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**NAVAL
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MONTEREY, CALIFORNIA

THESIS

**CRITICAL MASS: IS FEMALE MARINE ATTRITION
HIGHER IN NON-TRADITIONAL MILITARY
OCCUPATIONAL SPECIALTIES?**

by

Charlyne Delus

March 2017

Thesis Advisor:
Co-Advisor:

Latika Hartmann
Chad Seagren

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CRITICAL MASS: IS FEMALE MARINE ATTRITION HIGHER IN NON-TRADITIONAL MILITARY OCCUPATIONAL SPECIALTIES?

Charlyne Delus
Captain, United States Marine Corps
B.S., University of North Florida, 2011

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

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March 2017**

Approved by: Latika Hartmann, Ph.D.
Thesis Advisor

Chad Seagren, Ph.D.
Co-Advisor

Yu-Chu Shen, Ph.D.
Academic Associate
Graduate School of Business and Public Policy

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ABSTRACT

Despite the many restrictions women in the Marine Corps have had to endure and overcome, every year, thousands of women make the conscious decision to serve; however, they make the decision to leave at a high rate as well. This thesis uses data from Manpower and Reserve Affairs (M&RA) of all personnel who joined the Marine Corps from 2000–2014 and, specifically, it evaluates whether critical mass of female Marines in a particular Military Occupational Specialty (MOS) has an effect on attrition. The critical mass theory highlights the importance of numbers, directly relates to proportions, and questions if the proportion of a particular minority group affects behavior. Critical mass has been applied to various disciplines but seldom to the military. I collapse all of the MOSs in the Marine Corps into four separate bins (combat arms, combat service support, service support, and aviation support) and use three different attrition outcomes (months 0–6, 7–12, and 13–24) to generate meaningful analysis and evaluate if an effect exists. The traditional MOSs are those in the MOS category with the greatest proportion of women, which is combat service support, and combat arms is non-traditional with the lowest proportion of women. For the analysis, I generate a key variable for the portion of all women in an individual MOS during the year they accessed and, through multivariate regression analysis, I find that the results are in support of the idea that critical mass has some negative effect on attrition, but the findings are inconclusive.

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LIST OF ACRONYMS AND ABBREVIATIONS

ASVAB	Armed Service Vocational Aptitude Battery
CNA	Center for Naval Analyses
DOD	Department of Defense
EAS	End of Active Service
M&RA	Manpower and Reserve Affairs
MCO	Marine Corps Order
MOS	Military Occupational Specialty
PMOS	Primary Military Occupational Specialty
STEM	Science, Technology, Engineering, and Mathematics
USMC	United States Marine Corps

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This thesis is dedicated in memory of Monique Woolley—my cousin, my friend, my angel. Thank you for watching over me.

“For he will order his angels to protect you wherever you go.” Psalms 91:11

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I. INTRODUCTION

Higher attrition rates among female than male service members have long been a concern for the U.S. military. Attrition is costly both economically and in efficiency of the force. In the Marine Corps specifically, female attrition has been historically higher than that of males. For every interval of the first two years of service, more than one-half of female Marines attrite in the first term compared to approximately one-third of males (Flatter, 1996). In addition to high attrition numbers, the overall representation of women in the Marine Corps is also low, albeit, reflecting significant differences by occupational fields. In this thesis, I review whether differences in the proportion of women in an individual's occupational field can explain differences in first—term attrition among enlisted USMC personnel.

Attrition studies saturate the field of research in military studies, focusing on a variety of factors. This thesis is a quantitative study, does not include interviews or survey data, and focuses on whether critical mass is a factor in explaining female Marine attrition. Recently, headline news across America announced the decision that women in the Marine Corps are no longer restricted from combat arms occupational specialties, which, historically, had been the case. Perhaps this decision will motivate more women to join and retain. However, while the focus of this thesis is not on women in combat arms, the topic provides a current example of an issue where the results of this thesis could be applied to policy decisions in the USMC and to staffing of females in non-traditional MOSs in the future. Using multivariate regression analysis, I analyze accession and separation data of individual Marines who joined the Marine Corps from 2000–2014 to understand whether female critical mass has an effect on attrition.

A. BACKGROUND

Annually, on the birthday of the Corps, it is customary for Marines around the globe to read General John A. Lejeune's birthday message from 1921. The beginning of his message reads as follows, "On November 10, 1775, a Corps of Marines was created by a resolution of the Continental Congress. Since that date many thousand men have

borne the name Marine” (Marine Corps Association and Foundation, n.d., 1). The general’s statement is correct in stating only men bore the illustrious title. The initial women who served during times of war were called Marinettes, not Marines (Stremlow, 1994).

In 1918, during World War I, Opha Mae Johnson became the first woman to enlist in the United States Marine Corps Reserve (Stremlow, 1994). During a time in history when women were still unable to vote, Johnson and approximately 300 other women voluntarily joined to serve their nation, however, without recognition or veterans’ status upon discharge (Stremlow, 1994). The decision to allow women to serve in the armed forces was one of pragmatism and not equality. Many, including members of Congress, detested the idea as reflected in this quote:

Take the women into the armed service, who then will do the cooking, the washing, the mending, the humble homey tasks to which every woman has devoted herself. Think of the humiliation! What has become of the manhood of America? (Holm, 1992, 24)

However, the notion of enabling every man to participate in World War II had to be set aside with the acknowledgment that the service of women proved critical to military success in the past and could be beneficial in the future.

As a recruitment tool, the slogan read, “Free a Marine to Fight,” requesting women to free men from their clerical positions in Headquarters Marine Corps to allow them to join the fight (Stremlow, 1994). In the 1994 article, “Free a Marine to Fight,” Colonel Mary B. Stremlow describes the evolution of women in the Marines. She points out that the Marine Corps Women’s Reserve was established as a last ditch effort to resolve the male manpower shortages within the Corps. When faced with the challenge of growing the Marine Corps by nearly 21,000 Marines, while engaged in a war campaign, General Thomas Holcomb, 17th Commandant, announced the unpopular decision officially allowing women to serve. Stremlow adds that the women reservists were regulated to only fill occupations such as “office clerks, radiomen, drivers, mechanics, messmen, and commissary clerks” and fields that required training such as “paymaster, quartermaster, and communicator” (1994, 2).

Interestingly, it was not until 1943 (168 years post the Corps' existence) when proper acknowledgement for female Marines came about. General Holcomb was adamant that these women equally earn the title Marine though unofficially addressed by other nicknames (Stremlow, 1994). Since 1943, there has been a gradual increase in numbers and "the scope of promotion and career opportunities open to women has increased" (Division of Public Affairs, 1986, 1).

Over time, policy makers made modifications to the enlistment requirements; however, women still served in predominantly clerical occupations. Stremlow (1994) points out that initially, the enlistment requirements for the women were; age 20–35; a U.S. citizen; not married to a Marine; taller than 60 inches; weigh more than 95 pounds; and completion of at least two years of high school. Additionally, if the women who wanted to join had children, the children had to be older than the age of 18 (Stremlow, 1994). Later revisions to the enlistment requirements changed the age, marital status, and dependent and education criteria, while including the Armed Services Vocational Aptitude Battery (ASVAB) and mental and physical aptitude to the list of requirements (MCO 1100.1, Chapter 3). In 1976, the Marine Corps instituted the use of the ASVAB, for all Marines, as a tool to match applicant's skills with available occupations (ASVAB, n.d.). Further restrictions for women included the segregated nature of the occupations in which they were restricted to serve.

Progression toward inclusion became evident when President Truman signed the executive order desegregating the armed forces and leading Congress to pass the Women's Armed Services Integration Act of 1948 (Borlik, 1998). Additionally, women could now serve full-time in active components (Schulte, Quester, Shuford, & Hiatt, 2016). This law remained in place until 1994, when the Department of Defense (DOD) instated the Direct Ground Combat Definition and Assignment Rule which stated assignments to all positions are based on qualifications; however, it [still] excluded women below the brigade level to serve directly in ground-combat-related occupational specialties (Vergun, 2013). Essentially, this rule lifted the exclusion on aviation positions, to include combat aircraft assignments, withstanding restrictions on all other combat related occupations remaining in place (Lohrenz, 2013). In 2014, the Secretary of

Defense officially overturned this rule as an initiative to meet the needs of the Marine Corps by assigning female Marines to billets in accordance with their capabilities (Schulte et al., 2016). Of note, other services began allowing women to serve in combat-related fields prior to the dismissal of the rule, for example the Navy having women submariners (Ellis & Munson, 2015). As stated in *Women Marines in the 1980s* “By law, women Marines are restricted from assignment to combatant vessels or aircraft” and therefore are not assigned occupations such as “infantry, artillery, tank and assault amphibian vehicle, and pilot/naval flight officer; nor within certain combat-related military occupational specialties including flight crew” (Division of Public Affairs, 1986, 1). Since the 1970s, the percentage of women representation in the Marine Corps, for both enlisted and officers, has risen steadily (Patten & Parker, 2011). For example, today the female Marine portion of the Marine Corps is approximately 7%, a nearly 3% increase from 4.1% in 1983 and 4.5% in 1994 (Flatter, 1996). Although, Patten’s and Parker’s (2011) report focuses on all branches of the military and percentages by branch differ, the trend of having a high concentration of women serve in the occupational fields of administration, medical, and supply, are consistent.

In modern times, analysis of retention of women in the military have surrounded promotion rates, restrictions of service in certain occupational fields, appropriate length of maternity leave, body composition and physical fitness standards, and integration as motivating factors for separation. Tasked with generating a policy allowing females into combat arms occupational fields and units, the Marine Corps Force Innovation Office requested Center for Naval Analyses (CNA) conduct research analysis for their use (Schulte et al., 2016). The report examined 27 years of female representation in both the aviation and logistics primary military occupational specialties (PMOS) and found that “women who entered previously closed PMOSs have performed comparably to men and that separation rates differ by occupation” (Schulte et al., 2016, i). Using this framework, this thesis will analyze the retention of women in the Marine Corps to try to identify whether a lack of critical mass in non-traditional MOSs is a contributing factor. For the purpose of this thesis, traditional occupational specialties are those that never excluded women while non-traditional occupational specialties are those that previously excluded

women and currently have lower representations below the overall mean proportion of women in the USMC.

Critical mass refers to an appropriate proportion of a minority group. One definition for critical mass is “the discrete point at which the presence of a sufficient number brings about qualitative improvement in conditions and accelerates the dynamic of change” (Ceralde & Czepiel, 2014, 15). In other words, it is the quantitative number (or percentage) of representation which brings about change for a particular demographic. Rosebeth Kanter is one of the pioneers of the critical mass theory in the social context and she explains the critical nature of proportions, the “relative numbers of socially and culturally different people in a group,” when forming interactions within a group (1977, 965). She further describes two different types of groups, skewed and token, to consider when discussing critical mass. The skewed groups are the majority, while the tokens are the rare few (Kanter, 1977). Establishing a critical mass is the context in which to minimize the dominant effect on the token few. Tokens are often regarded as “representatives of their category” or as “symbols rather than individuals” (Kanter, 1977, 966). This concept is applicable to various demographics that extend beyond race and gender. To my knowledge, retention or attrition in the Marine Corps is not a concept previously applied to critical mass.

B. RESEARCH OBJECTIVE

Despite the many restrictions, women in the armed services have had to endure and overcome, every year thousands of women voluntarily decide to serve their country. This chapter gives a historical account of the evolution of women’s service in the Marine Corps. Initially, restricted to serve solely during times of war and relegated to only clerical roles, women chose to serve their country. Though the process of desegregation took several years, women of today’s armed forces have no restrictions on occupations in which they can serve. The emphasis of this study is on enlisted women in the Marine Corps and factors that contribute to the higher attrition rate compared to male Marines. With the inclusion of women in all occupational fields, the potential exists for a wider footprint of female representation in the Marine Corps. It is important to have a firm

understanding of how women behave within the Marine Corps in order to increase retention and decrease attrition.

This study will first document differences in attrition by occupational categories and, second, determine whether female critical mass has any effect on attrition. Though there has been a gradual increase in the number of women joining the Marine Corps since it became an all-volunteer force, the Marine Corps still lags their sister services in the representation of women service members. For example, Patten and Parker (2011) report that in fiscal year 2010, the total female representation (both enlisted and officers) in the Army was 37%, 31% in the Air Force, 27% in the Navy, and 7% in the Marine Corps. There is ample research that has explored why this disparity exists; however, attrition and retention of female Marines is still a topic of concern. There is not one definitive explanation; various factors play a role in a woman's decision whether to join the Marine Corps and how long to serve. This thesis explores critical mass as a factor.

Researchers have applied the critical mass concept to various sectors of the civilian labor market but not directly to any aspect of the Marine Corps. The results of this study are in line with previous research regarding the higher attrition rate of female Marines when compared to male Marines. Additionally, it highlights, that critical mass has a mixed effect on attrition and in need of more research. Future research would benefit leaders by providing another avenue of approach when formulating recruitment and retention efforts and incentives, especially given the recent change of allowing women to serve in combat occupational fields and units. These results will potentially open the door to a broader attrition conversation and the importance of representation, specifically—the day-to-day representation that potentially has the most effect on an individual's perception of the Marine Corps.

II. LITERATURE REVIEW

This literature review gives a detailed explanation of critical mass and provides an overview of various research on the topic. The critical mass theory highlights the importance of numbers and directly relates to proportions, which is, “relative numbers of socially and culturally different people in a group are seen as critical in shaping interaction dynamics” and has a direct impact on behavior (Kanter, 1977, 965). Not every piece of literature employed describes this as the definition of critical mass, but all literature agrees that critical mass essentially refers to identifying what percentage of the whole, if any, impacts change. Researchers apply the theory of critical mass to various disciplines such as politics, business, science, and academia, to determine if an effect exists that influences behavior and policy. However, many theorists analyze the theory as being invalid; much of the criticism surrounding the theory is not that the various disciplines fail to establish a critical mass but rather to disprove the validity of the theory entirely. In other words, identifying a quantitative value of representation, or proportion, for a particular demographic does not have an effect. As is the case in most research, some research is more accurate than others; however, the review of various types of research will help frame the objective for this study.

Tremblay (2006) examines critical mass as it relates to both descriptive and substantive representation. Descriptive representation refers to the likelihood that an individual of a particular demographic would advocate for policies representative of the same demographics—race, gender, socioeconomic status, etc. For example, women may be more likely to advocate or support policies relating to the determination of adequate maternity leave. Another example of descriptive representation would be personnel from any minority group supporting laws that promote equal rights for employment, education, etc. In contrast, substantive representation does not focus on a specific demographic such as race or gender but rather stresses the importance of the deliberate actions and views of an individual (Tremblay, 2006). Furthermore, due to the various factors taken into consideration, critical mass and substantive representation are not necessarily one and the same (Tremblay, 2006).

In her research, Beckwith (2007) describes the challenges presented by the critical mass theory, that it is quantitative in nature and uses numbers to predict outcome. Due to the innate problems of critical mass, Beckwith concludes that this topic needs more descriptive and substantive research. Beckwith (2007) describes the challenges as the difficulty in identifying and obtaining an exact (and possibly universal) number or percentage to create transformation; most research highlights the positive impacts of critical mass and fail to explain any potential negative effects; and lastly the poor construction of measurement. Since critical mass relies on change, the construction of the critical mass theory should be in such a way to measure change over time. This literature review covers research in various topics and explains the differing views and outcomes of the studies.

A. POLITICS

Dahlerup (2006) is one of the founding authors of the critical mass theory and in his essay, “The Story of the Theory of Critical Mass,” he explores the “theoretical foundation and underlying assumptions of the critical mass theory” (2006, 511). His research and that of Kanter’s specifically examine whether an increase in women politician representation makes a difference. Dahlerup (2006) further suggests a distinction between two different viewpoints, the policy outcome and workplace perspectives, when discussing relative numbers. The latter perspective relates to various aspects of changes such as “changes in the performance and efficiency of women politicians, changes in the social climate of political life, and changes in the political discourse” while the former relates to policy changes (Dahlerup, 2006, 513). Based on these perspectives, Dahlerup rejects the idea that there is an actual percentage, say approximately 30 percent (the percentage most commonly used), that once achieved establishes irreversible effects. This view is supported by Grey as she makes the claim that critical mass “calls for detection of an irreversible takeoff” contrary to the misconception of an “immediate takeoff” in change (2006, 496). By irreversible takeoff, one can assume she is referring to the point at which the lasting effect occurs not the exact moment one achieves the numerical critical mass.

Various authors stress the importance of the desired outcome rather than a specific numerical figure. Grey argues, “critical mass is only useful if we discard the belief that a single proportion holds the key to all representation needs of women and if we discard notions that numbers alone bring about substantive changes in policy processes and outcomes” (2006, 492). Furthermore, Childs and Krook (2008) conduct an analysis of both Kanter and Dahlerup’s research and argue that many researchers misinterpret the contributions of the founding authors by claiming there is only one impact regarding increasing female representation and have subsequently contributed to the spread of gender quotas around the world. In Grey’s (2006) research, she observed New Zealand’s parliament and created a joint-effects model using longitudinal data. Contrary to the suggested 15–30 percent that achieves critical mass, Grey (2006) suggests, basing critical mass on the desired outcome; although difficult to explore in communities with small representation of women, such as democratic legislature.

In other research, Childs and Krook (2008) recommend scholars adopt a different approach and question ‘how’ the substantive representation of women occurs rather than when women make a difference. Seemingly, these views are in line with Dahlerup’s politics as a workplace perspective which address “the importance of women’s relative number for their ability to become effective in their work, to perform their tasks as politicians the way they prefer instead of being a minority” (2006, 519). This raises questions regarding “the connection between the relative number of the minority and issues like stigmatization, exclusion, incumbency, and role models” as being most relevant in discussions of critical mass (Dahlerup, 2006, 519).

B. CORPORATE BUSINESSES

In contrast to the critical mass research in politics, one particular study in business literature focuses on the experience of women in higher echelons of corporate businesses. Konrad, Kramer, & Erkut (2008), interviewed 50 women regarding their experience as members on corporate boards and based on the description of their experience, concluded that in boardrooms (of a dozen members) three women (approximately 30 percent) is the critical mass in which a change in the group dynamic occurs. The first woman on the

board may have a marginal impact but present the risk of tokenism, while two women often improves the situation some may still experience effects of tokenism or be viewed as a conspiracy. Having at least three women eliminates the effects of tokenism and achieves critical mass (Konrad et al., 2008).

There are three explanations mentioned as to why three is the golden number. First, stereotypes associated with being the only woman diminish when more women are present; secondly, achieving critical mass changes the dynamic of communication amongst men; and lastly, “research on influence and conformity in groups indicate that...three women may be particularly beneficial for creating change” (Konrad et al., 2008, 146). The authors describe corporate boards as a “masculine arena.” Much like the military where “the competitive masculine dynamic focuses the men on each other, with the result that a solo woman gets talked over and ignored,” however, the presence of three or more women tends to eliminate this effect (Konrad et al., 2008, 148). Men tend to behave and communicate differently with an increase in women in a group (Konrad et al., 2008, 155). Other research contradicts the effect on male behavior and focus more on the behavior of the women.

Broome, Conley, & Krawiec (2011) researched whether the critical mass theory is relevant in the business sector by interviewing 48 different corporate directors and other insiders on their views on whether the composition of underrepresented demographic groups- racial, ethnic and gender- have an impact in corporate boardrooms. The method used for the interviews was the snowball sampling method in which the respondent of an interview provided the information of another potential interviewee. The main weaknesses in this study are a relatively small sample, predominately female (60%) and white (75%). Interestingly enough, the authors concluded that the, “interviews largely fail to support the [critical mass] theory because some women reported to embrace their first and only minority status and view themselves as pathbreakers and not tokens.

C. EDUCATION

In an academic setting, the influence of achieving critical mass can appear different from that of politics or corporate business research by focusing on either the

effect of the staff and/or students. One particular study conducted by Hagedorn, Chi, Cepeda, & McLain (2007) evaluates the impact of critical mass (of their staff) on academic success based on Latin students' representation within an urban community college. The authors were very specific with the research demographics and the medium for the data collection, Transfer and Retention of Urban Community College Students (TRUCCS), which developed a questionnaire specific to urban community colleges for the students whose native language is not English. The researchers then utilized ordinal regression analysis to assess the success level of the Latino students based on critical mass. Additionally, the level of Latino faculty displayed positive significance on Latino students' success however; the researchers contended critical mass has a positive effect on this academic environment. Therefore, indicating that it is not a specific number that makes the difference but rather achieving quality representation of the minority group that has the effect.

D. SCIENCE

Etzkowitz, Kemelgor, Neuschatz, Uzzi, & Alonzo (1994), apply the critical mass theory to the sciences comparing women in traditional versus non-traditional fields and departments that achieved critical mass to those that did not. There were several relevant findings; an increase in women yielded division and competition amongst the subgroups, and the presence of senior women improved male behavior towards women, however, in academia, critical mass has a marginal effect. The results identify that there are other factors to take into consideration and critical mass alone do not explain the effects. Ultimately, this study found a marginal effect for critical mass that may be relevant when considering the military where traditional and non-traditional occupational fields exist.

Research done at Cornell University questions the propensity of women to exit STEM (science, technology, engineering, and mathematics) occupations for another field (Steele, 2013). Though this particular report did not directly discuss critical mass, it did highlight the behavior of women when contrasting traditional versus non-traditional occupational fields. The result of this study found that the environment plays a significant role in behavior and women are more inclined to choose fields that provide more work-

family balance (Steele, 2013). Additionally, Steele (2013) reports that half of women working in STEM for 12 years or less leave the field in contrast to the 20 percent of women in other fields that change occupations. This report reveals that although STEM is a very lucrative field, money and skill are not enough to make women stay. The dominant male presence of men in this field have a greater effect on the retention of women.

E. MILITARY

In the context of traditional verse non-traditional, there are two studies specific to the military that are worth mentioning. The first is a thesis conducted by Ellis and Munson (2015) which focuses on gender integration of women in the Naval Submariner community. The ethnographic study describes the experiences, from interviews, of the first women assigned to submarines, a field that had previously excluded women. There were 24 women initially assigned to four different submarines however, only 11 from the initial group and four from the second group participated in this study (Ellis & Munson, 2015). Interestingly, nine of the participants were nuclear officers and the majority chose not to continue service. At the time of this study, five left or were preparing to leave the Navy, two contemplated separation, and the other two planned to submit for lateral move (Ellis & Munson, 2015). There are various reasons why these women chose not to continue service in this non-traditional occupational field but serves as evidence that traditionally women in non-traditional MOSs attrite at a higher rate than men are.

The second study worth mentioning pertains to the Marine Corps. Schulte et al. (2016) conducts an analysis of the representation of female Marines in the aviation field—previously banned for women while utilizing the logistics occupational field as the control group. There is plenty of research on the effect of female integration; this was such a study. They received their data from multiple manpower sources but only focused on the aviation and logistics occupational fields over a 20—year period. Their approach to the study was on female representation based on those who qualified for and those who chose to stay in the occupational fields (Schulte et al., 2016). The remainder of the report was broken down into six sections of different gender related comparisons.

The research focused on both enlisted and officer populations however, I will only focus on the findings for the enlisted personnel. They found a key difference between male and females on the technical scores; women score lower which disqualifies them for the more technical occupational fields (Schulte et al., 2016). Additionally, Schulte (2016) and her research partners report that first-term attrition for women is higher than men are; however, the results are opposite after completion of the first-term. An interesting recommendation made in this report is for future consideration of differences in abilities between the genders for occupational qualification (Schulte et al., 2016). Therefore, more women will qualify to serve in more technical MOSs and assist in recruiting women into these MOSs that currently have a lower proportion of women.

Similar to the study on STEM, research of military retention reveal that women have a higher tendency to exit the Navy than men do. However, the explanation is not completely clear. In the master's thesis completed by Ceralde and Czepiel (2014), they address the challenge within the Navy to recruit and retain qualified female Navy personnel given that females make up slightly over 50 percent of the national population and almost 60 percent of them are college graduates. Furthermore, they mention various programs in place to incentivize retention still fail to mitigate this effect, to which they relate it to the amount of support received and the proportions of female representation in occupational fields (Ceralde & Czepiel, 2014). The purpose of their study was to examine whether a positive relationship exists between the proportion and retention decision by exploring both demographic and occupational factors and if so, identify the critical mass necessary to maximize the retention of females (Ceralde & Czepiel, 2014). They use a logit model to estimate the numerical critical mass required for certain occupations and would therefore lead to the benefit of correct staffing levels and increase female retention in the Navy. The authors conclude, "the minority group is more likely to retain (in the Navy) if the minority group is better represented in the organization...not clear whether there is a minimum percentage within the organization that positively impacts minority retention, known as a critical mass" (Ceralde & Czepiel, 2014, 2). Therefore, representation of a minority group has a positive correlation with retention of the same minority group. The intent of their research was to examine "occupational and

demographic factors to determine the existence of a critical mass within specific Navy occupations” (Ceralde & Czepiel, 2014, 2). This thesis, though focused on female officers, is the framework in which the work for this research is set.

Motivated by diversity or military leadership, the next study of interest, though focused on the officer corps, it provides insight into the broad scope of proportional effects on women in the military. Asch, Miller, and Malchiodi (2012) conducted an update to previous research on the lower proportions of women of various racial and ethnic minorities in the senior officer corps. They used approximately 20 years of longitudinal demographic and commissioning data to estimate retention and promotion differences compared to the reference group (white males). Additionally, they examined the progression of female officers in ground combat occupational fields partially closed to them. Consistent with previous research, they found retention rates are lower for women O2-O6 (Asch, Miller, & Malchiodi, 2012). Interestingly, they compared partially closed to fully open occupations to examine whether restrictions are causal factors in lower retention and promotion rates and found a negative effect on both through the rank of O5 in most female officer groups (Asch, Miller, & Malchiodi, 2012). Though the findings are descriptive and not causal in nature, it highlights possible effects on retention and promotion the underrepresented within the ranks.

F. CONCLUSION

The theory of critical mass is one that attempts to improve the lives of the minority group within any organization. Research within the civilian sector has determined that a critical mass of approximately 30 percent is the desired number in which to influence change. As previously discussed in the research the achievement of this percentage is challenging due to the innate problems presented by the theory itself. Challenges such as determining what the exact percentage is and avoiding focusing more in the percentage achieved than the quality obtained. In political research of critical mass, the authors stress the importance of achieving the desired outcome vice the numerical value. While corporate businesses seem to focus more on achieving the suggested percentage. In contrast, in the urban community college environment students tend to

perform better when they have any amount of representation amongst the staff. Though the outcomes vary throughout the various arenas of research, it is important to note the weaknesses of the research, which may negatively influence the results. In a social context, representation does have an impact on stigmatization and feelings of inclusion or exclusion of the minority group. The dynamics of the military coupled with the theory of critical mass theory amplify the challenges to consider. However, if found that an effect exists, this may lead to innovations for change in representation of female Marines in non-traditional occupational specialties and ultimately integration in order to reduce attrition and maximize effectiveness of the force.

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III. DATA

In this chapter, I describe the data and construction of the variables used for the regression models analyzing the correlation between female attrition and the proportion of women in different MOSs.

The data for this study came from USMCM&RA. It includes the population of 472,790 individuals that joined the Marine Corps in years 2000–2014. For each individual, M&RA provided information on race, gender, education and marital status at the time of enlistment. In addition, they also provided education, primary MOS category, marital status and MOS at the time of separation or December 2016 for individuals that had not separated as of that date. In this study, I only focus on enlisted personnel therefore none of the MOS categories include officer MOSs. For individuals that separated, M&RA also provided the separation code to distinguish between individuals who chose not to re-enlist versus those that left before the end of their mandatory service obligation date.

A key challenge was correctly identifying attrition in the data. To that end, I used the detailed separation codes to assign individuals to six bins. First, I classified individuals who completed their obligated term of enlistment and separated voluntarily as separated, while I classified personnel who terminated their active duty status due to other reasons as attrition. There are 102,042 observations without a separation date corresponding to personnel who chose to continue service at the end of their initial obligatory term. The not separated classification serve as the control group for those that attrited along with individuals that completed their term of service but did not re-enlist.

I collapse the 104 different separation narratives listed in this dataset to 61 by first grouping several of the common narratives into a single reason. For example, there were multiple separation codes related to “court martial,” because of alcohol, desertion, drug abuse, homosexual conduct, or other. The different reasons are now in a single separation code of “court martial.” I used the same framework for the remainder of the separation narratives and reduced the total by nearly half.

Then, I put these 61 separation reasons into six bins, namely voluntary, misconduct/involuntary, death, disability/medical, family, and other. It is important to understand the various separation reasons in order to classify them properly and capture the true effect of attrition. Misconduct and Involuntary were categorized into one group which included separation reasons such as being the subject of court martial, committing any form of misconduct, or being denied reenlistment for any variety of reasons. Pregnancy or childbirth and being the surviving family member were the only two separation reasons due to family matters. The other category includes separation reasons that are unclear or do not easily fit into another bin. For example, accepting commission into an officer program or inter/intra-service transfer into another branch.

The voluntary bin includes completion of required active service as expected but also includes reasons such as “attend civilian school,” “early release program special-separation,” “early retirement” and “force shaping.” These reasons are not negative in nature but indicate that the service member voluntarily requested to have their end of active service (EAS) date adjusted to something other than what is on the initial contract. For example, “attend civilian school,” indicates acceptance of the individual to an institution of higher learning that has a start date prior to the EAS. An earlier separation date would afford the service member the opportunity to exit the Marine Corps and begin classes on the institution’s start date. Force shaping refers to the institutional initiative to reduce the force by allowing personnel to terminate their required service obligation early. Death and disability categories are self-explanatory and classified accordingly into a single group.

Using information on enlistment and separation dates, I created an individual’s months in service. Then, I constructed three attrition outcomes based on months in service. First, an indicator equal to one if the months in service was less than six months. This captures attrition in the first six months of service. Second, an indicator for 7–12 months in service. This captures attrition for the second six months of service and is conditional on not attriting in the first six months. Third, an indicator for 13–24 months in service. This captures attrition for the second year of service and is conditional on not attriting in the first year. Last, an indicator for not separating. This captures those

individuals that did not attrite. The dependent variable is an indicator for an individual that left service by way of attrition.

In terms of explanatory variables, I focused on standard demographic variables such as age, gender, marital status, number of dependents, and education. In order to study the effect by gender, I constructed an indicator variable for gender where one represents female and zero represents male. Additionally, I constructed an indicator variable for race, and collapsed the six different categories into three groups: black, white, and other. The other category for race includes Asian, Pacific Islanders and Native American because their representation is small enough to combine and not significantly affect the results. Similarly, there are various marital status codes in the data. I constructed three separate indicator variables for married, single, and not married at the time of enlistment. The not married category includes the legally separated, divorced, or widowed.

Initially, the civilian education variable contained 22 different categories that I collapsed into one of four groups- individuals with a high school diploma, with a GED, with some college, or other. The “some college” group varies from one semester of college to post doctorate degrees. Since this education information is from the time of enlistment, a majority of the individuals are high school graduates.

A. MOS CODES

Similarly, to the separation code, the MOS codes were collapsed into four different bins- combat arms, combat service support, service support, aviation support. I dropped individuals with missing MOS codes, those with MOS codes reserved for officers or senior enlisted, or are secondary and not primary MOSs. The indicator variable for combat arms include infantry, field artillery, and tank and assault amphibious vehicle; all previously closed to females until 2016. The combat service support included the MOSs taught at the Marine Corps Combat Service Support School on Camp Johnson in Jacksonville, NC. These are financial management, logistics, personnel and administration, and supply administration and operations.

Service Support are all other MOSs that are not aviation related. This group does indicate that these MOSs do not play a role in combat, essentially all MOSs have a part to play in combat. Aviation support are those occupational specialties that are organization level maintenance meaning they conduct the actual hands-on maintenance for either rotary or fixed wing aircraft, intermediate level maintenance and are component level technicians, and all other aviation related MOSs. Additionally, the MOS category includes the indicator variable (s_women_moacc) for the share of women in the individual’s MOS, the year they assess.

Table 1: Description of MOS Codes by Primary MOS Occupational Fields

	Primary MOSs	Comments
Combat Arms	03, 08, 18	
Combat Service Support	01, 04, 30, 34	
Service Support	02, 05, 06, 11, 13, 15, 21, 23, 26, 28, 31, 33, 35, 41, 43, 44, 46, 48, 55, 57, 58, 59, 68	
Aviation Support	60, 61, 62, 63, 64, 65, 66, 70, 72	
Dropped as Erroneous	00, 09, 25, 40, 48, 73, 75, 80, 81, 84, 85, 89, 97, 98, 99	Missing, Secondary, Miscellaneous, Senior Enlisted or Officer MOSs

B. SUMMARY STATISTICS

I generated three tables in order to show the summary statistics by the different attrition outcomes. From left to right, the columns display the three different attrition outcomes- zero-six months (Attrition, 0–6 months), seven to twelve months (Attrition, 7–

12 months), and thirteen to twenty-four months (Attrition, 13–24 months). Not separated is not an attrition outcome. Rather it is an indicator for individuals still in the USMC as of December 2016. The demographics of note are gender, race, age, education, and marital status. Each table displays different information, described in more detail in subsequent paragraphs.

The summary statistics in Table 2 has five columns; the attrition outcomes for the full sample, the three attrition outcomes, and the sample of not separated individuals. The variables included are the demographics, education, MOS, and attrition variable (used for the full sample only). Although, the results are relatively consistent across the attrition outcomes, the share of women variable displays that on average 7.1% of women do not separate from MOSs where there is higher female representation. The interpretation of the female variable in Table 2 is such that, on average females make up 7% of the full sample, but women account for 11% of individuals that attrite within the first six months. Months 7–12 and 13–24 are relatively close behind at 8.5% and 8.8%, respectively, and on average women account for 7.8% of individuals that do not separate. Another interpretation using the black variable, illustrates that while on average black individuals make up 9.4% of the full sample, they account for 8.1% of individuals that attrite in zero to six months; while months 13–24 and not separate have higher percentages at 11.3% and 11.5%, respectively. Therefore, more black individuals do not separate and they have lower attrition rates than non-black individuals.

Table 2: Summary Statistics of Control Variables by Attrition Outcomes

	Full Sample	Attrition 0-6	Attrition 7-12	Attrition 13-24	Not Separated
Age	19.297	19.632	19.211	19.239	19.382
Female	0.070	0.113	0.085	0.088	0.078
Black	0.094	0.081	0.072	0.113	0.115
White	0.803	0.833	0.833	0.795	0.809
Other	0.103	0.086	0.095	0.092	0.076
Married-Accession	0.023	0.031	0.018	0.021	0.027
HS Diploma-Accession	0.930	0.906	0.906	0.909	0.935
GED-Accession	0.012	0.023	0.023	0.024	0.004
Some College-Accession	0.022	0.025	0.023	0.020	0.028
Sum of Women in MOS-Accession	0.061	0.054	0.044	0.056	0.071
Combat Arms	0.287	0.395	0.499	0.357	0.216
Combat Service Support	0.120	0.131	0.272	0.132	0.126
Service Support	0.415	0.384	0.475	0.369	0.429
Aviation Support	0.179	0.090	0.318	0.142	0.229
Attrition 0-6	0.013				
Attrition 7-12	0.021				
Attrition 13-24	0.052				
Not Separated	0.232				

Table 3 displays the attrition outcomes for the different separation variables for the full sample and separated by gender. For example, on average 1.6% of those who attrite within the first six months do so voluntarily. However, women are less likely to attrite voluntarily than men are, 0.8% and 1.7% respectively, during this same period. Interestingly, women are more likely to attrite for disability reasons compared to men in each attrition window. For example, 42% of women attriting in the first six months leave on account of disability compared to 32% of men. Women are more likely to cite family reasons for attriting in each period compared to men. Men are more likely to attrite due to misconduct compared to women across each attrition window. For example, the attrition rates for men are between 60–65%, while females average between 47–54%. Likewise, although the percentages are significantly lower, men are more likely to attrite due to death in each period compared to women. This table is interesting because it shows on average the proportion based on the attrition timeframe and separation reason for which males and females attrite.

Table 3: Summary Statistics of Separation Controls by Attrition Outcomes

Full Sample	Attrition 0-6	Attrition 7-12	Attriton 13-24
Voluntary	0.016	0.003	0.018
Misconduct	0.617	0.636	0.588
Death	0.012	0.026	0.032
Disability	0.330	0.286	0.252
Family	0.001	0.001	0.002
Other	0.023	0.048	0.108
	Female Only		
Voluntary	0.008	0.007	0.026
Misconduct	0.538	0.526	0.466
Death	0.007	0.006	0.007
Disability	0.422	0.438	0.434
Family	0.008	0.007	0.016
Other	0.017	0.017	0.051
	Male Only		
Voluntary	0.017	0.003	0.017
Misconduct	0.627	0.646	0.600
Death	0.013	0.028	0.035
Disability	0.318	0.272	0.235
Family	0.000	0.000	0.000
Other	0.024	0.051	0.113

Using the share of women in the individual’s MOS in the year they accessed variable, I determined which MOS had the highest and lowest proportion of women relative to the total number in service, presented in Table 4. I determined that the highest proportion of women serve in combat service support, 16.9%, while the lowest proportion of women in combat arms, 0%. The highest proportions are the traditional occupational fields while the lowest are non-traditional. This is of no surprise and is indicative of the historical background previously discussed. Combat service support includes predominately clerical occupational fields, such as administration, financial management, and supply, and combat arms was closed to women for almost the entire timeframe captured in this study. Likely a mistake, there were four women recorded as combat arms. Due to this fact and for the sake of generating meaningful analysis, I determined the second lowest MOS category, aviation support (6.5), to be the non-

traditional MOS category because representation falls below the mean average of women in the total force. Furthermore, Table 4 presents the results by gender in order to give a more accurate picture of the attrition outcomes, demographic information, education, and separation outcomes for these particular MOSs.

There are some interesting differences by gender when focusing solely on combat service support and aviation support. Though enlisted females make up 7% of the total force, 20% are in combat service support and 8% in aviation support. Attrition in the first two years is higher for females in combat service support and lower in aviation support when compared to men. Additionally, slightly more women do not separate in combat service support, and approximately 20% more men do not separate in aviation support when compared to women. Voluntary separation accounts for the majority of separation in both occupational fields for both genders. Followed by misconduct, where for example, in aviation support 42% of males separate due to misconduct, nearly 20% more than the 23% of women that separate for this reason.

Table 4: Summary Statistics of MOS Proportions by Gender

Full Sample	Combat Service Support	Combat Arms	Aviation Support*
Attrition 0-6	0.014	0.018	0.007
Attrition 7-12	0.014	0.034	0.013
Attrition 13-24	0.057	0.066	0.041
Not Separated	0.245	0.174	0.297
Age	19.299	19.169	19.368
Female Only	0.195	0.000	0.079
Black	0.200	0.052	0.085
White	0.664	0.851	0.822
Other	0.137	0.097	0.093
Married- Accession	0.029	0.014	0.026
HS Diploma-Accession	0.931	0.922	0.935
GED- Accession	0.011	0.014	0.010
Some College- Accession	0.022	0.023	0.023
Voluntary	0.646	0.617	0.659
Misconduct	0.241	0.232	0.230
Death	0.004	0.013	0.005
Disability	0.080	0.113	0.087
Family	0.000	0.000	0.000
Other	0.027	0.025	0.019
Female Only			
Attrition 0-6	0.022	0.5	0.017
Attrition 7-12	0.021	0	0.025
Attrition 13-24	0.061	0	0.064
Not Separated	0.251	0	0.266
Age	19.105	21.5	19.333
Female	1	1	1.000
Black	0.205	0	0.131
White	0.661	1	0.764
Other	0.134	0	0.104
Married- Accession	0.036	0	0.035
HS Diploma-Accession	0.941	1	0.927
GED- Accession	0.005	0	0.005
Some College- Accession	0.021	0	0.037
Voluntary	0.616	0.5	0.577
Misconduct	0.222	0.5	0.230
Death	0.003	0	0.000
Disability	0.138	0	0.178
Family	0.004	0	0.004
Other	0.016	0	0.010
Male Only			
Attrition 0-6	0.012	0.018	0.075
Attrition 7-12	0.013	0.034	0.110
Attrition 13-24	0.056	0.066	0.193
Not Separated	0.243	0.174	0.458
Age	19.346	19.169	2.358
Black	0.198	0.052	0.273
White	0.664	0.851	0.379
Other	0.137	0.097	0.290
Married- Accession	0.027	0.014	0.157
HS Diploma-Accession	0.929	0.922	0.246
GED- Accession	0.013	0.014	0.102
Some College- Accession	0.023	0.023	0.146
Voluntary	0.653	0.617	0.471
Misconduct	0.246	0.232	0.421
Death	0.005	0.013	0.073
Disability	0.066	0.113	0.269
Family	0	0	0.000
Other	0.03	0.025	0.138

C. CONCLUSION

In this chapter, I detailed the construction of many of the variables, described the categorization process for the MOS codes, and provided summary statistics to show the differences between the attrition outcomes. The Marine Corps does not categorize MOSs by traditional and non-traditional therefore, it is imperative that I create a meaningful classification system. Unfortunately, not enough data exist at the time of this research to use the true non-traditional category of combat arms. The summary statistics of the separation codes and MOS proportions by attrition outcomes are rather interesting and set the stage for the analysis detailed in the next chapter.

IV. METHODOLOGY

For each attrition outcome and controlling for the demographic and MOS variables, I ran six separate regression models—four logistic and two linear probability (LPM) regressions. Tables 5–8, presented in Chapter V, display all six models per attrition outcome. It is important to note that the attrition outcome is conditional on making it through that period. For example, the attrition outcome of 7–12 months is conditional on making it to month 7; those who attrite in months 0–6 are set as missing and not “0” to avoid false reporting. The same conditional pattern is true for the remaining attrition outcomes.

The demographic information used in the models are age, female, black, married, some college, GED, share of women in the individual’s MOS in the year they accessed, and indicators for MOS. The reference group for each variable are male, not black, single, high school diploma, and aviation support. The first logistic regression analyzes only demographic information, expressed in the following equation:

$$attrition_i = \beta_0 + \beta_1 * demo_i + \varepsilon_i$$

In this regression, demo is a vector of individual i’s demographic where β_1 is the demographic information for the sample of individuals’ representative of the specific attrition outcome.

The second logistic regression includes the demographic and MOS information, expressed in the following equation:

$$attrition_i = \beta_0 + \beta_1 * demo_i + \beta_2 * combat\ arms_i + \beta_3 * service\ support_i + \beta_4 * aviation\ support_i + \beta_4 * combat\ service\ support_i + \varepsilon_i$$

In the regression, demo and the MOSs are vectors of individual i’s where β_1 is demographic information and β_{2-4} are the $MOSs_i$ for the sample of individuals’ representative of the specific attrition outcome.

The third logistic regression includes the demographics, MOS, and female critical mass, expressed in the following equation:

$$\begin{aligned} attrition_i = & \beta_0 + \beta_1 * demo_i + \beta_2 * combat\ arms_i + \beta_3 * service\ support_i + \\ & + \beta_4 * combat\ service\ support_i + \beta_5 * female\ critical\ mass + \varepsilon_i \end{aligned}$$

In this regression, demo, MOSs, and female critical mass are demo vectors of individual i 's where β_1 is the demographic information, β_{2-4} are the $MOSs_i$ and β_5 is the female critical mass variable.

In the fourth and final logistic regression, I focus only on the male sample with the same set of controls as above.

For ease of interpretation, I ran two LPM regressions namely one that includes an interaction of female with the share of women in an individual's MOS the year they accessed, and a second one that focuses on the female-only sample with all the controls.

V. RESULTS

In this chapter, I interpret the results of the logistic and LPM regressions for the models used for this study. I interpret the odds ratio, which is the increase or decrease in the odds of the response occurring, given the presence of the independent variable, for the logistic regressions and the coefficients for the LPM regressions for each model. As explained in Chapter III, there are six regressions for each of the models. Aviation support is the MOS reference group, high school education is the reference group for education, single is the reference group for marital status, and male is the reference group for gender. Additionally, a key is included at the bottom of each table for the asterisks to show at which level the significance, if any, occurs. I explain the results based on the five different attrition outcomes.

A. ATTRITION IN MONTHS 0–6

Table 5 displays the results for those who attrite in months 0–6 across the six (logit and LPM) models. Across the models with female representation, females are more likely to attrite than males. Specifically, in Model 2, when controlling for demographics and MOS, given the Marine is a woman, the odds that she attrites are twice (2.04) the odds that a man attrites in months 0–6. Additionally, all of the results which include females are significant at the 1% ($p < 0.01$) level. Black Marines are less likely to attrite than non-white Marines are in months 0–6 and are statistically significant across all models except Model 4. Individuals with a GED are substantially more likely to attrite than high school graduates—males with a GED have the highest likelihood (1.93), as displayed in Model 4. The interpretation of Models 5 and 6 are different since they do not involve odds ratios. For example, Model 5 suggests a 1% increase in the share of women in an individual’s MOS decreases attrition by 2%. Although the sign on the interaction term with female is positive, it is insignificant suggesting no differential effect of female critical mass for females. This is in contrast to Model 6 where the female proportion in a MOS category positively correlates with attrition, namely a one-percentage point increase in the share of women in an individual’s MOS leads to a 2.3 percentage point increase in

the female attrition rate in the first six months. This would suggest there is no differential effect of female critical mass on attrition. Both men and women are more likely to attrite from MOSs with a higher proportion of women.

When focusing on the combat service support variable, it is significant in Models 2–6, and men, are approximately 33 times more likely to attrite in this field in months 0–6 compared to aviation support (the reference group). The overall higher combat service support odds may be due to the fact that most aviation support occupational fields require a five-year obligatory contract in which the majority of the first year is spent in a student status. Additionally, much of the attrition in this category is in the initial phases of training—boot camp or MOS school.

Table 5: Dependent Variable, Indicator for Attrition in Months 0–6

	Demo	Demo + MOS	Demo + MOS + Female Critical Mass	All controls - Male Only	All controls - LPM	All controls - Female Only, LPM
Age	1.0300*** [0.0041]	1.0333*** [0.0043]	1.0335*** [0.0043]	1.0329*** [0.0044]	0.0009*** [0.0001]	0.0012** [0.0005]
Female	1.7294*** [0.0763]	2.0412*** [0.0956]	2.0724*** [0.0971]		0.0102*** [0.0020]	
Black	0.8749*** [0.0445]	0.9118* [0.0470]	0.9156* [0.0471]	0.9563 [0.0533]	-0.0011* [0.0006]	-0.0058*** [0.0021]
Married-Accession	1.1687* [0.0957]	1.2373*** [0.1018]	1.2316** [0.1013]	1.2170** [0.1097]	0.0015 [0.0014]	0.0059 [0.0059]
Some College-Accession	0.9329 [0.0850]	0.9205 [0.0841]	0.9184 [0.0839]	0.9268 [0.0914]	-0.0027** [0.0013]	-0.0038 [0.0052]
GED-Accession	1.9204*** [0.1787]	1.8825*** [0.1754]	1.8897*** [0.1761]	1.9321*** [0.1839]	0.0115*** [0.0023]	0.0100 [0.0145]
Combat Arms		2.9139*** [0.1506]	0.8472 [0.1234]	0.5763*** [0.0963]	-0.0016 [0.0015]	0.4840** [0.2465]
Combat Service Support		2.0120*** [0.1224]	14.8346*** [3.3091]	32.5575*** [8.1397]	0.0285*** [0.0025]	-0.0191** [0.0080]
Service Support		1.8540*** [0.0950]	2.0272*** [0.1057]	2.2392*** [0.1300]	0.0066*** [0.0004]	0.0046** [0.0022]
Share of Women in MOS-Accession			0.0000*** [0.0000]	0.0000*** [0.0000]	-0.2088*** [0.0229]	0.2325*** [0.0740]
Share of Women in MOS-Accession*Female					0.0049 [0.0182]	
Observations	408,006	408,006	408,006	379,281	408,006	28,725
Standard Errors in Brackets [Robust SE for LPM]. *** p<0.01, ** p<0.05, * p<0.1						
All models include FE for individual accession years.						

B. ATTRITION IN MONTHS 7–12

The column display for Table 6 and the remainder of the tables is in the same format, as previously described. Although slightly less likely than in months 0–6, females still have higher odds of attrition in months 7–12 than males and are statistically significant across all models in which they are included. However, odds decrease slightly across the models in comparison to the previous attrition outcome. In Model 2, black Marines have lower odds of attriting and was previously significant at the $p < 0.1$ level and in months 7–12 is significant at the $p < 0.01$ level. When controlling for all variables for males only, Model 4, married males are less likely to attrite than single males in months 7–12. An individual who has some college at accession, though not significant for any of the models during months 7–12, is more likely to attrite than high school graduates.

Interestingly, the results across Models 5 and 6 differ. The full sample in Model 5 suggests that there is a relationship between the proportion of females in an MOS and attrition in months 7–12. The interaction term is negative and significant suggesting an increase in female proportion in an MOS decreases attrition in months 7 to 12. However, the critical mass indicator variable is insignificant in the female only Model 6. It is hard to draw strong conclusions on critical mass based on these results. Males in combat service support continue to have higher odds of attrition than males in aviation support, though significantly lower than in months 0–6. Again, this may be due to the length of schooling for those individuals assigned an aviation support occupational field.

Table 6: Dependent Variable, Indicator for Attrition in Months 7–12

	Demo	Demo + MOS	Demo + MOS + Female Critical Mass	All controls - Male Only	All controls - LPM	All controls - Female Only, LPM
Age	0.9804*** [0.0058]	0.9871** [0.0058]	0.9872** [0.0058]	0.9841** [0.0061]	-0.0002** [0.0001]	0.0005 [0.0005]
Female	1.3014*** [0.0517]	1.8653*** [0.0782]	1.8758*** [0.0786]		0.0170*** [0.0022]	
Black	0.7648*** [0.0326]	0.8755*** [0.0376]	0.8758*** [0.0377]	0.8958** [0.0412]	-0.0023*** [0.0007]	-0.0059** [0.0024]
Married-Accession	0.7711*** [0.0657]	0.8360** [0.0715]	0.8343** [0.0713]	0.8541* [0.0780]	-0.0034** [0.0014]	-0.0082 [0.0051]
Some College-Accession	1.0849 [0.0832]	1.0477 [0.0805]	1.0470 [0.0804]	1.0709 [0.0868]	0.0008 [0.0016]	-0.0040 [0.0053]
GED-Accession	1.7830*** [0.1333]	1.7481*** [0.1311]	1.7504*** [0.1313]	1.7000*** [0.1319]	0.0170*** [0.0029]	0.0600** [0.0239]
Combat Arms		2.6624*** [0.0980]	1.7237*** [0.2078]	1.7347*** [0.2366]	0.0191*** [0.0019]	-0.0337*** [0.0063]
Combat Service Support		0.9809 [0.0502]	1.9644*** [0.3696]	2.0698*** [0.4390]	0.0032 [0.0030]	-0.0001 [0.0106]
Service Support		1.3002*** [0.0488]	1.3483*** [0.0522]	1.3664*** [0.0573]	0.0041*** [0.0006]	0.0050* [0.0026]
Share of Women in MOS-Accession			0.0011*** [0.0019]	0.0009*** [0.0019]	-0.0265 [0.0271]	-0.0319 [0.0925]
Share of Women in MOS-Accession*Female					-0.0520*** [0.0181]	
Observations	402,726	402,726	402,726	374,600	402,726	28,126
Standard Errors in Brackets [Robust SE for LPM], *** p<0.01, ** p<0.05, * p<0.1						
All models include FE for individual accession years.						

C. ATTRITION IN MONTHS 13–24

The odds are relatively consistent, with little to no variation, for the majority of the variables with regard to attrition within year two after accession. Table 7 displays very similar results as the previous tables. While the odds for females continue to decrease slightly, females continue to have higher odds of attrition than males. Unlike attrition in the first year, black Marines are more likely to attrite than non-black Marines across all models in months 13–24, which was not the case in either of the previous periods. That said black females are less likely to attrite as seen in Model 6. Where the variable some college was previously insignificant, it is now significant ($p < 0.05$) only in Model 4. Married personnel are still relatively less likely to attrite than single individuals. Additionally, combat arms, combat service support, and service support have higher odds of attrition than individuals in aviation support in months 13–24—all statistically significant ($p < 0.01$) in Models 2–5. Again, the results on female critical mass are mixed. In Model 5 both the share of females in an individual’s MOS at accession is negative as is the interaction of this term with female. This suggests the proportion of females in a

MOS has a negative effect on both male and female attrition with a larger negative effect on female attrition. However, we find no significant effects of female critical mass in Model 6 focusing on the female only sample.

Table 7: Dependent Variable, Indicator for Attrition in Months 13–24

	Demo	Demo + MOS	Demo + MOS + Female Critical Mass	All controls - Male Only	All controls - LPM	All controls - Female Only, LPM
Age	0.9886*** [0.0037]	0.9920** [0.0037]	0.9921** [0.0037]	0.9902** [0.0039]	-0.0004** [0.0002]	0.0003 [0.0008]
Female	1.3460*** [0.0344]	1.4990*** [0.0399]	1.5038*** [0.0401]		0.0400*** [0.0035]	
Black	1.2226*** [0.0280]	1.2641*** [0.0293]	1.2648*** [0.0294]	1.3273*** [0.0325]	0.0121*** [0.0013]	-0.0085** [0.0040]
Married-Accession	0.8498*** [0.0444]	0.8784** [0.0460]	0.8777** [0.0459]	0.8573*** [0.0487]	-0.0062*** [0.0023]	0.0014 [0.0091]
Some College-Accession	0.9644 [0.0507]	0.9475 [0.0499]	0.9468 [0.0498]	0.8933** [0.0514]	-0.0027 [0.0023]	0.0148 [0.0100]
GED-Accession	2.0158*** [0.0980]	1.9936*** [0.0972]	1.9952*** [0.0972]	1.9936*** [0.0989]	0.0506*** [0.0046]	0.0546* [0.0293]
Combat Arms		1.7025*** [0.0387]	1.4029*** [0.0906]	1.4620*** [0.1032]	0.0205*** [0.0034]	-0.0787*** [0.0135]
Combat Service Support		1.2966*** [0.0361]	1.7682*** [0.1774]	1.8228*** [0.1996]	0.0249*** [0.0055]	0.0265 [0.0187]
Service Support		1.1252*** [0.0251]	1.1445*** [0.0262]	1.1415*** [0.0279]	0.0054*** [0.0009]	0.0080** [0.0041]
Share of Women in MOS-Accession			0.0470*** [0.0449]	0.0707** [0.0741]	-0.0955* [0.0501]	-0.2664 [0.1652]
Share of Women in MOS-Accession*Female					-0.1898*** [0.0303]	
Observations	394,303	394,303	394,303	366,894	394,303	27,409
Standard Errors in Brackets [Robust SE for LPM], *** p<0.01, ** p<0.05, * p<0.1						
All models include FE for individual accession years.						

D. NOT SEPARATED

Table 8 presents the results of the logit and LPM for those who did not separate. When focusing on the female variable, women are less likely to not separate than males. Across the models, black Marines have higher odds of not separating compared to non-blacks barring out the summary patterns shown in the last chapter. These numbers are even higher for black women in Model 6 where black women are 4.1 percentage points more likely to not separate. The MOS and critical mass variables are significant across the models. Individuals in service support are less likely to not separate compared to individuals in aviation support. In Models 5 and 6, female proportion negatively correlates with not separating. This suggests as the share of women in an individual's

MOS increases, they are less likely to not separate. Individuals with some college are more likely to not separate, but the coefficient is insignificant in Model 6 for females only. Thus, education seems to play a bigger role in male decisions to enlist or not. Model 1 shows that those with a GED are less likely to not separate than those with a high school diploma. Males serving in combat service support are nearly two times more likely to not separate than aviation support. However, males in combat arms are far less likely to not separate than males in aviation support, as depicted in Model 4. Males in combat arms are more likely to attrite in any period than to not separate. Viewing the various separation codes for combat arms may reveal whether a majority of separations were voluntary or due to disability or misconduct.

Table 8: Dependent Variable, Indicator for Not Separated

	Demo	Demo + MOS	Demo + MOS + Female Critical Mass	All controls - Male Only	All controls - LPM	All controls - Female Only, LPM
Age	1.0482*** [0.0025]	1.0432*** [0.0025]	1.0432*** [0.0025]	1.0442*** [0.0026]	0.0049*** [0.0004]	0.0038*** [0.0011]
Female	0.9475*** [0.0175]	0.8104*** [0.0154]	0.8180*** [0.0154]		-0.0418*** [0.0050]	
Black	1.3928*** [0.0215]	1.3230*** [0.0207]	1.3241*** [0.0207]	1.3169*** [0.0218]	0.0322*** [0.0020]	0.0409*** [0.0062]
Married-Accession	1.8126*** [0.0517]	1.7492*** [0.0501]	1.7457*** [0.0500]	1.7887*** [0.0536]	0.0709*** [0.0043]	0.0361*** [0.0127]
Some College-Accession	1.0472 [0.0328]	1.0706** [0.0338]	1.0683** [0.0337]	1.0775** [0.0357]	0.0092** [0.0039]	0.0075 [0.0128]
GED-Accession	0.6998*** [0.0398]	0.7094*** [0.0405]	0.7102*** [0.0406]	0.7179*** [0.0415]	-0.0253*** [0.0037]	-0.0447*** [0.0165]
Combat Arms		0.4187*** [0.0061]	0.2314*** [0.0106]	0.2202*** [0.0109]	-0.1169*** [0.0050]	-0.1531*** [0.0156]
Combat Service Support		0.7462*** [0.0129]	1.9636*** [0.1424]	1.9775*** [0.1544]	-0.0003 [0.0078]	0.0527** [0.0229]
Service Support		0.7120*** [0.0090]	0.7409*** [0.0096]	0.7315*** [0.0099]	-0.0395*** [0.0016]	-0.0144*** [0.0055]
Share of Women in MOS-Accession			0.0001*** [0.0001]	0.0001*** [0.0001]	-0.3747*** [0.0755]	-0.5249** [0.2194]
Share of Women in MOS-Accession*Female					0.1889*** [0.0468]	
Observations	408,006	408,006	408,006	379,281	408,006	28,725
Standard Errors in Brackets [Robust SE for LPM], *** p<0.01, ** p<0.05, * p<0.1						
All models include FE for individual accession years.						

E. KEY FINDINGS

Ultimately, the odds of attrition are higher for women across most of the models, while the odds of not separating are lower for women. The results of this study is

consistent with previous research in that women tend to attrite within the first two years at a higher rate than males. On average, females are less likely to not separate than males. Having some college is a key indicator for retention. Model 6 displays that females are less likely to not separate than males. There are various factors as to why this is this the case however; it does appear that the proportion of females has some impact on attrition, sometimes positive and sometimes negative, with the results changing between the full versus female only sample. More than critical mass, the MOS variables consistently highlight the large differences in attrition across occupations. The mixed findings on the critical mass indicator variable could be because there is limited temporal variation in the share of women within MOS categories. Including indicators for the MOS categories captures most of the variation in critical mass. This highlights that gender representation and MOS are both key determinants of attrition.

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VI. CONCLUSION AND RECOMMENDATION

In today's Marine Corps, female Marines make up less than 10 percent of the organization. Though statistics show that women are joining at a steady rate annually, there are equally as many statistics that show women are leaving the service at a higher rate than males. In an attempt to lower attrition rates, the Marine Corps instituted several reenlistment incentives, retention initiatives, and policy changes (i.e., maternity leave) as efforts to positively affect retention and reduce attrition. However, the results of this thesis reveals that more can be done remedy this issue.

As an active duty female Marine, I found this topic to be of personal interest. In the past fourteen years of my service, the proportion of women in the Marine Corps has increased by perhaps two to three percent. I have also personally witnessed high attrition of many of my female friends, co-workers, and peers. Though I have my own personal ideas as to why this is the case, representation being one of them, I conducted this study to see whether or not the data supports this idea. Furthermore, the results of this thesis empirically validate though mixed, there are implications of critical mass (or representation) and a greater solution may lie in the knowledge of this factor.

This thesis sought to find whether critical mass has an effect on females Marines attrition in non-traditional MOSs. Again, there is no such listing as traditional and non-traditional; therefore, I generated four MOS bins for the different occupational fields. Through analysis, I determined traditional MOSs to be combat service support and combat arms to be non-traditional. I decided to use the second lowest proportional distribution, aviation support, as the non-traditional MOS category due to the lack of representation of females in combat arms. The multivariate regressions estimated attrition outcomes while controlling for various variables.

The key findings support the claim that overall women attrite at higher odds than males. Although, women are more likely to attrite, they are also less likely to separate once they make it past the first two years after accession. The results of the different attrition outcomes for some demographics have similar results, such as gender, while

others did not. Black Marines for example, have lower odds of attrition than non-black Marines in the first year however, they are more like to attrite in their second year of service. Additionally, black Marines are more likely to not separate than non-black Marines. Likewise, education level is interesting in that individuals with a GED are consistently more likely to attrite yet they are less likely to separate than Marines with a high school diploma. Clearly, gender, race and education all have a different effect on attrition.

The share of women in an individual's MOS variable consistently indicate that an increase in percentage produces a decrease in attrition (Model 5). However, this variable when interacted with female is inconsistent being either positive or negative, significant or insignificant depending on the attrition outcome. For example, in months 0–6 Model 5 suggests an increase in females in an MOS yields a decrease in female attrition. In months 7–12 however, an increase in female critical mass yields a decrease in female attrition and is significant—yet, insignificant in Model 6. The results are mixed and inconsistent. Furthermore, the results are in support of the idea that critical mass has some negative effect on attrition but the findings here are inconclusive. What was interesting to me was finding that the MOS has almost the equal effect on female attrition as critical mass. This highlights another a separate, yet equally important, factor that effects attrition.

Although, there is not one solution that would accommodate the various reasons for leaving the service, the Marine Corps should focus efforts on proper MOS fit and distribution of females within a MOS to maximize retention efforts. Now that combat arms occupational fields are open to women, I make the following recommendation to conduct future studies specifically on the importance of proportional representation. My personal belief is that there is power in representation. People (not all) tend to respond differently when there are not feelings of tokenism or isolation due to lack of representation. Since combat arms occupations opened to women, presumably there will be enough data in the future to conduct research specifically in these non-traditional MOSs to determine if the results of attrition are consistent and conclusive over time. Conducting future research on this topic, to include survey data, and presumably having enough data to classify accurately combat arms as the non-traditional MOS to determine if the results are consistent over time.

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