0.070%
INVOL DIS (NO BOARD ENT) (SECRETARIAL A	Other	0.064%
DIS INVOL-DETERMINATION OF SERV SECRETA	Other	0.064%
VOL DIS (ACC COMM OR WARRANT--REG)	Other	0.061%
DEATH OUTSIDE US BATTLE-DIED OF WOUNDS	Other	0.059%
VOL DIS (SECRETARIAL AUTH)	Other	0.055%
DEATH INSIDE US-UNKNOWN	Other	0.049%
INVOL DIS (REDUCTION IN FORCE)	Other	0.047%
DEATH INSIDE US-DISEASE	Other	0.043%
INVOL DIS (PARENTHOOD OR CUSTODY OF MIN	Other	0.040%
TERM-SPECIAL ENL PROG INITIAL PERIOD AC	Other	0.038%
VOL DIS (ACC COMM OR WARRANT--RES)	Other	0.034%
DEATH OUTSIDE US NON BATTLE-HELICOPTER	Other	0.032%
DEATH INSIDE US-HANGING	Other	0.030%
DIS VOL-MISC INDIVIDUAL REASONS (FOR VO	Other	0.030%
DEATH INSIDE US-HELICOPTER CRASH	Other	0.028%
VOL DIS (HOLIDAY EARLY RELEASE PGM) (EO	Other	0.026%
VOL DIS (CONSCIENTIOUS OBJECTOR)	Other	0.023%
VOL ASSIGN TO ACTIVE RES PGM	Other	0.019%
VOL ASSIGN TO TEM ACDU OTHER THAN RECAI	Other	0.018%
DEATH INSIDE US-AIRPLANE CRASH (EXCLUDE	Other	0.018%
DEATH OUTSIDE US NON BATTLE-OTHER	Other	0.018%
DIS INVOL-REVOCATION OF APPOINTMENT	Other	0.018%
VOL DIS (NAV ACAD/NROTC)	Other	0.018%
RESIG (MISCELLANEOUS/GENERAL REASONS)	Other	0.015%
VOL DIS (DSABL EPTE) PEB	Other	0.015%

OTHER CODES		
Separation	**Category**	**% of total**
VOL DIS (PARENTHOOD OR CUSTODY OF MINOR	Other	0.014%
DEATH OUTSIDE US NON BATTLE-DROWNING	Other	0.011%
DEATH OUTSIDE US NON BATTLE-AUTOMOBILE	Other	0.009%
DEATH OUTSIDE US NON BATTLE-GUNSHOT	Other	0.009%
INVOL DIS (PARENTHOOD OR CUSTODY OF MIN	Other	0.009%
DEATH INSIDE US-DROWNING	Other	0.008%
DEATH OUTSIDE US NON BATTLE-AIRPLANE CR	Other	0.008%
DEATH INSIDE US-DECLARED DEAD FROM MISS	Other	0.007%
DEATH INSIDE US-PARACHUTING	Other	0.006%
DEATH OUTSIDE US NON BATTLE-HANGING	Other	0.006%
VOL REESIG OTHER EARLY REL PGM-VSI	Other	0.006%
RESIG (SECRETARIAL AUTH)	Other	0.006%
INVOL DIS-NO BOARD (INSUFF RETAINABILIT	Other	0.006%
INVOL REL/TR (REQ FOR EXT OF SERV DENIE	Other	0.006%
DEATH INSIDE US-FALL	Other	0.005%
DEATH INSIDE US-POISONOUS AGENT	Other	0.005%
DEATH OUTSIDE US NON BATTLE-UNKNOWN	Other	0.005%
VOL RES EARLY REL PGM SSB	Other	0.005%
RESIG (HARDSHIP)	Other	0.005%
INVOL DIS BOARD WAIVER (MIL PERS SECTY	Other	0.005%
INVOL DIS (COMP AUTH W/OUT BOARD ACTION	Other	0.005%
VOL DIS INTERDEPARTMENTAL TRANSFER	Other	0.005%
DIS VOL IMM ENL/REENL USMCR	Other	0.005%
INVOL DIS (PARENTHOOD OR CUSTODY OF MIN	Other	0.004%
VOL DIS (MIL PERS SCTY PGM)	Other	0.004%
VOL DIS (FAIL TO ACCEPT REG APPT)	Other	0.004%
INVOL RELACDU (EXT DENIED) EAS W/OUT RE	Other	0.004%
DEATH INSIDE US-ELECTROCUTION	Other	0.002%
DEATH INSIDE US-FIRE	Other	0.002%
DEATH OUTSIDE US NON BATTLE-MOTORCYCLE	Other	0.002%
INVOL DIS (NO BOARD) (MILITARY PER SCTY	Other	0.002%
DIS INVOL-MISC GEN(ALL OTHER REASONS)	Other	0.002%
INVOL EARLY DIS FY 88	Other	0.002%
VOL DIS (MEDAL OF HONOR RECIPIENT)	Other	0.002%
VOL DIS (CIVIL OFFICE)	Other	0.002%
INVOL RELACDU (EXT DENIED) EAS W/READJP	Other	0.002%
DEATH OUTSIDE US BATTLE-KILLED IN ACT (	Other	0.001%
DEATH OUTSIDE US NON BATTLE-DECLARED DE	Other	0.001%
DEATH OUTSIDE US NON BATTLE-ELECTROCUTI	Other	0.001%
DEATH OUTSIDE US NON BATTLE-FALL	Other	0.001%

OTHER CODES		
Separation	**Category**	**% of total**
DEATH OUTSIDE US NON BATTLE-FIRE	Other	0.001%
DEATH OUTSIDE US NON BATTLE-HEAT STROKE	Other	0.001%
DEATH OUTSIDE US NON BATTLE-PARACHUTING	Other	0.001%
RESIGN (PARENTHOOD OR CUSTODY OF MINOR	Other	0.001%
SURVIVING FAMILY MEMBER-SOLE SURVIVORSH	Other	0.001%
INVOL DIS (RED IN FORCE) NO BOARD ENT	Other	0.001%
VOL DIS (ALIEN)	Other	0.001%
DIS VOL RES OFF TO ACC REG COMM	Other	0.001%
VOL DIS ENTER OFFICER TRAINING PROGRAM	Other	0.001%
VOL DIS-MARRIED TO SVCMBR	Other	0.001%
INVOL RELACDU (INIT EAS) EXT DENIED W/R	Other	0.001%

Table 22. Other Separation Codes

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APPENDIX C – DESCRIPTIVE STATISTICS BY RANK

Appendix C provides descriptive statistics broken down into five enlisted rank categories and four officer rank categories. This gives an interesting perspective of the shape of the force and the relationships between ranks. The Senior SNCO and all GO ranks are not unilaterally represented in the GCE, LCE, or ACE categories as these are divided only by MOS, and no specific unit data is available. Generals, first sergeants, and sergeants major have an MOS that is unique to the rank, but applicable in any type of Marine Corps unit. Concerning education, CGOs and FGOs with less than a bachelor's degree are LDOs, promoted from the warrant officer ranks where no such degree is required.

Table 23. Descriptive Statistics by Rank

	NonNCO	NCO	SNCO	MSNCO	SSNCO	WO	CGO	FGO	GO
Key Variables									
Female	0.0453	0.0692	0.0762	0.0352	0.0182	0.0824	0.1007	0.0416	0.0196
Post 9/11	56.67%	54.77%	57.58%	57.34%	55.54%	68.46%	58.59%	65.92%	64.71%
No deployments	64.66%	55.39%	55.18%	48.41%	37.03%	55.08%	56.29%	52.67%	34.64%
One deployment	12.77%	19.58%	19.34%	26.52%	31.42%	17.81%	12.59%	19.42%	28.76%
Two or more deployments	22.57%	25.03%	25.48%	25.07%	31.56%	27.11%	31.12%	27.90%	36.60%
Separation Causes									
Contract Separation	11.62%	62.53%	66.80%	77.83%	87.10%	92.94%	67.65%	91.73%	98.69%
Medical Separation	16.66%	22.64%	19.43%	17.31%	8.98%	3.14%	6.32%	1.52%	0.00%
Performance-failure Separation	10.63%	4.94%	2.91%	0.06%	0.00%	0.35%	10.11%	5.06%	0.00%
Legal Separation	57.92%	4.19%	3.87%	2.40%	1.26%	2.28%	10.57%	1.24%	1.31%
Other Separations	3.17%	5.70%	6.99%	2.40%	2.66%	1.29%	5.34%	0.44%	0.00%
Family Status									
Married	50.99%	69.45%	74.52%	87.49%	89.76%	87.56%	63.54%	88.06%	97.39%
# of dependents	1.0126	1.6248	2.0446	2.2887	2.195	2.6618	1.3412	2.565	1.5686
Religion									
Protestant Christian	51.73%	53.23%	53.61%	61.81%	62.97%	58.30%	52.10%	52.94%	52.29%
Catholic	23.33%	25.62%	27.71%	27.19%	27.63%	30.25%	34.84%	38.67%	43.79%
Other/No religion	24.94%	21.14%	18.69%	11.00%	9.40%	11.46%	13.05%	8.40%	3.92%
Race									
Caucasian	67.95%	68.24%	71.93%	59.07%	60.17%	78.07%	83.95%	90.28%	93.46%
African-American	19.51%	18.55%	15.87%	32.16%	32.68%	14.04%	7.71%	5.17%	4.58%
Hispanic	9.63%	10.28%	9.41%	7.43%	6.17%	6.16%	5.66%	3.01%	1.96%
Asian or Native American	2.91%	2.93%	2.79%	1.34%	0.98%	1.73%	2.68%	1.55%	0.00%
Education									
High School	96.49%	94.87%	87.54%	73.87%	74.19%	53.43%	4.37%	3.07%	0.00%
Some college	2.54%	3.84%	7.69%	14.96%	16.55%	18.95%	1.89%	1.31%	0.00%
Bachelor's Degree	0.93%	1.21%	4.29%	8.38%	7.99%	19.97%	86.69%	55.40%	28.10%
Masters or Doctorate	0.04%	0.09%	0.48%	2.79%	1.26%	7.65%	7.05%	40.22%	73.21%
Job Category									
Ground Combat Element	31.52%	30.99%	23.63%	18.76%	0.00%	17.89%	28.02%	19.33%	0.00%
Logistics Combat Element	48.06%	48.61%	51.96%	58.91%	100%*	66.10%	44.67%	46.37%	100%*
Air Combat Element	20.42%	20.40%	24.41%	22.33%	0.00%	16.01%	27.31%	34.30%	0.00%
Military Demographics									
GCT score	106.08	107.09	109.84	108.87	108.87	118.39	124.98	123.25	123.00
Years of service	5.82	8.23	11.96	27.10	27.61	22.69	10.11	21.61	32.12
Age at separation	25.71	27.84	31.14	47.02	47.72	41.96	30.71	42.28	56.24
Observations	9,875	39,887	15,284	1,791	713	2,549	4,965	10,647	153

* 100% of 1stSgts, SgtsMaj, and Generals are shown as LCE due to command MOS codes. This is not necessarily their original job category.

APPENDIX D – SEPARATION MODELS

	ENLISTED - LPM									
	Medical		Contract Completion		Unsat Performance		Legal		Other	
	coef	se	coef	se	coef	se	coef	se	coef	se
Key Variables										
Female	0.0686***	(0.0069)	-0.0851***	(0.0074)	0.0240***	(0.0042)	-0.0388***	(0.0038)	0.0313***	(0.0043)
Post 9/11	-0.0482***	(0.0036)	0.0772***	(0.0040)	-0.0120***	(0.0021)	0.0063***	(0.0024)	-0.0233***	(0.0019)
One deployment	-0.0107***	(0.0041)	0.0245***	(0.0047)	-0.0139***	(0.0022)	0.0014	(0.0026)	-0.0014	(0.0024)
Two or more deployments	-0.0142***	(0.0040)	0.0453***	(0.0047)	-0.0241***	(0.0021)	-0.0114***	(0.0026)	0.0043*	(0.0022)
Family Status										
Married	-0.0016	(0.0043)	0.0219***	(0.0048)	0.0006	(0.0024)	-0.0120***	(0.0029)	-0.0089***	(0.0025)
# of dependents	0.0043***	(0.0014)	-0.0079***	(0.0017)	0.0003	(0.0008)	0.0021**	(0.0009)	0.0011	(0.0008)
Religion										
Catholic	-0.0123***	(0.0039)	0.0126***	(0.0044)	-0.0078***	(0.0021)	0.0056**	(0.0025)	0.0019	(0.0023)
Other/No religion	-0.0154***	(0.0040)	0.0167***	(0.0045)	0.0019	(0.0023)	-0.0024	(0.0027)	-0.0007	(0.0023)
Race										
African-American	-0.0296***	(0.0042)	0.0240***	(0.0049)	-0.0076***	(0.0024)	0.0250***	(0.0030)	-0.0118***	(0.0024)
Hispanic	-0.0562***	(0.0051)	0.0546***	(0.0060)	0.0034	(0.0030)	0.0078**	(0.0036)	-0.0097***	(0.0029)
Asian or Native American	-0.0409***	(0.0089)	0.0412***	(0.0104)	-0.0077	(0.0047)	0.0119*	(0.0062)	-0.0044	(0.0052)
Education										
Some college	0.0048	(0.0073)	-0.0067	(0.0083)	0.0076**	(0.0039)	-0.0056	(0.0045)	-0.0002	(0.0042)
Bachelors or Higher	-0.0439***	(0.0092)	-0.0045	(0.0116)	0.0357***	(0.0064)	-0.0175***	(0.0057)	0.0302***	(0.0071)
Rank										
E1/E2/E3	-0.1101***	(0.0045)	-0.4522***	(0.0045)	0.0491***	(0.0033)	0.5383***	(0.0051)	-0.0250***	(0.0023)
E6/E7	0.0547***	(0.0039)	-0.0485***	(0.0049)	-0.0109***	(0.0018)	-0.0073***	(0.0020)	0.0121***	(0.0024)
E8/E9 1stSgt/SgtMaj (admin specialists)	0.2850***	(0.0155)	-0.2068***	(0.0179)	0.0099**	(0.0049)	-0.0639***	(0.0084)	-0.0242**	(0.0095)
E8/E9 MSgt/MGySgt (tech specialists)	0.3535***	(0.0143)	-0.2853***	(0.0160)	0.0095**	(0.0047)	-0.0492***	(0.0080)	-0.0285***	(0.0079)
Job category										
Logistics Combat Element	-0.0498***	(0.0038)	0.0304***	(0.0042)	0.0125***	(0.0020)	0.0123***	(0.0025)	-0.0054***	(0.0021)
Air Combat Element	-0.0667***	(0.0045)	0.0564***	(0.0050)	0.0055**	(0.0024)	0.0108***	(0.0029)	-0.0060**	(0.0026)
Military Demographics										
GCT score	-0.0004***	(0.0001)	0.0002	(0.0002)	0.0002**	(0.0001)	-0.0002***	(0.0001)	0.0003***	(0.0001)
Years of service	-0.0305***	(0.0007)	0.0329***	(0.0009)	-0.0029***	(0.0004)	0.0006	(0.0005)	-0.0002	(0.0005)
Age at separation	0.0094***	(0.0006)	-0.0099***	(0.0007)	-0.0004	(0.0003)	0.0009*	(0.0005)	0.0000	(0.0004)
Constant	0.3377***	(0.0218)	0.5129***	(0.0245)	0.0710***	(0.0115)	0.0304**	(0.0146)	0.0480***	(0.0129)
Observations	67,550		67,550		67,550		67,550		67,550	
Adjusted R-squared	0.0466		0.1852		0.0221		0.3490		0.0077	
Robust standard errors in parentheses										
*** p<0.01, ** p<0.05, * p<0.1										

Table 24. Enlisted Separations Linear Probability Model

	ENLISTED - PROBIT									
	Medical		Contract Completion		Unsat Performance		Legal		Other	
	coef	se	coef	se	coef	se	coef	se	coef	se
Key Variables										
Female	0.0712***	(0.0071)	-0.0961***	(0.0084)	0.0203***	(0.0036)	-0.0350***	(0.0031)	0.0311***	(0.0043)
Post 9/11	-0.0510***	(0.0037)	0.0987***	(0.0048)	-0.0095***	(0.0017)	0.0001	(0.0024)	-0.0241***	(0.0021)
One deployment	-0.0084**	(0.0041)	0.0290***	(0.0054)	-0.0098***	(0.0018)	0.0009	(0.0028)	-0.0011	(0.0022)
Two or more deployments	-0.0140***	(0.0043)	0.0550***	(0.0056)	-0.0221***	(0.0018)	-0.0118***	(0.0027)	0.0050**	(0.0026)
Family Status										
Married	-0.0020	(0.0043)	0.0296***	(0.0057)	0.0010	(0.0021)	-0.0138***	(0.0030)	-0.0095***	(0.0024)
# of dependents	0.0050***	(0.0015)	-0.0096***	(0.0019)	0.0010	(0.0007)	0.0024**	(0.0010)	0.0012	(0.0008)
Religion										
Catholic	-0.0125***	(0.0039)	0.0146***	(0.0052)	-0.0068***	(0.0018)	0.0055**	(0.0027)	0.0019	(0.0022)
Other/No religion	-0.0149***	(0.0039)	0.0200***	(0.0054)	0.0016	(0.0019)	-0.0013	(0.0026)	-0.0006	(0.0022)
Race										
African-American	-0.0293***	(0.0042)	0.0307***	(0.0058)	-0.0055***	(0.0020)	0.0240***	(0.0032)	-0.0118***	(0.0022)
Hispanic	-0.0556***	(0.0049)	0.0650***	(0.0072)	0.0034	(0.0029)	0.0071*	(0.0039)	-0.0093***	(0.0028)
Asian or Native American	-0.0379***	(0.0086)	0.0482***	(0.0123)	-0.0063	(0.0043)	0.0125*	(0.0069)	-0.0041	(0.0049)
Education										
Some college	0.0017	(0.0073)	-0.0069	(0.0096)	0.0065	(0.0040)	-0.0013	(0.0051)	0.0003	(0.0040)
Bachelors or Higher	-0.0506***	(0.0093)	-0.0029	(0.0138)	0.0408***	(0.0079)	-0.0153**	(0.0067)	0.0303***	(0.0071)
Rank										
E1/E2/E3	-0.1001***	(0.0036)	-0.4933***	(0.0045)	0.0349***	(0.0029)	0.5303***	(0.0060)	-0.0263***	(0.0021)
E6/E7	0.0699***	(0.0048)	-0.0641***	(0.0056)	-0.0112***	(0.0021)	-0.0068**	(0.0031)	0.0126***	(0.0025)
E8/E9 1stSgt/SgtMaj (admin specialists)	0.3233***	(0.0316)	-0.1583***	(0.0276)			-0.0535***	(0.0059)	-0.0214***	(0.0077)
E8/E9 MSgt/MGySgt (tech specialists)	0.4610***	(0.0191)	-0.2847***	(0.0160)	-0.0417***	(0.0029)	-0.0377***	(0.0060)	-0.0254***	(0.0051)
Job category										
Logistics Combat Element	-0.0493***	(0.0037)	0.0349***	(0.0049)	0.0108***	(0.0019)	0.0112***	(0.0025)	-0.0056***	(0.0021)
Air Combat Element	-0.0621***	(0.0040)	0.0643***	(0.0059)	0.0054**	(0.0024)	0.0081**	(0.0032)	-0.0060***	(0.0023)
Military Demographics										
GCT score	-0.0004***	(0.0001)	0.0002	(0.0002)	0.0002**	(0.0001)	-0.0004***	(0.0001)	0.0003***	(0.0001)
Years of service	-0.0321***	(0.0008)	0.0384***	(0.0010)	-0.0030***	(0.0004)	0.0006	(0.0005)	-0.0006	(0.0004)
Age at separation	0.0101***	(0.0006)	-0.0122***	(0.0009)	-0.0003	(0.0003)	0.0001	(0.0004)	0.0001	(0.0003)
Constant										
Observations	67,550		67,550		66,837		67,550		67,550	
Pseudo R2	0.0480		0.149		0.0534		0.340		0.0198	
Obs P	0.208		0.567		0.0519		0.119		0.0550	
Robust standard errors in parentheses										
*** p<0.01, ** p<0.05, * p<0.1										

Table 25. Enlisted Separations Probit Estimation Model

	OFFICER - LPM									
	Medical		Contract Completion		Unsat Performance		Legal		Other	
	coef	se	coef	se	coef	se	coef	se	coef	se
Key Variables										
Female	-0.0023	(0.0063)	0.0241**	(0.0114)	-0.0307***	(0.0066)	0.0218***	(0.0084)	-0.0129***	(0.0044)
Post 9/11	0.0110***	(0.0033)	0.0448***	(0.0061)	-0.0286***	(0.0041)	-0.0258***	(0.0038)	-0.0014	(0.0027)
One deployment	-0.0113***	(0.0032)	0.0066	(0.0066)	0.0196***	(0.0047)	-0.0158***	(0.0037)	0.0008	(0.0028)
Two or more deployments	-0.0170***	(0.0031)	0.0326***	(0.0057)	0.0218***	(0.0041)	-0.0284***	(0.0029)	-0.0091***	(0.0024)
Family Status										
Married	0.0015	(0.0045)	0.0446***	(0.0087)	-0.0168***	(0.0060)	-0.0175***	(0.0053)	-0.0118***	(0.0039)
# of dependents	-0.0003	(0.0009)	-0.0015	(0.0018)	-0.0005	(0.0013)	0.0013	(0.0010)	0.0010	(0.0008)
Religion										
Catholic	-0.0025	(0.0027)	0.0113**	(0.0052)	-0.0062*	(0.0036)	-0.0007	(0.0030)	-0.0019	(0.0021)
Other/No religion	0.0003	(0.0046)	-0.0072	(0.0089)	0.0019	(0.0063)	0.0020	(0.0052)	0.0031	(0.0040)
Race										
African-American	-0.0020	(0.0054)	-0.0636***	(0.0106)	0.0315***	(0.0075)	0.0306***	(0.0074)	0.0035	(0.0047)
Hispanic	-0.0056	(0.0064)	-0.0506***	(0.0139)	0.0309***	(0.0102)	0.0166*	(0.0086)	0.0087	(0.0065)
Asian or Native American	0.0002	(0.0100)	-0.0255	(0.0198)	0.0034	(0.0136)	0.0184	(0.0127)	0.0035	(0.0091)
Education										
HS or some college	0.0021	(0.0048)	-0.0139*	(0.0082)	-0.0197***	(0.0045)	0.0082*	(0.0049)	0.0233***	(0.0051)
Masters or Doctorate	-0.0034	(0.0027)	0.0075	(0.0053)	-0.0158***	(0.0037)	0.0060**	(0.0029)	0.0058***	(0.0019)
Rank										
Warrant Officers	0.0178***	(0.0047)	0.0325***	(0.0076)	-0.0387***	(0.0040)	-0.0038	(0.0042)	-0.0077**	(0.0038)
O1/O1E to O3/O3E	0.0268***	(0.0047)	-0.0952***	(0.0098)	-0.0032	(0.0074)	0.0412***	(0.0050)	0.0304***	(0.0039)
General officers	-0.0011	(0.0039)	-0.1095***	(0.0118)	0.0316***	(0.0042)	0.0564***	(0.0100)	0.0225***	(0.0027)
Job category										
Logistics Combat Element	0.0041	(0.0035)	-0.0322***	(0.0066)	0.0135***	(0.0042)	0.0117***	(0.0039)	0.0029	(0.0028)
Air Combat Element	0.0057	(0.0037)	-0.0815***	(0.0072)	0.0602***	(0.0053)	0.0076*	(0.0039)	0.0080***	(0.0030)
Military Demographics										
GCT score	-0.0003***	(0.0001)	0.0022***	(0.0002)	-0.0001	(0.0001)	-0.0013***	(0.0001)	-0.0005***	(0.0001)
Years of service	-0.0045***	(0.0005)	0.0033***	(0.0010)	0.0031***	(0.0007)	-0.0018***	(0.0006)	-0.0001	(0.0005)
Age at separation	0.0026***	(0.0004)	0.0087***	(0.0008)	-0.0071***	(0.0006)	-0.0025***	(0.0005)	-0.0017***	(0.0004)
Constant	0.0376**	(0.0186)	0.1699***	(0.0385)	0.3087***	(0.0261)	0.3458***	(0.0250)	0.1380***	(0.0161)
Observations	18,314		18,314		18,314		18,314		18,314	
Adjusted R-squared	0.0210		0.1527		0.0596		0.0771		0.0332	
Robust standard errors in parentheses										
*** p<0.01, ** p<0.05, * p<0.1										

Table 26. Officer Separations Linear Probability Model

	OFFICER - PROBIT									
	Medical		Contract Completion		Unsat Performance		Legal		Other	
	coef	se	coef	se	coef	se	coef	se	coef	se
Key Variables										
Female	-0.0014	(0.0038)	0.0169**	(0.0077)	-0.0144***	(0.0029)	0.0058*	(0.0031)	-0.0039***	(0.0011)
Post 9/11	0.0076***	(0.0023)	0.0396***	(0.0056)	-0.0188***	(0.0031)	-0.0113***	(0.0021)	0.0001	(0.0011)
One deployment	-0.0083***	(0.0025)	-0.0053	(0.0062)	0.0179***	(0.0039)	-0.0027	(0.0018)	0.0019	(0.0015)
Two or more deployments	-0.0126***	(0.0023)	0.0166***	(0.0055)	0.0205***	(0.0036)	-0.0113***	(0.0017)	-0.0025**	(0.0011)
Family Status										
Married	0.0007	(0.0030)	0.0343***	(0.0074)	-0.0105***	(0.0037)	-0.0076***	(0.0026)	-0.0051***	(0.0019)
# of dependents	-0.0000	(0.0009)	-0.0047**	(0.0019)	0.0017*	(0.0009)	0.0015**	(0.0006)	0.0011***	(0.0004)
Religion										
Catholic	-0.0019	(0.0023)	0.0099**	(0.0047)	-0.0039*	(0.0022)	-0.0007	(0.0016)	-0.0008	(0.0010)
Other/No religion	0.0002	(0.0035)	-0.0050	(0.0074)	0.0002	(0.0034)	0.0011	(0.0024)	0.0015	(0.0016)
Race										
African-American	-0.0014	(0.0039)	-0.0616***	(0.0112)	0.0279***	(0.0067)	0.0132***	(0.0040)	0.0016	(0.0020)
Hispanic	-0.0042	(0.0046)	-0.0432***	(0.0129)	0.0213***	(0.0073)	0.0067	(0.0042)	0.0031	(0.0027)
Asian or Native American	0.0000	(0.0074)	-0.0220	(0.0171)	0.0036	(0.0078)	0.0075	(0.0064)	0.0010	(0.0033)
Education										
HS or some college	0.0020	(0.0043)	-0.0192*	(0.0103)	-0.0093**	(0.0045)	0.0048	(0.0036)	0.0163***	(0.0043)
Masters or Doctorate	-0.0041	(0.0029)	0.0140**	(0.0062)	-0.0114***	(0.0027)	0.0035	(0.0025)	0.0024	(0.0019)
Rank										
Warrant Officers	0.0248***	(0.0070)	0.0244***	(0.0089)	-0.0328***	(0.0025)	0.0057	(0.0042)	0.0002	(0.0023)
O1/O1E to O3/O3E	0.0194***	(0.0046)	-0.0374***	(0.0074)	-0.0066**	(0.0027)	0.0106***	(0.0030)	0.0123***	(0.0028)
General officers			-0.0577	(0.0704)			0.1055*	(0.0612)		
Job category										
Logistics Combat Element	0.0027	(0.0028)	-0.0267***	(0.0060)	0.0066**	(0.0030)	0.0056***	(0.0019)	0.0012	(0.0012)
Air Combat Element	0.0037	(0.0032)	-0.0784***	(0.0076)	0.0416***	(0.0046)	0.0041*	(0.0023)	0.0047***	(0.0016)
Military Demographics										
GCT score	-0.0002**	(0.0001)	0.0017***	(0.0002)	0.0001	(0.0001)	-0.0007***	(0.0001)	-0.0002***	(0.0000)
Years of service	-0.0040***	(0.0004)	0.0042***	(0.0008)	0.0010***	(0.0004)	-0.0016***	(0.0003)	-0.0001	(0.0002)
Age at separation	0.0024***	(0.0003)	0.0088***	(0.0006)	-0.0046***	(0.0003)	-0.0013***	(0.0002)	-0.0011***	(0.0001)
Constant										
Observations	18,161		18,314		18,161		18,314		18,161	
Pseudo R2	0.0767		0.192		0.161		0.225		0.177	
Obs P	0.0306		0.854		0.0578		0.0392		0.0190	
Robust standard errors in parentheses										
*** p<0.01, ** p<0.05, * p<0.1										

Table 27. Officer Separations Probit Estimation Model

LIST OF REFERENCES

Arkes, J., & Mehay, S. (2013). The impact of unemployment on attrition of first-term enlistees. *Defence and Peace Economics.* Advance online publication. doi:10.1080/10242694.2013.752244

Buddin, R. J. (2005). *Success of first-term soldiers* (MG-262-A). Retrieved from Rand Corporation website: http://www.rand.org/pubs/monographs/MG262.html

Culler, K. W. (2000). *The decision to allow military women into combat positions: A study in policy and politics* (Master's thesis). Monterey, CA: Naval Postgraduate School.

Fricker, R. D. (2003). *How does deployment affect retention of military personnel?* (RB-7557-OSD). Retrieved from RAND Corporation website: http://www.rand.org/pubs/research_briefs/RB7557/index1.html

Golder, M., Brambor, T., & Clark, W. R. (2006). Understanding interaction models: Improving empirical analyses. *Political Analysis, 14*, 63-82. Retrieved from https://files.nyu.edu/mrg217/public/presentation_interaction.pdf

Hall, J. T. (2009). *Forecasting Marine Corps enlisted attrition through parametric modeling* (Master's thesis). Monterey, CA: Naval Postgraduate School.

History of the Women Marines. (n.d.). Retrieved from the Women Marines Association website: http://www.womenmarines.org/wm_history.aspx

Lamothe, D. (2009, November 9). Junior officers to face more career hurdles. *Marine Corps Times.* Retrieved from http://marinecorpstimes.com/news/2009/11/marine_thinning_ranks_110909w

Lizzaraga, J. M. (2011). *Patterns of Marine Corps Reserve continuation behavior: Pre- and post-9/11* (Master's thesis). Monterey, CA: Naval Postgraduate School.

Morgan, J. R. (2005). *A study of promotion and attrition of mid-grade officers in the U.S. Marine Corps: Are assignments a key factor?* (Master's thesis). Monterey, CA: Naval Postgraduate School.

Norton, E. C., Wang, H., & Ai, C. (2004). Computing interaction effects and standard errors in logit and probit models. *Stata Journal, 4*(2), 154-167.

Petronio, K. (2012). *Get over it! We are not all created equal.* Retrieved from https://www.mca-marines.org/gazette/article/get-over-it-we-are-not-all-created-equal

Redmond, B.F. (2011). *Job Design.* Penn State WikiSpaces. Retrieved from https://wikispaces.psu.edu/display/PSYCH484/10.+Job+Design

Roush, P. E. (1991). Women serving in combat would strengthen America's defense. In C. Wekesser & M. Polesetsky (Eds.), *Women in the military* (pp. 59-63). San Diego, CA: Greenhaven Press.

Ryan, R. M., Frederick-Recascino, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology*, *28*, 335-354.

Segal, D. R., & Segal, M. W. (2004). America's military population. *Population Bulletin, 59*(4). Retrieved from Population Reference Bureau website: http://www.prb.org/Source/ACF1396.pdf

U.S. Army Soldier Systems Center (USASSC). (2004). *Study says combat load too heavy.* Natick, MA: Soldier Systems Center.

Wetzel, D. (2012, April 12). Reduction by the numbers: "A smaller, but still lethal force" [Web log post]. Retrieved from http://marines.dodlive.mil/2012/04/18/force-reduction

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