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**NAVAL
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THESIS

**USING A DYNAMIC RETENTION MODEL TO ANALYZE
THE IMPACT OF AVIATION CAREER CONTINUATION
PAY ON THE RETENTION OF NAVAL AVIATORS**

by

Sarah Watson

September 2012

Thesis Advisor:

Gregory K. Mislick

Second Reader:

Samuel E. Buttrey

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REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>
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 September 2012	3. REPORT TYPE AND DATES COVERED Master's Thesis	
4. TITLE AND SUBTITLE Using a Dynamic Retention Model to Analyze the Impact of Aviation Career Continuation Pay on the Retention of Naval Aviators		5. FUNDING NUMBERS	
6. AUTHOR(S) Sarah Watson		8. PERFORMING ORGANIZATION REPORT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number NPS.2012.0044-IR-EP5-A			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited		12b. DISTRIBUTION CODE A	
13. ABSTRACT (maximum 200 words) The United States military is not immune to the effects of the current recession. Many areas of military compensation are being considered for reduction and elimination in order to alleviate budget constraints throughout the federal government. Questions have arisen regarding the degree to which retention goals would be met if special bonus pay programs were reduced or eliminated. Mattock and Arkes (2007) claimed success with predicting the retention of Air Force pilots by using their Dynamic Retention Model (DRM). This thesis utilizes the DRM, coded for R by Mattock and Arkes, to create a simulation of Naval aviator retention at different bonus amounts. The model predicted a 75.2% retention rate with a bonus of \$25,000 per year for five years, a retention rate of 64.3% with a bonus of \$15,000 per year for five years, and a retention rate of 50.6% with a bonus of \$5,000 per year. It predicted that only 14 Naval Aviators (0.46%) would remain past their minimum service requirement if the bonus were discontinued. A critique of the DRM is that it is an econometric approach that leaves out other factors. A logistic regression with demographic variables was found to be better for predicting retention decisions.			
14. SUBJECT TERMS Aviation Career Continuation Pay, ACCP Naval Aviator, Department Head, Retention, Dynamic Retention Model, DRM, bonus		15. NUMBER OF PAGES 65	
		16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU

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**USING A DYNAMIC RETENTION MODEL TO ANALYZE THE IMPACT OF
AVIATION CAREER CONTINUATION PAY ON THE RETENTION OF NAVAL
AVIATORS**

Sarah Watson
Lieutenant, United States Navy
M.S., North Dakota State University, 2007
B.A., Purdue University, 2001

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

**NAVAL POSTGRADUATE SCHOOL
September 2012**

Author: Sarah Watson

Approved by: Gregory K. Mislick
Thesis Advisor

Samuel E. Buttrey
Second Reader

Robert Dell
Chair, Department of Operations Research

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ABSTRACT

The United States military is not immune to the effects of the current recession. Many areas of military compensation are being considered for reduction and elimination in order to alleviate budget constraints throughout the federal government. Questions have arisen regarding the degree to which retention goals would be met if special bonus pay programs were reduced or eliminated. Mattock and Arkes (2007) claimed success with predicting the retention of Air Force pilots by using their Dynamic Retention Model (DRM). This thesis utilizes the DRM, coded for R by Mattock and Arkes, to create a simulation of Naval aviator retention at different bonus amounts. The model predicted a 75.2% retention rate with a bonus of \$25,000 per year for five years, a retention rate of 64.3% with a bonus of \$15,000 per year for five years, and a retention rate of 50.6% with a bonus of \$5,000 per year. It predicted that only 14 Naval Aviators (0.46%) would remain past their minimum service requirement if the bonus were discontinued. A critique of the DRM is that it is an econometric approach that leaves out demographic factors. A logistic regression with demographic variables was found to be better for predicting retention decisions.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACCP	Aviation Career Continuation Pay
ACIP	Aviation Career Incentive Pay
ACOL	Annualized Cost of Leaving
ACP	Aviation Continuation Pay
ADSEP	Administrative Separation
COL	Cost of Leaving
DH	Department Head
DRM	Dynamic Retention Model
FITREP	Fitness Report
FTS	Full Time Support
GAO	General Accounting Office
LORIO	Level of Officer Retention and Inventory Optimizer
MSR	Minimum Service Requirement
MTA	Member Trait Average
NDAA	National Defense Authorization Act
NFO	Naval Flight Officer
NROTC	Naval Reserve Officer Training Corps
OSD	Office of the Secretary of Defense
RSCUMAVG	Reporting Senior Cumulative Average
SWO	Surface Warfare Officer
SWOCP	Surface Warfare Officer Continuation Pay
YOS	Years of Service

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EXECUTIVE SUMMARY

In 2009, Vice Admiral Mark Ferguson, then Chief of Naval Personnel, testified to Congress that a thorough review of all bonus programs administered by the U.S. Navy would be forthcoming (CNP, 2010). The Aviation Career Continuation Pay (ACCP) was one of the programs to be evaluated. In a time of “belt-tightening” across services, it is no surprise that these programs are coming under increasing scrutiny with a need to justify themselves. With some aviators capable of earning bonuses as high as \$25,000 per year for five years, this large sum of money needed to be reviewed for its cost-effectiveness when all eligible aviators are considered.

With fewer high paying airline jobs being readily available, there may be less allure for a Naval Aviator to seek a better job in the civilian sector. If one has the good fortune to be offered one of these jobs, it may not necessarily come with the promise of better working hours and benefits comparable to those that are available to members of the military. The service may be able to keep enough qualified aviators without an annual bonus of \$25,000.

The ACCP was designed to “provide selected bonuses as an incentive to eligible pilots and naval flight officers through department head, sea duty and command billets” (CNP, 2010). Yet the military is faced with the task of reducing budgets, and bonuses are not exempt from being reduced or discontinued. Further, declining economic conditions have made civilian job opportunities less plentiful in all fields, potentially creating an incentive for military personnel to continue military service. For these reasons, we can ask whether the ACCP is fulfilling its role of providing enough aviators to accomplish the mission of the United States Navy. If this bonus is truly required to maintain proper pilot manning levels, then the goal of this study is to prove that the ACCP is essential and should not be considered in the realm of possible budget cuts.

Mattock and Arkes (2007) claimed to find success with predicting the retention of Air Force pilots by using their Dynamic Retention Model (DRM). Up to this point, there has yet to be a study in which this model is used with Navy data to look at the retention

of Naval Aviators. This thesis utilizes the DRM as implemented in the statistical program R (R Development Core Team, 2011), using code developed by Mattock and Arkes (2007). The R code was modified for the Navy to take into account Navy bonus amounts that differ from the Air Force. It was also modified to look only at the probability of remaining in the Navy at the conclusion of the minimum service obligation, as opposed to looking at all possible years following the MSR. The R implementation then produced a simulation of the expected retention rates for various bonus amounts.

The model predicted a 75.2% retention rate with a bonus of \$25,000 per year for five years, a retention rate of 64.3% with a bonus of \$15,000 per year for five years, and a retention rate of 50.6% with a bonus of \$5,000 per year. This model predicted that only 14 Naval Aviators (0.46%) would remain past their minimum service requirement if the bonus were to be discontinued.

A logistic multiple regression was run with the following independent variables: commissioning source (source), length of initial service obligation (liso), race and sex combined (RaceSex), and rank at the time of making the retention decision (rank). The dependent variable was whether or not a pilot took the ACCP (“Stay” or “Leave”). Source was not a significant factor in predicting a decision to stay or leave. RaceSex was found to be significant independent variable. Specifically, non-black females are highly likely to leave naval aviation. Length of initial service obligation was found to be a significant independent variable. Those with a length of initial service of 10 or more years are more likely to leave naval aviation than those with a service obligation of eight years or fewer. Finally, rank was found to be a significant independent variable. Those of rank O-4 or senior (O4+) were more likely to remain in the Navy as pilots than pilots of rank O-3.

There were problems with the model, and for several reasons, the DRM was not considered a good method for making predictions about Naval aviator retention. The logistic regression was determined to be a better model for predicting retention decisions.

ACKNOWLEDGMENTS

First of all, thank you Gregory K. Mislick, LTCol (ret), USMC, and Dr. Samuel E. Buttrey for your expert guidance and advice. I would not have made it through this process without the two of you. Thank you to Mr. Steven Galing at OSD (P&R) for a valuable experience tour and for putting me in touch with key players in the Navy's aviation community. Thank you to Mrs. Freda Hudspeth in the Aviation Community Manager's office in Millington, TN. I appreciate the data, the answers to my questions, and the hospitality. You are a gracious hostess! Thank you to LCDR Jack "Shaggy" Parker, formerly of PERS-43 aviator detailing. Your information about aviation detailing and aviation bonuses was invaluable, especially coming from an aviator. Thank you to LT Byron Lee for your expert programming knowledge and R support. You truly are a man of many talents. Most importantly, thank you to Rich. Not only did you show me a true aviator perspective, but your support, understanding, and patience during this process was beyond compare. I look forward to the next chapter in our story.

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I. INTRODUCTION

A. PURPOSE

The purpose of this thesis is to analyze the effect of Aviation Career Continuation Pay (ACCP) on the retention of Naval Aviators in the United States Navy. This study examines the extent to which the ACCP impacts the retention of Naval Aviators. Further, this study examines the possible reasons that these officers choose to remain in the service, and the extent to which the ACCP is the primary factor that compels a Naval Aviator to continue his or her service.

B. PROBLEM

In 2009, Vice Admiral Mark Ferguson, then Chief of Naval Personnel, testified to Congress that a thorough review of all bonus programs administered by the U.S. Navy would be forthcoming (CNP, 2010). The ACCP was one of the programs to be evaluated. In a time of “belt-tightening” across services, it is no surprise that these programs are coming under increasing scrutiny with a need to justify themselves. With some aviators capable of earning bonuses as high as \$25,000 per year for five years, this large sum of money needed to be reviewed for its cost-effectiveness when all eligible aviators are considered.

Also in 2009, the director of Personnel, Plans, and Policy Division at Headquarters, U.S. Navy stated that “We are committed to continuing our investment in the aviation community and our efforts remain responsive to retention behavior and mission requirements” (CNP, 2010). Perhaps there are other factors that come into play when a Naval Aviator makes the decision whether to continue his or her service or not. One big consideration is the availability of jobs in the civilian community and aviation industry. The events of September 11, 2001, served as a catalyst for widespread changes in the airline industry. In just over a decade, numerous airlines have merged or have ceased to exist altogether. Existing commercial airlines have been forced to lay off even the most experienced pilots during the time of airline mergers and bankruptcies, and lowered the retirement age to 60.

In addition to the decline in airline jobs, there is an overall decline in the pay of aviation professionals. Not long ago, a seasoned airline pilot could earn as much as \$300,000 per year, and sometimes more, for flying international routes (McCartney, 2009). In recent years, the maximum salary for an airline captain is around \$165,000 per year, while the average starting pilot at a major airline can expect to earn roughly \$36,000 per year (McCartney, 2009).

With fewer high paying airline jobs being readily available, there may be less allure for a naval aviator to seek a better job in the civilian sector. If one has the good fortune to be offered one of these jobs, it may not come with the promise of better working hours and comparable benefits to those that are available to members of the military.

C. RESEARCH QUESTIONS

The ACCP was designed to “provide selected bonuses as an incentive to eligible pilots and naval flight officers through department head, sea duty and command billets” (CNP, 2010). Yet the military is faced with the task of reducing budgets, and bonuses are not exempt from being reduced or discontinued. Further, declining economic conditions have made civilian job opportunities less plentiful in all fields, potentially creating incentive for military personnel to continue military service. For these reasons, is the ACCP fulfilling its role of providing enough aviators to accomplish the mission of the United States Navy? Or, is it possible that there is another explanation? If this bonus is truly required to maintain proper pilot manning levels, then the goal of this study is to prove that the ACCP is essential and should not be considered in the realm of possible budget cuts.

This study aims to answer two questions:

- 1) How does the ACCP impact the retention of Naval Aviators in the United States Navy?
- 2) How would aviator retention be impacted if the ACCP program were to be altered, or discontinued altogether?

D. SCOPE AND METHODOLOGY

This study begins with a review of available literature that have studied the retention of officers in all branches of the armed forces. The focus of the literature review is on factors that compel an officer to remain on active duty in the military after his or her Minimum Service Requirement (MSR) has been fulfilled.

The following steps are used to answer the study questions posed in this thesis:

- A review of the literature, including articles on past research in the field of military bonuses and retention. For the purposes of this study, government publications are reviewed to gain an understanding of the Aviation Career Continuation Pay.
- Data from Bureau of Personnel (BUPERS) Aviation Community Manager was evaluated for a specific cohort of Naval Aviators. This information includes demographics, data on whether or not the ACCP was accepted when it was offered to each aviator, and whether that person remained on active duty beyond the MSR.
- Statistical methods used in the analysis are described.
- Statistical analysis and results are presented, with recommendations on how to further administer the ACCP.

E. ORGANIZATION OF STUDY

The current chapter describes the purpose of this research, including the research questions that are to be answered, as well as the scope and methodology. Chapter II is the literature review, which includes an introduction, and a description of studies that have analyzed bonus programs in other services and other occupational specialties. Chapter III describes the ACCP program, including its history and the current status of the program. Chapter IV describes the data and the development of the model and data analysis. Chapter V gives the results of the analysis. Chapter VI is a summary and recommendations for the ACCP program.

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II. LITERATURE REVIEW

A. INTRODUCTION

Numerous studies have focused on various continuation pays for military officers, as well as re-enlistment bonuses for enlisted military personnel. There is a wide variation in these bonuses, in terms of entitlement, payment methods and amounts, while all are aimed at maintaining required levels of personnel in specified career specialties. There have been many different conclusions with regard to the efficacy of these programs.

B. THE AIR FORCE AVIATION CONTINUATION PAY (ACP)

Like other services, the Air Force has experienced problems related to retaining high-quality pilots once their initial service obligation has expired. In fact, the problem of retaining pilots is especially pronounced, and is at the top of a list of four officer specialties that experience issues related to retention. A loss of a promising pilot is a loss of a great amount of time and money that has been invested in developing that skilled pilot, and one who will be ready for potential battle. In 2007, RAND Corporation published “The Dynamic Retention Model for Air Force Officers.” In the past, the Annualized Cost of Leaving (ACOL) model was that of choice when analyzing ways to address retention issues. The ACOL is a useful model for determining how changes in compensation will impact retention, but it fails to address other issues. Mattock and Arkes (2007) cite the uncertainty of the future, as well as “random shock,” as factors that are significant in impacting retention decisions.

Using the Dynamic Retention Model (DRM), researchers Michael Mattock and Jeremy Arkes evaluate how the Air Force Aviation Continuation Pay (ACP) program affects retention of Air Force pilots. This model varies from the ACOL because it attempts to model future uncertainty and “shocks” discussed above. Mattock and Arkes asserted that eliminating the ACP as a retention bonus and incentive to remain on active duty would result in a loss of up to 15 percent of Air Force pilots.

Mattock and Arkes (2007) claimed to find success with predicting the retention of Air Force pilots by using their Dynamic Retention Model (DRM). Up to this point, there has yet to be a study in which this model is used with Navy data to look at the retention of Naval Aviators, and this thesis seeks to remedy the omission. This thesis utilizes the DRM as implemented in the statistical program R (R Development Core Team, 2011), using code developed by Mattock and Arkes (2007). The R code was modified for the Navy to take into account Navy bonus amounts that differ from the Air Force. It was also modified to look only at the probability of remaining in the Navy at the conclusion of the MSR, as opposed to looking at all possible years following the MSR. The R implementation then produced a simulation of the expected retention rates for various bonus amounts.

C. ANNUALIZED COST OF LIVING APPROACH AND NAVAL AVIATORS

Mills (1999) evaluated the potential retention effects of the ACCP using an ACOL approach. At that time, the ACCP was still in the planning phase, and the ACP was the bonus being offered to Naval Aviators. Mills looked at this new system by evaluating both financial incentives for an aviator to resign from the military, and the non-financial value placed on continued service. He utilized the Annualized Cost of Living Technique, developed in 1981 by Warner (1981). Using a Cost of Leaving (COL) factor, this technique quantifies one's "taste" for military service with a dollar amount associated with leaving.

Mills looked at years that marked significant career decision milestones for aviators under the ACCP, which were 9, 11, 16, and 21 years of commissioned service. It was determined whether each aviator decided to stay or leave at this point, leading to a COL value. The COL value plays a similar role to that of the ACCP, as a monetary value to the aviator who chooses to stay. At each milestone, if the aviator decided to stay and the ACCP was received, the COL was increased, indicating increased retention likelihood. Mills found that the COL amount was statistically significant in determining retention decisions for Naval Aviators. As a result of accepting the ACCP, his estimates

yielded increases of 19.68 percent in retention likelihood for 11 to 20 years, 29.72 percent for 16 to 20 years, 13.9 percent for 16 to 25 years, and finally 8.86 percent for 21 to 25 years.

As stated above, the ACOL is a useful model, but it fails to consider other factors in the decision-making process of a Naval Aviator. Further, conversations with the Aviation Community Manager's office at BUPERS have yielded the notion that aviators who choose to leave the Navy generally do so immediately following their initial service requirement. This research factors in future uncertainty as well as "shock" in the decision-making process. Also, the focus of this research centers on whether or not Naval Aviators leave the Navy, or just the aviation community, at their first opportunity.

Another consideration is that the Mills study was conducted just prior to the change in the retention bonus for Naval Aviators. It has been 12 years since the change in the bonus structure that took place in 2000, and much has happened in over a decade. Wars have broken out, the economy has fluctuated, and the airline industry has experienced major setbacks since September 11, 2001. When these factors are considered, it gives credence to the notion that an up-to-date analysis of aviator retention is required.

D. SURFARE WARFARE OFFICERS AND THE SURFACE WARFARE OFFICER CONTINUATION PAY (SWOCP)

Lorio (2006) evaluated the impact of the Surface Warfare Officer Continuation Pay on the impact of retaining Surface Warfare Officers (SWO) beyond their initial service obligations to complete two Department Head (DH) tours afloat. DH manning has long been an issue in the Navy, with the failure to retain enough Surface Warfare Officers to fill these billets (Hoewing, 2004). Because of manning shortfalls, SWOCP was established in 2000 as a mechanism to increase retention of SWOs, reduce the number of manning shortfalls, and to maintain higher-quality officers within the Surface Warfare community.

The goal of Lorio's research was to measure the extent to which higher-quality officers were being retained when compared to other officers in the Surface Warfare

Community. Lorio created the Level of Officer Retention and Inventory Optimizer (LORIO) score to evaluate the performance of these junior officers. This method takes into account the performance of the individual, as quantified through his or her Fitness Reports (FITREP). It starts with an adjusted Member Trait Average (MTA), which is calculated based on the scores one receives in a FITREP, and then standardized to account for differences in Reporting Senior Cumulative Averages (RSCUMAVG), which is the manner in which reporting seniors rate their junior officers. The standardized MTA is calculated as follows:

$$\text{MTA}_{\text{adjusted}} = (\text{MTA} - \text{RSCUMAVG}) / (5.0 - \text{RSCUMAVG})$$

Once the MTA is standardized, a time decay factor is included in the analysis to place increased weight on more recent FITREPs. The final value for the LORIO score has a number between minus 1 and plus 1. This outlines a possible method of separating the higher-quality Surface Warfare Officers from the rest of the group.

As a result of her analyses, Lorio was able to determine that the LORIO score was no different for those officers who remained on active duty before or after SWOCP was implemented. In other words, the Surface Warfare Officer Continuation Pay did not have any impact on retaining higher-quality officers. She also determined that SWOCP did not significantly impact the level of future performance by an officer that had received the bonus. SWOCP appears to retain quantity, without having a means to selectively target higher-quality officers. Lorio determined that SWOCP should be used more selectively in the future to help retain the better performers.

The above study demonstrates that there has been success in using newer techniques to evaluate the retention of another group of naval officers, specifically Surface Warfare Officers. Lorio demonstrated the utility of a new approach to retention studies as long ago as 2006. It is important to continue to study retention and associated bonuses, especially as budgets are tightened and services are forced to justify these bonuses. The Lorio study shows that new techniques are possible, and for that reason it is crucial to explore new methods of assessing naval aviator retention. This thesis presents yet another potential technique for evaluating retention.

III. AVIATION CAREER CONTINUATION PAY (ACCP)

A. HISTORY

In the 1970s, aviator retention in the United States Navy was of significant concern. Historically, when the Navy has had retention shortfalls, the Navy has brought reservists onto active duty to supplement the force during times of need. From 1971 to 1972, it is estimated that 35 percent of pilots serving in the Navy were reservists brought onto active duty (Thie et al., 1995). Activated reservists still comprised 13 percent of the aviator population in 1980 (Thie et al., 1995). The Department of Defense and the Congress recognized this shortage, and in 1980 began to institute aviator bonuses. Under U.S. Code Title 37, Section 301b, bonuses were authorized to alleviate shortages in flight personnel and to improve levels of retention. Aviation Officers Continuation Pay was offered in fiscal years 1981–1982 and 1984–1988 to address the same concerns. The Aviation Continuation Pay (ACP) was then enacted by the Congress in fiscal year 1989 as a replacement to the original Aviation Officers Continuation Pay. The ACP was again authorized under the National Defense Authorization Act for fiscal years 1990 and 1991 (GAO, 1994).

Under the new Aviation Continuation Pay program, each of the armed services was authorized to pay bonuses to its aviators, at a level of \$12,000 per year, to those aviators that had completed at least six years but fewer than 13 years of active duty service. The bonus program was not to extend beyond the 14th year of service. With the exception of the U.S. Army, each of the United States Armed Services utilized the ACP program. One noteworthy point is that while the Army agreed that they had shortfalls in aviator retention that could not be alleviated without the ACP program, it felt it was unfair to single out a group of officers for special treatment (GAO, 1994).

The reality was that there were many concerns about the ACP beyond those expressed by the Army. Namely, failure of pilots to fulfill their obligations was a concern associated with the ACP. Under this program, pilots were obligated to serve through the 14th year of commissioned service. However, many recipients of the ACP

were failing to meet this obligation. In many cases, pilots were leaving the aviation community to convert to another officer specialty, or were experiencing circumstances that caused them to leave the Navy altogether, such as failing to be selected for O-4 or having an injury (Moore & Griffis, 1999).

A second concern about the ACP program involved failure to fill billets other than the Department Head tour. Prior to their Department Head tour, pilots are expected to fill a non-flying sea billet, known as the disassociated sea tour. This billet was often difficult to fill, and because it occurred after the minimum service requirement, Navy personnel were concerned that high-quality pilots were being discouraged from staying in the Navy (Moore & Griffis, 1999).

The numerous critiques about the Aviation Continuation Pay in the 1990s led to the commencement of the ACCP in fiscal year 2000. During this period, the Navy was experiencing shortages of over 1000 pilots and NFOs throughout all career milestones. The purpose of this new bonus program was to provide incentive for high-quality, eligible aviators to choose the Navy as their enduring career choice. Under U.S. Code Title 37, Section 301b, the Service Secretaries were now given the discretion to pay up to \$25,000 per year for every year that a pilot or NFO remained on active duty following his or her minimum service requirement, and this bonus was available up until 25 years of commissioned aviation service had been reached (PERS-43, 2010).

The Navy used this new authorization to specifically target Naval Aviators and Naval Flight Officers for sea duty and command billets. From the initial year of the ACCP in 2000, the Navy chose to offer contracts of two to three years consisting of up to \$15,000 for sea duty-assigned officers up through “post command” O-5 tours. Yet the bigger issue was getting junior officers to remain in the aviation community following their minimum service requirement. The ACCP program was modified after just several months of existence in fiscal year 2000 to allow a five-year contract option to aviators in year groups 1989 and later who were becoming eligible for a retention bonus for the first time. Under the modified ACCP of 2000, the long-term contract offered \$25,000 per year for eligible pilots of all platforms, and \$15,000 per year for Naval Flight Officers. In an effort to further entice potential bonus takers, these junior aviators could choose to

receive half of the total amount up front as a lump sum. The bonus was also extended beyond the limits of sea duty billets, whereby it was offered to those in designated command billets ashore or afloat, including O-6 aviators with less than 24 years of commissioned aviation service (PERS-43, 2010).

In 2001, the Navy ACCP remained the same as the modified ACCP that was introduced in July of 2000. The 2002 ACCP program replicated the 2001 program but with one notable exception. In 2002, the Navy introduced the one-year early payment option for aviators nearing the end of their minimum service requirement. The FY-2002 National Defense Authorization Act (NDAA), Section 301b(b) 4 of Title 37, U.S. Code, was changed and now the services had the option to pay the ACCP bonus one year before the end of the minimum service requirement. This change was critical, creating a noteworthy financial incentive during the time that a pilot or NFO was deciding whether or not to remain in the aviation community (PERS-43, 2010).

No changes to the program were made in 2003, and fiscal year 2004 was an extension of this, with one significant change. Lump sum payments of the bonus were now contingent upon successful screening (selection) for Department Head by the Aviation Department Head Screen Board. Therefore, an aviator reaching the end of the minimum service requirement could not receive his or her lump sum bonus payment until he or she had been found eligible for service as a Department Head (PERS-43, 2010).

The fiscal year 2005 ACCP program included two changes from fiscal year 2004. While there had been a three-year contract option at one time for junior officers following the minimum service requirement, this was no longer an option. The three-year contract was discontinued, and the five-year contract was all that remained for aviators at this career milestone. The purpose was to ensure that any aviator that took the bonus would remain in the naval aviation community through his or her respective Aviation Department Head Screen Board. This was also the first year where aviators completed a second screening on the Aviation Department Head Screen Board after failing to select during their first board. The Navy would no longer pay long-term contract bonuses to

pilots and NFOs that had not screened for Department Head. Because of this, the United States Navy saved \$1.8 million due to the termination of 67 contracts that occurred under this new policy (PERS-43, 2010).

While the fiscal year 2005 program was characterized by PERS-43 as “highly successful,” the fiscal year 2006 program saw two changes that were targeted specifically at Naval Flight Officers. First, the long-term bonus for NFOs was increased from \$15,000 to \$25,000 per year. Second, the short-term bonus options were separated into three different categories: sea duty, command, and astronaut, with all short-term bonuses still paying \$15,000 per year. There were three reasons for these changes: (1) to make the ACCP more appealing to more NFOs; (2) to reverse trends in retention of NFOs; and (3) to simplify the various short-term bonus options into just three categories. Additionally, the 2005 policy, under which the Navy would no longer pay long-term bonuses to aviators who failed to select for Department Head, continued. For fiscal year 2006, this policy led to savings of \$1.9 million following the termination of 61 contracts affected by the policy (PERS-43, 2010).

The implementation of the ACCP program for fiscal year 2006 continued into fiscal years 2007 and 2008. In 2008, there were a few noteworthy changes in the criteria of eligibility for the bonus. Aviation-designated astronauts were no longer eligible for the ACCP program. However, Aviation Engineering Duty Officers (AEDO) were now eligible for the bonus if a screening board had selected them for Commander and Major Command. Payment rates continued to be \$15,000 for three-year (short-term) contracts, and \$25,000 per year for five-year (long-term) contracts. The fiscal year 2008 program also clarified eligibility for the bonus with regards to the Department Head requirement for junior officers. Under this program, an aviator was not eligible for the ACCP bonus if (1) he or she failed to screen for a Department Head tour on two separate selection boards; (2) he or she declined to be considered by the Aviation Department Head Screen Board; or (3) the aviator declined orders to an aviation Department Head tour after successfully being selected for a Department Head tour. Under scenario (1) where an aviator failed to select, he or she would receive no future installments of the bonus, while those installments already received were the property of the aviator. Under scenarios (2)

and (3), all bonus funds received by the aviator were to be returned, and no future installments of the bonus would be received. Because of this change, 39 aviators did not receive orders to a Department Head billet in fiscal year 2008. Their contracts were subsequently terminated, and the Navy saved in excess of \$1.69 million for fiscal year 2008 and also in future payments (PERS-43, 2010).

A few changes were then incorporated into the 2009 program, though the program mostly mirrored the implementation of the fiscal year 2008 program. In fiscal year 2009, eligibility for the astronaut bonus was reinstated, and eligibility of Aerospace Engineering Duty Officers to receive the short-term command bonus was discontinued. It was determined that while an AEDO qualified for the Aviation Career Incentive Pay, commonly known as “flight pay,” they should not be included in an incentive program targeted at pilots and Naval Flight Officers (PERS-43, 2010). Put simply, the changes that were instituted for fiscal year 2008 were reversed for fiscal year 2009.

The fiscal year 2010 program was modified to reflect earlier program characteristics of the ACCP. The annual rate of the five-year contract for Naval Flight Officers was reduced from \$25,000 back to \$15,000. All other characteristics of the fiscal year 2009 program remained in effect.

Table 1 summarizes the bonus amounts for fiscal years 2011 and 2012. For fiscal year 2011, bonus amounts were drastically reduced for pilots, a first-time development in the history of the current ACCP bonus system. This trend of changing amounts continued for fiscal year 2012 as well.

Type of Squadron/Aircraft	2011 Amount	2012 Amount
VQ(T) (ES-3 Shadow)	\$5,000	\$15,000
VQ(P) (ES-3 Shadow)	\$10,000	\$15,000
HSL/HSM (SH/HH-60 Seahawk)	\$10,000	\$5,000
HSC (SH/HH-60 Seahawk)	\$10,000	\$15,000
VP (P-3 Orion)	\$10,000	\$10,000
VAQ (EA6-B Prowler)	\$15,000	\$15,000
VFA (F/A-18 Hornet)	\$25,000	\$25,000
VAW/VRC (E-2C Hawkeye)	\$0	\$5,000
VRC (C-2A Greyhound)	\$0	\$5,000

Table 1. Aviator Bonus Amounts for Fiscal Years 2011 and 2012

In 2012, the bonus amounts remain substantially less than in the past for some groups of Naval Aviators and Naval Flight Officers. The bonuses have been subject to drastic change in the past two fiscal years, where they not only are based on being a pilot or NFO, but are based on the type of aircraft as well. This is an interesting development, because an early criticism of the old ACP system was that the varied bonus amounts were unfair and negatively impacted the morale of those who were to receive less.

B. ELIGIBILITY

OPNAVINST 7220.9 outlines several criteria to determine whether a pilot in the Navy is eligible for the ACCP. An aviator is eligible for this bonus when all of the following are met. He or she must:

- 1) Be entitled to ACIP (Aviation Career Incentive Pay; also known as “flight pay”).
- 2) Be serving in a billet designated by COMNAVPERSCOM (PERS-43).
- 3) Be in a paygrade O-6 or below.
- 4) Be qualified to perform operational flying duty.
- 5) Have completed any Aviation Active Duty Service Obligation incurred for undergraduate aviator training leading to designation as a naval aviator or is within 1 year of completing such commitment.
- 6) Have completed less than 24 years of aviation service.
- 7) Be recommended for receipt of ACCP by their commanding officer.

C. RELEVANCE TO THIS STUDY

Naval Aviators are a highly important component of national defense, and a shortage of pilots could present negative implications, especially in time of war. Because aviators are at greater risk of leaving the aviation community at the conclusion of their minimum service requirement than at any other time in a 20-year career, this study specifically focuses on the “long-term” bonus paid to Naval Aviators. This is a five-year contract, under such an aviator will receive between \$5,000 and \$25,000 per year for five years to serve in department head billets. Further, the initial payment for the long-term bonus may be authorized for receipt one year prior to the end of the minimum service requirement. In total, an eligible aviator who accepts the long-term bonus over five years will receive between \$25,000 and \$125,000 depending on the type of aircraft flown and the need for qualified aviators to remain in that field (CNO, 2012).

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IV. DATA AND MODEL DEVELOPMENT

A. RATIONALE

This thesis describes the administration of the ACCP program since its inception in fiscal year 2000, and the effect on retention rates within the aviation community of the United States Navy. Personnel data that comprise the independent variables for the study include commissioning source, length of initial service obligation, sex, race, and rank at each year starting with the year prior to the minimum service requirement through the fifth year following the MSR.

The dependent variable is the career outcome for the individual pilot: whether he or she decides to remain in the military. Besides the independent variables listed above, the DRM includes economic data. Average pay by year of service for military pilots is included for fiscal years 1996 through 2001. Civilian pay statistics come from the Current Population Survey for 1996 through 2001.

The DRM is comprised of five equations with regards to a retention decision, and all five factor into the aviator's decision to remain or leave. The first three equations give a predicted value of staying for a specific period of time. One equation represents the expected value of staying in the Navy's aviation community for one additional year; the second equation represents the expected value of staying in the aviation community for five additional years; and the third equation represents the value of staying for a 20-year career. The last two equations deal with the probability of staying. The first of these equations is the probability of staying in the Navy, and the second equation is the probability of leaving. If the pilot achieves a highest expected value from signing a five-year contract, the model assumes that the pilot will choose to stay.

B. DATA DESCRIPTION

Prior to obtaining data, a thorough review of the study was conducted by the Naval Postgraduate School Institutional Review Board. Data was obtained from the Navy Personnel Command, Aviation Officer Community Manager. Data was also obtained through aviation detailers, PERS-43. The data originated from fiscal years 1997

through 2011, and consisted of all officers detailed to the aviation community. Not limited to Naval Aviators and Naval Flight Officers, this data included all officers such as flight surgeons, nurses, chaplains, intelligence officers, and those who had previously served as Naval Aviators and Naval Flight Officers. Each fiscal year included over 50,000 personnel records, for a grand total of 801,132 records. For each of these officers, dozens of data elements were provided. These elements included such items as the officer's name, social security number, designator (a four-digit number indicating the officer's job specialty), year group (fiscal year in which the officer was commissioned), sex, race, ethnic group, active duty start date, rank, date of rank, commissioning source (for example, the United States Naval Academy, Officer Candidate School, NROTC), platform (aircraft flown), and dependent status.

Additional data sets were provided to determine retention decisions. One data set in particular listed all Naval Aviators and all Naval Flight Officers who had accepted the ACCP bonus. This data covered retention decisions made by bonus takers in fiscal years 2003 through 2011. A third data set containing aviation strength losses was provided as well. This data set displayed the year of departure and the reason for the departure of every Naval Aviator and Naval Flight Officer during each year from 1997 through 2011. Some of the common reasons for departure included resignation from the Navy, conversion to another job in the Navy, retirement, administrative separation (ADSEP), and "other".

Using personally identifiable information, the three data sets were compared to determine the final disposition for each Naval Aviator, or whether he or she remained in the Navy's aviation community. The dataset was reduced to a smaller dataset to include pilots only, as this thesis seeks to answer questions about their retention as affected by the ACCP. These pilots consisted only of those that were commissioned in fiscal years 1996 through 2001. The base year of 1996 was chosen because this cohort of pilots would have only been eligible for a retention bonus through the system that was introduced in the year 2000, whereas earlier year groups may have been eligible for the older bonus system, or possibly a choice of either bonus. The final year group of 2001 was chosen

because this year group was the most recent year group that would have entirely reached the point of choosing whether or not to remain in the Navy's aviation community.

Of significant note is that for each year group, there were a number of pilots for whom no final disposition information was available (approximately 15 percent). That is, there was no indication that he or she had chosen to stay as indicated by accepting the ACCP bonus. Likewise, there was no information to indicate that the individual had left the aviation community or left the Navy. These individuals were removed from the final data set. What remained as the group to be analyzed included Naval Aviators for which there was data available for each year that he or she remained in the Navy, with data up through the sixth year after the minimum service requirement, or the year 2011, whichever came first.

Another point of interest is that the data set used in the analysis included only those pilots who had stayed in long enough to reach their MSR. Since this thesis seeks to investigate decision-making in retention decisions, it was important to include only the Naval Aviators who had reached a point where they were eligible to make retention decisions. Those who had left the Navy or the aviation community earlier in their career for any reason were excluded. At the end of the data filtering process, 3,041 pilots remained. At least eight years of data were included for each of these pilots, with over 24,000 points of data utilized to analyze this population.

By the time the final data set was created, all personally identifiable information had been removed, and each pilot had been assigned a 6-digit identification number. The first two digits indicate the fiscal year in which the pilot received his or her commission, and the last four digits were randomly assigned. In keeping the data format designed by the RAND Corporation for use with the DRM, the final data set also consisted of commissioning source, length of the initial service obligation, final disposition (stay or leave), sex, and race (black or other).

Commissioning Source. The Commissioning Source (source) was coded with a number, either "1," "2," or "3." A "1" indicated that the pilot attended a service academy, that is, the United States Naval Academy, the United States Air Force

Academy, the United States Military Academy, or one of the various maritime academies located in the United States. A “2” indicated that a pilot had received a commission through a Naval Reserve Officer Training Corps program at a civilian university. Finally, a “3” indicated that the officer was commissioned through any other source, including Officer Candidate School.

Length of Initial Service Obligation (liso). The liso was indicated by a numeric value indicating a number of years. A pilot’s minimum service requirement is determined by a pre-established requirement corresponding to the platform flown by the pilot. Up until the 2001 year group, a helicopter pilot was generally obliged to serve seven years following “winging,” or completion of flight training culminating in the receipt of the Naval Aviator wings of gold warfare pin. The pilot of a jet or propeller-driven plane was obliged to serve eight years following winging. The minimum service requirement is therefore variable and dependent on many factors, which may include the time it takes an officer to master his or her skills as a pilot, or down time spent between the date of commissioning and the start of flight school.

The final disposition (final) of the pilot was indicated by the word “Stay” or “Leave,” where “Stay” indicated that he or she had accepted the ACCP bonus. Sex of an aviator (sex) was indicated by a value of “0” or “1,” where a “0” indicated a male and a “1” indicated a female. Finally, the race of the aviator (black) was also indicated by a value of “0” or “1.” A “0” indicated that the pilot was identified as any race except black, whereas a value of “1” indicated a black aviator.

Each pilot’s rank was recorded over a seven year period, including in the year prior to the year of minimum service requirement (y0), followed by rank in the year of the MSR, and rank in each of the five years following the MSR (y1 through y6). For each year, the rank is indicated by an “s” followed by a 3-digit number. The first digit in the number indicated the officer’s rank, while the last two numbers indicate the years of service that it took for the pilot to reach that rank. For example, a value of “s304” indicated that in a particular year, the pilot was at the rank of an O-3, which was achieved

after four years of commissioned service. Likewise, a value of “s410” indicated that the pilot held the rank of O-4, which was attained following 10 years of commissioned service.

C. MODEL DEVELOPMENT

The Air Force study documented by Mattock and Arkes (2007) covers several different options with regards to the impact of the aviation bonus on retention decisions of pilots. For the purposes of this study, the option of the five-year commitment was the only one evaluated. Options beyond this point are of less interest since an officer who has stayed in the aviation community until the 15 year point is likely to stay until retirement, regardless of bonuses.

Simple retention models do not work well in the real world. They assume that people who share similar characteristics will behave the same way under similar circumstances. Yet the real world does not operate in this manner. There are factors of uncertainty that make a difference in retention decisions, and one of these factors is a taste for military service. That is, *how much does he or she like being in the military?* Second, there are positive and negative shocks that factor into decision making. With regards to staying in the military, a positive shock may be an early promotion or a monetary bonus. A negative shock may be an unexpected deployment or a “less-than-desirable” job assignment. In other words, a positive shock will reinforce the desire for an officer to remain a pilot in the Navy, whereas a negative shock may cause him or her to lose desire for remaining in this position. This is where the DRM exposes its relevance.

A five-year commitment is modeled by using five equations in accordance with the DRM. As previously stated in Chapter IV, A., this includes a “stay” equation for remaining in the aviation community for one additional year. The second equation is a “stay” equation for remaining in the aviation community for five additional years. The third equation is a “stay” equation for remaining in the aviation community until 20 years of commissioned service. The fourth and fifth equations are probability equations, with the fourth being the probability of staying, and the fifth being the probability of leaving.

In this section, we restate the model of Mattock and Arkes (2007). The first “stay” equation for the nonstochastic value of remaining in the aviation community one year is as follows:

$$V_t^{S1} = \gamma + W_t^m + \beta E_t[\text{Max}(V_{t+1}^L, V_{t+1}^{S1}, V_{t+1}^{S5}, V_{t+1}^{S20})]$$

where:

V_t^{S1} is the value of staying in the aviation community for one year,

γ is the individual taste for military service,

W_t^m is military earnings in a given year, which includes retirement benefits that will accrue for staying until t , and

$\beta E_t[\text{Max}(V_{t+1}^L, V_{t+1}^{S1}, V_{t+1}^{S5}, V_{t+1}^{S20})]$ is the discounted expected value of leaving, remaining in the aviation community for one year, remaining for five years, or remaining for 20 years, where:

β is the annual discount rate, and

E_t is the random shock.

The second “stay” equation for the nonstochastic value of remaining in the aviation community five years with a retention bonus is as follows:

$$V_t^{S5} = \sum_{\tau=t}^{t+4} \beta^{\tau-t} (\gamma + W_\tau^{m5}) + \beta^5 E_t[\text{Max}(V_{t+1}^L, V_{t+1}^{S1}, V_{t+1}^{S5}, V_{t+1}^{S20})]$$

where:

V_t^{S5} is the monetary value of the five-year contract,

$\sum_{\tau=t}^{t+4} \beta^{\tau-t} (\gamma^m + W_\tau^{m5})$ is the discounted present value of military earnings, which

includes the bonus for the five-year contract,

$\beta^5 E_t[\text{Max}(V_{t+1}^L, V_{t+1}^{S1}, V_{t+1}^{S5}, V_{t+1}^{S20})]$ is the discounted expected value of leaving, remaining in the aviation community for one year, remaining for five years, or remaining for 20 years, where:

β is the annual discount rate, and

E_t is the random shock.

The third “stay” equation for the nonstochastic value of remaining in the aviation community 20 years is as follows:

$$V_t^{S20} = \sum_{\tau=1}^{19} \beta^{\tau-t} (\gamma + W_\tau^{m20,t}) + \beta^{20-t} E_t[\text{Max}(V_{20}^L, V_{20}^{S1}, V_{20}^{S5})]$$

where:

V_t^{S20} is the monetary value of staying in the Navy for 20 years,

$\sum_{\tau=1}^{19} \beta^{\tau-t} (\gamma + W_\tau^{m20,t})$ is the discounted present value of military earnings through 20 years of service,

$\beta^{20-t} E_t[\text{Max}(V_{20}^L, V_{20}^{S1}, V_{20}^{S5})]$ is the discounted expected value of leaving, remaining in the aviation community for one year, or remaining in the aviation community for five years, where:

β^{20-t} is the annual discount rate for 20 years of service, and

E_t is the random shock.

The probability of staying equation is as follows:

$$\Pr[\text{Stay}_t | \gamma, \sigma] = \Pr[\text{Max}(V_t^{S1}, V_t^{S5}, V_t^{S20}) - V_t^L > \varepsilon_t] = F\left(\frac{\text{Max}(V_t^{S1}, V_t^{S5}, V_t^{S20}) - V_t^L}{\sigma}\right)$$

where:

$\Pr[\text{Max}(V_t^{S1}, V_t^{S5}, V_t^{S20}) - V_t^L > \varepsilon_t]$ is the probability that the maximum value of staying for one year, five years, or 20 years exceeds the value of random shock.

The probability of leaving equation is as follows:

$$\Pr[\text{Leave}_t | \gamma, \sigma] = 1 - \Pr[\text{Stay}_t | \gamma, \sigma]$$

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V. ANALYSIS RESULTS

A. DESCRIPTIVE STATISTICS

A total of 3,041 pilots are represented in the dataset used in this study. Of this 3,041, 1,516 pilots accepted the ACCP bonus (49.8%). This is broken down by year group (YG) in Table 2.

Fiscal Year	# Bonus Takers	Percentage
1996	245	47.6%
1997	240	46.6%
1998	247	49.3%
1999	216	45.8%
2000	271	52.0%
2001	297	57.5%

Table 2. Number of Pilots Accepting ACCP Bonus

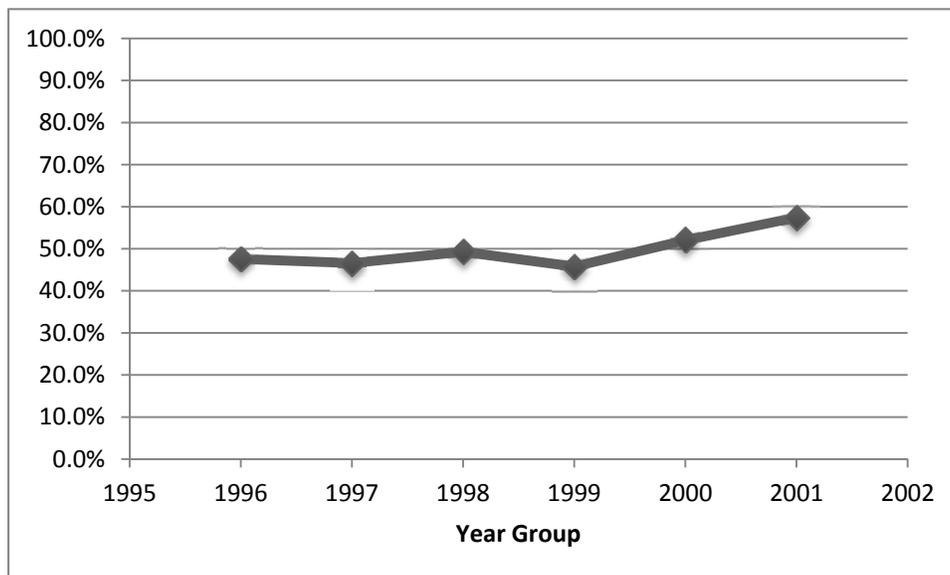


Figure 1. Percentage of Pilots who Accepted the Bonus by Year Group

Out of the total 3,041 pilots in the study, 177 (5.8%) were female. Year group 2001 had the highest percentage of female pilots, with a population that was 7.0% female, while year group 1996 had the lowest percentage, with a population that was 3.9% female. Only 29 females in the study chose to accept the ACCP, accounting for 16.3% of female pilots in the population, and comprising 1.9% of the overall population of bonus takers.

Fiscal Year	# Females	Percentage	# Bonus Takers	% Bonus Takers	% Total Bonus Taker Population
1996	20	3.9%	3	15.0%	1.2%
1997	27	5.2%	6	22.2%	2.5%
1998	30	6.0%	5	16.7%	2.0%
1999	28	5.9%	4	14.3%	1.9%
2000	36	6.9%	7	19.4%	2.6%
2001	36	7.0%	4	11.1%	1.3%
Total	177	5.8%	29	16.3%	1.9%

Table 3. Number of Female Pilots by Year Group

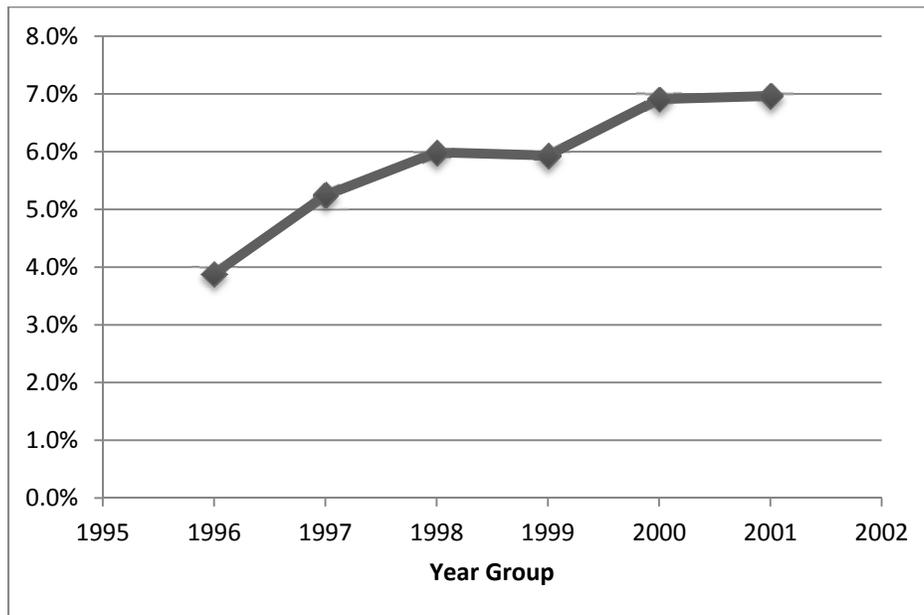


Figure 2. Percentage of Female Pilots by Year Group

The entire population of pilots consisted of 92 black pilots, or 3% of the population. Year group 1998 had the highest percentage of black pilots, with 3.9% of the population consisting of black pilots, while smallest percentage was in year group 2000, with 2.1%. Fifty-four black pilots chose to accept the ACCP bonus, consisting of 58.7% of the population of black pilots, and 3.6% of the overall population of bonus takers. One noteworthy observation was that there were no black female pilots found in the population used for this study.

Fiscal Year	# Black Pilots	Percentage	# Bonus Takers	% Bonus Taker	% Total Bonus Taker Population
1996	18	3.5%	10	55.6%	4.1%
1997	16	3.1%	8	50.0%	3.3%
1998	20	3.9%	11	55.0%	4.5%
1999	15	3.2%	11	73.3%	5.1%
2000	11	2.1%	5	45.5%	1.8%
2001	12	2.3%	9	75.0%	3.0%
Total	92	3.0%	54	58.7%	3.6%

Table 4. Number of Black Pilots by Year Group

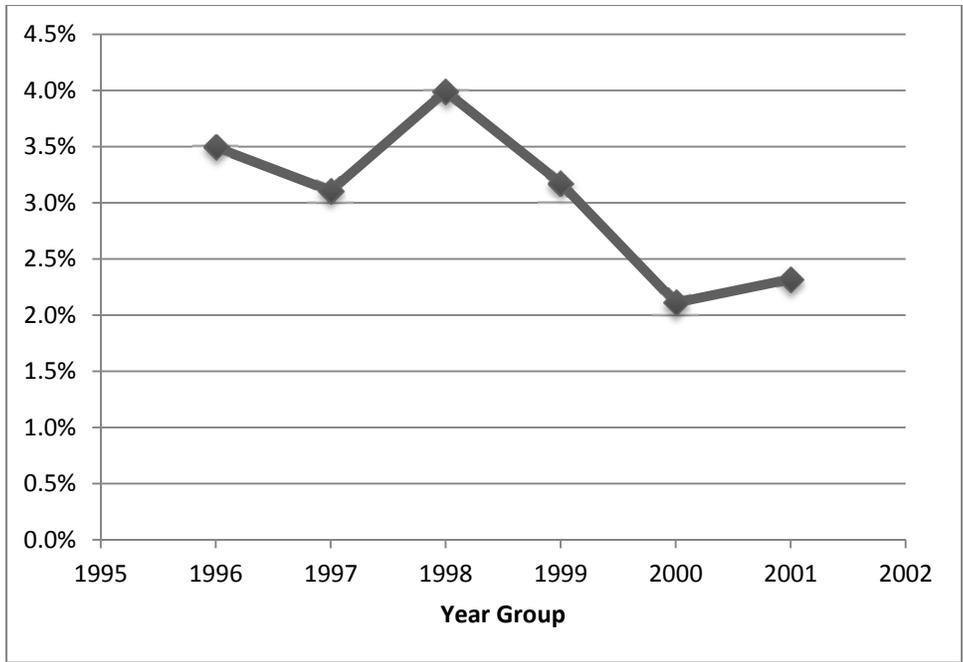


Figure 3. Percentage of Black Pilots by Year Group

A slight majority of pilots were commissioned through Officer Candidate School or any other commissioning program, those not including NROTC or service academies. A total of 1140 pilots were commissioned in this group, comprising 37.5% of the entire population. Service academies accounted for the second-largest commissioning source, with 1128 pilots comprising 37.1% of the population. Those commissioned through NROTC programs numbered 773, or 25.4% of the population.

Source	Number	Percentage
Service Academies	1128	37.1%
NROTC	773	25.4%
Others	1140	37.5%

Table 5. Number of Pilots by Commissioning Source

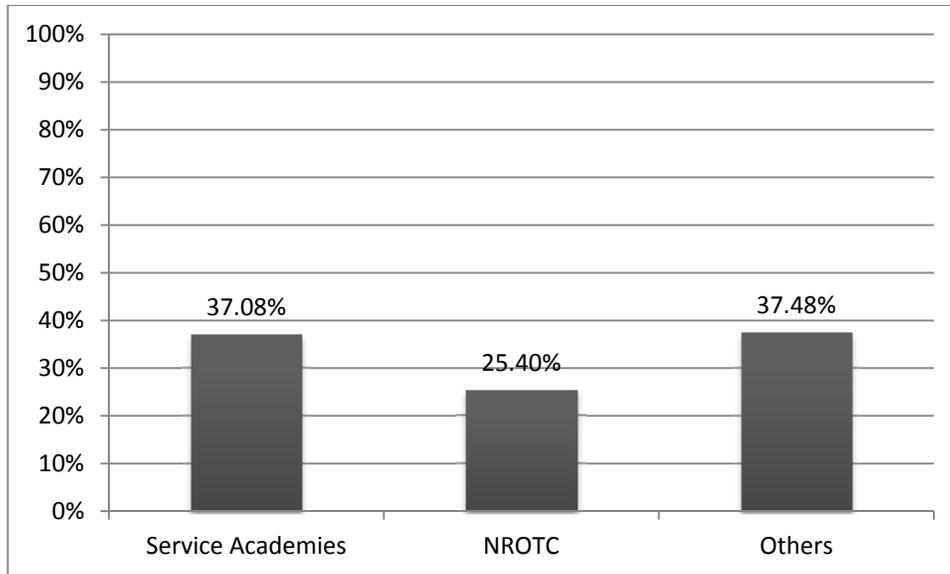


Figure 4. Percentage of Pilots Commissioned by Each Source

Source 3, consisting of all commissioning sources except for service academies and NROTC programs, had the highest percentage of bonus takers. Approximately 51.7% of this group accepted the long-term ACCP bonus. Source 1, consisting of service academy graduates, closely followed with 49.8% of the population choosing to accept the bonus. Finally, 47.2% of NROTC graduates comprising Group 2 chose to remain in the Navy as pilots.

Source	Number	Percentage
Service Academies	562	49.8%
NROTC	365	47.2%
Others	589	51.7%

Table 6. Number of ACCP Bonus Takers by Commissioning Source

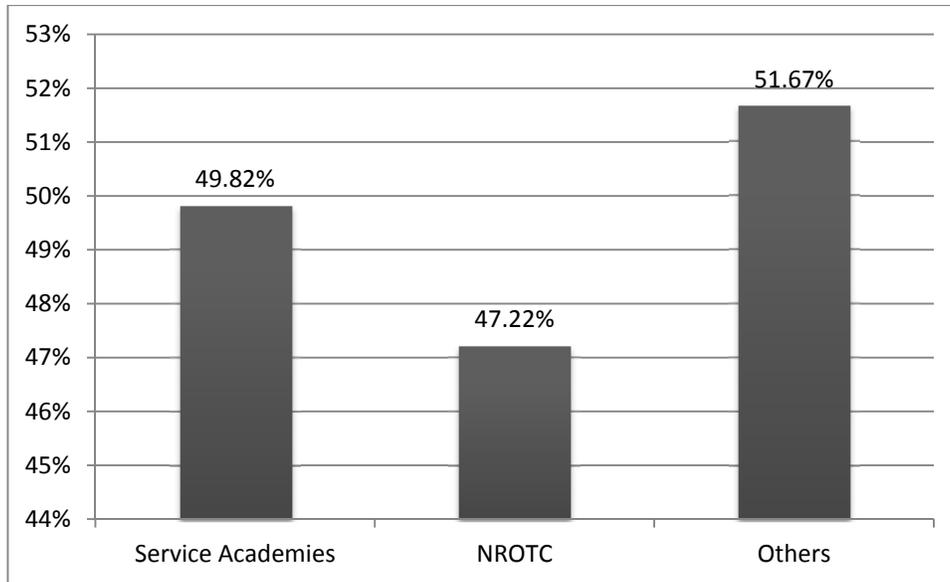


Figure 5. Percentage of Bonus Takers by Commissioning Source

The data was further subdivided by aircraft platform, or type of aircraft flown by a given pilot. The categories included “helo” for helicopter pilots, “jet” for pilots of jet-propelled aircraft, and “prop” for pilots of propeller-driven aircraft. There were a total of 1285 helicopter pilots, 908 jet pilots, and 848 prop pilots represented in the study. Helicopter pilots had the second-highest percentage of bonus takers, with 54.5% accepting the bonus. Jet pilots had the highest percentage of bonus takers, with approximately 55% of pilots accepting the ACCP bonus and remaining in the aviation community after their minimum service requirement had ended. Pilots flying propeller-driven aircraft had significantly fewer bonus takers, consisting of only 37.3%.

Platform	Number	Percentage
Helo	700	54.5%
Jet	500	55.1%
Prop	316	37.3%

Table 7. Number of Bonus Takers by Aircraft Platform

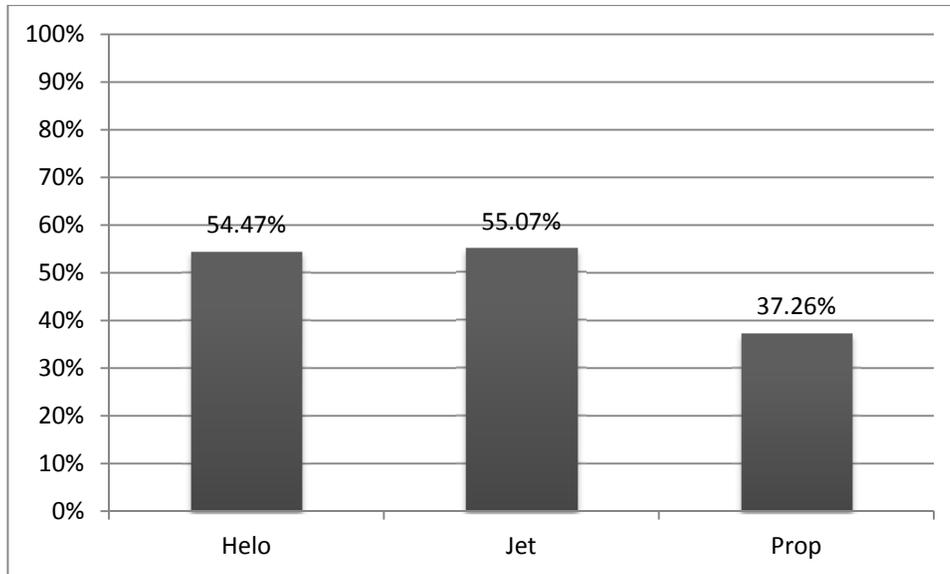


Figure 6. Percentage of Bonus Takers by Aircraft Platform

The average minimum service requirement for the population was 9.36 years from the date of commissioning. The mode for the MSR was nine years, while the maximum MSR was 15 years (N = 2). While this is lengthy, a pilot with such an MSR most likely started in another community and converted to be a pilot later in their career as a naval officer. The minimum MSR was seven years (N = 4). This was very uncommon, with only four occurrences, all of which fell into source category “3.” It is likely that these pilots had begun their career in another service (i.e., Air Force, Marine Corps) and were under a shorter contract when they transferred to the Navy.

It is not surprising that the shortest average minimum service requirement was found among the population of helicopter pilots. This is because with an MSR of 7 years following winging, the average length of initial service requirement was 8.99 years. For jet pilots, the average length of initial service requirement was 10.18 years. Finally, prop pilots had an average length of initial service requirement of 9.03 years.

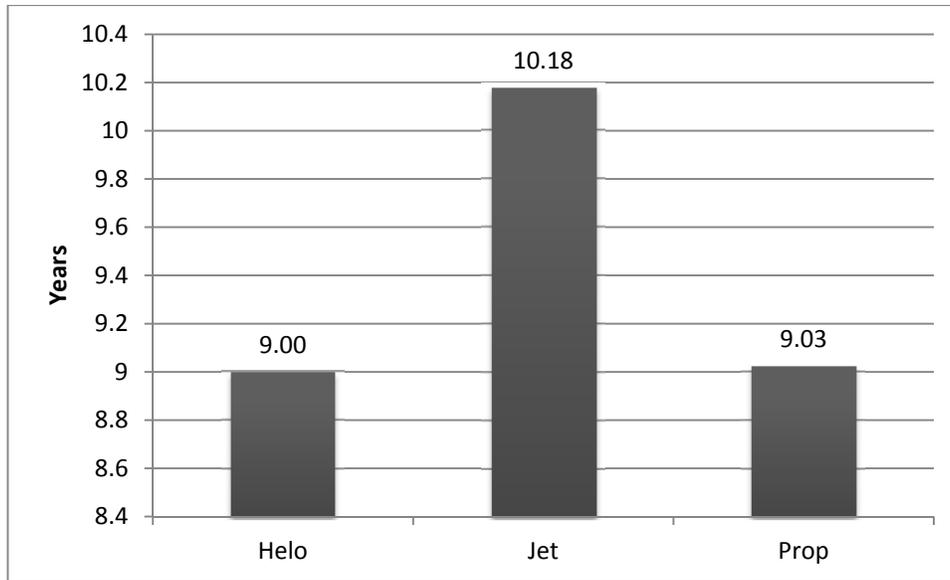


Figure 7. Average Length of Initial Service Obligation by Aircraft Platform

B. IMPLEMENTING THE DRM: THE IMPACT OF THE ACCP RETENTION BONUS

Computations were made via the statistical program R, using R code developed by Mattock and Arkes (2007). An additional function was created that would specifically call the function “PrStay” from the RAND model. This function takes three inputs: gamma, sigma, and beta. Gamma is used to model the taste of military service for an individual and uses an extreme value distribution. A random Weibull distribution was utilized to generate the gamma parameter, using the scale of 221.4 that was given in the RAND report. Sigma is used to simulate the potential shock that each pilot would experience. The model takes the standard deviation of shock, which was given in the RAND report as 566.8. Finally, beta is the annual discount rate. RAND used a value of 0.9 and this was maintained in the attempt to validate their DRM as implemented in R.

Each pilot in the dataset was entered into the model in a manner that would take his or her initial service obligation and input it as “t” (time). In other words, this program was used to simulate each pilot’s most likely retention decision at the time of completing the minimum service requirement. Table 8 displays the results of these simulations.

Bonus Amount (Annual)	# Bonus Takers	% Bonus Takers
\$25,000	2288	75.2%
\$15,000	1957	64.4%
\$5,000	1540	50.6%
\$0	14	0.5%

Table 8. Predicted Rate of Bonus Takers by Bonus Amounts

As displayed in Table 8, 75.2% of pilots were predicted to sign a five-year contract when a bonus of \$25,000 per year was offered. This is in contrast to what was observed in the actual data, where approximately 50% of pilots accepted the bonus (Table 2). When the bonus was lowered to \$15,000 per year, approximately 64.4% of pilots were predicted to sign a five-year contract to remain in the Navy as a pilot. With a bonus of \$5,000 per year, the predicted rate of bonus takers is lowered to 50.6%. Finally, with the removal of the bonus altogether, only 14 pilots (0.5%) were predicted to sign a five-year contract. This finding is suspect and highly unlikely. Even in the absence of the bonus, there will be individuals who enjoy their job in the Navy and are committed to serving until retirement age.

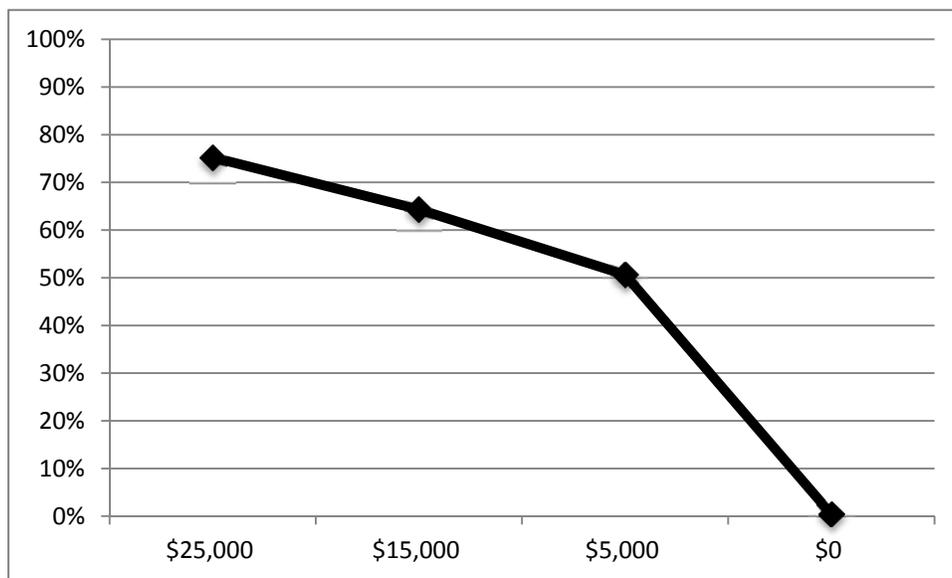


Figure 8. Predicted Percentages of Bonus Takers by Annual Bonus Amounts

C. MODELING THROUGH LOGISTIC REGRESSION

Because the DRM did not appear to be successful in predicting retention, a logistic regression was initiated using the same data. The dependent variable (final) was defined as whether or not each aviator had taken the bonus, as indicated by “stay” or “leave.” Independent variables were commissioning source (source), race, sex, length of initial service obligation, and rank at the time the initial service obligation had been completed.

In order to simplify the model and mitigate the impact of outliers, some of these variables were collapsed further into factors for the model. Race (black) and sex were combined into “RaceSex,” with “BM” denoting a black male, “WF” denoting a non-black female, and “WM” denoting a non-black male. Length of initial service obligation (liso) was combined into four possible categories, with “8-” denoting an obligation of eight or fewer years, “9” denoting nine years, “10” denoting 10 years, and “11+” denoting 11 or more years. Finally, rank at the conclusion of service obligation (rank) was collapsed into factors of “O3” for an O-3, and “O4+” for an officer who was an O-4 or senior.

A logistic multiple regression was run with all of the above factors, as displayed in Table 9 (Devore, 2010). Source did not appear to be a significant factor in predicting a decision to stay or leave, and it was removed from the model. When the logistic regression was run again, RaceSex was found to be significant with a p-value of 0. Specifically, non-black females are highly likely to leave naval aviation, with an estimated coefficient (log odds) of minus 1.84 and a p-value of 0. The odds of a non-black female staying in the Navy are only 16% of that for a comparable non-black male.

Coefficient	$\hat{\beta}$	$\text{Exp}(\hat{\beta})$	$\text{SE}(\hat{\beta})$	p-value
RaceSex BM	0.34	1.40	0.22	0.13
RaceSex WF	-1.84	0.16	0.22	0.00
Liso9	0.15	1.16	0.13	0.27
Liso10	-2.01	0.13	0.24	0.00
Liso11+	-2.29	0.10	0.27	0.00
rankO4+	3.07	21.54	0.22	0.00

Table 9. Multiple Regression Results

Length of initial service obligation was found to be significant at a p-value of 0. Those with a length of initial service of 10 or more years are likely to leave naval aviation. Log odds were minus 2.01 for factor “10” and minus 2.29 for factor “11+.” The odds of staying for a pilot with a 10-year initial service obligation are 13.4% of the odds for a comparable pilot with a service obligation of eight or fewer years. The odds of staying for a pilot with a service obligation of 11 or more years are 10.1% of the odds for a comparable pilot with a service obligation of eight or fewer years.

Finally, rank was found to be significant at an alpha-level of 0. Those of rank O-4 or senior (O4+) were likely to remain in the Navy as pilots, with log odds of 3.07 and a p-value of 0. The odds of a pilot with rank O-4 staying in the Navy are 21.54 times greater than the odds of an O-3 staying in the Navy (1 to 21.54). This makes sense, as an O-4 or above will have already served for at least 10 years.

The logistic regression was also used to calculate the predicted probability of staying in the naval aviation community for each set of characteristics. Table 10 displays predicted probabilities of staying, and the corresponding frequency of pilots sharing that probability. In terms of retention, 889 pilots had a greater than 50% predicted probability of staying, and 620 pilots in this group actually took the ACCP.

The predicted probabilities are grouped as seen here because the model only produces 54 distinct predictions, corresponding to the 36 distinct combinations of RaceSex, liso, and rank.

Predicted Probability	Actual # Leave	Actual # Stay	Actual % Takers	Average Predicted Probability
< .467	497	159	24.2%	25.1%
.467 - .487	216	182	45.7%	46.7%
.487 - .497	249	258	50.9%	48.8%
.497 - .5	298	294	49.7%	49.7%
.5+	269	620	69.7%	69.8%

Table 10. Predicted Probabilities of Retention

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VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

To answer the question about the impact of the ACCP on retention, the DRM did predict a downward trend of retention as the annual bonus was reduced. While this model may be useful for looking at potential trends in changing bonus amounts for Naval Aviators, the results do not conclusively demonstrate the utility of this model. First, the model did not produce an accurate number of bonus takers when the annual bonus was \$25,000. Though bonus amounts have fluctuated in recent years, all of the pilots in this study had the opportunity of signing a five-year contract when the only possible bonus amount was \$25,000 per year. The model predicted a retention rate of 75.2%, while the actual data showed that approximately 50% of the population had actually taken the bonus. The model predicted 50% more signers of a five-year contract, which is a substantial difference.

Second, the model predicted that only 14 officers (0.46%) would remain in the Navy as pilots if the bonus were to be discontinued. These results are highly implausible and vastly underestimate the taste for military service that one may have. While this model attempts to quantify a person's preference for the military, it is not easy to put a dollar amount on levels of being patriotic and passion one may have for his or her job. The idea that no pilots would stay in the service without a bonus is unrealistic.

The DRM failed to take into account the demographics of a population. While the dataset calls for several elements, including commissioning source, length of initial service obligation, final disposition (stay or leave), sex, race, and promotion history, reading the R code revealed that the only element actually used to predict retention is the length of initial service obligation. All other elements are disregarded. It is unlikely that these other elements do not factor into a retention decision, and basing a decision to stay or leave solely on the length of initial service obligation is unrealistic.

The logistic regression appeared to create significantly better predictive results. A review of the logistic regression results produces the conclusion that demographics are important when considering the issue of retention decisions. Race, sex, length of initial service, and rank at the time of the retention decision are all associated with whether a pilot will remain in naval aviation. Perhaps a more successful model would include these demographics, in addition to the economic factors considered in the DRM. This may help to produce a more complete picture of pilot retention decisions.

B. RECOMMENDATIONS

The DRM presents another way of analyzing past retention and using it to make recommendations about future behavior. By reducing the possible annual bonus amounts, the model may be used to look at the decreasing trend in aviator retention. Yet the accuracy of simulated retention decisions is in question. This model may be a starting point for calculating potential retention decisions, but it leaves unanswered questions about the actual number of aviators that can be expected to remain in the Navy. Perhaps this model can be further developed and built upon in a manner that would be of more utility to the United States Navy. Until the DRM is appropriately modified, the logistic regression is a better method for predicting retention

C. FUTURE RESEARCH

1. Ask Aviators Why They Leave

With regard to future research, the primary question that was identified is “why do aviators leave the Navy?” It would be beneficial to ask aviators themselves why they chose to leave, or why they chose to take the bonus and continue their service. This could be done through surveys or interviews with aviators in the U.S. Navy. This would certainly give qualitative data as to whether the ACCP influences one to stay in the Navy.

An example of an area where this would be of great utility would be with female aviators. It was observed in the data that the vast majority of female aviators chose to leave the Navy or convert to other Navy communities once their minimum service

requirement had been reached. It is possible that this is a point when many female aviators are ready to start a family. There is a question about whether the aviation community is conducive to motherhood.

Another area of interest is that of operational tempo. The United States has been at war since 2001, and all aviators in this study have been in the Navy during a conflict period. It is likely that most of these aviators have deployed to conflict zones, and potentially deployed on many occasions. As a result of conversations with Navy pilots, perhaps there is a level of “burnout” associated with these multiple deployments, and a desire to have a more steady and predictable work schedule. This desire alone could be motivation to leave naval aviation. By addressing these and related issues, one can better understand the factors involved in the decision-making process of whether or not to leave the aviation community.

2. Evaluate Economic Factors

A study of economic factors would also be of value. There are countless economic factors to be considered that could influence a decision to stay or not, and conversations with aviators have yielded many factors of particular interest. The housing market was a concern that has been cited by not just Naval Aviators, but service members as a whole. Many members of the Navy have purchased homes in high-cost, fleet concentration areas, only to be saddled with the burden of being unable to sell these homes at a price that would cover the amount owed on the mortgage when PCS orders arrive. The uncertainty of covering this cost could influence one’s decision to stay in the Navy. To look at this, a researcher could find a way to quantify the nature of the housing market in the years leading up to the minimum service requirement of the service member. Analysis could then examine the correlation between this factor and retention.

The availability of commercial pilot jobs should be considered, instead of focusing on average salaries as a factor that is relevant to the retention decision. Regardless of starting salary, it is likely that aviators would be impacted by the availability of commercial aviation jobs. A potential area of research could be to evaluate unemployment rates of trained pilots, or to research the demand for these jobs

versus the supply of qualified pilots. The Naval Aviation community could use these results to their benefit, increasing the bonus in years of high job availability, and reducing the bonus in years in which an aviator is less likely to leave to pursue a commercial aviation career due to lack of opportunity. This could be analyzed for aviators of different platforms to determine how bonus amounts should vary depending on platform and the availability of comparable civilian jobs.

3. Evaluate Aviator Service Records

A valuable addition to this body of research would be specific information on why an aviator potentially left on an involuntary basis. While the information on each aviator used in this research was extensive and adequate for these purposes, the information on losses was often limited to such categories as “ADSEP” (Administrative Separation), “Resignation,” “Retirement,” and others.

But what do these categories really mean? And if the connotation is negative, would a researcher have success in gaining this information through surveys and interviews? This research basically assumed that if an aviator made it to the end of his or her minimum service requirement, then he or she made the choice to stay or leave the Navy or the aviation community. Yet there are myriad reasons why one may leave without really wanting to. Perhaps an aviator who left due to medical reasons may have remained on active duty if he or she had remained healthy. Another aviator may have been forced to leave due to disciplinary action.

It would be beneficial to have the ability to divide the groups of losses into those who voluntarily left active service, and those who had no choice.

4. Evaluate NFO Retention

The final recommendation is for an evaluation of the retention of Naval Flight Officers, or NFOs. Naval Flight Officers receive retention bonuses in a similar manner to Naval Aviators. However, it is the theory of this researcher that NFO retention may be different in terms of motivators. While some economic reasons may be the same, NFOs possess a different skill set than Naval Aviators. In many cases, their job opportunities in the civilian sector would not be the same as those for pilots.

For that reason, it would be worthwhile to analyze if there is a difference in NFO retention versus that of pilots. If there is a difference, then perhaps there should be separate bonus programs for aviators and NFOs. This study focused solely on aviator retention.

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