NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A STATISTICAL ANALYSIS OF RETENTION IN THE SURFACE WARFARE COMMUNITY

by

Jonathan C. Duffy

June 2000

Thesis Co - Advisors: J. Eric Fredland
Stephen L. Mehay

Approved for public release; distribution is unlimited.

20000720 018

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE June 2000	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE : A Statistical Analysis of Retention In The Surface Warfare Community

5. FUNDING NUMBERS

6. AUTHOR(S)
Duffy, Jonathan C.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

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

12b. DISTRIBUTION CODE

13. ABSTRACT ***(maximum 200 words)***

This thesis develops multivariate models to estimate the determinants of retention in the Surface Warfare community to the Lieutenant Commander (O-4) promotion board. Using data from the Navy Officer Master File and the Navy Officer Loss File, logit models are specified to analyze the probability of Surface Warfare Officer (SWO) retention to the O-4 board, transfer from the SWO community prior to the O-4 board, and resignation from the Navy prior to the O-4 board. The probabilities are modeled as functions of background and demographics, early Navy experience, and combinations thereof. The findings reveal that serving initially in a cruiser or destroyer, having children, being older at commissioning and being recommended for accelerated promotion more often as an O-1 or O-2 are all positive indicators of Surface Warfare community retention. Having a higher undergraduate GPA, majoring in engineering as an undergraduate, and being commissioned via Officer Candidate School are all negatively associated with Surface Navy retention. Based upon the research results, recommendations are made for the Navy to investigate alternative means of ranking year groups for service and ship selection.

14. SUBJECT TERMS
Surface Warfare, Retention

15. NUMBER OF PAGES
96

16. PRICE CODE

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

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std. 239-18

Approved for public release; distribution is unlimited

A STATISTICAL ANALYSIS OF RETENTION IN THE SURFACE WARFARE COMMUNITY

Jonathan C. Duffy
Lieutenant, United States Navy
B.S., United States Naval Academy, 1994

Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF SCIENCE IN LEADERSHIP
AND HUMAN RESOURCE DEVELOPMENT**

from the

**NAVAL POSTGRADUATE SCHOOL
June 2000**

Author: _____
Jonathan C. Duffy

Approved by: _____
J. Eric Fredland, Co - Advisor

_____
Stephen L. Mehay, Co - Advisor

_____
Reuben T. Harris, Chairman
Department of Systems Management

ABSTRACT

This thesis develops multivariate models to estimate the determinants of retention in the Surface Warfare community to the Lieutenant Commander (O-4) promotion board. Using data from the Navy Officer Master File and the Navy Officer Loss File, logit models are specified to analyze the probability of Surface Warfare Officer (SWO) retention to the O-4 board, transfer from the SWO community prior to the O-4 board, and resignation from the Navy prior to the O-4 board. The probabilities are modeled as functions of background and demographics, early Navy experience, and combinations thereof. The findings reveal that serving initially in a cruiser or destroyer, having children, being older at commissioning and being recommended for accelerated promotion more often as an O-1 or O-2 are all positive indicators of Surface Warfare community retention. Having a higher undergraduate GPA, majoring in engineering as an undergraduate, and being commissioned via Officer Candidate School are all negatively associated with Surface Navy retention. Based upon the research results, recommendations are made for the Navy to investigate alternative means of ranking year groups for service and ship selection.

TABLE OF CONTENTS

I. INTRODUCTION **1**

A. BACKGROUND 1
B. OBJECTIVE 2
C. SCOPE, LIMITATIONS AND ASSUMPTIONS 2
D. ORGANIZATION OF THE STUDY 3

II. LITERATURE REVIEW **5**

A. ECONOMIC FACTORS 5
B. INITIAL SHIP TYPE 8
C. CAREER REQUIREMENTS ATTAINMENT 10
D. PERSONAL CHARACTERISTICS 11
E. SUMMARY 15

III. DATA AND METHODOLOGY **17**

A. DATA 17
B. VARIABLE DEFINITIONS 21
1. Dependent variables *21*
2. Explanatory Variables – Independent of Fleet Experience *22*
3. Explanatory Variables – Based on Fleet Experience *26*
C. METHODOLOGY 30

IV. ANALYSIS **33**

A. BASELINE HYPOTHESIZED RETENTION FACTORS 33
B. MODEL INCLUDING FLEET EXPERIENCE VARIABLES 36
C. COMBINED BASELINE/FLEET EXPERIENCE RETENTION MODEL 38
D. LOGIT MODEL OF DECISION TO TRANSFER FROM SURFACE COMMUNITY 42
E. LOGIT MODEL OF RESIGNATION DECISION 45

V. CONCLUSIONS AND RECOMMENDATIONS **51**

A. RETENTION CONCLUSIONS 51
B. USE OF THE RETENTION MODEL 59
C. RECOMMENDATIONS 62

APPENDIX A. REASONS FOR DATA LOSS **65**

APPENDIX B. FREQUENCIES AND PERCENTAGES OF DEPENDENT AND INDEPENDENT VARIABLES **67**

APPENDIX C. RETENTION / SEPARATION MODEL VARIABLE MEAN VALUES **73**

APPENDIX D. MEAN VALUE MARGINAL EFFECT COMPUTATIONS **77**

LIST OF REFERENCES **83**

INITIAL DISTRIBUTION LIST **85**

LIST OF TABLES

Table 1. Factors Hypothesized to Affect Retention in the Surface Warfare Community 20
Table 2. Descriptive Statistics of Dependent Variables 22
Table 3. Undergraduate Major Descriptive Statistics 23
Table 4. Dependent Status Descriptive Statistics 24
Table 5. Commissioning Source Descriptive Statistics 25
Table 6. Ethnic Background Descriptive Statistics 26
Table 7. Initial Ship Type Descriptive Statistics 27
Table 8. Initial Department Descriptive Statistics 28
Table 9. Retention Modeling Methodology 30
Table 10. Separation Modeling Methodology 31
Table 11. Baseline Retention Model Regression Results 35
Table 12. Navy Experience Retention Model Regression Results 37
Table 13. Combined Baseline and Fleet Experience Retention Model Results 40
Table 14. Logit Model of Decision to Transfer From Surface Community 44
Table 15. Logit Model of Resignation Decision 47
Table 16. Retention Probabilities for Nominal Officer "Ensign Average". 61

ACKNOWLEDGEMENTS

I wish to extend my sincere appreciation to the many individuals who contributed to this thesis. In particular, the insight, wisdom and editing prowess of my advisors, Dr. Eric Fredland of the U.S. Naval Academy and Dr. Stephen Mehay of the Naval Postgraduate School, contributed greatly to the completion of this project. Additionally, I would like to recognize Dr. William Bowman of the U.S. Naval Academy for his help forming the initial data set and great insight during the modeling portion of this research. I would also like to thank Mr. Chris Jehn of the Congressional Budget Office who pointed me in the right direction in completing much of the necessary background research for this project. Lastly, I would like to thank my wife, Shelly, for her encouragement and support which truly made this research possible.

I. INTRODUCTION

The goal of this thesis is to identify and quantitatively evaluate factors that affect retention in the Surface Warfare community of the United States Navy. The Surface Warfare community is examined due to a recent focus on retention in the surface fleet. The ultimate objective of this study is to provide Navy policy makers with information that can be used in formulating policies to increase retention within the Surface community.

A. BACKGROUND

The Surface Warfare Officer community has traditionally had little trouble filling its ranks. Until the early 1990's, the Navy was able to completely man its ships and retention among Surface Warfare Officers was rarely an issue. However, following the post-Gulf War drawdown, the numbers of officers ascending through the community began to severely fall off. In the mid 1990's, some officers filling department head level billets on ships were remaining in those billets not for the traditional 36 month tour but for as many as 56 months since no relief was slated in the detailing pipeline. Much of this dearth of junior officers was due to especially low retention (20% or less of a year group) among junior officers after their first sea tours. In 1999, the Navy for the first time offered a bonus to Surface Warfare Officers who committed to serve a 36 month department head tour in order to fill out the required numbers of Surface Warfare Officers. Despite the enactment of this bonus, no thorough economic retention model has ever been constructed to estimate retention factors in the Surface Warfare community.

B. OBJECTIVE

As stated, the objective of this study is to provide policy makers with information that may be used in the formulation of specific policies to increase retention in the Surface Warfare community. This thesis investigates both the factors that the Navy can directly control (detailing officers to ships, ranking officers within a year group) and the factors over which the Navy has little or no control (officers' family status or undergraduate major) to determine which, if any, indicate an increased likelihood of retention.

This thesis is not intended to be an analysis of whether the Navy is placing the right or wrong officers in the Surface community. Rather it is intended to provide valuable information to the decision makers who affect the community's detailing and assignment procedures.

C. SCOPE, LIMITATIONS AND ASSUMPTIONS

The Surface Warfare Officer (SWO) community is the focus of this study since it has recently experienced substantial manning shortfalls attributed to high attrition in the junior officer ranks. Based on the Navy's focus on junior officer retention, the Surface community is examined to provide information on retention habits to senior policy makers.

Officers in this data set include the entire population of officers who appeared before the Lieutenant (O-3) (1981-1990) and Lieutenant Commander (O-4) (1986-1995) promotion selection boards with some exceptions as discussed in Chapter III.

This study defines the basic outcomes - retention, transfer within the Navy, and separation from the Navy - as binary variables. Retention is defined as staying in the

Navy until and being promoted by the O-4 board; transferring is defined as being promoted by the O-4 board while in a community other than Surface Warfare; and separation is defined as leaving active duty between the O-3 and O-4 promotion boards. The reasons for separation (voluntary or involuntary) are not reviewed.

D. ORGANIZATION OF THE STUDY

This study is organized into five chapters. Chapter II reviews applicable studies that relate to this research, but do not necessarily specifically address this topic completely. Chapter III details the contents of the data set that was used for this research. A complete explanation of the research methodologies used to construct the study's models is also included. Chapter IV provides the empirical results of this analysis. Chapter V summarizes the conclusions of this study, provides policy recommendations based on this research and recommends further research topics based on this study.

THIS PAGE INTENTIONALLY LEFT BLANK

II. LITERATURE REVIEW

Research in the area of retention in the military has traditionally sought to quantify why individuals or groups of individuals tended to separate voluntarily from the service. As pointed out in the literature review conducted by Bautista (1996), research seeking specific indicators of separation tendencies such as demographic group, assignment, or gender issues, have for the most part, modeled retention using many of the concepts outlined in the Annualized Cost Of Leaving (ACOL) model developed by Warner and Goldberg (1984). The ACOL model basically breaks the individual separation decision down to a comparison of present and future monetary earnings in the military combined with a variable for the "taste" of military life against the earnings potential of starting a civilian career with a similar variable for civilian life "taste." (For retention studies incorporating the ACOL model, the reader is directed toward Mackin, Hogan, and Mairs, 1995; Mairs, Mackin, Hogan and Tinney 1992; or Hogan, 1990.) The pecuniary and non-pecuniary factors of the Warner and Goldberg ACOL model, an officer's initial ship type assignment, his ability to achieve certain career requirements and his personal background characteristics all factor in to the decision to remain in or separate from the military (and specifically the Surface Warfare Community). Studies encompassing these factors as they may relate to the Surface Warfare Community are discussed in detail below.

A. ECONOMIC FACTORS

In the derivation of the ACOL model, Warner and Goldberg (1984) sought to determine how non-pecuniary factors (specifically sea duty) affected the re-enlistment decision of Navy enlisted personnel. The ACOL model assigns a cost to both remaining

in the military and separating to the civilian community while accounting not only for pecuniary factors, but also for an individual's "taste" for military or civilian service. Re-stated, if a summation of the present values of future expected military pay and the military "taste" over a given time horizon and of the individual's retirement earning potential and then civilian taste from the retirement point through his life expectancy are greater than the sum of the present value of civilian pay and civilian "taste" factors from the decision point over a given time horizon, then the individual would tend to remain in the military. If the latter outweighs the former, then the individual would tend to separate from the service. Very simply, if the "net taste" of civilian life over military life exceeds the cost (annualized) associated with leaving the military, then the individual will be likely to separate. (Warner and Goldberg, 1984).

The ACOL model is designed to estimate the cost of leaving the military over given time horizons. For example, an enlistee at the first re-enlistment point would evaluate the ACOL over one more re-enlistment (four more years), two more re-enlistments (eight years), and so forth. The maximum ACOL value over these alternative horizons would be the most relevant for the first term stay-leave decision. An individual one year from retirement would have a much higher cost of leaving the military (based on the cost of the loss of expected retirement benefits) than an individual in their second year of service. Therefore, application of the ACOL model demonstrates that the longer an individual remains in the service the greater his cost of leaving it becomes (Warner and Goldberg, 1984).

Despite the seemingly simple variables in the ACOL model, Warner and Goldberg point out that the education level, mental group and race is accounted for in the

model through the future earning potential variable an individual would expect in the civilian community. The most important conclusion of the study was that ACOL variations explain much of the variation in re-enlistment choices in the data set. (Warner and Goldberg, 1984).

According to the ACOL model, if the Navy adequately compensates sailors and officers, via both pecuniary and non-pecuniary means to such an extent that their compensation outweighs their "taste" for civilian life, they will remain in the naval service. This assumption is applied in research conducted by Mackin and Darling (1996) on the then proposed (and now enacted) career incentive bonus for Surface Warfare Officers. Modeling retention behavior in the Surface Community using pay elasticities taken from ACOL studies for aviation retention (the authors point out that there exist no studies of conventional Surface officer retention), Mackin and Darling determined that a Career Incentive Pay program for Surface Warfare Officers would yield significant cost savings while improving the Navy's ability to attract and retain high quality officers. (Mackin and Darling, 1996).

In a study of separating Surface Warfare Officers, Howell (1980) analyzed the post-resignation questionnaires of 281 mid-grade officers (from LTJG to LCDR) who separated from 1978 to 1980. In his analysis, too little pay was found to be the second most common reason for Surface Warfare Officer resignations. (Insufficient pay was second to too much family separation.) Howell (1980) also stated that this finding was consistent with other separation studies that demonstrate a correlation between monetary compensation and retention. Generally the studies agree that increases in pay and

benefits are positively correlated to retention and that greater compensation can counterbalance an officer's intention to enter the civilian work force.

DTI Associates, Inc. recently surveyed 4,500 Surface Warfare Lieutenants, Lieutenants (junior grade) and Ensigns in the Surface Warfare community. Of the 2,200 responses, 44% said that if offered a $50,000 bonus they would either definitely agree to complete a department head tour or that it would positively influence the decision to remain in the service for a department head tour. (DTI Survey, 1999). Clearly economic considerations weigh significantly on an officer's retention decision, although survey responses do not necessarily predict actual choices officers might make.

B. INITIAL SHIP TYPE

The characteristics of one's initial ship assignment may also influence an officer's decision to remain in the naval service. Although officers attending the Naval Academy are allowed to select their initial ship specifically, the bulk of newly commissioned Surface Warfare Officers (NROTC and OCS graduates) are assigned their first ship by the Bureau of Naval Personnel. Most previous studies concerning ship type have focused on ship type as it relates to officer performance and promotion potential. (For example, Mehay, 1995; Nolan, 1993.) However, Kear (1989) analyzed 77,502 male enlisted sailors who joined their first ship in fiscal years 1977, 1981, and 1985. The results of the analysis were that attrition (separation rate) for those sailors varied widely with ship type. Across the three cohorts of sailors examined, Kear determined that oilers generally had the highest rate of attrition followed by amphibious ships, minesweepers and repair ships and that cruisers, destroyers and frigates (CRUDES) had the lowest attrition rates (Kear, 1989). It should be noted again that Kear's research focused on enlisted attrition;

however, some of his conclusions may weigh on the officer retention question as it relates to ship type. For example, in explaining the low attrition associated with the CRUDES community, Kear theorized that since cruisers, destroyers and frigates are perceived as the capital ships of the fleet, that they

> provide sailors with greater challenge, prestige, opportunities for warfare skill development, and 'importance'. Thus, among many Surface Warfare officers and enlisted alike, (CRUDES) are the most sought after ships for duty assignment. This introduces the opinion in some of the Surface Warfare Navy that, in general, more qualified leaders (in commanding officer and executive officer positions) are being assigned to these ships than others. This may partially explain the difference in attrition between ship types, assuming that attrition is influenced to some extent by the greater abilities or higher achievements of senior personnel (officer and enlisted) on the ship. (Kear, 1989, p. 65).

This theory could hold some weight since the same 1999 DTI survey of junior Surface Warfare officers noted above determined that command leadership weighs most heavily on a junior officer's career decision (DTI Survey, 1999). If, as Kear theorizes, better commanders are being assigned to CRUDES platforms, then they could exert a positive effect on the career decisions of junior Surface Warfare officers in their initial assignment.

Conducting a similar analysis for officer separation and ship type, Bautista (1996) determined that initial assignment to an aircraft carrier was not conducive to retention in the Surface Warfare community. Further conclusions were that initial assignment to an aircraft carrier or to a CLF ship (Combat Logistics Force - an oiler or cargo ship) may not be career-enhancing for officers seeking promotion to Lieutenant Commander (LCDR) (Bautista, 1996). The relationship between failure to promote and retention in the Surface Warfare community will be addressed later in this chapter. Most notably, however, Bautista (1996) determined that initial assignment to a cruiser or destroyer

(CRUDES) was correlated with both an increased likelihood of retention and career advancement (to include timely promotion to Lieutenant (junior grade) (LTJG), Lieutenant (LT), and LCDR). Despite the seemingly imbalanced promotion and retention rates among officers initially assigned to different ship types, it appears as if an "interrelationship" between initial ship type, performance, and personal characteristics is more of an indicator of separation likelihood than any one particular factor (Bautista, 1996). Re-stated, retention is not based solely on one's initial assignment, rather it is a combination of that assignment, personal characteristics and performance.

By way of explaining the lack of uniformity in retention and performance in Surface Warfare Officers assigned to different platforms, Bautista theorized that the possibility existed that "CARRIER and CLF officers lacked the required knowledge and experience that others gained onboard CRUDES and AMPHIB ships. Thus, a larger proportion of CARRIER and CLF officers who were promoted to LCDR may not have been able to compete well with other officers for mid-level career milestones such as selection for executive officer." (Bautista, 1996, p. 73). This hypothesis relates to Kear's above hypothesis that CRUDES platforms are the backbone of the surface fleet and offer broader opportunities and better qualified leadership to their crews and officers.

C. CAREER REQUIREMENTS ATTAINMENT

An officer's ability and desire to remain in the Surface Warfare community will be affected by his or her ability to achieve certain requirements along the path of their career. Failure to achieve certain career requirements as defined in the Military Personnel Manual (promotion, attainment of warfare qualification or satisfactory job completion, for example) result in mandatory separation for officers from the naval

service. To illustrate, if an officer with the requisite amount of time-in-service meets the other requirements for promotion and fails to promote after review by a promotion board, he must wait until the next board a year later. If he fails to promote before the second board, he is forced to separate from the service (MILPERSMAN, 1995).

Equally important to a Surface Warfare Officer's promotion concerns is his ability to achieve a warfare qualification (a SWO pin.) The SWO pin is in fact a requirement and an officer deficient in its attainment is issued a "Letter of Non-Attainment" by his commanding officer and typically transferred from the community. Bautista (1996) determined that officers initially assigned to amphibious platforms tended to stay in the Navy but transferred out of the Surface community at a higher rate than those assigned to other platforms. It remains unclear whether this is due to a failure to achieve career milestones or a developed distaste for the community. The Naval Officers Career Planning Guidebook (NAVPERS 15605) states that one must qualify as a SWO in order to have a career in the Surface Navy. Therefore, an officer unable to qualify or promote in the Surface Warfare community has had the retention decision made for him (since transfer can be approved only after qualification as a SWO) and the ACOL cost associated with separation from the service is a moot point.

D. PERSONAL CHARACTERISTICS

As important as any of the above mentioned factors to the retention decision, personal characteristics such as race, gender and undergraduate background may bear on an officer's decision to remain in the naval service. They also are relevant in the ACOL model (Warner and Goldberg, 1984). In a study of junior officer performance data for the Navy and Marine Corps, Mehay (1995) determined that minority officers receive

lower evaluations than non-minorities on their fitness reports. Further, he determined that not only were minority junior Surface Warfare Officers less likely to serve in a combatant ship (CRUDES or amphibious) but they also tended to serve on fewer numbers of those ships. The study also indicates that since undergraduate Grade Point Average (GPA) is a significant determinant of initial ranking within a year group, and since minorities are less likely to have a high GPA, they tend to be assigned to the "less desirable ships" (aircraft carriers and CLF.) The inference drawn is that minorities receive weaker performance ratings and are less likely to be SWO qualified due to their initial ship assignment. (Mehay, 1995). Implicit in these findings is that minorities are missing some of the earlier stated career requirements criteria and are therefore not being afforded the option to continue on in the Surface Warfare community based on the greater rate of performance deficiencies. Despite these findings, Mehay was unable to draw a causality between racial or ethnic status and performance as a Surface Warfare Officer.

Mehay (1995) did determine that the personal characteristics most likely to indicate a greater likelihood of retention in the Surface community were being married, having dependents, being female, and having graduated from the Naval Academy. For the most part, explaining these tendencies makes inherent sense. Being married and having dependents would force an individual to factor in more of the non-pecuniary benefits of remaining in the naval service (medical care, retirement pay) than an individual without dependents. The cost of leaving would be potentially greater to an officer with dependents, all other things equal. Also, having graduated from the Naval Academy being an indicator or increased retention potential is intuitive in that an

individual immersed in and successful at the culture of the Naval Academy would likely be able to successfully translate to the similar culture in the fleet. The question of increased female retention is explained through the Mehay data set. The data studied were 1,569 SWO's who appeared before the LCDR board from 1985-1990. At that time, women were not allowed to serve on combatant ships and were only in the Surface Warfare community on a voluntary basis. Women in the Navy from 1985 to 1990 were serving in support and non-combat roles. (This exclusion was lifted in 1992.) Therefore, a woman serving in the Surface fleet between 1985 and 1990 would have served solely on a CLF ship and one might assume, because of the voluntary nature of her service in a limited community, be very motivated to remain in the community.

Both Mehay (1995) and Bautista (1996) determined that high GPA (3.2 and above) indicated a decreased retention likelihood. However, one might draw the conclusion that with a higher undergraduate GPA, an individual may have a higher earnings potential in the civilian community (based on marketability and graduate education potential) and have a lower cost associated with separation in accordance with the ACOL model. Bautista (1996) determined that officers who were married at the Lieutenant level were more likely to separate than those who were married at commissioning. Intuitively, officers are promoted to the Lieutenant level at the four-year point. Therefore, an officer who had been married since commissioning would have an increased likelihood of having more than just a spouse as a dependent at the four year point and could have a larger cost associated with leaving the service. The newly married lieutenant with no children would have a lower cost of leaving, all other things equal.

Personal characteristics such as race, education, and gender have shown to affect the retention decisions of officers in the Surface community.

Why race especially matters in the retention and performance equation is difficult to quantify. In keeping with the Kear and Bautista theories, if according to Mehay, minority officers are more likely to be assigned to the less desirable platforms (carriers or CLF), this would tend to decrease the retention of minorities in the community. Finally, Mehay (1995) concedes the difficulty in drawing conclusions from the inconsistencies in minority performance from his descriptive models as follows:

> ...these models do not allow researchers to draw any inferences about possible *causality* between racial/ethnic status and performance. The multivariate models are purely *descriptive*, in that they attempt to statistically identify and compare the relative effects of different types of determinants on officer career outcomes. The search for causal relationships is considerably more complicated and typically calls for speculative conclusions. (Mehay, 1995, p.24)

Identifying causal relationships in these types of statistical analyses requires considerably more complex models. For one thing, the 'correct' specification of the estimating models is not clear because some variables may be endogenous to minority status. That is, some career outcomes may be made because individuals are minorities. The presence of endogenous variables requires a multiple equation model (see Neal and Johnson, 1996 for an analysis of this issue in the civilian labor market.) Secondly, there may be unobserved factors that affect several of the outcome measures and that are correlated with minority status. Again, statistical solutions generally require two stage econometric models, that to date have not been performed. (Phone Conversation w/ Dr. S. Mehay 3-3-00).

E. SUMMARY

To conclude, initial ship assignment is just one factor that has a bearing on the retention decision faced by junior Surface Warfare Officers. The retention decision is further compounded by an ability to assimilate into and qualify in the community, weighing the costs of continued service with the net "taste" of civilian life, and a myriad of personal characteristics many of which correlate with the above factors.

THIS PAGE INTENTIONALLY LEFT BLANK

III. DATA AND METHODOLOGY

This section outlines the data that were compiled and utilized to estimate the statistical relationships between the probability of remaining in the Surface Community for a career and specific explanatory variables. The variables are explained in this section. These relationships were modeled using binary logit analyses of different model specifications. A methodology review of this study comprises the remainder of this section.

A. DATA

The data file used for this analysis was obtained from Dr. William Bowman of the U.S. Naval Academy. Dr. Bowman constructed the "General Unrestricted Line Background-Performance Data File" from the Navy Officer Master File and portions of the Navy Officer Loss File. The merged file contains data on personal background, Navy career experiences, early promotion history and separation status of all officers in the Surface Warfare community who were reviewed by the 1981-1990 Lieutenant (O-3) promotion boards and the 1986-1995 Lieutenant Commander (O-4) promotion boards. Information from both promotion boards is essential to the data set since officers intending to resign from the Navy usually do so between the Lieutenant and Lieutenant Commander promotion boards. By examining data on the same officer over two boards, determining which officers left the Navy is simplified.

The data set covers essentially the entire population of officers in the Surface Warfare community who appeared before the above promotion boards for this period. Officers who were missing data on their career paths were excluded. Additionally, nuclear trained officers and females were filtered out of the data set. Nuclear-trained

Surface Warfare Officers were deleted because the retention patterns of nuclear-trained officers tend to differ from that of conventional Surface Officers and the focus of this study is the latter group. Women were excluded because during the periods this data covers, those serving in the Surface community were restricted to the Combat Logistics Force (CLF) branch of the community. Because women served voluntarily in the Surface community, they were more likely to remain in the community and would alter the results of the analysis. Men, on the other hand, were required to serve in a line officer billet upon commissioning and did not have the option of entering a staff or general unrestricted line billet like their female counterparts. If these men were excluded for some reason from either the aviation or submarine communities they were assigned to the Surface community. Therefore, the women chose the Surface community despite having other non-warfare options. Since women were required to serve in line officer billets beginning with Year Group (YG) 1994, future retention studies should include them. However, this study includes YG's 1977-1985, which encompasses the period when women were not required to serve in the surface fleet like their male counterparts. The resulting data loss from filtering out the above factors resulted in the initial 10,105 records being pared down to 7,354. See Appendix A for a detailed description of the records excluded from this study.

The factors used to predict retention behavior were classified into two major categories. The first category includes demographics and other Navy experience. The second category includes variables that describe an officer's experience in the fleet as a junior officer. The two categories and the variables included in each are displayed in Table 1. The variables shown in Table 1 were selected based on the factors that might

affect the decision to stay in the Surface community. Like the Warner and Goldberg Annualized Cost of Leaving (ACOL) model (1984), the assumption in the retention model used in this study is that the stay-leave decision is based on a comparison of the economic benefits associated with leaving versus the economic benefits associated with staying. Compensation is the same for members of the military at the same rank, so current military pay would not differentiate individuals in the data set. However, one who assesses his chances of promotion to be good – perhaps because of positive fitness reports or perceived "better" assignments may find the benefits of staying in the Surface community high relative to the costs. Conversely, future anticipated civilian pay and employment opportunity would be benefits that could be associated with leaving the military. No data is available on the civilian labor market opportunities or the earnings potential of the officers in the data set, but variables (undergraduate GPA, undergraduate major) are included that may influence one's post-military earning capacity. Additionally, more time with family might be a benefit associated with leaving the Surface community, but the loss of fringe benefits such as medical coverage and commissary privileges would be a cost of leaving. Therefore, dependent status is accounted for in the model.

Based on the data available, modeling retention in the Surface community cannot be completed using the formal ACOL framework. The model constructed for this research uses as many factors as are available in the data set that allow a comparison of the net benefits of leaving the Surface community. The ultimate goal is to provide policy makers with information that affects the policies (if any) that they can directly or indirectly change that might increase retention within the community.

Table 1. Factors Hypothesized to Affect Retention in the Surface Warfare Community

BASELINE RETENTION FACTORS (INDEPENDENT OF FLEET EXPERIENCE):

- Undergraduate Major
- Age at Commissioning
- Number of Dependents
- Undergraduate Grade Point Average
- Commissioning Source
- Ethnic Background

RETENTION FACTORS BASED SOLELY ON FLEET EXPERIENCE:

- Initial Ship Type Assignment
- Initial Department Assignment
- Percentage of Times Recommended for Accelerated Promotion as an O-1 or O-2
- Number of Billets Held as a Junior Officer
- Having Served on More Than One Ship as a Junior Officer
- Beginning One's Career as a Member of a Community Other than Surface Warfare

As seen in Table 1, the variables that are hypothesized to impact retention are basically divided among those that the Navy can control (fleet experience) and those that it cannot control (independent of fleet experience). While the Navy has essentially no control over these latter factors, one might assume that the Surface community could determine which officers it allows to serve in the community based on many of the variables examined in this study. However, the Navy policy with regards to line officer selection at commissioning is based on ranking the year group with respect to its peers. If a male officer selects a warfare community other than Surface Warfare (Aviation or Submarines) and is not qualified to be either an aviator or submariner, he is automatically assigned to be a Surface Warfare Officer, regardless of his other characteristics. This is also true of officers whose first choice is Surface Warfare; as long as they are physically qualified for a commission, they can serve in the Surface Warfare community. Simply stated, to say that the Navy has no control over the above fleet independent variables, is to say that by policy, the Navy has chosen to ignore those factors as critical to service in

the Surface Warfare community and allows officers to serve in it as long as they meet the minimum requirements of a commission. This is not true of the aviation and submarine (the two other large warfare) communities both of which require a more substantial screening process beyond simply qualifying for a commission.

B. VARIABLE DEFINITIONS

In order to better explain the variables used in the retention model, an overview of the explanatory and dependent variables, the reasons for their inclusion and hypothesized effects are provided in this section. Descriptive frequencies for each variable are included in Appendix B. Mean values for each variable are provided in each variable description.

1. Dependent variables

a. STAYSWO. The construction of the dichotomous variable for retention (STAYSWO) requires three key conditions. The officer must have remained on active service beyond the minimum service requirement (MSR), must have been promoted by the Lieutenant Commander board, and must have remained in the Surface community. Therefore, officers who have lateral transferred from the Surface community to another warfare or restricted line community but remain on active duty will be considered the same as those who separated from the service at MSR for this variable.

b. STAYNAV. The STAYNAV dichotomous variable is similar to the STAYSWO variable with one key exception. The officer must have been promoted to either Lieutenant (jg) or Lieutenant while in the Surface community, but be in another community at the time of his promotion by the Lieutenant Commander board. Officers

with a value of one for this variable would have stayed in the Navy, but transferred from Surface Warfare into another community.

c. LEAVERS. The LEAVERS dichotomous variable is simply those officers who were at one time in the Surface community but left the naval service completely before the O-4 board.

Table 2 provides descriptive statistics for the dependent variables. Note that 64% of officers leave the Surface community. The vast majority of these officers leave the Navy (52%) while 12% transfer to another community in the Navy.

Table 2. Descriptive Statistics of Dependent Variables

VARIABLE	CASES	MEAN VALUE	STD DEVIATION
STAYSWO	2626	.3571	.4792
STAYNAV	894	.1216	.3268
LEAVERS	3834	.5213	.4996

2. Explanatory Variables – Independent of Fleet Experience

As mentioned in the data section of this chapter, the baseline variables that are used in this thesis to predict retention are undergraduate major, age at commissioning, dependent status, undergraduate GPA, commissioning source, and race/ethnicity. They are described in detail below.

a. Undergraduate Major. The undergraduate major variable is broken into six categories: Biology/Physics/Pure Sciences, Math/Computer Science/Operational Analysis, Engineering, Social Sciences, Business/Economics, and Humanities. This variable is included to determine if the emphasis that the Navy places on an engineering and science background is important in explaining the retention of officers in the community. The Navy gives more weight to officers majoring in engineering when ranking them to select their warfare specialty. For example, if two soon-to-be

commissioned officers have identical records in terms of grades and recommendations, the one who majored in engineering or math or science will be ranked higher than the one who was an economics major. Undergraduate major is expected to be a significant factor in explaining separation since major selection may indicate one's "taste" factors for military service in accordance with the ACOL Model. (Warner and Goldberg 1984.) For example, an engineering major may be more prone to remain in the Navy based on its technical focus than a humanities major. Table 3 provides the percentages of the sample in each of the six majors. Note that approximately 45% of SWO's have a science, mathematics or engineering degree.

Table 3. Undergraduate Major Descriptive Statistics

VARIABLE	CASES	MEAN VALUE	STD DEVIATION
PURE SCIENCE	1094	.1488	.3559
MATH/COMP SCI	684	.09301	.2905
ENGINEER	1632	.2219	.1932
SOCIAL SCIENCE	1421	.1932	.3949
BUSINESS/ECON	1262	.1716	.3771
HUMANITIES	1261	.1715	.3769

b. Age. The age variable is based on the officer's age at commissioning. The mean age value of the officers in the data set is 23.63 with a standard deviation of 2.85. Since age is negatively correlated with one's mobility in the job market (Ehrenberg and Smith, 1993), those who are older at commissioning are more likely to remain in the Surface community.

c. Dependent Status. Dependent status for this variable determines how many (if any) dependents an officer had at the O-3 board. Since most officers' minimum service requirements expire at the four or five-year point, the decision to remain in the Navy is often made soon after the O-3 promotion. Therefore, dependent status at the

time of O-3 promotion is factored into the retention model. The dependent status variable is also broken into six categories: single/divorced, married/no children, married/1 child, married/2 children, married/3 or more children, and divorced/1 or more children. Dependent status is included to determine if an officer's family and its size affect the retention decision. Since Howell (1980) determined that too much family separation is the most common reason cited for separation from the Surface Warfare community, having a spouse and children could predict an increased likelihood of separation from the Surface community. Table 4 provides descriptive statistics on dependent status at the O-3 point. Note that approximately 53% of SWO's are single and approximately 82% do not have children.

Table 4. Dependent Status Descriptive Statistics

VARIABLE	CASES	MEAN VALUE	STD DEVIATION
SINGLE/ DIVORCED	3907	.5313	.4991
MARRIED – NO CHILDREN	2123	.2887	.4532
MARRIED – ONE CHILD	644	.08757	.2827
MARRIED – TWO CHILDREN	430	.05847	.2346
MARRIED – THREE OR MORE CHILDREN	152	.02067	.1423
DIVORCED – ONE OR MORE CHILDREN	98	.01333	.1147

d. GPA. The undergraduate grade point average variable is categorized into six groups: 0.0-2.0, 2.0-2.2, 2.2-2.5, 2.5-2.8, 2.8-3.3, 3.3-4.0. Each group is assigned a number from 0 to 5 (five being equivalent to 3.3-4.0). Based on the six groups numbered 0 to 5, the mean GPA value is 2.6644 with a standard deviation of .9435.

Since the Navy bases as much as 75% of its ranking of each graduating class on undergraduate grades (regardless of commissioning source) GPA is included in the retention model. Both Mehay (1995) and Bautista (1996) showed that officers with higher GPA's were more likely to separate than those with low GPA's. This could indicate that they enjoy a higher earnings potential in the civilian work force and thus a lower cost of leaving.

e. Commissioning Source. The commissioning source variable is grouped into four categories: U.S. Naval Academy (USNA), Reserve Officers Training Corps (ROTC), Officer Candidate School (OCS), and Enlisted Commissioning Programs or Other. No differentiation has been made between ROTC Scholarship students and ROTC Contract (non-scholarship) students due to a lack of data. Commissioning source is included to test whether the richer indoctrination of four years at the Naval Academy versus four years at a civilian institution (ROTC) or 13 weeks in OCS affects an officer's tendency to separate. Since the intense competition to be admitted and the rigorous demands of the Naval Academy would seem to demonstrate an officer's commitment to the naval service, attending the Naval Academy is expected to be positively associated with retention. Table 5 shows the descriptive statistics associated with commissioning source. Note that 43% of the officers in this data set was commissioned via OCS.

Table 5. Commissioning Source Descriptive Statistics

VARIABLE	CASES	MEAN VALUE	STD DEVIATION
USNA	1826	.2483	.4321
ROTC	2090	.2842	.4511
OCS	3170	.4311	.4953
ENLISTED/OTHER	268	.03644	.1874

f. Racial Background. Race is divided into white, black, and other minorities. This variable is included to try to determine if separation tendencies among minorities are similar to whites in the Surface community. If, as Mehay suggests, minorities have lower GPA's and are therefore being assigned to less desirable ships, then they would be expected to separate at a higher rate than whites. (Mehay, 1995). Table 6 shows that approximately 91% of the officers in this data set were white.

Table 6. Ethnic Background Descriptive Statistics

VARIABLE	CASES	MEAN VALUE	STD DEVIATION
WHITE	6701	.9112	.2845
BLACK	417	.0567	.2313
OTHER MINORITY	236	.03209	.1763

3. Explanatory Variables – Based on Fleet Experience

The variables hypothesized to affect retention that are based on an officer's fleet experience are initial ship type assignment, initial department assignment, percentage of Ensign and Lieutenant (junior grade) fitness reports in which the officer is recommended for accelerated promotion, the number of jobs held by the officer on his first ship(s), having served on more than one ship, and having begun one's career in a community other than Surface Warfare. These variables and their descriptive statistics are described in detail below.

a. Initial Ship Type Assignment. The initial ship type assignment is broken down as follows: Frigate, Cruiser, Destroyer, Larger Amphibious Ship (BIG AMPHIB includes LHA, LHD, LCC, LPH, LPD), Smaller Amphibious Ship (SMALL AMPHIB includes LSD, LKA, LST), Battleship, Minesweeper, Aircraft Carrier, and Combat Logistics Force (CLF- includes AD, AE, AS, AO, AOE, AFS). Bautista's research concluded that assignment to a cruiser, destroyer or frigate (CRUDES) platform

increased the retention likelihood whereas assignment to an aircraft carrier decreased the retention likelihood. (Bautista, 1996). The initial assignment variable used in this study is broken down into a larger number of ship types to determine more specifically which ship types affect retention. Bautista's conclusions were based on percentages of resignations by ship type. By disaggregating the ship category this study hopes to determine which ships (if any) affect retention when holding other factors equal. If CRUDES platforms are the most desirable (Mehay 1995), one would expect retention to be higher among officers beginning their career from those platforms. Table 7 shows the descriptive statistics associated with initial ship type assignment. Note that 51% of officers in this data set began their careers in either a frigate or a destroyer.

Table 7. Initial Ship Type Descriptive Statistics

VARIABLE	CASES	MEAN VALUE	STD DEVIATION
CARRIER	597	.08118	.2731
CRUISER	751	.1021	.3028
DESTROYER	2039	.2773	.4477
FRIGATE	1818	.2472	.4314
BATTLESHIP	57	.007751	.0877
BIG AMPHIB	646	.08784	.2831
CLF	757	.1029	.3039
MINSWEEPER	254	.03454	.1826
SMALL AMPHIB	747	.1016	.3021

b. Initial Department Assignment. The Initial Department Assignment variable is divided into three categories: Combat Systems/Weapons, Engineering, and Operations departments. No previous research has been conducted on the effect of one's initial department assignment as it relates to retention. This variable is included to determine if department assignment of newly commissioned officers affects their likelihood of retention. Based on the workload associated with operating the engineering plant of a ship, the large amount of work may decrease one's taste for the naval service

and reduce retention among officers starting in the engineering department. Table 8 shows the statistics associated with officers' initial shipboard department assignments. Note that less officers (28%) begin their careers in the operations department than engineering (36%) or combat systems (36%). The explanation behind this tendency is that the complexity associated with the operations department makes less of the billets within it available to a brand new Ensign just reporting to a ship.

Table 8. Initial Department Descriptive Statistics

VARIABLE	CASES	MEAN VALUE	STD DEVIATION
COMBAT SYSTEMS	2671	.3632	.4810
ENGINEERING	2603	.3540	.4782
OPERATIONS	2080	.2828	.4504

c. Percentage of Fitness Reports as an ENS or LTJG where Officer is Recommended for Accelerated Promotion (PRAP12). The PRAP12 variable is the ratio of fitness reports with a recommendation for accelerated promotion to the total number of valid fitness reports. The mean value of the PRAP12 variable is .2573 with a standard deviation of .3322. Officers are often told that the quality of their early fitness reports (at the O-1/O-2 level) has little bearing on their long-term promotion potential (O-5/O-6 level). However, no research has been conducted to determine if the quality of initial fitness reports has any bearing on officers' retention decisions. Since officers who are repeatedly recommended for accelerated promotion may have a higher taste for naval service, it is expected that they will tend to retain at a greater rate than those that do not receive as many recommendations for accelerated promotion.

d. Number of Jobs. The job number variable (JOBNUM) is defined as the number of billets the officer held in his initial sea tour(s). The mean value of the

JOBNUM variable is 1.7985 with a standard deviation of .7456. No research has been conducted on whether or not the number of billets an officer holds in his initial tour affects retention. This variable is included to test whether or not the Navy's current policy of assigning officers to more than one job might positively affect the retention/separation decision of officers in the Surface community. It is expected that being exposed to a wide array of billets will increase an officer's taste for the Navy and will increase his retention likelihood.

e. Serving on More Than One Ship. This variable (MT1S) is dichotomous and indicates whether or not the officer served in more than one ship as a junior officer. The mean value of MT1S is .1504 with a standard deviation of .3575. The current Navy policy requires that officers serve in two ships as division officers. However, this policy was put in place for YG's 1993 and above. This variable is added to determine if voluntarily serving in two ships increases retention likelihood. It is expected to be a positive contributor to retention as volunteering to serve another sea tour in a ship indicates an increased taste for the Navy.

f. Beginning Career in Community other than Surface Warfare. This variable (STRTOTH) is equal to one if the officer selected or was assigned to a non-Surface Warfare community at commissioning. These include Aviation, Submarines, General Unrestricted Line, or Staff/Restricted Line Officers. If the officer received a fitness report in one of the other communities as an Ensign, but appeared before either the Lieutenant or Lieutenant Commander board as a Surface Warfare Officer, he would be coded one for this variable. The mean value of the STRTOTH variable is .1222 with a standard deviation of .3276.

Officers who start their careers in communities other than Surface Warfare are often forced into Surface Warfare because of a failure to meet the standards of the other community. For example, failing out of Nuclear Power School or not qualifying as a naval aviator would require an officer to transfer to the Surface Warfare community. Since these officers initially selected another community and are mostly forced to transfer to the Surface community, it is expected that they will retain at a lower rate than those who started in the Surface community at commissioning.

C. METHODOLOGY

The purpose of this analysis is to empirically determine if certain factors affect the retention patterns of the Surface Warfare Community. This section of the chapter describes the specifications of the retention/separation models. Surface Warfare retention was modeled using binomial logit analysis since the STAYSWO dependent variable is dichotomous. Three basic logit models for retention were specified and estimated. The three basic models are detailed in Table 9.

Table 9. Retention Modeling Methodology

Baseline Logit Retention Model:
STAYSWO = f (Source, Ethnic, Undergrad Major, GPA, Age, Dependent Status)
Logit Retention Model With Fleet Experience:
STAYSWO = f (Initial Ship, Initial Department, % recommend accel promote, Number of Jobs, Serve on >1 Ship, Start in other Community)
Logit Retention Model With Fleet Experience and Baseline Variables:
STAYSWO =f (Source, Ethnic, Undergrad Major, GPA, Age, Dependent Status, Initial Ship, Initial Department, % recommend accel promote, Number of Jobs, Serve on >1 Ship, Start in other Community)

The assumption behind these models is that there may exist a correlation between some of the fleet-related factors and the non-fleet related factors so each set of variables should be examined separately. The combined model is constructed to see if any of those correlations exist and to examine whether or not a combination of the factors significantly affects the retention probability for the community. However, this analysis is an examination of the pooled data of those who stayed in the Surface community, those who transferred from it while remaining in the Navy and those who simply left military service. Since the model constructed above is essentially an economic one, the economic motivation behind the decision to leave the Surface community for the latter two groups could be vastly different, especially since the pay of individuals who do not leave the Navy will not change in another community.

Since those who leave the Surface community either leave the Navy entirely or transfer to another community within the Navy, two more analyses were undertaken to determine if the effect of the explanatory variables on transferring from the Surface Warfare community differs from their effect on leaving the Navy. The two separation models are displayed in Table 10.

Table 10. Separation Modeling Methodology

Probabilty of Transferring From SWO to other Community Model:
STAYNAV =f (Source, Ethnic, Undergrad Major, GPA, Age, Dependent Status, Initial Ship, Initial Department, % recommend accel promote, Number of Jobs, Serve on >1 Ship, Start in other Community)
Probabilty of Separating From the Navy Model:
LEAVERS =f (Source, Ethnic, Undergrad Major, GPA, Age, Dependent Status, Initial Ship, Initial Department, % recommend accel promote, Number of Jobs, Serve on >1 Ship, Start in other Community)

The binary logit regressions that were used to model these above equations used data slightly modified from the original database. In the case of transferring from the Surface community, those officers who separated from the military were filtered out of the database so the factors that contributed to a likelihood of transfer would be compared only to those who remained in the Surface community. Because of this, the data set for the probability of transfer regression included 3520 records. Similarly, in the separation from the Navy model, officers who transferred from the community but stayed in the Navy were filtered out so the factors indicating an increased probability of separation are being compared only to the officers who stayed in the Surface community. The modified data set for this model included 6460 cases. The mean values associated with these modified data sets are included in Appendix C. These models are constructed to estimate the variables that contribute to each type of separation from the Surface community. They should also help determine whether or not the decision process is similar or different for officers transferring from the Surface community versus leaving the Navy entirely. A likelihood ratio test is conducted to determine whether the models are different.

IV. ANALYSIS

This chapter uses logit analysis to analyze the effect of the selected explanatory variables on the probability of retention among Surface Warfare Officers. Retention probability is predicted using variables reflecting baseline demographic and personal background factors, variables reflecting experiences in the fleet, and then a combination of all of the explanatory variables. Separate retention models are estimated on two sub-samples, one including only those who separated from the Navy compared with those who stayed in the Surface community, the second including only those who transferred from the Surface community compared with those who stayed in the Surface Navy. This section provides the overall results of these models.

The tables provided in this chapter display the results of the logit estimates for each model. The chapter then discusses the significant variables. The tables also include the marginal effect of each variable. The marginal effect is provided since the binary logit coefficients do not indicate the impact of a small change in each independent variable on the dichotomous dependent variable. The marginal effects are computed so that the reader can see the effect of a change in the independent variable on the probability of the outcome (retention).

A. BASELINE HYPOTHESIZED RETENTION FACTORS

Table 11 displays the maximum likelihood estimates of the logit model for the baseline retention variables that reflect personal demographics. In this model, eight of the seventeen explanatory variables were statistically significant in predicting Surface Warfare retention. Majoring in engineering as an undergraduate negatively affects the likelihood of remaining in the Surface Warfare community to the O-4 promotion point.

Based on the marginal effect of this variable, majoring in engineering decreases an officer's retention probability by approximately .10 as compared with a pure science major. Similarly, a high undergraduate grade point average and being commissioned via OCS are also negatively associated with retention. While the marginal effect of the GPA variable is seemingly small (-.04) based on the set-up of the variable in the model this translates to an officer with a 2.2 GPA having a retention probability that is .20 greater than one with a 3.3 undergraduate GPA. (.43 versus .23). The marginal effect associated with being commissioned via OCS indicates that an OCS graduate's retention probability is .11 less than a Naval Academy graduate's. However, the older an officer is at commissioning, and having children (married or divorced) positively affect the probability of remaining in the Surface community. Age has a small (but significant) impact on retention probability. An officer's retention probability increases .02 for every year of age at commissioning. The number of children an officer has increases the marginal effect by as little as .07 to as much as .13 depending on how many children he has at the O-3 point (compared to a single officer).

Table 11. Baseline Retention Model Regression Results

VARIABLE	MARGINAL EFFECT	LOGIT COEFFICIENT	STANDARD DEVIATION	SIGNIFICANCE
FOR UNDERGRADUATE MAJOR: PURE SCIENCE MAJOR =REFERENCE CATEGORY				
MATH COMP-SCI MAJOR	-.0317	-.1390	.1059	.1891
ENGINEERING MAJOR	-.1048	-.4597	.0869	.0000
SOCIAL SCIENCE MAJOR	.0230	.1010	.0845	.2318
BUSINESS/ECON MAJOR	-.0195	-.0857	.0878	.3291
HUMANITIES MAJOR	-.0233	-.1020	.0894	.2542
AGE AT COMMISSIONING	.0201	.0880	.0125	.0000
FOR DEPENDENT STATUS: SINGLE/DIVORCED = REFERENCE CATEGORY				
MARRIED/ NO CHILDREN	.0205	.0899	.0579	.1203
MARRIED W/ ONE CHILD	.0753	.3300	.0911	.0003
MARRIED W/ TWO CHILDREN	.1293	.5667	.1130	.0000
MARRIED W/ THREE (+) CHILDREN	.1361	.5965	.1799	.0009
DIVORCED W/ ONE (+) CHILDREN	.1212	.5313	.2137	.0129
UNDERGRAD GPA	-.0437	-.1915	.0276	.0000
FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY				
COMMISIIONED VIA ROTC	-.0094	-.0414	.0691	.5490
COMMISSIONED VIA OCS	-.1093	-.4792	.0794	.0000
ENLISTED COMMISSION	.0059	.0258	.1533	.8663
FOR RACE/ETHNICITY: WHITE = REFERENCE CATEGORY				
BLACK	-.0064	-.0281	.1070	.7929
OTHER MINORITY	-.00434	-.1921	.1447	.1841
CONSTANT		-1.9340	.2900	.0000
CHI SQUARE:	281.870	**-2 LOG LIKELIHOOD:**	9303.662	**SAMPLE SIZE:** 7354

B. MODEL INCLUDING FLEET EXPERIENCE VARIABLES

Table 12 shows the results from estimating the fleet experience model. In this model, only five of the fourteen variables associated with early career fleet experience are statistically significant (at the .05 level or better) in terms of predicting the retention probability. However, two more variables are significant at the .10 level. Based on this model, serving initially in a cruiser, a destroyer, or a smaller amphibious ship (compared to the reference variable frigate) positively contributes to an increase in the retention probability. Based on the computed marginal effects, cruiser, destroyer and smaller amphibious ship service increases the retention probability by .06, .03, and 0.6, respectively. Additionally, the more times an officer is recommended for accelerated promotion as an Ensign and Lieutenant (JG) the higher his probability of retention. While the marginal effect of the PRAP12 variable seems larger compared with the other marginal effect magnitudes (.23) it represents the probability difference between an officer who never gets recommended for accelerated promotion as compared with one who gets recommended for accelerated promotion on every fitness report. The only statistically significant variable negatively associated with retention is an officer beginning a career in a non-Surface community and transferring to the Surface community. Having transferred into the Surface community decreases the retention probability by .04.

Table 12. Navy Experience Retention Model Regression Results

VARIABLE	MARGINAL EFFECT	LOGIT COEFFICIENT	STANDARD ERROR	SIGNIFICANCE LEVEL
FOR INITIAL SHIP: FRIGATE = REFERENCE CATEGORY				
CARRIER	.0153	.0670	.0994	.5001
CRUISER	.0602	.2636	.0901	.0262
DESTROYER	.0373	.1631	.0663	.0205
BATTLESHIP	.0887	.3884	.2742	.1567
BIG AMPHIB	.0052	.0226	.0961	.8143
CLF	-.0124	-.0542	.0914	.5531
MINESWEEP	-.0015	-.0067	.1416	.9622
SMALL AMPHIB	.0621	.2720	.0892	.0023
FOR INITIAL DEPARTMENT: OPERATIONS = REFERENCE CATEGORY				
COMBAT SYSTEMS DEPARTMENT	.0051	.0222	.0630	.7244
ENGINEERING DEPARTMENT	.0101	.0443	.0631	.4829
% OF FITREPS RECC FOR ACCEL PROMOTE	.2347	1.0272	.0743	.0000
NUMBER OF J.O. BILLETS HELD	.0136	.0596	.0341	.0805
SERVE IN MORE THAN 1 SHIP	.0302	.1323	.0742	.0747
START IN COMMUNITY OTHER THAN SWO	-.0351	-.1536	.0769	.0457
CONSTANT		-1.1053	.0870	.0000
CHI SQUARE:	233.162	**-2 LOG LIKELIHOOD:**	9352.370	**SAMPLE SIZE:** 7354

C. COMBINED BASELINE/FLEET EXPERIENCE RETENTION MODEL

In order to best estimate the retention factors examined in the above models and to test whether the factors in the two distinct models above were correlated with one another, a single model was estimated with all the variables included. Table 13 displays the variables from the combined baseline and fleet experience logit retention model.

Most variables that are significant in the individual models are also significant in the combined model. Majoring in engineering, having a higher GPA and being an OCS graduate are still negatively associated with retention in the Surface community. The marginal effect of majoring in engineering (compared to pure science) is -.10, the same effect as in the baseline model. The negative marginal effects of higher GPA and being commissioned via OCS (-.05 and -.09 respectively) are within .02 of their coefficients in the baseline model. Serving initially in a cruiser or destroyer, and the more times an officer is recommended for accelerated promotion in his first four years of service are positively associated with retention. Additionally, officers having children (married or divorced), and age at commissioning are positive predictors of the retention probability in the Surface community. Having children has a marginal effect of between 05 and .11, depending on number of children and marital status. The age at commissioning variable still exerts a small, but significant positive effect on retention probability with a .02 increase for every year older an officer is at commissioning. The two variables that are no longer significant at the .05 level in this model are serving an initial tour in a smaller amphibious ship and starting one's career in a community other than Surface Warfare.

In order to test whether or not the combined model explains the retention decision better than the baseline or fleet experience model alone, a log likelihood ratio test was

conducted. This tests the null hypothesis that adding the fleet experience variables does not significantly improve the predictive power of the model as compared to the baseline model. In this case, the difference between the –2 Log Likelihood statistics (9303.662 for the baseline model and 9056.140 for the combined model) was greater than the critical chi-square statistic for the baseline model (17.6 in this case). Therefore, the null hypothesis is rejected and the conclusion that adding Navy experience in the combined model increases the explanatory power of the retention model is accepted.

Table 13. Combined Baseline and Fleet Experience Retention Model Results

VARIABLE	MARGINAL EFFECT	LOGIT COEFFICIENT	STANDARD ERROR	SIGNIFICANCE LEVEL
FOR INITIAL SHIP: FRIGATE = REFERENCE CATEGORY				
CARRIER	-.0054	-.0239	.1023	.8150
CRUISER	.0609	.2685	.0923	.0036
DESTROYER	.0460	.2028	.0679	.0028
BATTLESHIP	.0952	.4197	.2809	.1350
BIG AMPHIB	-.0195	-.0859	.0989	.3849
CLF	-.0294	-.1297	.0939	.1670
MINESWEEP	-.0088	-.0390	.1450	.7879
SMALL AMPHIB	.0329	.1450	.0915	.1129
FOR INITIAL DEPARTMENT: OPERATIONS = REFERENCE CATEGORY				
COMBAT SYSTEMS DEPARTMENT	.0010	.0045	.0644	.9443
ENGINEERING DEPARTMENT	.0157	.0692	.0646	.2845
% OF FITREPS RECC FOR ACCEL PROMOTE	.2458	1.0838	.0770	.0000
NUMBER OF J.O. BILLETS HELD	.0123	.0544	.0349	.1190
SERVE IN MORE THAN 1 SHIP	.0319	.1405	.0760	.0646
START IN COMMUNITY OTHER THAN SWO	-.0232	-.1021	.0806	.2053
FOR UNDERGRADUATE MAJOR: PURE SCIENCE = REFERENCE CATEGORY				
MATH COMP-SCI MAJOR	-.0330	-.1453	.1078	.1775
ENGINEERING MAJOR	-.1144	-.5044	.0885	.0000
SOCIAL SCIENCE MAJOR	.0166	.0734	.0861	.3940
BUSINESS/ECON MAJOR	-.0336	-.1480	.0895	.0982
HUMANITIES MAJOR	-.0242	-.1067	.0913	.2421
AGE AT COMMISSIONING	.0219	.0964	.0128	.0000
FOR DEPENDENT STATUS: SINGLE/DIVORCED = REFERENCE CATEGORY				
MARRIED/ NO CHILDREN	.0104	.0458	.0591	.4389
MARRIED W/ ONE CHILD	.0562	.2480	.0931	.0077
MARRIED W/ TWO CHILDREN	.1142	.5035	.1153	.0000
MARRIED W/ THREE (+) CHILDREN	.1149	.5068	.1835	.0058
DIVORCED W/ ONE (+) CHILDREN	.0971	.4283	.2183	.0498

VARIABLE	MARGINAL EFFECT	LOGIT COEFFICIENT	STANDARD ERROR	SIGNIFICANCE LEVEL
UNDERGRAD GPA	-.0542	-.2391	.0287	.0000
FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY				
COMMISSIONED VIA ROTC	.0065	.0288	.0709	.6852
COMMISSIONED VIA OCS	-.0933	-.4112	.0825	.0000
ENLISTED COMMISSION	.0128	.0565	.1579	.7204
FOR RACE/ETHNICITY: WHITE = REFERENCE CATEGORY				
BLACK	.0217	.0958	.1088	.3789
OTHER MINORITY	-.0263	-.1159	.1468	.4298
CONSTANT		-2.5188	.3091	.0000
CHI SQUARE:	529.392	**-2 LOG LIKELIHOOD:**	9056.140	**SAMPLE SIZE:** 7354

D. LOGIT MODEL OF DECISION TO TRANSFER FROM SURFACE COMMUNITY

Since this study is basically constructed on an economic model of retention, it is designed to explain the choice of staying in the military versus leaving for the civilian sector. However, economic factors would not necessarily explain the choice of leaving the Surface community but staying in the Navy via a community transfer. Therefore, separate models of separation from the Navy entirely versus one of transferring from the Surface community were also estimated. Of the 7354 officers in this data set, 2626 (35.7%) remained in the Surface community, 894 (12.2%) transferred to another community, and 3834 (52.1%) resigned from the Navy. Table 14 displays significant variables affecting the decision to transfer out of the Surface Warfare community, but remain in the Navy. The comparison group for this model are those who remained in the Surface community. Officers who resigned from the naval service are excluded from the data set used for this model so only those who transferred from the Surface community are compared with those who stayed in the Surface community.

Overall, the model does not appear to predict the transfer rate very well as only six variables are significant at the .05 or better level. However, another six variables are significant at the .10 level. In Table 14, the significant factors that predict the transfer decision are majoring in engineering, being married with no children, or being commissioned via an enlisted commissioning program. Based on the marginal effects of these variables, engineering majors have .10 higher transfer probability than pure science majors. Married officers with no children have a .03 higher probability of transferring and prior enlisted officers have a .10 higher transfer probability than U.S. Naval

Academy graduates. The higher an officer's undergraduate grade point average, the more likely he is to remain in the naval service, yet transfer from the Surface community. Again, based on marginal effects, the seemingly small marginal effect associated with GPA translates to an officer with a 3.3 undergraduate GPA having a .20 higher transfer probability than an officer with a 2.2 undergraduate GPA. (.38 versus .18). The age of an officer at commissioning is negatively associated with the likelihood of transferring from the Surface community within the Navy. This effect is very small, however, since the transfer probability decreases just .01 for every year of age at commissioning. Social science majors have a .07 smaller probability than pure science majors of transferring from the Surface community. It is interesting that those who serve on carriers and cruisers, and those who serve in the combat systems department are less likely to transfer out of the SWO community. The carrier, cruiser, and combat systems coefficients are significant at the .10 level.

Table 14. Logit Model of Decision to Transfer From Surface Community

VARIABLE	MARGINAL EFFECT	LOGIT COEFFICIENT	STANDARD ERROR	SIGNIFICANCE
FOR INITIAL SHIP: FRIGATE = REFERENCE CATEGORY				
CARRIER	-.0565	-.3089	.1743	.0764
CRUISER	-.0475	-.2595	.1473	.0782
DESTROYER	-.0271	-.1483	.1044	.1554
BATTLESHIP	-.0870	-.4753	.5011	.3428
BIG AMPHIB	-.0066	.0360	.1558	.8174
CLF	-.0016	.0086	.1491	.9543
MINESWEEPER	-.0253	-.1383	.2354	.5568
SMALL AMPHIB	-.0323	-.1746	.1484	.2347
FOR INITIAL DEPT: OPERATIONS = REFERENCE CATEGORY				
COMBAT SYSTEMS	-.0368	-.2011	.1031	.0510
ENGINEERING	-.0163	-.0890	.1000	.3733
% RECC FOR ACCEL PROMOTE	.0285	.1559	.1164	.1803
NUMBER OF BILLETS	-.0037	-.0203	.0554	.7142
MORE THAN 1 SHIP	-.0277	-.1513	.1251	.2263
START IN COMMUNITY OTHER THAN SWO	-.0290	-.1586	.1264	.2097
FOR UNDERGRADUATE MAJOR: PURE SCIENCE = REFERENCE CATEGORY				
MATH/COMPSCI	.0404	.2207	.1590	.1652
ENGINEERING	.0919	.5020	.1305	.0001
SOCIAL SCIENCE MAJOR	-.0727	-.3972	.1412	.0049
BUSINESS ECONOMICS MAJOR	-.0354	-.1937	.1467	.1867
HUMANITIES MAJOR	-.0451	-.2522	.1524	.0981
AGE @ COMMISS	-.0123	-.0670	.0210	.0014
FOR DEPENDENT STATUS SINGLE/DIVORCED = REFERENCE CATEGORY				
MARRIED NO CHILD	.0344	.1880	.0936	.0445
MARRIED 1 CHILD	.0435	.2379	.1413	.0923
MARRIED 2 CHLDRN	.0073	.0400	.1752	.8192
MARRIED 3+ CHLDRN	.0688	.3762	.2497	.1318
DIVORCED 1+ CHLDRN	.0362	.1981	.3141	.5282
UNDERGRAD GPA	.0532	.2910	.0448	.0000
FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY				
ROTC GRADUATE	-.0372	-.2035	.1094	.0629
OCS GRADUATE	-.0164	-.0896	.1306	.4926
ENLISTED COMMISSION	.0959	.5242	.1981	.0081
FOR RACE/ETHNICITY: WHITE = REFERENCE CATEGORY				
BLACK	.0005	.0025	.1785	.9887
OTHER MINORITY	.0344	.1882	.2221	.3968
CONSTANT		-.0872	.4954	.8602
CHI SQUARE:	192.936	**-2 LOG LIKELIHOOD:**	3989.3046	**SAMPLE SIZE:** 3520

E. LOGIT MODEL OF RESIGNATION DECISION

Table 15 displays the variables from the separation model predicting probability of separating from the naval service versus staying in the Surface community. For this model, those officers who separated are only compared with those who remained in the Surface community to the O-4 point. Officers who transferred fro the Surface community yet stayed on active service in another community are excluded from this model's data set.

Overall, fourteen explanatory variables are significant at the .05 or better level. The explanatory variables associated with an increased likelihood of separating from the Navy are starting one's career in a non-SWO community, majoring in engineering, or economics as an undergraduate, or being commissioned via OCS. Reviewing the marginal effects of these variables, transferring into the Surface community after commissioning increases the likelihood of resignation by .05, majoring in engineering or economics increases the resignation likelihood by .11 and .05, respectively, as compared with pure science majors, and being commissioned via OCS increases resignation likelihood by .13 compared with Naval Academy graduates. Additionally, the higher an officer's undergraduate grade point average, the more likely he is to separate from the Navy. Based on marginal effect, this again translates to a .20 higher resignation probability between a 2.2 undergraduate GPA officer and one with a 3.3 grade point average. (.51 versus .71).

The factors that are negatively associated with leaving the Navy entirely are initially serving in a cruiser or destroyer, having any children or having been commissioned via an enlisted commissioning program. Serving in a cruiser or destroyer

lessens the probability of resigning by .06 and .05, respectively, as compared with an officer initially serving in a frigate. Being a parent decreases the separation rate by between .08 and .20 depending on number of children and marital status. Officers commissioned via an enlisted commissioning program are less likely to resign than Naval Academy graduates. The older an officer is, the less likely he is to separate, but this small effect only accounts for a .02 separation likelihood decrease for each year of age at commissioning. The more times an officer is recommended for accelerated promotion, the less likely he is to resign from the naval service. Based on the marginal effect of this variable, an officer who has never been recommended for accelerated promotion at the O-1 or O-2 level has a separation probability .35 higher that one who is recommended for accelerated promotion on every O-1 an O-2 fitness report.

Table 15. Logit Model of Resignation Decision

VARIABLE	MARGINAL EFFECT	LOGIT COEFFICIENT	STANDARD ERROR	SIGNIFICANCE
FOR INITIAL SHIP: FRIGATE = REFERENCE CATEGORY				
CARRIER	.0245	.1021	.1073	.3413
CRUISER	-.0641	-.2670	.0938	.0066
DESTROYER	-.0496	-.2064	.0722	.0043
BATTLESHIP	-.0941	-.3918	.2973	.1874
BIG AMPHIB	.0263	.1094	.1048	.2966
CLF	.0407	.1693	.0993	.0882
MINESWEEPER	.0153	.0636	.1534	.6784
SMALL AMPHIB	-.0298	-.1242	.0971	.2012
FOR INITIAL DEPARTMENT: OPERATIONS = REFERENCE CATEGORY				
COMBAT SYSTEMS	.0075	.0314	.0683	.6456
ENGINEERING DEPT	-.0166	-.0691	.0688	.3149
% RECC FOR ACCEL PROMOTE	-.3504	-1.4593	.0851	.0000
NUMBER OF J.O. BILLETS	-.0148	-.0617	.0371	.0965
MORE THAN 1 SHIP	-.0319	-.1330	.0810	.1005
START IN COMM OTHR THAN SWO	.0488	.2033	.0858	.0179
FOR UNDERGRADUATE MAJOR: PURE SCIENCE = REFERENCE CATEGORY				
MATH/COMPSCI	.0326	.1359	.1165	.2436
ENGINEERING	.1121	.4670	.0944	.0000
SOCIAL SCIENCE	-.0018	-.0076	.0911	.9331
BUSINESS/ECONOMICS	.0535	.2230	.0947	.0185
HUMANITIES	.0410	.1706	.0962	.0761
AGE AT COMMISSIONING	-.0249	-.1035	.0137	.0000
FOR DEPENDENT STATUS: SINGLE/DIVORCED = REFERENCE CATEGORY				
MARRIED NO CHILD	-.0199	-.0830	.0624	.1836
MARRIED 1 CHILD	-.0831	-.3461	.1009	.0006
MARRIED 2 CHILDREN	-.1616	-.6728	.1280	.0000
MARRIED 3(+) CHLDREN	-.2006	-.8353	.2209	.0002
DIVORCED 1(+)CHILDRN	-.1429	-.5953	.2488	.0167
UNDERGRADUATE GPA	.0546	.2272	.0304	.0000
FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY				
ROTC GRADUATE	.0075	.0314	.0751	.6760
OCS GRADUATE	.1274	.5307	.0874	.0000
ENLISTED COMMISSION	-.2293	-.9548	.2185	.0000
FOR RACE/ETHNICITY: WHITE = REFERENCE CATEGORY				
BLACK	-.0319	-.1330	.1154	.2492
OTHER MINORITY	.0206	.0875	.1557	.5742
CONSTANT		2.5037	.3326	.0000
CHI SQUARE:	731.748	**-2 LOG LIKELIHOOD:**	7996.487	**SAMPLE SIZE:** 6460

Based on the chi square, the model seems to fit the data well. However, the log likelihood ratio test is again required to test the null hypothesis that there exist no differences between the coefficients of the transfer model and the separation model. The difference in the –2 Log Likelihood values for the separation and transfer models (7996.487 for separation and 3989.3046 for transfer) is far greater than the critical chi-square value for a model with 31 degrees of freedom (approx. 18.5). Therefore the null hypothesis that there is no difference in the models is rejected; the test indicates that the models are not the same and should be estimated separately.

The transfer and separation models were constructed to determine if differences exist between the decision to resign from the naval service and to transfer within the Navy. The results indicate that there are both differences and similarities in the decision behind the two paths to leave the Surface community. Officers with higher GPA's and engineering majors are likely to leave the Surface community via a transfer or resignation. Older officers are less likely to leave the Surface community, but based on the marginal effects of this variable in both models, age exerts a very small effect.

The differences in the models include dependent status and commissioning source. Officers who have children are likely to stay in the Surface community and officers who are married with no children are likely to transfer form the Surface community when compared with single or divorced officers without children. Officers commissioned via OCS are more prone to resign from the naval service altogether whereas officers commissioned via an enlisted commissioning program are likely to remain in the Navy but transfer from the SWO community (as compared to Naval Academy graduates).

As seen in the retention models, serving initially in a cruiser or destroyer and the more times an officer is recommended for accelerated promotion indicate a greater probability of remaining in the Surface community to the O-4 point. All of these variables predict a reduced separation likelihood from the Surface community.

THIS PAGE INTENTIONALLY LEFT BLANK

V. CONCLUSIONS AND RECOMMENDATIONS

This study focused on determining the factors that predict retention in the Surface Warfare Community to the O-4 promotion review. The ultimate goal of this study is to provide policy makers with information that affects the policies that they can directly or indirectly change to increase retention within the Surface community. The study found several factors that are important in explaining individual retention/separation decisions. The significant factors and an attempt to explain them are provided below. Recommendations are then made about whether the Surface community should consider altering some of its recruiting, detailing or assignment procedures.

A. RETENTION CONCLUSIONS

1. Initial assignment in a cruiser or destroyer is conducive to retention in the surface community. Previous retention studies have lumped together cruisers, destroyers and frigates in a "CRUDES" category to examine the retention decision. The results of this analysis indicate that this is not entirely appropriate. Officers initially assigned to cruisers and destroyers tend to retain at a higher rate than those assigned to frigates and to other platforms.

There are multiple explanations for these relationships. The first is for the time period examined in this study, many of the KNOX-class frigates in which officers were serving were Naval Reserve Force (NRF) ships. (This is true for many of the PERRY-class frigates in the current fleet). Service on a reserve ship is substantially different than service on an active fleet ship. Only one-third of the crew of a reserve frigate is permanently assigned to the ship and active duty officers analyzed in this study are part of the permanent crew. The other two-thirds of the crew are Naval Reservists fulfilling

their reserve duty commitment on weekends and two-week training periods. Therefore, the workload/operating schedule of an officer assigned to an NRF frigate (who often works weekends with only a third of the ship's crew complement) is far different than his peers on active ships. There is no way to glean from the data which frigates were reserve and which were active at the time the officers served on them, so they are grouped together in the data. Therefore, the separation tendencies of officers assigned to reserve frigates could differ from those serving on active duty frigates.

While the above explains the difference between initial service in a frigate compared with a cruiser or destroyer, it does not explain why the retention tendencies associated with initial cruiser and destroyer tours vary so greatly from the other ship types in the fleet. That answer could lie in the perceived image of cruisers and destroyers and in the size of the ships. Cruisers and destroyers are regarded in the Surface community as the most prestigious ship assignments. Whether true or false, cruisers and destroyers are perceived to provide officers and sailors with greater challenges. Consequently, the more able commanders may be assigned to cruisers and destroyers and thus foster an environment within the ship that is more conducive to a positive perception of the Navy by a junior officer in his first tour. Cruisers and destroyers are also reasonably small ships (crew size of 350 vice 3200 on an aircraft carrier) and offer more of an intimate environment in the wardroom setting. This allows more personal attention and training of junior officers by the potentially more capable commanders and could positively influence officers' career plans in the Navy.

Another explanation for the positive retention effect of cruisers and destroyers could be the officers who are selecting them from various commissioning sources.

Because cruisers and destroyers are usually selected near the top ranks of the commissioned year group, this could indicate that those with the greater "taste" for the naval service (as evidenced by their high performance in relation to their peers at their commissioning source) are selecting these ships. This suggests that those who serve in these ships are already motivated for longer service in the Navy. That motivation, coupled with the influence of good commanding officers could sway a borderline officer to stay in the Surface Navy.

2. The older an officer is at commissioning, the more likely he is to remain in the Surface community for a career. As seen in the analysis section of this study, the effect of age is very small. However, the effect is significant and could be explained by the time in their lives in which the officers are moving into commissioning sources. Officers who are commissioned later than the average (23.6 years old for this data set) have likely held some other job prior to joining the Navy. This provides them with more information on what life is like in the civilian sector. Those commissioned at the average age or below have likely never worked in the civilian sector and joined the Navy with little knowledge of other opportunities. Those who join the Navy later have developed a distaste for something other than the Navy and have gone to it as a better option. Those commissioned earlier have only the Navy for which to develop a distaste.

3. Officers with children (married or divorced) are more likely to remain in the Surface community than their married or single counterparts without children. The explanation behind this retention factor may lie in the cost associated with leaving the military as the number of dependents of a service member increases. Because of the structure of military compensation, i.e., commissary and exchange privileges, medical

coverage, housing allowances, etc., the value of benefits increases as the number of family members increases. Additionally, housing allowances are tax-free and no state sales tax is associated with purchases made at the commissary or exchange. Government housing is also larger for officers with multiple children as compared with those with one or no children. Therefore, the cost associated with leaving the Navy increases with the number of dependents.

Though the increased benefits associated with more dependents would explain why an officer would remain in the Navy, it does not explain why officers would remain in the Surface community. The possible explanation of this lies in the process associated with transfer from the Surface community. In order to transfer from the Surface community to another community in the Navy, an officer must submit a "transfer package." This package is a complex collection of recommendations, past fitness reports and service records that must be submitted to a board that decides which officers it will allow into other communities. The daunting size of the transfer package and the fact that not all transfer packages are approved often discourages officers interested in transferring communities. The transfer model indicates that married officers are more likely to remain in the Navy but transfer from the Surface community than single officers. Again, the officers who stay in the Surface community may be trying to transfer in some cases, but have their transfer package rejected. This could explain why officers with children who might be interested in transferring stay in the Surface community.

Another possible explanation for this phenomenon is that officers who separate from the service can usually expect a decrease in pay during the first year or two in the

civilian work force. Accepting a pay decrease attaches a much greater cost to leaving the Navy as the number of dependents for whom an officer is responsible increases.

4. The more times an officer is recommended for accelerated promotion as a junior officer (O-1/O-2) the more likely he is to remain in the Surface community. Officers in this data set on average, were recommended for accelerated promotion about one-quarter of the time. While it is common for junior officers to be told that early fitness reports have little bearing on long-term promotion potential, higher quality fitness reports seem to have a distinct bearing on retention. This result seems intuitive. The more positive early feedback on an officer's performance, the more likely he is to remain in the community. In 1999, the Navy determined that Ensign and Lieutenant (junior grade) officers would no longer be eligible to be recommended as an early promote or must promote, officer on their fitness reports. Instead all Ensigns and Lieutenant (jg)'s are given the grade of promotable regardless of their performance in relation to their peers. Traditionally, the promotion status portion of the fitness report was the principal means junior officers used to compare their performance against that of their peers. The promotion recommendation category of the fitness report was also the means by which the officer knew that future promotion boards would consider how he had performed in relation to his peers. The officer can still get positive feedback from his chain of command on his performance under the current system, but to a promotion board, his fitness report looks remarkably similar to the officer's ahead of whom he would have been ranked under the previous system. However, examination of this data set reveals that only 46.3% (3405 out of 7453 officers) were ever recommended for accelerated promotion during their first four years. Therefore, 53.7% of this data set (3949 officers)

never felt the positive benefits of a recommendation for accelerated promotion. The Navy policy may have been changed in order to encourage greater effort from all officers rather than discouraging a significant portion of them. The question remains, how this policy will affect retention now that one of the most significant early predictors of retention has been removed from use in the fleet.

5. The higher an officer's undergraduate grade point average, the less likely he is to remain in the Surface community to the O-4 point. This factor's influence on retention may be explained by virtue of greater potential an officer with a high grade point average has to be accepted to an upper tier graduate school or to be hired in the civilian labor force. Undergraduate grade's positive influence on probability of transfer may be explained by some of the shore based research or intelligence opportunities that allow naval officers to use their undergraduate education in a more practical application than the Surface community. This variable poses a problem to the Surface Navy, however, as the multiple for ranking new graduates from the various commissioning programs is heavily based (at least 75%) on undergraduate GPA. Therefore, based on this ranking, the Navy is placing officers at the top of each year group who have a greater likelihood of leaving the Surface community either via transfer or separation. Stated simply, based on the current ranking system of newly commissioned officers, the Navy allows those with a greater likelihood of separating from the Navy and the Surface community (based on GPA) to select the most prestigious ships and billets for their initial tour. This implication is disconcerting. Newly commissioned officers with the highest GPA's are usually more likely to pick cruisers and destroyers for their first tour (Bautista, 1996). If officers with high GPA's are leaving the Navy from ships that would otherwise likely

retain officers with middle to low GPA's, the Navy could be wasting the positive effect of initially serving in a cruiser or destroyer on officers who would likely leave the Navy anyway. To illustrate, the average officer has a retention probability .06 higher if he is initially stationed in a cruiser. However, he has an approximately .10 lower retention probability if he has a 3.3 GPA or higher. Therefore, an officer with a 2.2 undergraduate GPA serving initially in a cruiser has a .26 higher retention probability than an officer with a 3.3 GPA initially stationed in a frigate. The Navy, however, must weigh the costs of higher retention against the benefit of stationing seemingly more capable officers (based on GPA) on its critical capital ships (cruisers and destroyers).

6. An officer who majored in engineering as an undergraduate is not likely to remain in the Surface community. Like higher GPA, the marketability of an officer with an engineering degree may lead to broader opportunities for him in the civilian labor force and increase his likelihood of separation. An engineering major is also more likely to transfer from the Surface community. This may again be caused by some of the opportunities to better use an engineering degree in communities other than Surface Warfare. Based on the age of this data set, the same effect would likely be seen for computer science and math majors in today's fleet. This phenomenon poses a problem to the Navy similar to the effect of high GPA. The Navy encourages officers to major in science and engineering. For example, the Naval Academy is made up of 40% engineering majors and the Navy gives more weight to the record of an engineering major than a non-engineering major. This effect is realized when officers are ranked at commissioning to select their warfare communities or ships in the case of the Surface community. If two officers' records are alike in all aspects except for undergraduate

major, the one who majored in engineering will be ranked higher than the science or liberal arts major. Similarly to GPA, the Navy bases assignment on a factor that is negatively associated with retention.

7. Being commissioned via Officer's Candidate School (OCS) is an indicator that an officer is less likely to remain in the Surface community for a career. This result may be explained by the exposure an officer has to the naval service prior to his commissioning. A Naval Academy graduate has been immersed in a military environment for four years prior to his commissioning and would have had to develop some taste for the naval service to graduate from the Academy. An ROTC graduate would have spent four years in college with the knowledge that they would be commissioned at graduation and have had time to explore what that meant. This would include summers assigned to the fleet and weekly ROTC courses during four years of college. An OCS graduate, on the other hand, would have had little to no exposure to the Navy prior to attending OCS for 13 weeks and being commissioned. While an OCS graduate would have the baseline knowledge necessary to be commissioned, he might not have had sufficient time to develop a real taste for the Navy lifestyle. He might also not have realized exactly what the job entailed before he signed on with a recruiter and joined the Navy. This result reinforces that the money spent on commissioning Naval Academy and ROTC graduates by the Navy tends to pay off with regards to retention.

8. There are differences in the separation behavior of those who transfer from the Surface community compared to those who separate from the Navy. The two variables that have not been explained above are the increased probability of prior enlisted officers and married officers with no children to transfer. The explanation behind the prior

enlisted transfer tendency may lie in the opportunity a commission provides an enlisted sailor. By being commissioned, a sailor increases his pay, but assumes a much larger workload on the ship. Since he is closer to retirement than an officer commissioned out of college, he has a much higher cost of leaving the naval service if he develops a distaste for working as an officer in the Surface community. Therefore, he avoids the cost of leaving the Navy, and still does away with the job for which he has developed a distaste by transferring to another community.

The increased likelihood of married officers to transfer could be explained by the greater time ashore that an officer could look forward to if he were to leave the Surface community. A married officer looking forward to starting a family could see the financial benefits of remaining in the Navy (i.e., medical coverage, housing allowances) as a substantial cost if he were to separate from the Navy. However, if he were to transfer from the Surface community, he could still enjoy these benefits and have more time at home to start a family than would likely be afforded to him as a Surface Warfare Officer.

B. USE OF THE RETENTION MODEL

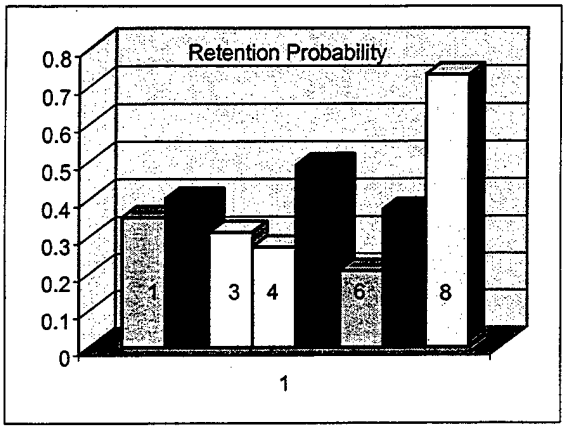
The results of this study reveal interesting effects. Table 16 shows the retention probabilities for a hypothetical officer (Ensign Average) using the retention model developed in this study. (See Table 13.). Using the mean values of the variables in the model in Table 13, Ensign Average has approximately a .35 probability of remaining in the Surface Navy. Keeping all other variables at their mean values, if Ensign Average serves his initial tour in a cruiser, the probability of remaining in the Surface community rises to .40. If he is an engineering major on that cruiser (with an average GPA), his

retention probability drops to .31. If ENS Average serves in a cruiser in his first tour and has a high GPA (3.3-4.0) his retention probability is .27. Conversely, with a low GPA (2.0-2.2) his retention probability is .49. However, based on the current ship selection policy using GPA as at least 75% of the ranking weight, an officer with a 2.2 GPA is not very likely to serve on a cruiser in his initial tour.

Using the criteria of the service selection policy, if Ensign Average is the ideal graduate according to the Navy (GPA 3.3-4.0, engineering major, serving initially in a cruiser) his probability of remaining in the Surface Navy for a career is only .206. Factoring in his fleet performance (to some degree) by his promotion recommendations in his Ensign and Lieutenant (jg) fitness reports, if ENS Average has a 4.0 GPA, majors in engineering, selects a cruiser and receives a recommendation for accelerated promotion on every fitness report as an ENS and LTJG, his probability of remaining in the Surface Navy is .37.

If, however, Ensign Average is not the ideal officer in terms of the Navy ship selection criteria (2.0-2.2 GPA, social science major), yet still manages to be assigned to a cruiser in his initial tour and performs well enough to be recommended for accelerated promotion on every fitness report, his Surface community retention probability is now .73.

Table 16. Retention Probabilities for Nominal Officer "Ensign Average".



1- ENS AVG
2- ENS in CG
3- Cruiser / engineering major
4- Cruiser / 4.0 GPA
5- Cruiser / 2.0 GPA
6- Cruiser / 4.0 GPA / engineering major
7- Cruiser / 4.0 GPA / engineer / 100% fitness reports recommended for accelerated promotion
8- Cruiser / 2.0 GPA / social science / 100% fitness reports recommended for accelerated promotion

However, based on current Navy ship assignment policies, a social science major with a 2.0 grade point average has a very small chance of being detailed to a cruiser for his initial tour. Therefore, the increased retention effects of serving in a cruiser or destroyer may be denied to those officers who are more likely to remain in the Navy. Additionally, the positive retention factor of being recommended for accelerated promotion when compared to one's peers has been taken away completely.

C. RECOMMENDATIONS

The results of this analysis indicate that there are factors that affect retention in the Surface Warfare community. Based on these results, several questions and issues are raised that warrant further investigation.

- Is the difference in retention among ship types enough to warrant changes in initial billet assignment procedures for officers going into their first sea tour?
- Is there a perception within the Surface community that service in a cruiser or destroyer is more career enhancing and more highly valued than service in other ship types?
- Are the retention benefits associated with ranking the Navy's most junior officers against one another for early or accelerated promotion important enough to warrant re-examining the current policy that does not allow such a recommendation?
- Should the Navy examine the policy of assigning officers to their choice of ship based primarily on undergraduate grade point average?
- Should the Navy try to commission more officers who have majored in undergraduate subjects other than engineering?
- Is there a way to increase the retention of officers commissioned via OCS?

Multiple possibilities exist for future research on the subject of retention in the Surface Warfare community. For example, based on data availability, modeling SWO retention using the techniques of the Warner and Goldberg (1984) Annualized Cost of Leaving (ACOL) model would lend valuable information to the separation decision. The model used in this study should also be applied to more current data. Since only year groups 1977-1985 are used for this study, applying this model to year groups that have been affected by and commissioned after the force reductions of the early 1990's and the full inclusion of women in the commissioned cohorts would positively contribute to the understanding of this issue in the drawdown and post-drawdown environments. Since

this data set requires ten years of service to determine if an officer has remained in the Surface community, an alternative would be to develop a database that determines whether an officer leaves at the end of MSR (i.e., four or five years). This would allow more timely examination of the community.

Specific to the results of this study, however, future research could focus on many areas. One option would be to survey the Surface Warfare community to determine if the perception exists that cruiser or destroyer service is more enhancing to an officer's career. If this is the case, are detailing and assignment procedures being affected by this perception at the cost of retention in other ship classes?

Research into retention and performance in the Surface community would be well served by an investigation into the effectiveness of using undergraduate grade point average as the primary determinant of rank in a year group. Officer year groups are ranked giving GPA as much as a 75% weight. No consideration is given to the quality of the undergraduate school, or the difficulty of the major at that specific school. This rank, as determined by the Chief of Naval Education and Training (CNET), is the primary determinant of selection of warfare specialty and ship selection in the Surface community. Is the Navy maximizing its performance and retention potential with the system that is currently in place? To illustrate, an officer with only a 2.5 undergraduate GPA would be more likely to remain in the Navy for at least ten years if he were allowed to select a cruiser at commissioning, compared with a new entrant with a 4.0. However, the 2.5 officer might not get that chance based on the current assignment/selection process.

One approach to deal with this problem is to adopt a "quality spread" type system like the Marine Corps uses for its Basic School graduates. For example, if there were 100 graduates in a given year, the cohort would be divided up into thirds. The top graduate would obviously select his ship first. The next selection would go to number 34, then graduate number 67, then graduate 2, then graduate 35, and so on. This allows an even spread of officer quality (as judged primarily by GPA) across the fleet. However, it should be pointed out that this policy is difficult to reconcile to the number 33 graduate who sees officers ranked below him serve in what is perceived as a better ship.

Future research should investigate whether the Navy's recent (1999) policy of not ranking junior officers against one another with respect to a recommendation for promotion status will affect the long-term retention of the year groups involved. Because of this policy change, one of the most significant factors that indicates increased retention likelihood is no longer being used to offer junior officers feedback on their performance in relation to their peers. Future research should also test the retention effect of the Navy's policy of insisting that officers now serve in two ships and at least two billets in their division officer tours.

Clearly, being able to retain quality officers in sufficient numbers is critical to the readiness of the Surface Fleet and to the US Navy. No one alteration will fix the problems associated with poor officer retention. The Navy will have to address each of these issues in the best way that it can in order to man the ships of the 21st century with the highest quality people available.

APPENDIX A. REASONS FOR DATA LOSS

The following tables describe the initial data lost from filtering females, nuclear trained officers and those missing data from the initial data set.

Initial data set is 10,105 officers.

Table 1. Cases discarded due to no Undergraduate GPA data.

N	Valid	8750
	Missing	1355

Table 2. Female Officers discarded from study.

		Frequency	Percent
Valid	Male	8625	98.6
	Female	125	1.4
	Total	8750	100.0

Table 3. Cases discarded due to no initial department data. This group includes nuclear-trained officers.

N	Valid	7497
	Missing	1128

143 other cases were deselected due to missing data on dependent status, age, initial ship type and percentage of times recommended for accelerated promotion.

Data set used for retention analysis includes 7,354 cases.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B. FREQUENCIES AND PERCENTAGES OF DEPENDENT AND INDEPENDENT VARIABLES

Table 1. Frequency of Remaining in the Navy as a Surface Warfare Officer

		Frequency	Percent
Valid	.00	4728	64.3
	1.00	2626	35.7
	Total	7354	100.0

Table 2. Frequency of Remaining in the Navy but Transferring from SWO community

		Frequency	Percent
Valid	.00	6460	87.8
	1.00	894	12.2
	Total	7354	100.0

Table 3. Frequency of Getting Out of the Navy

		Frequency	Percent
Valid	.00	3520	47.9
	1.00	3834	52.1
	Total	7354	100.0

Table 4. Frequency of Officers' Undergraduate Major

		Frequency	Percent
Valid	BioPhy Sci	1094	14.9
	MthCmtrSciOA	684	9.3
	Engineer	1632	22.2
	SocSci	1421	19.3
	Business	1262	17.2
	HumanNEC	1261	17.1
	Total	7354	100.0

Table 5. Frequency of Commissioning Age.

		Frequency	Percent
Valid	19.00	1	.0
	20.00	11	.1
	21.00	1295	17.6
	22.00	2382	32.4
	23.00	1116	15.2
	24.00	650	8.8
	25.00	416	5.7
	26.00	333	4.5
	27.00	319	4.3
	28.00	205	2.8
	29.00	205	2.8
	30.00	153	2.1
	31.00	79	1.1
	32.00	69	.9
	33.00	41	.6
	34.00	76	1.0
	35.00	3	.0
	Total	7354	100.0

Table 6. Frequencies of Family Situations for Officers in Data Set.

		Frequency	Percent
Valid	SNGL-DIV	3907	53.1
	MRD0C	2123	28.9
	MRD1C	644	8.8
	MRD2C	430	5.8
	MRD3+C	152	2.1
	DIV1+C	98	1.3
	Total	7354	100.0

Table 7. Undergraduate GPA frequency.

		Frequency	Percent
Valid	0.0-2.0	27	.4
	2.0-2.2	675	9.2
	2.2-2.5	2458	33.4
	2.5-2.8	3049	41.5
	2.8-3.3	869	11.8
	3.3-4.0	276	3.8
	Total	7354	100.0

Table 8. Commissioning Source Frequency.

		Frequency	Percent
Valid	USNA	1826	24.8
	ROTC	2090	28.4
	OCS	3170	43.1
	Enl-Other	268	3.6
	Total	7354	100.0

Table 9. Ethnic Background Frequency

		Frequency	Percent
Valid	White	6701	91.1
	Black	417	5.7
	Other	236	3.2
	Total	7354	100.0

Table 10. Frequency of Initial Ship Assignment.

		Frequency	Percent
Valid	Frigate	1758	23.9
	Cruiser	688	9.4
	Big amph	596	8.1
	Battleship	54	.7
	Carrier	577	7.8
	CLF	706	9.6
	Destroyer	1985	27.0
	Minesweep	243	3.3
	Small amph	747	10.2
	Total	7354	100.0

Table 11. Frequency of Initial Shipboard Department Assignment

		Frequency	Percent
Valid	Combat Systems	2671	36.3
	Engineering	2603	35.4
	Operations	2080	28.3
	Total	7354	100.0

Table 12. Frequency of Fitreps with Recommendation for Accelerated Promotion.

		Frequency	Percent
Valid	.00	3949	53.7
	.06	1	.0
	.10	2	.0
	.13	22	.3
	.17	162	2.2
	.19	1	.0
	.20	2	.0
	.25	606	8.2
	.30	3	.0
	.33	134	1.8
	.38	25	.3
	.42	10	.1
	.50	1379	18.8
	.58	8	.1
	.63	1	.0
	.67	33	.4
	.75	298	4.1
	.83	40	.5
	.88	4	.1
	1.00	674	9.2
	Total	7354	100.0

Table 13. Frequency of Junior Officer Billet Number.

		Frequency	Percent
Valid	1.00	2820	38.3
	2.00	3306	45.0
	3.00	1122	15.3
	4.00	102	1.4
	5.00	4	.1
	Total	7354	100.0

Table 14. Frequency of Serving in More Than One Ship as a Junior Officer.

		Frequency	Percent
Valid	Just one	6248	85.0
	More than one	1106	15.0
	Total	7354	100.0

Table 15. Frequency of Starting Career in Community Other than SWO.

		Frequency	Percent
Valid	Start SWO	6455	87.8
	Start other	899	12.2
	Total	7354	100.0

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C. RETENTION / SEPARATION MODEL VARIABLE MEAN VALUES

Table 1. Mean Values of Retention Model Variables.

VARIABLE	MEAN VALUE
INTIAL TOUR IN CARRIER	.08118
INITIAL TOUR IN CRUISER	.1021
INITIAL TOUR IN DESTROYER	.2773
INITIAL TOUR IN FRIGATE	.2472
INITIAL TOUR IN BATTLESHIP	.007751
INITIAL TOUR IN BIG AMPHIB	.08784
INITIAL TOUR IN SMALL AMPHIB	.1016
INITIAL TOUR IN CLF	.1029
INITIAL TOUR IN MINESWEEPER	.03454
WHITE	.9112
BLACK	.0567
MINORITY OTHER THAN BLACK	.03209
PURE SCIENCE MAJOR	.1488
MATH/COMP SCI MAJOR	.09301
ENGINEERING MAJOR	.2219
SOCIAL SCIENCE MAJOR	.1932
BUSINESS/ECONOMICS MAJOR	.1716
HUMANITIES MAJOR	.1715
USNA GRADUATE	.2483
ROTC GRADUATE	.2842
OCS GRADUATE	.4311
NESEP/OTHER GRADUATE	.03644
SERVE IN MORE THAN ONE SHIP	.1504
NUMBER OF J.O. BILLETS HELD	1.7985
% RECCOMENDED FOR ACCEL PROM	.2573
SINGLE / DIVORCED	.5313
MARRIED – NO KIDS	.2887
MARRIED – ONE KID	.08757
MARRIED – TWO KIDS	.05847
MARRIED – THREE OR MORE KIDS	.02067
DIVORCED – ONE OR MORE KIDS	.01333
COMBAT SYSTEMS DEPT	.3632
ENGINEERING DEPT	.3540
OPERATIONS DEPT	.2828
START IN COMM OTHER THAN SWO	.1222
GPA	2.6644
AGE AT COMMISSIONING	23.6267
STAY IN SWO FOR CAREER	.3571
STAY IN NAVY – TRANSFER FM SWO	.1216
SEPARATE FROM NAVY	.5213

Table 2. Mean Values of Transfer Model Variables.

VARIABLE	MEAN VALUE
INTIAL TOUR IN CARRIER	.07385
INITIAL TOUR IN CRUISER	.1085
INITIAL TOUR IN DESTROYER	.292
INITIAL TOUR IN FRIGATE	.2455
INITIAL TOUR IN BATTLESHIP	.009091
INITIAL TOUR IN BIG AMPHIB	.08494
INITIAL TOUR IN SMALL AMPHIB	.1063
INITIAL TOUR IN CLF	.09261
INITIAL TOUR IN MINESWEEPER	.03409
WHITE	.9088
BLACK	.05994
MINORITY OTHER THAN BLACK	.03125
PURE SCIENCE MAJOR	.1526
MATH/COMP SCI MAJOR	.1051
ENGINEERING MAJOR	.2199
SOCIAL SCIENCE MAJOR	.1949
BUSINESS/ECONOMICS MAJOR	.1656
HUMANITIES MAJOR	.1619
USNA GRADUATE	.2639
ROTC GRADUATE	.2722
OCS GRADUATE	.3977
ENLISTED/OTHER GRADUATE	.06619
SERVE IN MORE THAN ONE SHIP	.1548
NUMBER OF J.O. BILLETS HELD	1.8369
% RECCOMENDED FOR ACCEL PROM	.337
SINGLE / DIVORCED	.4673
MARRIED – NO KIDS	.294
MARRIED – ONE KID	.1063
MARRIED – TWO KIDS	.08097
MARRIED – THREE OR MORE KIDS	.03267
DIVORCED – ONE OR MORE KIDS	.01875
COMBAT SYSTEMS DEPT	.3514
ENGINEERING DEPT	.3685
OPERATIONS DEPT	.2801
START IN COMM OTHER THAN SWO	.1205
GPA	2.6179
AGE AT COMMISSIONING	23.9557
TRANSFER FM SWO FOR CAREER	.2540

Table 3. Mean Values of Separation Model Variables.

VARIABLE	MEAN VALUE
INTIAL TOUR IN CARRIER	.08421
INITIAL TOUR IN CRUISER	.1028
INITIAL TOUR IN DESTROYER	.2745
INITIAL TOUR IN FRIGATE	.2452
INITIAL TOUR IN BATTLESHIP	.00805
INITIAL TOUR IN BIG AMPHIB	.08808
INITIAL TOUR IN SMALL AMPHIB	.1029
INITIAL TOUR IN CLF	.1042
INITIAL TOUR IN MINESWEEPER	.03498
WHITE	.9110
BLACK	.05743
MINORITY OTHER THAN BLACK	.03158
PURE SCIENCE MAJOR	.1477
MATH/COMP SCI MAJOR	.08901
ENGINEERING MAJOR	.2077
SOCIAL SCIENCE MAJOR	.2002
BUSINESS/ECONOMICS MAJOR	.1769
HUMANITIES MAJOR	.1785
USNA GRADUATE	.2407
ROTC GRADUATE	.2873
OCS GRADUATE	.4452
ENLISTED/OTHER GRADUATE	.02678
SERVE IN MORE THAN ONE SHIP	.1528
NUMBER OF J.O. BILLETS HELD	1.7949
% RECCOMENDED FOR ACCEL PROM	.2438
SINGLE / DIVORCED	.5441
MARRIED – NO KIDS	.2841
MARRIED – ONE KID	.08437
MARRIED – TWO KIDS	.05619
MARRIED – THREE OR MORE KIDS	.01858
DIVORCED – ONE OR MORE KIDS	.01269
COMBAT SYSTEMS DEPT	.3697
ENGINEERING DEPT	.3495
OPERATIONS DEPT	.2808
START IN COMM OTHER THAN SWO	.1224
GPA	2.6481
AGE AT COMMISSIONING	23.6195
SEPARATE FM NAVY	.5935

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D. MEAN VALUE MARGINAL EFFECT COMPUTATIONS

Table 1. Marginal Effects of Baseline Retention Model.

			LOGIT	MARGINAL
VARIABLE	MEAN	LOGIT	X*LOGIT	EFFECT
	VALUE	COEFF		LOGIT*P(1-P)
INTRCPT	1	-1.934	-1.934	
Math/Comp Sci	0.09301	-0.139	-0.0129284	**-0.0317**
Engineering	0.2219	-0.4597	-0.1020074	**-0.10485**
Social Sciences	0.1932	0.101	0.0195132	**0.023036**
Business/Econ	0.1716	-0.0857	-0.0147061	**-0.01955**
Humanities	0.1715	-0.102	-0.017493	**-0.02326**
Age	23.6267	0.088	2.0791496	**0.020071**
Married - 0 kids	0.2887	0.0899	0.0259541	**0.020505**
Married - 1 kid	0.08757	0.33	0.0288981	**0.075267**
Married - 2 kids	0.05847	0.5667	0.0331349	**0.129254**
Married - 3+ kids	0.02067	0.5965	0.0123297	**0.136051**
Divorced - 1+ kids	0.01333	0.5313	0.0070822	**0.12118**
Undergrad GPA	2.6644	-0.1915	-0.5102326	**-0.04368**
ROTC	0.2842	-0.0414	-0.0117659	**-0.00944**
OCS	0.4311	-0.4792	-0.2065831	**-0.1093**
Enlisted / Other	0.03644	0.0258	0.0009402	**0.005885**
Black	0.0567	-0.0281	-0.0015933	**-0.00641**
Other minority	0.03209	-0.1921	-0.0061645	**-0.04381**
			Z=∑(X*LOGIT)	
			-0.6104723	
		PROBABILITY:	P=1/(1+e^-Z)	
			0.351951	

Table 2. Marginal Effects of Navy Experience Retention Model.

VARIABLE	MEAN VALUE	LOGIT COEFF	LOGIT X*LOGIT	MARGINAL EFFECT LOGIT*P(1-P)
INTRCPT	1	-1.1053	-1.1053	
Carrier	0.08118	0.067	0.0054391	**0.015308**
Cruiser	0.1021	0.2636	0.0269136	**0.060226**
Destroyer	0.2773	0.1631	0.0452276	**0.037264**
Battleship	0.00751	0.3884	0.0029169	**0.08874**
Big Amphib	0.08784	0.0226	0.0019852	**0.005164**
CLF	0.1029	-0.0542	-0.0055772	**-0.01238**
Minesweep	0.03454	-0.0067	-0.0002314	**-0.00153**
Small Amphib	0.1016	0.272	0.0276352	**0.062145**
Combat Sys dept	0.3632	0.0222	0.008063	**0.005072**
Engineer dept	0.354	0.0443	0.0156822	**0.010121**
% recc for accel	0.2573	1.0272	0.2642986	**0.234689**
Number of jobs	1.7985	0.0596	0.1071906	**0.013617**
More than 1 ship	0.1504	0.1323	0.0198979	**0.030227**
Start in other	0.1222	-0.1536	-0.0187699	**-0.03509**
community				
			Z=∑(X*LOGIT)	
			-0.6046287	
		PROBABILITY: P=1/(1+e^-Z)		
			0.353285	

Table 3. Marginal Effects of Combined Baseline / Fleet Experience Retention Models.

				MARGINAL
VARIABLE	MEAN	LOGIT	LOGIT	EFFECT
	VALUE	COEFF	X*LOGIT	LOGIT*P(1-P)
INTRCPT	1	-2.5188	-2.5188	
Carrier	0.08118	-0.0239	-0.0019402	-0.00542
Cruiser	0.1021	0.2685	0.0274139	0.060898
Destroyer	0.2773	0.2028	0.0562364	0.045997
Battleship	0.00751	0.4197	0.0031519	0.095192
Big Amphib	0.08784	-0.0859	-0.0075455	-0.01948
CLF	0.1029	-0.1297	-0.0133461	-0.02942
Minesweep	0.03454	-0.039	-0.0013471	-0.00885
Small Amphib	0.1016	0.145	0.014732	0.032887
Combat Sys dept	0.3632	0.0045	0.0016344	0.001021
Engineer dept	0.354	0.0692	0.0244968	0.015695
% recc for accel	0.2573	1.0838	0.2788617	0.245815
Number of jobs	1.7985	0.0544	0.0978384	0.012338
More than 1 ship	0.1504	0.1405	0.0211312	0.031867
Start other	0.1222	-0.1021	-0.0124766	-0.02316
Math/Comp Sci	0.09301	-0.1453	-0.0135144	-0.03296
Engineering	0.2219	-0.5044	-0.1119264	-0.1144
Social Science	0.1932	0.0734	0.0141809	0.016648
Business/Econ	0.1716	-0.148	-0.0253968	-0.03357
Humanities	0.1715	-0.1067	-0.0182991	-0.0242
Age	23.6267	0.0964	2.2776139	0.021864
Married - 0 kids	0.2887	0.0458	0.0132225	0.010388
Married - 1 kid	0.08757	0.248	0.0217174	0.056249
Married - 2 kids	0.05847	0.5035	0.0294396	0.114198
Married – 3+ kids	0.02067	0.5068	0.0104756	0.114947
Divorced - 1+ kids	0.01333	0.4283	0.0057092	0.097142
Undergrad GPA	2.6644	-0.2391	-0.637058	-0.05423
ROTC	0.2842	0.0288	0.008185	0.006532
OCS	0.4311	-0.4112	-0.1772683	-0.09326
Enlisted - Other	0.03644	0.0565	0.0020589	0.012815
Black	0.0567	0.0958	0.0054319	0.021728
Other minority	0.03209	-0.1159	-0.0037192	-0.02629
			Z=∑(X*LOGIT)	
			-0.6291061	
		PROBABILITY:	P=1/(1+e^-Z)	
			0.347713	

Table 4. Marginal Effects of Separation by Transferring to Other Community Model.

VARIABLE	MEAN VALUE	LOGIT COEFF	LOGIT X*LOGIT	MARGINAL EFFECT LOGIT*P(1-P)
INTRCPT	1	-0.0872	-0.0872	
Carrier	0.07385	-0.3089	-0.0228123	**-0.05652**
Cruiser	0.1085	-0.2595	-0.0281558	**-0.04748**
Destroyer	0.292	-0.1483	-0.0433036	**-0.02714**
Battleship	0.009091	-0.4753	-0.004321	**-0.08697**
Big Amphib	0.08494	0.036	0.0030578	**0.006587**
CLF	0.09261	0.0086	0.0007964	**0.001574**
Minesweep	0.03409	-0.1383	-0.0047146	**-0.02531**
Small Amphib	0.1063	-0.1764	-0.0187513	**-0.03228**
Combat Sys dept	0.3514	-0.2011	-0.0706665	**-0.0368**
Engineer dept	0.3685	-0.089	-0.0327965	**-0.01628**
% recc for accel	0.337	0.1559	0.0525383	**0.028526**
Number of jobs	1.8369	-0.0203	-0.0372891	**-0.00371**
More than 1 ship	0.1548	-0.1513	-0.0234212	**-0.02768**
Start other	0.1205	-0.1586	-0.0191113	**-0.02902**
Math/Comp Sci	0.1051	0.2207	0.0231956	**0.040383**
Engineering	0.2199	0.502	0.1103898	**0.091854**
Social Science	0.1949	-0.3972	-0.0774143	**-0.07268**
Business/Econ	0.1656	-0.1937	-0.0320767	**-0.03544**
Humanities	0.1619	-0.2522	-0.0408312	**-0.04615**
Age	23.9557	-0.067	-1.6050319	**-0.01226**
Married - 0 kids	0.294	0.188	0.055272	**0.034399**
Married - 1 kid	0.1063	0.2379	0.0252888	**0.04353**
Married - 2 kids	0.08097	0.04	0.0032388	**0.007319**
Married – 3+ kids	0.03267	0.3762	0.0122905	**0.068836**
Divorced - 1+ kids	0.01875	0.1981	0.0037144	**0.036248**
Undergrad GPA	2.6179	0.291	0.7618089	**0.053246**
ROTC	0.2722	-0.2035	-0.0553927	**-0.03724**
OCS	0.3977	-0.0896	-0.0356339	**-0.01639**
Enlisted – Other	0.06619	0.5242	0.0346968	**0.095916**
Black	0.05994	0.0025	0.0001499	**0.000457**
Other minority	0.03125	0.1882	0.0058813	**0.034436**
			Z=∑(X*LOGIT)	
			-1.1466047	
		PROBABILITY: P=1/(1+e^-Z)		
			0.24111	

Table 5. Marginal Effects of Separation from the Navy Model.

VARIABLE	MEAN VALUE	LOGIT COEFF	LOGIT X*LOGIT	MARGINAL EFFECT LOGIT*P(1-P)
INTRCPT	1	2.5037	2.5037	
Carrier	0.08421	0.1021	0.0085978	**0.024517**
Cruiser	0.1028	-0.267	-0.0274476	**-0.06411**
Destroyer	0.2745	-0.2064	-0.0566568	**-0.04956**
Battleship	0.00805	-0.3918	-0.003154	**-0.09408**
Big Amphib	0.08808	0.1094	0.009636	**0.026269**
CLF	0.1042	0.1693	0.0176411	**0.040653**
Minesweep	0.03498	0.0636	0.0022247	**0.015272**
Small Amphib	0.1029	-0.1242	-0.0127802	**-0.02982**
Combat Sys dept	0.3697	0.0314	0.0116086	**0.00754**
Engineer dept	0.3495	-0.0691	-0.0241505	**-0.01659**
% recc for accel	0.2438	-1.4593	-0.3557773	**-0.35041**
Number of jobs	1.7949	-0.0617	-0.1107453	**-0.01482**
More than 1 ship	0.1528	-0.133	-0.0203224	**-0.03194**
Start other	0.1224	0.2033	0.0248839	**0.048817**
Math/Comp Sci	0.08901	0.1359	0.0120965	**0.032633**
Engineering	0.2077	0.467	0.0969959	**0.112138**
Social Science	0.2002	-0.0076	-0.0015215	**-0.00182**
Business/Econ	0.1769	0.223	0.0394487	**0.053548**
Humanities	0.1785	0.1706	0.0304521	**0.040965**
Age	23.6195	-0.1035	-2.4446183	**-0.02485**
Married - 0 kids	0.2841	-0.083	-0.0235803	**-0.01993**
Married - 1 kid	0.08437	-0.3461	-0.0292005	**-0.08311**
Married - 2 kids	0.05619	-0.6728	-0.0378046	**-0.16156**
Married - 3+ kids	0.01858	-0.8353	-0.0155199	**-0.20058**
Divorced - 1+ kids	0.01269	-0.5953	-0.0075544	**-0.14295**
Undergrad GPA	2.6481	0.2272	0.6016483	**0.054556**
ROTC	0.2873	0.0314	0.0090212	**0.00754**
OCS	0.4452	0.5307	0.2362676	**0.127433**
Enlisted - Other	0.02678	-0.9548	-0.0255695	**-0.22927**
Black	0.05743	-0.133	-0.0076382	**-0.03194**
Other minority	0.03158	0.0857	0.0027064	**0.020579**
			Z=∑(X*LOGIT)	
			0.4028876	
		PROBABILITY: P=1/(1+e^-Z)		
			0.599381	

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

1. Bautista, G. E., "Surface Warfare Junior Officer Separation: Does Ship Type Make a Difference?". Master's Thesis, Naval Postgraduate School, Monterey, CA, March 1996.

2. DTI Associates, INC. "Surface Warfare Officer Survey". Washington, DC, November 1999.

3. Ehrenberg, R. G., and Smith, R. S., "Modern Labor Economics: Theory and Public Policy." Harper Collins College, New York City, NY, 1993.

4. Hogan, P. F., "Family Annualized Cost of Leaving: The Household as the Decision Unit in Military Retention". U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, 1990.

5. Howell, J.R., "Why Mid-Grade Surface Warfare Officers are Resigning from the Naval Service". Master's Thesis, Naval Postgraduate School, Monterey, CA, December 1980.

6. Kear, J.R., "Surface Warfare Attrition: Does Ship Type Matter?". Master's Thesis, Naval Postgraduate School, Monterey, CA, December 1989.

7. Mackin, P.C. and Darling, K.L.,"Economic Analysis of Proposed Surface Warfare Officer Career Incentive Pay". Bureau of Naval Personnel, Washington, DC, September 1996.

8. Mackin, P.C. and Hogan, P.F. and Mairs, L.S., "Estimation of Retention Parameters for the Prototype Officer Personnel Inventory, Cost and Compensation (OPICC) Model: Final Report". U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, January 1995.

9. Mairs, L.S. and Mackin, P.C. and Hogan, P.F. and Tinney, R. "A Model of U. S. Army Retention behavior: Final Report". U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, 1992.

10. Mehay, S.L., "Analysis of Performance Data for Junior Navy and Marine Corps Officers". Naval Postgraduate School, Monterey, CA, October 1995.

11. MILPERSMAN. U.S. Government Printing Office, 1995.

12. "The Naval Officers Career Planning Guidebook (NAVPERS 15605). U.S. Government Printing Office, 1990.

13. Neal, D. and Johnson, W., "The Role of Pre-Market factors in the Black-White Wage Differences". Journal of Political Economy. Vol. 104, 1 OCT 96: 869-95.

14. Nolan, J.F., "An Analysis of Surface Warfare Officer Measures of Effectiveness As Related to Commissioning Source, Undergraduate Education and Navy Training". Master's Thesis, Naval Postgraduate School, Monterey, CA, March 1993.

15. Warner, J.T. and Goldberg, M.S., "The Influence of Non Pecuniary Factors on Labor Supply: The Case of Enlisted Personnel". Review of Economics and Statistics. Vol. 66, 1984.

INITIAL DISTRIBUTION LIST

No. of Copies

1. Defense Technical Information Center 2
   8725 John J. Kingman Rd, STE 0944
   Ft. Belvoir, VA 22060-6218

2. Dudley Knox Library 2
   Naval Postgraduate School
   411 Dyer Rd.
   Monterey, CA 93943-5101

3. Nimitz Library 1
   U.S. Naval Academy
   589 McNair Rd.
   Annapolis, MD 21402-5029

4. Superintendent 1
   U.S. Naval Academy
   Annapolis, MD 21402-5029

5. United States Naval Academy 1
   Office of Institutional Research
   Stop 2B
   Annapolis. MD 21402

6. Professor J. Eric Fredland 2
   Department of Economics
   U.S. Naval Academy
   Annapolis, MD 21402-5008

7. Professor Stephen L. Mehay 2
   Department of Systems Management (SM/Eb)
   Naval Postgraduate School
   Monterey, CA 93943

8. Professor William R. Bowman 1
   Department of Economics
   U.S. Naval Academy
   Annapolis, MD 21402-5008

9. LT Jonathan C. Duffy 2
   307 Meares Ct.
   Annapolis, MD 21401