CRM D0004216.A2 / Final
August 2001

Fleet Attrition: What Causes It and What To Do About It

Heidi L. W. Golding • James L. Gasch • David Gregory
Anita U. Hattiangadi • Thomas A. Husted • Carol S. Moore
Robert W. Shuford • Daniel A. Seiver

4825 Mark Center Drive • Alexandria, Virginia 22311-1850

Approved for distribution: August 2001

Donald J. Cymrot, Director
Workforce, Education and Training Team
Resource Analysis Division

This document represents the best opinion of CNA at the time of issue.
It does not necessarily represent the opinion of the Department of the Navy.

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED
For copies of this document, call CNA Production Services (703) 824-2122 or (703) 824-2123

Contents

THIS PAGE INTENTIONALLY LEFT BLANK

Summary

When the Navy's downsizing ended in the 1990s, undermanning in the fleet became evident. By the end of the decade, fewer than 90 percent of the enlisted billets were filled. Problems with recruiting, distributing, and retaining sailors all contributed to the undermanning difficulties. In response, the Navy fought to reverse the trend by instituting initiatives to alleviate attrition.

As part of the Navy's efforts to increase manning through reduced attrition, the Assistant Deputy Chief of Naval Operations, Manpower and Personnel (N1B) asked CNA to analyze the causes of fleet attrition—that is, early separations among sailors who make it to a full-duty billet, both on shore and at sea. Because most fleet attrition occurs soon after arrival in the fleet, we focused on first-term attrition. First, we studied the patterns of fleet attrition losses in the Navy. Then we investigated the causes of attrition and how those factors changed in the 1990s. We conducted an analysis of yearly cohort attrition for first-term sailors on both sea and shore duty. Then, restricting our analysis to sailors on surface ships, we explored how the deployment cycle influences attrition. Finally, because attrition is costly, we explored strategies aimed at reducing it and keeping it low.

Findings

During the 1990s, first-term fleet attrition increased; about 25 percent of sailors who made it to a full-duty billet in FY97 attrited from the fleet before the end of their first obligation. The most recent attrition rates, however, show substantial improvement. If these rates continue, fleet attrition rates for sailors currently in their first term will decline to rates last seen in the late 1980s.

This change is positive, but our analysis uncovered some trends to be concerned about. Increases in attrition occurred disproportionately among sailors in the first year in the fleet, among the sea-duty

population and among the most highly trained sailors. The latter two changes persist despite the recent decreases in attrition.

Our statistical work showed that many factors contribute to first-term fleet attrition:

- **Civilian opportunities and compensation**. A booming civilian economy with low unemployment causes higher attrition because sailors have relatively better opportunities outside the Navy than they do in economic downturns. Increases in sailors' current income (as measured by the military-to-civilian wage ratio) and future income (measured as the expectation of receiving a Selective Reenlistment Bonus, or SRB) both reduce attrition—particularly after the first year in the fleet.

- **Quality of service at sea**. Some aspects of sea duty are particularly arduous, involving substantial amounts of time away from home and particularly high workloads. Other aspects, primarily travel to foreign lands, partially offset the most difficult aspects of sea duty. We found that sailors who experience higher nondeployed time under way or who have been deployed are more likely to attrite. Time spent in "good" ports helps mitigate the effects of deployments, whereas time spent in "bad" ports exacerbates the attrition problems. Finally, major preplanned maintenance periods and inspections also increase attrition.

- **Unit leadership**. Commanding Officers (COs) do not receive all the benefits of low attrition nor do they pay the full costs of attrition. Historically, the primary incentive commanders have had to lower attrition is gapped billets—lack of manpower potentially affects readiness. We found that COs do respond to this incentive. Lower manning is associated with decreases in attrition.

  The CO's style of leadership appears to affect attrition as well. Despite the fact that COs have similar incentives, our data show large variation in attrition rates across COs. Differences in a ship's attrition rates across consecutive COs cannot be explained by disparities in crew composition, deployment schedules, or ships. COs do have an impact on attrition.

Some of the past several years' increases in fleet attrition can be attributed to changes in civilian compensation (primarily for the most skilled sailors) and deterioration in sea-duty conditions. Once manning problems developed, however, leadership's attention became focused on attrition. The fleet reversed the rising level of attrition through improvements in underway time, reduced inspections, and other initiatives.

Implications and recommendations

We investigated several possible strategies for the Navy to undertake. The most promising involved realigning incentives for unit COs. Because we find that COs do respond to incentives, we recommend that the Navy:

- Expand its reporting systems to identify ships that consistently rank above the acceptable ceiling in attrition
- Investigate and track progress with these problem ships
- Permit and reward experimentation at the unit level
- Award low attrition commands—publish the best performing ship quarterly, reinstitute the Golden Anchor Award, and make retention part of the Battle E requirement.

One way for leadership to cut attrition is to make the Navy a better place to be. Local commands could enhance worklife and shipboard living. However, it is also necessary to pursue systematic integration of worklife issues into Navy-wide planning and to track and measure improvements throughout the fleet.

Two other strategies we investigated do not appear as promising. First, a completion bonus to keep sailors in the Navy would not be cost-effective. Even under the most optimistic scenarios, savings from lower accessions do not cover the costs of offering a lump sum bonus at the end of a sailor's obligation. Second, based on interviews with focus groups and personnel data, we believe tightening the separation rules within the administrative separation system would do little for overall fleet attrition. Sailors who want to attrite can usually find an official reason, no matter what the true cause. For this strategy to

reduce attrition, it must be the case that the sailor cannot leave through any other means. All rules would need to be tightened to be effective.

Introduction

Background

During the early 1990s, the Navy began a significant downsizing that decreased endstrength by more than 30 percent over the decade. Sea manning was high during the drawdown despite the Navy's reduction of personnel because sailors from decommissioning ships could be reassigned to other ships. Thus, the Navy could both aggressively remove problem sailors from service and allow sailors who wanted to separate early to do so, and still meet Navy manning needs. As the drawdown ended, however, shortages in sea manning began to appear. No longer did the fleet have ready access to replacements. Research shows that readiness in the areas of personnel, training, equipment, and supply on ships suffers when manning is low [1], while anecdotal evidence suggests that gapped billets create additional workload and stress for the remaining sailors—potentially exacerbating retention problems. The Navy began to investigate ways to increase manning in the fleet. One solution is to reduce the number of the sailors who separate before their enlistment contracts end—in other words, cut attrition.

The Navy has pursued several avenues to reduce attrition—from new programs at bootcamp to tightening the criteria for separating sailors to encouraging experimentation at the local commands. The most direct and immediate way to reduce undermanning at sea, however, is to reverse the rising level of attrition in the fleet. To this end, the Navy has pursued increases in compensation, reductions in in-port workload, and alternative work schedules. It is perhaps because of such efforts that attrition from the fleet peaked in the late 1990s and has now dropped substantially.

Since these first steps, Navy efforts to reduce attrition have only intensified. The current CNO set an aggressive goal of reducing overall attrition (including prefleet and fleet attrition) by one-fourth, which would drive first-term attrition to or below pre-drawdown rates.

To support its ongoing efforts to reduce attrition, the Navy asked CNA to examine the causes of attrition from the fleet and investigate the strategies and policies the Navy might employ to lower attrition permanently. Because attrition from the fleet usually occurs soon after sailors arrive at their first full-duty billet, we focused on first-term fleet attrition.

Framework

As our first step, we considered who makes the attrition decision—the Navy or the sailors themselves. Understanding this issue shaped our approach in studying why atttrition occurs.

Some have argued that the Navy determines the level of attrition because it has final discharge authority and sets criteria by which sailors may separate early. The Navy may sanction an early release for many reasons, including misconduct, drug use, medical problems, pregnancy, or hardship. Generally, the commanding officer or the medical establishment makes the determination whether the sailor has met the criteria for separation.

If the attrition decision rests with the Navy, one might conclude that the causes of attrition are easy to identify: We need only look at the official reason for loss recorded in sailors' personnel files.[1] Policies to reduce attrition would attack problems before they occur—offering programs to reduce drug use, information on pregnancy prevention, and so forth.

However, many attrition decisions are not cut-and-dried. Often, attrition is only one of several ways to deal with sailors who present behavioral or health problems. Individual COs interpret the criteria for discharge differently and have discretion in recommending

1. The Navy groups reasons for losses into: (1) cause losses, which it feels it can influence, and (2) other losses, which it cannot influence. It is not apparent, however, which losses should be classified as cause losses and which are other losses. For example, medical problems and pregnancies are other losses, while personality disorders and patterns of misconduct are cause losses.

discharge. One commander might recommend a nonjudicial punishment, while another may attrite the sailor. The same is true of medical professionals. They may have different separation recommendations when presented with the same medical complaint. In addition, the discretion inherent in interpreting the criteria and the sailors' actions or condition allows other factors to influence a CO's willingness to release a sailor. For example, as we conducted our study, we heard frequent mention of the "zero-defect mentality" that arose during the drawdown. With high manning, COs could attrite sailors. To avoid a gapped billet, however, COs with low manning may, instead, recommend a nonjudicial punishment (such as a demotion or fine) instead of separation. In this sense then, the decision to attrite the sailor is based not only on the condition or situation of the sailor, as represented by the official Navy loss reason, but also by the retention environment and other influences that the commands must address.

Alternatively, some argue that the vast majority of attrition is determined by the sailors. Sailors decide throughout their contract whether they want to stay or leave. Factors affecting their satisfaction with Navy life influence whether they will seek out a way to attrite. This was confirmed during our study. According to focus groups we conducted, sailors who have decided to leave simply use the Navy's separation criteria as a means to do so. Those wanting rapid separation may take a disciplinary route—the easiest and quickest of which is drug use. Others may choose a way out that takes more time but doesn't involve a general discharge. For example, a sailor may have an existing medical condition and attempt to use that. If that doesn't work, the sailor might return with complaints of a vague, chronic condition and, as necessary, proceed through other legitimate reasons.

It is likely that the separation decision can be either the Navy's or the sailor's. For this reason, when we developed a framework for studying the causes of attrition, we focused on factors affecting sailors' satisfaction with Navy life and, potentially, attrition, as well as the commander's incentives to attrite sailors.

Approach

In the past, the Navy's ability to monitor and understand fleet attrition has been hampered by a lack of good data. In this study, after creating a consistent measure of attrition from the fleet, we analyzed historical patterns and trends in attrition. We identified trends in the timing of attrition, as well as trends in the characteristics of the sailors who attrite and the assignments they leave. Because most of the early attrition occurs from sea duty, we also took a closer look at that attrition, specifically from ships. To gain insight into the reasons sailors separate early, we examined variation in attrition rates by ship types and over time, and detailed patterns in attrition over the deployment cycle.

Based on our findings from focus groups, statistical analyses, and comparisons of the civilian and military sectors, we explained the causes of attrition. Because our research confirmed the inability of official Navy loss codes to accurately describe the underlying reasons for the early separations, we concentrated on Navy and civilian influences, as well as the sailor's characteristics, to explain the causes of attrition. We separated the primary factors driving attrition into three categories: (1) economic opportunities and military compensation, (2) quality of service at sea, and (3) the role of leadership.

Finally, we examined strategies the Navy might pursue to improve fleet attrition. Broadly defined, the strategies we investigated were to: (1) give greater flexibility and incentives to local commands but require accountability for high attrition, (2) provide financial and other incentives to sailors, and (3) limit local command authority to attrite sailors and tighten rules of eligibility. For each strategy, we assessed some policy measures based on their expected effectiveness and costs (when available).

What's happening in the fleet

Our first step was to determine a consistent definition of fleet attrition and a way to measure it that would help guide us to its underlying causes. Here, we describe the attrition measure we used and present attrition trends at the Navy level and by ship.

Defining and measuring attrition: first-term cohort attrition

Because we were interested in attrition from the fleet, we focused our analysis only on sailors who had completed their initial skills training and had begun their initial full-duty assignment either at sea or on shore. To calculate the rate at which these sailors leave the Navy, we had several alternative methods available. Two of the most familiar were to follow individuals from the time they entered the fleet to when they left (cohort attrition rates) or to measure the percent of sailors in their first term who attrited in a given time frame (cross-sectional attrition rates).[2] We present cohort attrition rates here for two reasons. First, cohort attrition rates gave us the most accurate information on how many sailors who have entered productive billets have made it to the end of their term. Also, we could follow cohorts at different stages in their assignments. This provided valuable information on the timing of attrition and helped identify its causes.

To calculate the first-term attrition rate, we tracked sailors from their arrival at their initial fleet assignment through 36 months in the fleet.[3] For instance, the FY97 cohort—the most recent cohort to

2. As part of this study, we investigated the advantages and disadvantages of alternative attrition measures, compared historical attrition rates for each measure, and recommended measures for the Navy to track.

3. Some sailors, particularly 6-year obligors (YOs), have up to 24 months in the Navy before entering the fleet because of the length of their training pipelines.

complete 36 months in the fleet—follows sailors through FY00.[4] We used 36 months in the fleet as the benchmark first-term rate because it was the point where the majority of sailors were close to their reenlistment decision.[5]

We defined first-term attrites as sailors who left the Navy at least 3 months before the expiration of their initial constract. The definition includes all but one type of early loss. We did not consider "good" early separations—those who the Navy permitted to separate early during the drawdown or to enter officer programs—as attrites. To calculate an attrite's time in the fleet, we excluded any time spent processing out or in non-full-duty status (i.e., non-productive billet) before separating from the Navy. In other words, to be a 36-month fleet attrite, a sailor must both separate early and leave a full-duty assignment before 36 months in the fleet.

Navy-wide fleet attrition

Historically, fewer than 25 percent of first-term sailors attrite from the fleet. In fact, cohorts in the late 1980s averaged just over 21 percent. Since that time, attrition has trended upward—with the 36-month fleet attrition rate peaking at over 25 percent (figure 1). The same upward pattern is mimicked for 12-month and 24-month attrition.

The most recent data show attrition rates falling, and falling substantially. Should the attrition rates from the last 12 months continue into the future, first-term fleet attrition will stabilize at about 22 percent—

4. Our data track sailors through December 2000. Based on historical experience, we know a small number of sailors who left their full-duty assignment in FY00 will not be recorded on the Enlisted Master Record (EMR) as having left their assignments and the Navy until later in FY01. We adjusted the attrition rates upward to reflect this.

5. Because we wanted to capture only first-term attrition, the sample for 36 months in the fleet excludes sailors with contracts that would expire before 36 months in the fleet. Consequently, the sample omits 2- and 3-year obligors and about 30 percent of the 4-year obligors. We used similar sample selection procedures for the 12- and 24-month rates. The 2-year obligors and 20 percent of the 3-year obligors were dropped from the sample for the 24-month rate. Very few sailors were eliminated from the sample for the 12-month rate.

a rate last experienced over 10 years ago. Figure 2 shows our extrapolation of recent cohort rates into the future to estimate first-term attrition rates for the FY98 and FY99 cohorts.

Figure 1. First-term fleet attrition

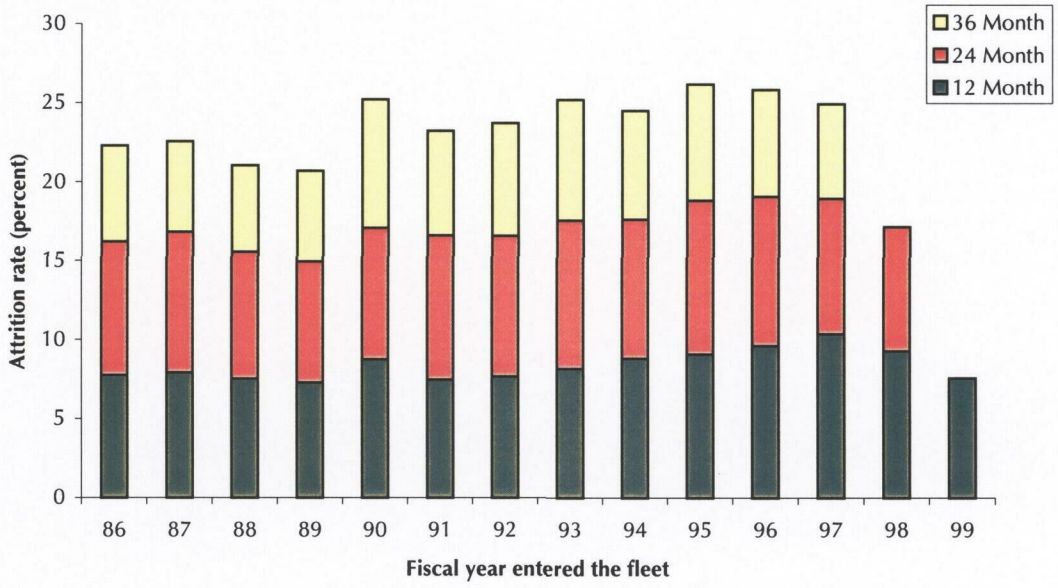
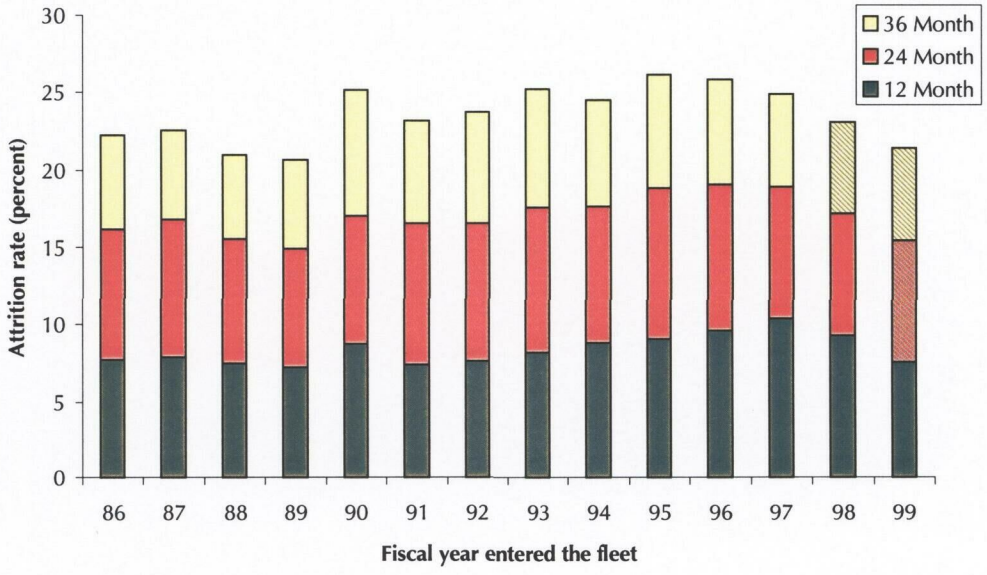


Figure 2. Historical first-term attrition with predicted attrition for FY98 and FY99 cohorts



This decline may indicate that the Navy's initiatives over the past years are working. It is not yet apparent, however, that the initiatives will permanently cut attrition. Previous attrition reduction efforts resulted in short-term improvements, but, once the emphasis shifted to other problems, the climb in attrition resumed. For that reason, we believe it is essential to understand who is attriting and quantify the causes for the losses.

Historical relationships and recent trends

When we examined who attrites and from where, it was apparent that different groups of sailors had persistently different attrition patterns. Traditionally, fleet attrition has been concentrated disproportionately among sailors on certain assignments or ratings/skill groupings, as well as among some demographic groups. We found that the strongest and most persistent differences in attrition occur between:

- Lesser skilled sailors and more skilled sailors
- Sailors on sea duty and sailors on shore tours.

There are several ways to measure skill or quality. Typically, the Navy considers those recruits with regular high school diplomas and test scores in the top half of the distribution on the Armed Forces Qualification Test (sailors categorized as A-cell) as higher quality. These sailors typically qualify for ratings with longer training pipelines and have historically been more successful in the Navy than other sailors. We found fleet attrition rates for A-cell sailors also were lower than for other sailors. Over our sample, A-cell sailors averaged 24-month attrition rates of 15 percent, in comparison with 20 percent for other sailors.

Another way of defining skill levels is by the length of training pipelines. Under this definition, the relationship between skill and attrition is even more pronounced. In the 1990s, General Detail sailors (Gendets), who receive only a few weeks of apprenticeship training after boot camp, experienced attrition rates over 60 percent higher than those of rated sailors. Comparing Gendets to technical sailors,[6] that ratio increases to about 2:1.

6. The technical group includes ratings with such descriptors as technician, electrician, mechanic, utilities, and engineering, as well as the medical ratings. A more complete description is given in [2].

When we looked at where first-term fleet attrition is occurring, we found it is more likely to occur on sea duty than on shore duty. In the 1990s, first-term attrition rates for sailors on sea duty were about 40 percent higher than for sailors on shore tours for their initial assignment. In addition, sailors assigned to ships had higher attrition rates than those on submarines or in squadrons—with 24-month attrition averaging 20 percent versus 15 percent over the past 15 years.

Fleet attrition rates also differ by gender and race. Females have had similar or higher rates than men overall, but the differences are larger and more volatile for sailors serving at sea. For example, females were 60 percent more likely to attrite in FY93, but just 2 years later were only 20 percent more likely.

Areas of concern

The changes in attrition through the 1990s have not been uniform across the Navy. We found that increases in attrition have been disproportionately concentrated among sailors who are:

- In the first year of their initial assignment
- The most highly skilled
- On sea duty.

All three are of concern. Increases in early fleet attrition mean that the Navy has had little or no return on its recruiting and training expenditures on a larger proportion of its sailors. In addition, the most skilled sailors are the most expensive for the Navy to recruit and train. CNA estimated that these costs alone exceed $40,000 for highly technical sailors as compared to about $10,000 for the least-skilled sailors [3]. As the mix of attrites is more heavily weighted with highly technical sailors, the costs of the attrition rise. Finally, given the shortages in manning at sea in recent years, disproportiate increases in attrition at sea could harm readiness.

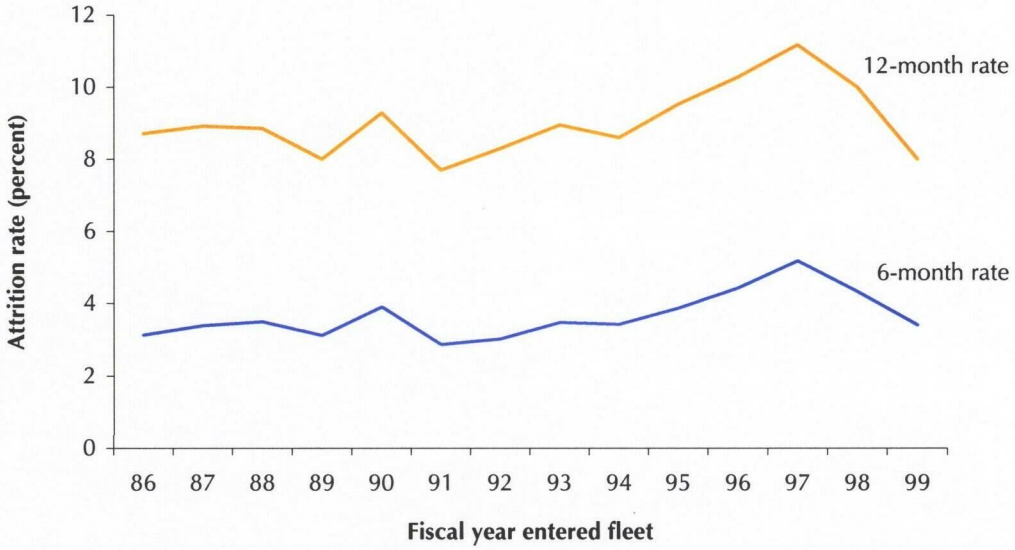
First year in the fleet

We found that, in the 1980s, the likelihood of attriting was highest, not upon arrival into the fleet, but in the second year in the fleet. By the time attrition peaked, this pattern had changed. Attrition was

most likely to take place in the first 12 months with subsequently lower attrition thereafter.

In figure 3, we show early fleet attrition for 4-year obligors. Attrition rose disproportionately among sailors who were new to the fleet. Approximately one-third of the increase occurred before 6 months in the fleet and one-half occurred within the first year. In addition, the recent declines in attrition have been driven by lower rates of attrition early upon arrival into the fleet.

Figure 3. Attrition rates upon arrival into the fleet



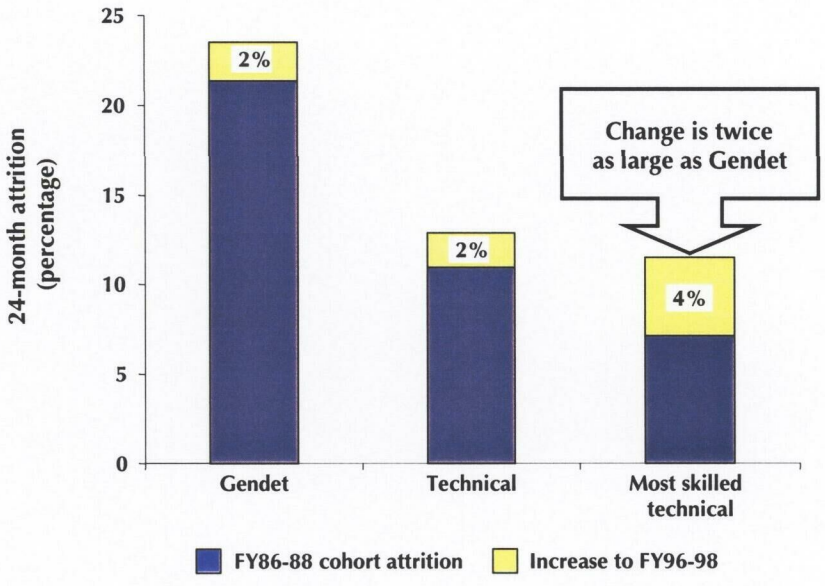
It is of concern that attrition behavior appears to be highly sensitive to conditions sailors face when they first reach the fleet. One goal of this study was to explore in greater depth the experiences the sailors have upon arrival at their first full-duty billet that can so strongly shape their attrition behavior.

High-quality/highly skilled sailors

The Navy has counted on smart sailors in high-tech ratings to complete their enlistment—these sailors have always attrited at lower rates, and this is still true. An alarming trend, however, is the growth in fleet attrition among high-quality, highly skilled sailors.

Figure 4, which shows this change, compares 24-month fleet attrition rates of three groups: Gendets, sailors in technical ratings, and sailors in the most skilled technical ratings. The most skilled technical group is a select subset of the technical ratings and includes such ratings as aviation and electronics technicians. Those ratings have some of the longest training pipelines, and they afford some of the best civilian job opportunities. Because most Gendets have either 3- or 4-year obligations and the most skilled sailors enlist for longer periods, we used the 24-month attrition rate to avoid the difficulty of comparing attrition rates across groups with differing lengths of obligation.

Figure 4. Changes in attrition rates for nontechnical and technical sailors

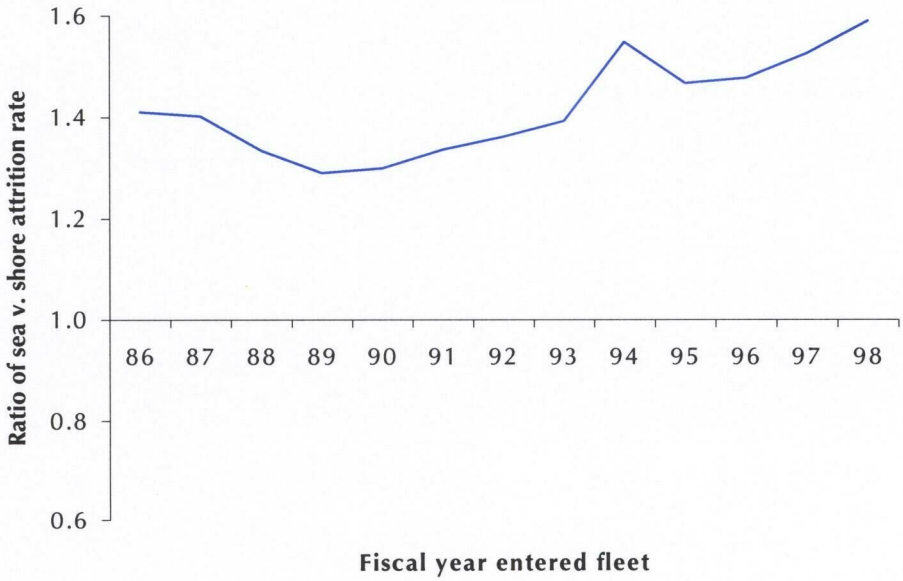


The lower parts of the bars in figure 4 show the fleet attrition rates of these three groups from the baseline cohorts (FY86 to FY88). The upper parts of the bars show the increase in fleet attrition rates between the baseline and the most recent cohorts (FY96 through FY98). The increase in the attrition rate of Gendets entering the fleet in FY96 through FY98 was 2 percentage points higher than that of Gendets entering a decade before. But among the subset of sailors who are the most highly skilled and technical, the increase was 4 percentage points, twice as great [4]. This holds despite the recent declines in fleet attrition.

Sea duty

First-term fleet attrition has increased both at sea and on shore, but the increase has been greater from sea tours. At the trough (the FY89 cohort), the rate of attrition from sea billets was about 30 percent higher than that from shore billets (figure 5). Even with the recent declines in fleet attrition, this ratio has continued to climb. For sailors who entered the fleet in FY98, those who went to sea duty attrited at a rate 60 percent higher than those assigned to a shore tour—18-percent attrition by 24 months versus 11 percent.

Figure 5. Ratio of sea-attrition rate to shore-attrition rate (by 24 months)



Why would this trend continue upward? It may be that the type of sailor on sea duty has changed—sailors with a relatively higher dislike of sea duty are now assigned to sea tours, rather than assigned to shore duty. Two facts support this idea. First, the percentage of sailors assigned to shore tours has declined over this time period from about 20 percent to only 10 percent, and, second, women (who have much higher attrition rates) are now more likely to be assigned to sea duty than previously. Or, it may be that the nature of sea duty has changed or that the willingness of youth to do what sea duty entails may have changed. What is clear is that, with over 90 percent of sailors assigned to sea duty for their first tour, almost all of the first-term fleet attrites leave a sea-duty assignment.

A closer look at attrition from ships

Because more than 50 percent of first-term sailors serve their first billet on ships, we looked at ship attrition rates to give us insight into what aspects of sea duty might influence attrition.

Measuring ship-based attrition rates

Cohort attrition is not a feasible way to analyze attrition rates by ship. Instead, we calculated cross-sectional measures of attrition. We used the Enlisted Master Record (EMR) to tabulate the number of first-term sailors who attrite from a ship in a fiscal year and divided that by the average first-term inventory. In this case, we defined first-term sailors as all sailors in zone A (i.e., in length of service through 6 years). Sailors who processed out of the Navy while in a non-full-duty billet were attributed back to the ship to which they had most recently been assigned.

We merged the personnel data with Ship Employment Histories for information on ship type and class, deployment schedules, and other ship-specific information. Our dataset includes all surface ships from FY87 through FY99 with billets authorized greater than 50. We did not have complete and accurate information on submarines or squadrons, and smaller ships tend to have highly variable rates of attrition.

Are all ships equal?

First, we asked whether attrition rates are roughly similar across ship classes and ships. If so, this would indicate that the entire sea-duty tour is driving attrition from sea duty, as opposed to idiosyncratic differences in sailors' experiences of sea duty.

To determine whether there are systematic differences by type of ship, we grouped ships into the following categories: aircraft carriers, surface combatants, amphibious warfare ships, and auxiliaries (including underway replenishment ships and material support ships). We then tabulated annual attrition rates by ship, aggregated the data by ship type and overall, and plotted the percentile distributions. In figure 6, we show the range in ships' annualized zone A attrition rates for FY99 fleetwide and by ship type. Each bar depicts the distribution of attrition rates while the thick, horizontal lines represent the median, or 50th percentile, ships. For example, 10 percent of all ships fleet-wide had attrition rates of 4.1 percent or less in FY99, whereas 50 percent of all ships had attrition lower than 7.9 percent.

Median attrition rates vary from a low of 7 percent for aircraft carriers to 9 percent for auxillaries. Across ship types, then, median attrition rates do not differ much, particularly in comparison to the large differences we see by occupational grouping or by sea versus shore duty.[7] By itself, this information might suggest that attrition is distributed fairly evenly throughout the fleet.

Looking at the median, however, masks important differences in ships' attrition. Individual ships, even within ship type, had dramatically different experiences. Overall, 50 percent of the ships have attrition rates under 5.5 percent or over 10.25 percent; each ship type experienced large differences in attrition.

Even when comparing attrition rates by ship class, the dispersion within ship class is substantially larger than between class (figure 7). This implies that attrition does not vary systematically with ship class. Other factors must account for differences in attrition.

7. This rather narrow band in attrition rates across ship types is consistent throughout the years we studied (FY87 through FY99).

Figure 6. Range in first-term (zone A) attrition all ships and by ship type, FY99

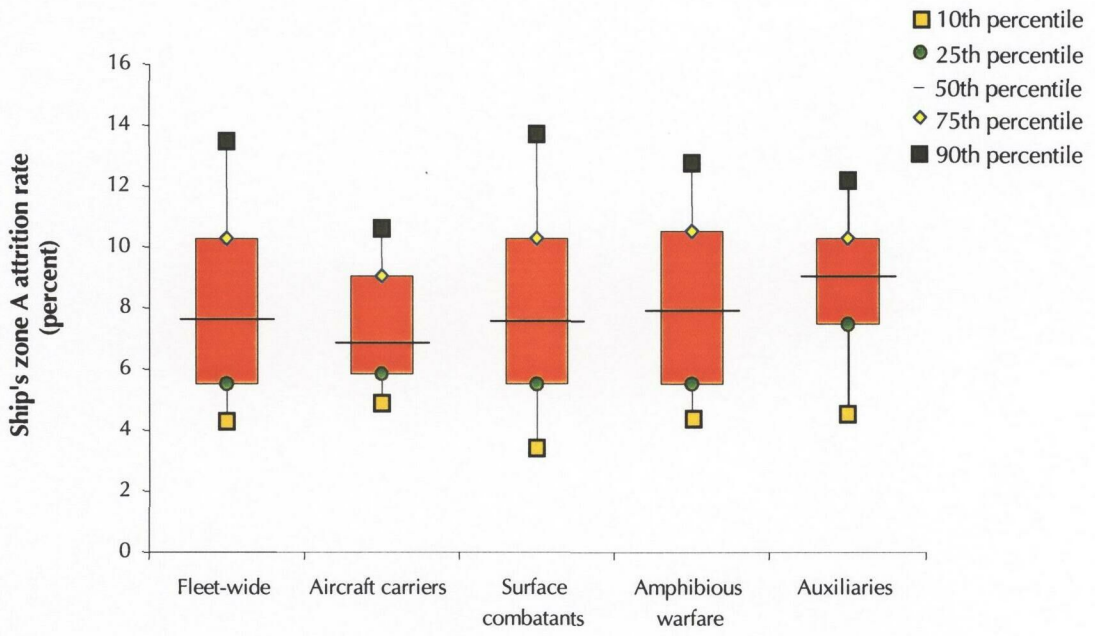
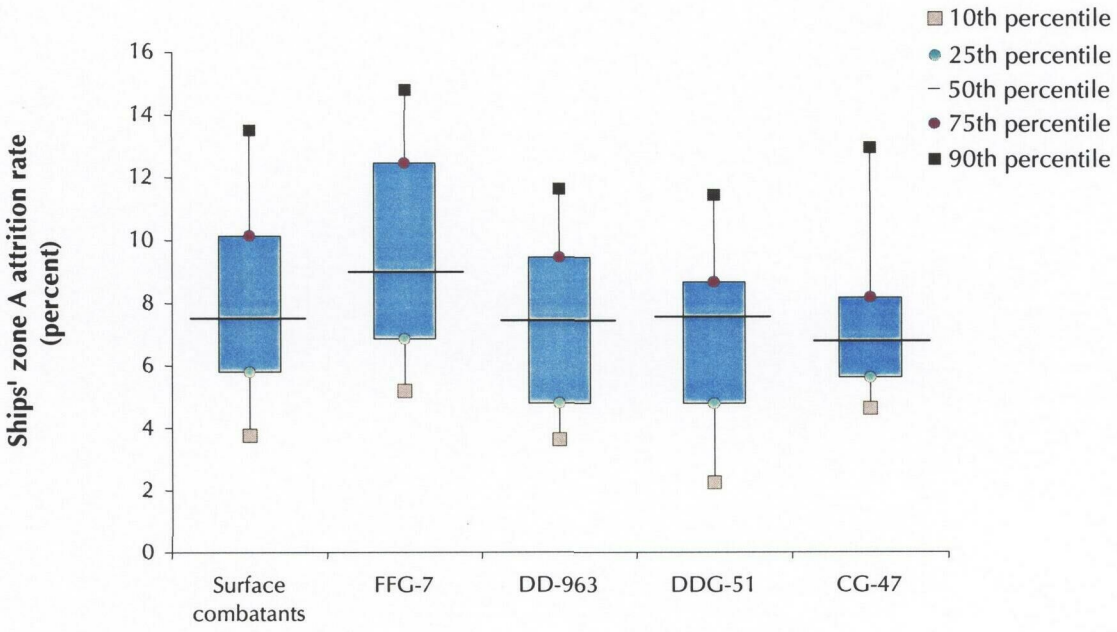


Figure 7. Dispersion in first-term (zone A) attrition on surface combatants, FY99



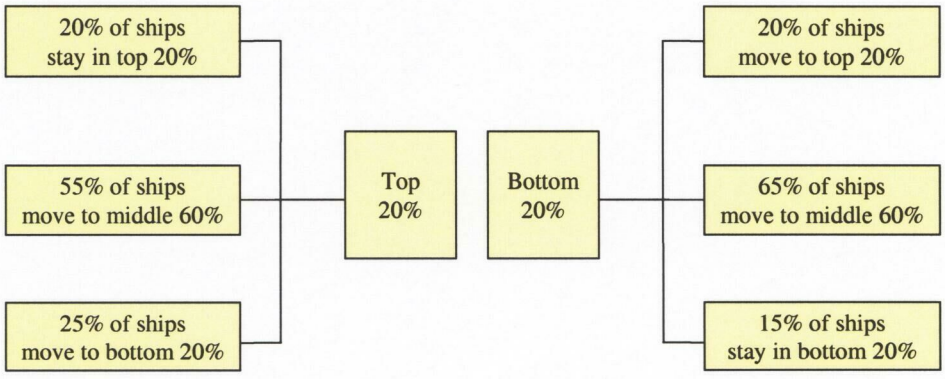
Do good ships stay good and bad ships bad?

Next, we asked whether individual ships consistently maintain similar rates of attrition. If so, it suggests that attrition is largely determined either by the material condition of the ship or the reputation of the ship.

We ranked active surface ships according to the attrition rates they experienced in FY98. We defined "good" ships as having attrition rates in the bottom 20 percent of the distribution, while "bad" ships had attrition rates in the top 20 percent. Then, we calculated how many ships ranking "good" or "bad" in FY99 remained in those categories the following year. We also made these calculations within ship type to eliminate attrition differences across ship types.

We summarize our findings for surface combatants in figure 8. For the most part, although a few ships continue to be the best or worst ships, ships' rank in attrition does not stay constant from one year to the next. Indeed, rank can move dramatically—about 20 percent of the ships switched from one tail to the other tail of the distribution. It appears that other factors, not the ship itself or its crew, dominate the attrition determination. What other factors are left? Deployment characteristics or leadership may explain these differences.

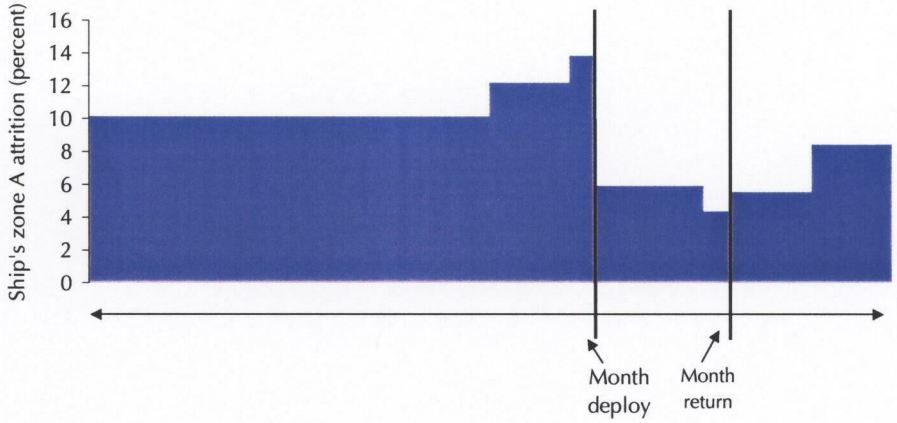
Figure 8. Movement of ship attrition rates across years



Deployment cycle and attrition at sea

A ship's attrition rate fluctuates with its deployment cycle. In figure 9, we show the average (annualized) monthly attrition rates during the deployment cycle in FY98.[8] Typically, the attrition rate peaks immediately preceding a deployment and plunges during and after a deployment. This pattern, it's widely believed, reflects both the desire of the ship's leadership to get rid of "bad apples" before deploying and the desire of sailors not to deploy. In FY98, attrition escalated to over 13 percent before deployment and dipped to 4 percent in the month the deployment ended.

Figure 9. Average attrition over the deployment cycle, FY98



Historically, the relationship between attrition and the deployment cycle we just described has held. During the 1990s, however, the largest increases in attrition occurred during the 6 months preceding a deployment and during a deployment. Attrition rates in those months averaged almost 20 percent higher in FY97 through FY99 than attrition rates in FY87 through FY89. Attrition rates immediately following deployments actually dropped slightly over the 1990s. The shift in timing suggests that: (1) deployments and time under way

8. Here, to obtain average attrition rates for all surface ships, we weighted each ship's attrition rate by the number of sailors on that ship.

may have become more arduous, as the fleet maintains, and (2) the 30-day standdown after a deployment ends may have had some positive impact on attrition.

However, where a ship is in its deployment cycle does not fully explain the dispersion we saw in ships' attrition rates. Indeed, even when we compare ships within the same portion of the deployment cycle, their attrition rates vary substantially. For example, half of the ships with deployments in FY98 had annualized attrition rates of under 1.5 percent or above 7 percent during their deployments. Between 4 and 6 months before a deployment, the corresponding range was 5 percent to 15 percent.

Because ships have such different rates of attrition, we look to aspects of the deployment cycle that vary by ship, such as:

- Time spent underway
- Ports of call
- Differences in workload and work over the cycle.

We also explore the role of leadership, ships' characteristics, sailors' traits, and the civilian economy in the attrition decision.

How do we determine the causes of attrition?

In the course of this study, we relied on several methods to investigate the causes of attrition. After identifying trends in attrition, we went to the fleet where we solicited sailors' and officers' views on why a sailor would leave the Navy early. We then tested these findings against our data and civilian-sector information.

Focus groups

We conducted more than 30 focus groups of enlisted personnel and developed and administered a short survey. The participants numbered more than 400 and included enlisted sailors serving on carriers, submarines, supply ships, and other platforms in Pearl Harbor, San Diego, Earle, and Norfolk. Although a few of the focus groups were composed exclusively of sailors in the process of separating from the Navy, most were still serving at sea. This allowed us to gain insight into the factors affecting sailors before they had reached the decision to attrite. For sailors in the process of separating early, it was difficult to prioritize which reasons were most influential. By interviewing sailors in the fleet, we did miss some of the sailors who attrite upon arrival into the fleet, but the experiences of the remaining sailors helped to fill this gap.

We also solicited the insights of Navy leadership. We interviewed ship ship commanding officers (COs) and executive officers (XOs), and manpower specialists. In addition, we surveyed command master chiefs.

We asked the fleet about the causes of attrition and whether it was easy or hard to separate early. We received information on reasons that we could quantify in our data but also on the role of others more difficult to quantify statistically—such as sailors' financial situations, their work environment, and enjoyment of Navy life. Finally, we received feedback on the effectiveness of ongoing fleet initiatives to

reduce attrition and collected suggestions on ways to alleviate attrition.

The focus groups and interviews were conducted from late in FY99 through FY01.

Statistical analyses

The shortcoming of focus groups was that we were unable to see whether sailors who had a specific concern with the Navy went on to attrite. All the people who went to the focus groups were still in the Navy. Instead of linking the individual participant's concern and subsequent attrition to determine the causes of attrition, the focus groups and fleet feedback became the source of hypotheses that we could test in our data. In this way, we could establish whether the conditions that concern sailors actually lead them to "vote with their feet."

To link the issues raised in the focus groups with behavior, we relied on statistical analyses of several datasets: the Enlisted Master Record, the Officer Master Record, the billet file, PRIDE, and the Ship Employment History data.

We merged these datasets and conducted two regression analyses, with individual sailors as the unit of analysis. The advantage of this technique is that we could determine the importance of a factor we believed influences attrition while controlling for the influence of other variables that may also affect attrition. Our first analysis included all first-term sailors serving in the Navy. We analyzed separately the likelihood that a sailor would leave within the first year, the second year, or the third year in the fleet. We limited the second analysis to sailors whose first assignment was to a ship and examined the role of personnel tempo of operations (PERSTEMPO) and the working environment in greater detail.

Finally, we investigated differences between ship attrition rates to determine the role of ship leadership.

Other sources

We also examined the economics literature and medical research about the effects of pay and workplace environment on employee turnover rates within the private sector. Although the private sector is, of course, not directly comparable, the findings on why employees leave their jobs are suggestive for the Navy.

THIS PAGE INTENTIONALLY LEFT BLANK

Economic opportunities and compensation

Although there is a negative correlation between manning levels in the Navy and earnings in comparable civilian occupations [5], the private sector's role in attrition is not completely understood. In an attempt to better understand the relationship, we investigated changes in the economy over the past decade and sailors' perceptions of their opportunities both inside the Navy and out. Finally, we used various statistical techniques to estimate the changes in attrition arising from changes in sailors' earnings and outside opportunities.

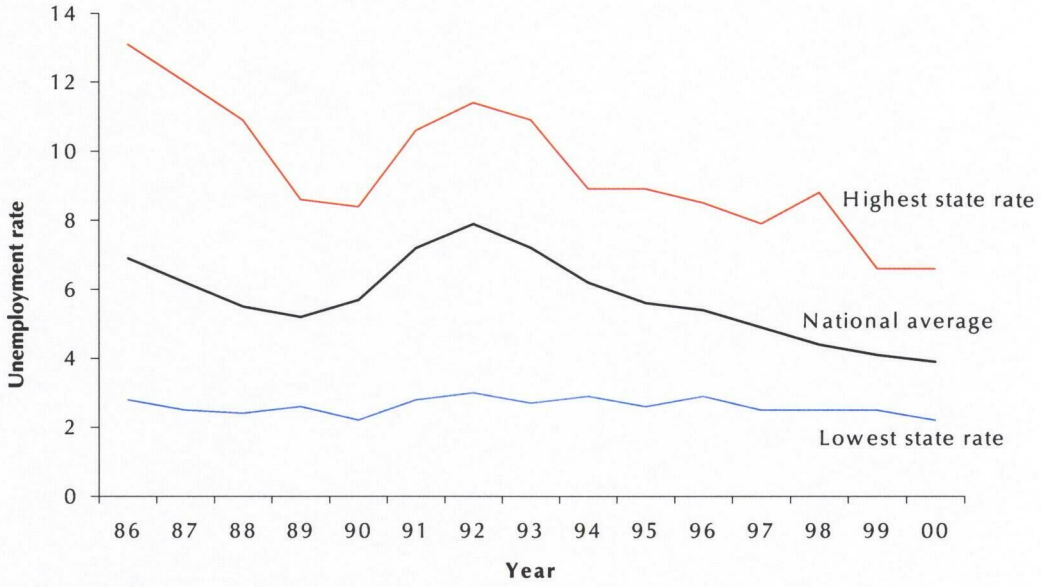
Civilian opportunities

It is important to consider the changes in attrition against the backdrop of the U.S. economy. Although Americans faced a deterioration in the economic environment in the early 1990s, the United States has experienced a sustained, and often rapid, expansion of the economy since 1992. And, although there are substantial differences in economic opportunities by state, overall the rapid job expansion has led to the lowest levels of unemployment in 30 years (figure 10) [6]. Even with the recent slowdown in economic growth, monthly unemployment rates have barely edged up.

As employers have struggled to fill vacancies, inflation-adjusted wages for workers without college degrees have rebounded after years of decline. Table 1 shows wage growth for young, full-time workers without a college degree by occupational grouping.[9] Growth was greatest in highly skilled technical occupations, particularly in the high demand areas of computers and engineering. But, wages also grew in nontechnical occupations, which had the largest declines in income in the preceding decade.

9. The sample includes only civilian occupations with Navy counterparts. For a listing of civilian occupations included in each group, see [2].

Figure 10. Unemployment rates, workers aged 16 and above[a]



a. Data are from the Bureau of Labor Statistics, U.S. Department of Labor.

Table 1. Earnings growth by occupational grouping, civilian sector[a]

Occupational group	Growth in inflation-adjusted earnings, 1992 to 1999 (%)
Nontechnical	4
Technical	2
Most skilled technical[b]	13

a. Annual earnings of 18- to 30-year-old full-time workers without a college degree 1992–1999, Current Population Survey.

b. The most technical grouping is weighted to more accurately reflect the occupational mix of the Navy's most skilled, technical sailors. The correspondence between military and civilian occupations is, however, imprecise. Alternate matching schemes resulted in earnings growth from 6 percent to over 20 percent.

Civilian employers have also responded to the competition for skilled workers with incentive packages, expanded benefits, and aggressive recruiting. In fact, according to [7], several recruiting companies have developed websites geared toward attracting former military personnel.

We found evidence that sailors have been finding it easy to find jobs. Focus group participants spoke of sailors receiving attractive,

unsolicited job offers while in the Navy. In addition, we surveyed Navy career counselors about the civilian job opportunities of the last attriting sailor with whom they had contact. Thirty-eight percent responded that the attrite had accepted a civilian job before leaving the Navy. Similarly, of those sailors who had not obtained a job before separation, 55 percent had obtained a job immediately after separation. Technically rated sailors obtained jobs before separation at a slightly greater rate than nontechnically rated sailors.[10] They were also more likely to obtain a job after separation than their nontechnically rated counterparts.

How do Navy opportunities compare?

Sailors are well aware of the economic climate they face, and most believe that they are losing out economically by remaining in the Navy. They claim they could do better outside. Survey data from the focus group participants reflect this: 95 percent of sailors responded that they believe civilians with similar experience and skills earn more than they do.

Can the Navy offer the same opportunities to its personnel—particularly to its high-skilled sailors? Many believe that the answer is "no." The military offers a rich set of benefits, but civilian employers have more flexibility in designing compensation packages to target the workforce they need.

The single largest component of military compensation is basic pay, which DoD adjusts each year. Basic pay of sailors entering the fleet has increased at about the same rate as the average earnings of demographically similar private sector workers.[11] The gap, however, between Navy pay and the pay received by demographically similar civilian workers in some high-tech jobs has increased.[12] For example, workers in one civilian job—electronics repair—had inflation-adjusted earnings growth of over 30 percent between 1992 and

10. Sailors who were not rated when they left the Navy were omitted from the analysis. Technical and nontechnical groupings were determined based on CNA analysis of data relating to the length of the requisite training pipeline.

1999.[13] In contrast, real growth in the basic pay of E-3s was 8 percent during this period.[14] Inflation-adjusted regular military compensation (RMC)—which includes allowances and other cash payments in addition to basic pay—increased faster for E-3s—by 18 percent—with the largest raises occurring in the past few years [8].

The Navy competes for skilled sailors largely through special and incentive pays. A sailor who completes his or her first term may be eligible for a Selective Reenlistment Bonus (SRB). CNA research has shown that, while the SRB is a powerful retention tool, it doesn't offset the premium available to similarly skilled workers in the civilian job market [5]. For instance, [5] shows that the median percentage difference in compensation between electronics technicians and mess specialists at 45 months of service is 22 percent. In contrast, the earnings difference for civilians in equivalent occupations is more than 150 percent. Furthermore, for sailors in their first term, the SRB is just a future possibility. The Navy's ability to offer skill-based pay to new fleet arrivals is limited.

Private employers are able to offer bonuses to junior workers as the need arises. This and other structural differences in military and civilian pay may give civilian firms an edge in competing for skilled workers. According to [7], large civilian employers offer more

11. DoD annually adjusts basic pay by the increase in the Employment Cost Index minus one-half percent. Because the index is based on all workers, including those with college degrees who have had higher earnings growth over the past decade, the lower adjustment has not meant that the gap between enlisted basic pay and comparable civilian wages has increased.

12. Our private-sector sample consists of young, non-college graduates in jobs similar to those in the Navy and is drawn from the Current Population Survey, Bureau of Labor Statistics, U.S. Department of Labor.

13. Due to small sample sizes in the civilian dataset, we were unable to compute the growth in some individual highly technical occupations that we anticipated had similarly large, if not larger, changes in earnings, such as in IT occupations.

14. Most technically rated sailors enter the fleet as E-3s.

performance-based, or incentive, pay; greater workplace flexibility; and more variety and choice in workers' benefit packages.

Do sailors leave for economic reasons?

Focus group and survey evidence

Based on the fleet's input, the answer is yes.

In the survey we administered to Navy career counselors, 57 percent of respondents agreed or strongly agreed that private-sector opportunities played a role in a sailor's decision to attrite.[15] In addition, over one-third (36 percent) said that they agreed or strongly agreed that such opportunities were the *primary* reason for the sailor's decision to attrite from the Navy (see table 2).[16]

Table 2. Role of the private sector in attrition decisions

	Percentage	
Extent of role	Agree	Strongly agree
A significant role	26	31
The primary reason	31	5

Survey data also reflected the importance of compensation. On our survey of focus group participants, basic pay was one of the three largest dissatisfiers influencing the decision of sailors planning to separate. Over 70 percent responded that their level of basic pay had a negative or strongly negative effect on their desire to stay in the Navy.

15. A second part of the survey examined the role of the private sector in the separation decisions of those leaving the Navy at EAOS. For a description of these results, see [7].

16. Although the Navy attrites sailors for a variety of medical and misconduct circumstances, anecdotal evidence suggests that some sailors may exaggerate circumstances to avoid completion of their periods of obligated service.

Although pay seemed to be an important factor in servicemembers' decisions to seek private-sector employment, benefits figured less prominently into their decisions. In fact, benefits ranked low as a reason for seeking private-sector employment among attrites. Although there were pockets of discontent—for instance, many sailors did rank the educational opportunities on sea duty as low and a major dissatisfier—most focus group participants rated their benefits as a reason to stay in the Navy, not as a reason to leave.

Statistical models of attrition

Our statistical modeling, too, supports the conclusion that civilian opportunities and compensation affect attrition.

We measured the lure of the private sector along two dimensions: (1) civilian pay relative to current and future Navy pay, and (2) the ease of obtaining private-sector employment. First, we calculated the earnings gap for each sailor by predicting civilian pay for each individual and comparing that to basic pay at the time of entry, at one year, and at two years into the fleet. Then we looked at the effect of future earnings increases in the Navy. We tested whether sailors were more likely to stay in the Navy if they expected to receive an SRB upon reenlistment. We used the SRB level offered in their rating or skill as an indicator of whether the sailors expected to receive an SRB. Finally, we included the unemployment rate in the sailor's home state as a measure of the ease with which the sailor could find a job.[17]

We found that the wage gap has a significant effect on attrition, although the effect is not sizable until the second and third years in the fleet. The magnitude of the effect is somewhat sensitive to the particular variables included in the model and the construction of the pay comparison. A midrange estimate is that a 10-percent decrease in the military-to-civilian earnings gap lowers overall attrition in that year by 1.1 percentage points (about 15 percent of the average attrition rate for sailors in their third year in the fleet).[18]

17. For additional discussion on the variables we used, see appendix A.

Why might the wage gap have its biggest effect in a sailor's third year in the fleet? We expect initial experiences in the fleet—workload and temporary assignments, shipboard berthing, and deployments—to dominate as sailors adjust to Navy life. Once the sailors have gained experience, however, they may begin to weigh other job options in making an attrition decision.

We also found that increases in expected future Navy income in the form of SRBs decrease attrition throughout the first term. The effects are smallest early in the fleet and rise as the SRB gets closer. By the third year, a one-level SRB reduces attrition in that year by one-half of a percentage point.[19] In addition, as seen in studies on reenlistment, the power of an SRB is lower for the high-tech sailors than for the low-tech sailors.

Unemployment rates have a small, but statistically significant, impact on attrition. As unemployment rates in sailors' home states increase, sailors are less likely to attrite. Jobs become more scarce, and the relative value of a Navy job increases.

Summary of effects

Taken together, how much might the civilian opportunities and compensation affect attrition? Figure 11 shows, for the most highly technical ratings,[20] how much attrition would change if: (1) the wage gap and unemployment rates return to 1992 values, and (2) the Navy offers an additional 1-level SRB for these sailors. Our regressions pre-

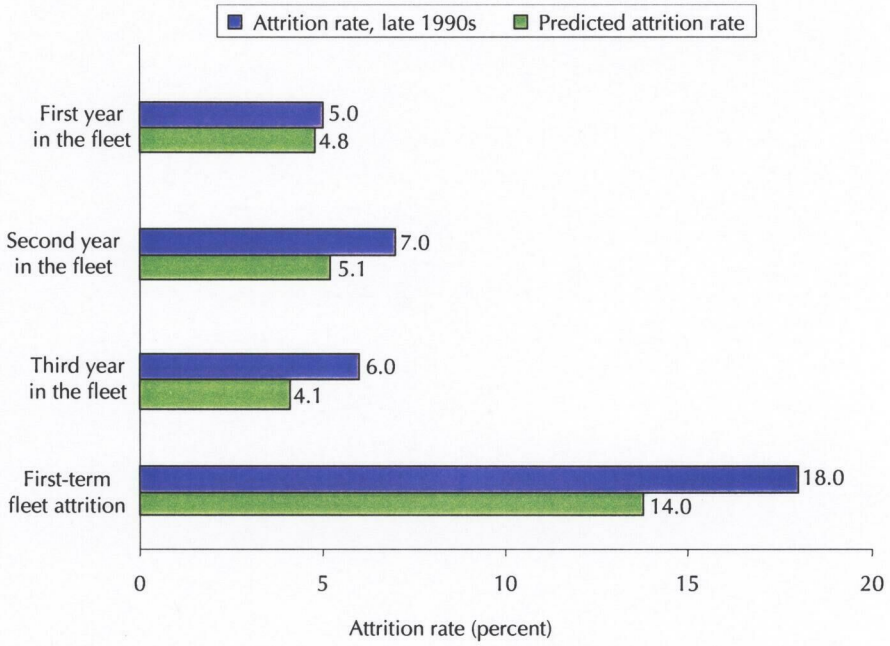
18. We also estimated separate regressions for the following three occupational groupings: Gendets, other nontechnical, and technical ratings. Appendix A contains the regression results by occupational grouping and for the overall Navy sample.

19. This result is dampened slightly when we control for more detailed ratings groups or individual ratings, suggesting that the SRB variable may also reflect, in part, some other characteristics correlated with our ratings groups that we cannot observe.

20. For ratings included in the most technical rating grouping, see appendix A.

dict that attrition would drop almost 18 percent, equivalent to about one-half of the increase in these rates over the past 15 years.

Figure 11. Simulated attrition response for selected highly technical ratings



Quality of service at sea

Previous CNA research investigated the role of sea duty [9] and PERSTEMPO [10, 11] on retention decisions and found that some aspects of the deployment cycle affect reenlistment behavior. Here, we first consider the differences in the schedule of work hours in the civilian sector. Scheduling refers to both the number of hours worked and the timing of work. Then we discuss the amount and type of work sailors do and how they are affected by manning and the deployment schedule. Finally, we show evidence from focus groups and statistical analysis of the effects of sea duty and the deployment cycle on attrition.[21] Because of the limited availability of data, our discussion focuses on surface ships.

Work schedules and sailors' workloads

Civilian schedules

We've heard about the overworked American, but how many hours do full-time civilian workers typically work in a week? Research shows that most full-time civilian employees work 40 hours a week or less [12]. See table 3.

Table 3. Typical hours of work in a week, private sector[a]

	Percentage	
Hours of work	Males	Females
40 hours or less	63	81
More than 60 hours	Under 23	Under 9

a. Data from the 1995 Current Population Survey [12].

21. Focus groups cited shipboard berthing and lack of voluntary educational opportunities as additional drivers of attrition. We had insufficient data to test these claims.

In addition, the same researchers found that only 14 percent of full- and part-time employees regularly work rotating or split shifts or irregular hours or days. Of those who do, almost half of those who stayed at the same job switched to standard working hours by the following year. Of those employees who changed jobs, most obtained work with regular hours. Few workers switched from standard hours to nonstandard work hours. Researchers concluded that such work is generally viewed as unattractive or inferior.

How do Navy work schedules compare?

Work schedules afloat

Estimates of the number of hours sailors work at sea are difficult to obtain, but several indicators are useful. One is the Navy Standard Workweek (NSW), a planning factor the Navy uses to predict shipboard manpower requirements. Empirical studies also shed light on sailors' workweeks at sea.

Table 4 gives the NSW as well as a range of estimates from studies on ship personnel. Work time is split between productive work (watchstanding and ship's work) and other duties (training and supporting activities). By all available measures, the hours worked by a ship's company at sea are at least twice those of the typical 40-hour civilian full-time workweek. A 1975 NPRDC survey [13] found that enlisted personnel work an average of 91.8 hours per week while at sea. The gap between that average and the NSW may reflect undermanning at the time of the study.

Table 4. Workweek of military personnel afloat (wartime)

	Planned average hours per week[a]	Recorded hours per week (range of estimates)[b]
Productive work	67.0	70.7 to 79.0
Other duties	14.0	7.6 to 12.8
Total	81.0	78.3 to 91.8

a. Navy Standard Workweek. See [14].
b. Data from various studies. See [13] and [15].

In-port work schedule

Over the past years, the Navy has worked to reduce the number of duty days a sailor serves while in port, but our focus groups suggested that in-port hours continue to be irregular and long. Sailors' schedules while in port are even less well-documented than are their workweeks at sea. In-port work often falls through the cracks in research, planning, and administration. For example, the Navy has no unique planning factor for the in-port workweek—although in the 1970s it employed an in-port NSW of 45 hours [16]. Furthermore, sailors spend many days under way while officially not on deployment, thereby blurring the distinction between in-port and at-sea time.

The NPRDC study [13] reported that sailors work about 73 hours per week while in port. However, a more recent survey of officers by the Navy Manpower Analysis Center found that sailors spend fewer than 40 hours per week in work, training, and supporting activities while in port. In-port schedules appear to fluctuate. For example, focus group participants claimed that certain in-port periods involve unusually long workhours. Major pre-planned maintenance and inspections were the two categories usually mentioned.

Watchstanding schedules

In addition to long hours at sea and fluctuating hours in port, sailors must adjust to a watchstanding schedule. Several studies have shown that night shifts decrease sleep time, increase sleepiness and fatigue, and impair mood in comparison to day shifts. Rotating shift schedules such as the three-section watch may worsen this effect. One study recorded the impact of rotating 8-hour shifts in a sample of firefighters, who not only suffered the problems listed above, but failed to adapt to the schedule over time [17]. Some researchers have suggested that permanent night shifts are preferable to rotating shifts, especially when safety is an issue [18].

How do sailors spend their time?

Deployments

The Navy policy on PERSTEMPO seeks to preserve an adequate quality of life (as measured by time at home) for Navy personnel while performing its missions as a forward-presence force. The policy, instituted in the mid 1980s, places limits on units' deployments: (1) constraining deployments to 6 months, (2) restricting turnaround ratios (TARs), or time between deployments divided by deployment length, to a minimum of 2:1, and (3) requiring units to spend at least 50 percent of its time in home port over a 5-year span.[22]

We show historical deployment lengths in figure 12. Each bar represents the range in deployment days for deployments ended in that fiscal year. For example, for deployments ended in FY87, half of all deployments lasted less than 180 days (the median is represented by the thick, black line). Ten percent of the deployments lasted 60 days or less; 90 percent of deployments were 195 days or less. We defined a deployment as time away from home port greater than 56 days (not including extended overhauls and maintenance away from home port).[23]

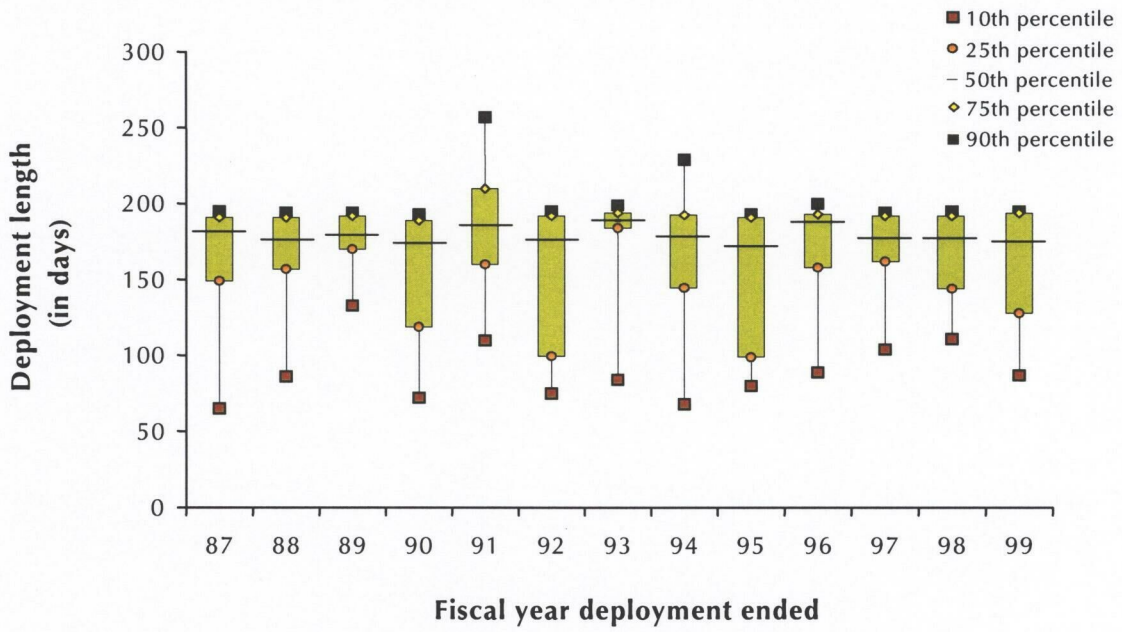
Since the PERSTEMPO rules went into effect, most deployments have shortened to 6 months, and median deployment lengths have been nearly constant. There is, however, still substantial variation in the time ships spend deployed. Deployment lengths vary for many reasons, including the mission of the ship. For instance, drug operations have tended to involve shorter (3 or 4 month) deployments.

---

22. The 5-year span at any given time counts the days in home port over the past 3 years plus the scheduled days in home port for the upcoming 2 years.

23. Official OPNAV estimates of the fraction of the fleet deployed show a large increase as of 1995, but, as other CNA research [19] demonstrates, this appears to be largely due to a change in the definition of "deployed." Ships home-ported outside the U.S. are now counted as deployed all of the time, even when in their home port. The researchers continue, "[for U.S. home-ported ships] the increase in this fraction—if it could be said to increase at all—is only slight."

Figure 12. Range in deployment lengths, deployments ended in FY87 through FY99



We do see that, although average deployment lengths have not changed, short deployments had been getting longer since 1994 (with a reversal in 1999). At that time, 10 percent of ships had deployments lasting under 70–80 days; by 1998, the tenth percentile had risen to 110 days.

How do sailors spend their time while deployed? First, there is steaming, which involves long and irregular hours of work. On the other hand, sailors have liberty while in foreign ports. As of FY99, time in foreign ports of call accounted for a little over 20 percent of the typical deployment (about 43 days). There had been a sizable downtrend in the time ships spent in foreign ports of call through FY94 that then rebounded (figure 13).

We also saw that the composition of time in foreign ports has changed dramatically over the past decade (figure 14) [19]. For instance, the percentage of foreign port time ships spent in the Persian Gulf has doubled while time in the Mediteranean and elsewhere has shrunk.

Figure 13. Time spent in foreign ports

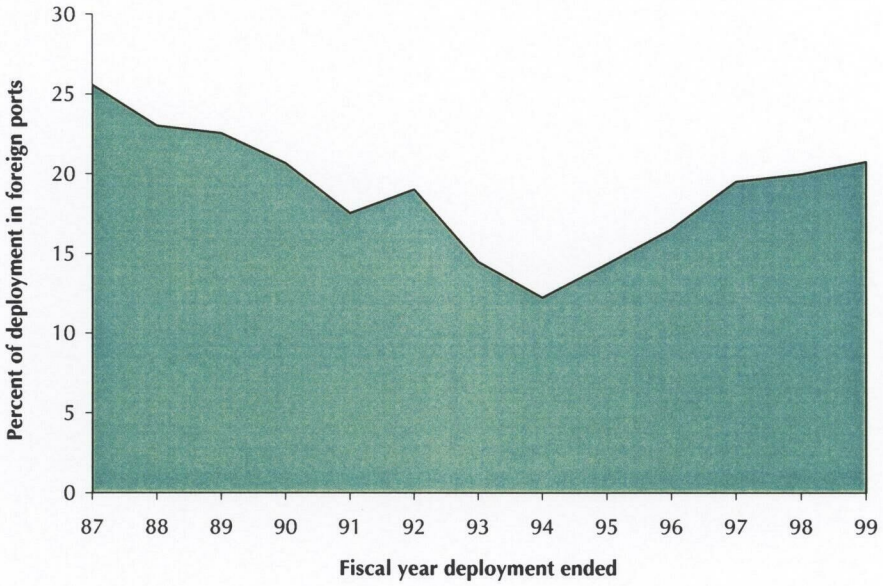
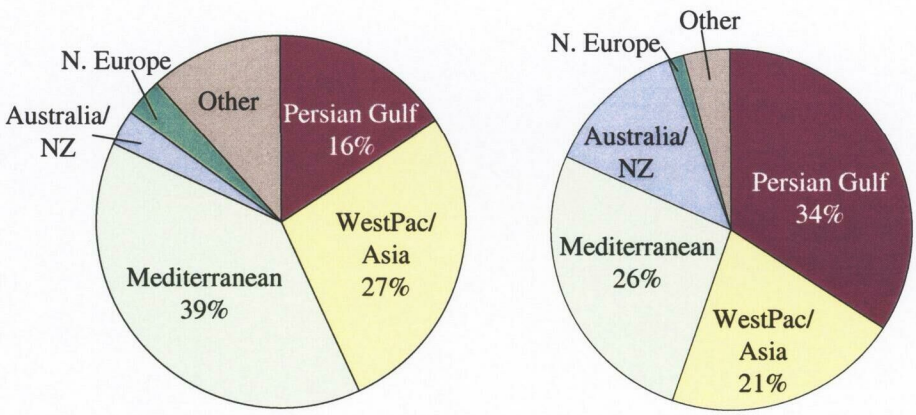


Figure 14. Change in ports of call, percent of foreign port time spent in given locale

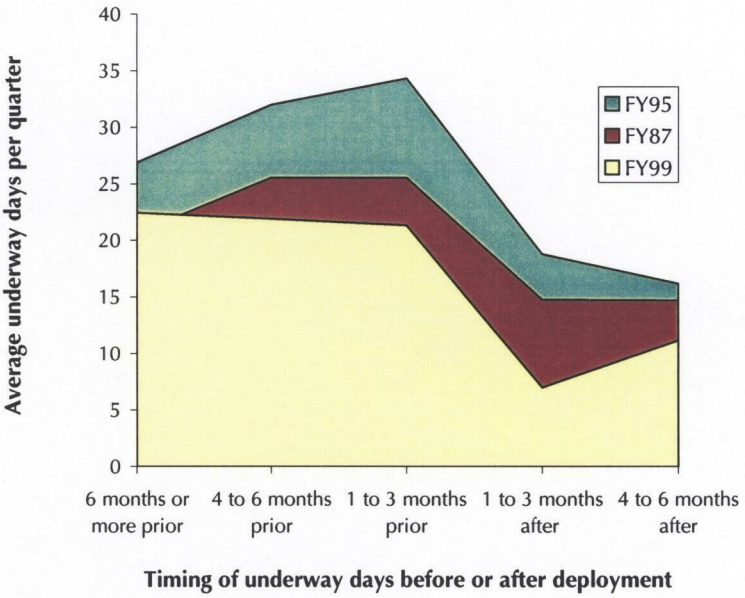


Nondeployed time under way

An integral part of Navy life is the large portion of time spent at sea while not deployed.

In figure 15, we show ships' average time under way over the deployment cycle and how that has changed over time.[24] Time under way rose rapidly throughout the first half of the 1990s, leveled off in FY95 and FY96, and then dropped through FY99. By FY99, underway time was lower than at any time in the previous 10 years.

Figure 15. Time under way, before and after deployments



Several events that took place between FY96 through FY98 appear to have precipitated the dramatic drop in nondeployed underway days.

- The criteria to get listed on the CNO's Watch List for violating PERSTEMPO rules were broadened. In the effort to stay off the list, units cut back their underway time.
- Nondeployed ships' OPTEMPO budgetary guidelines were changed so as to limit days under way to 28 days per quarter.

24. This measure is a simple count of nondeployed underway days in a quarter divided by the days in the quarter. It is not an operational tempo (OPTEMPO) measure that requires adjusting the days in the quarter for the time spent in maintenance.

- The interdeployment training cycle (IDTC) work-reduction initiatives, begun in FY98, redefined OPTEMPO guidelines to apply to individual ships. Previously, they had applied only to Atlantic Fleet and Pacific Fleet averages.
- The Navy created a special unit to undertake drug operations. That unit consolidated short-term drug operations, previously classified as underway time, into normal deployments, thus easing other ships' underway burdens.

What aspects of the deployment cycle affect attrition?

The sailors in our focus groups emphasized that they generally liked their jobs and their responsibilities, but that many aspects of sea duty influence their desire to leave the Navy early. The most important were:

- The duration of deployments and time away from home
- The duration and quality of ports of call
- Work hours and workload while in port.

Time away from home

Sailors in our focus groups maintained that both deployments and nondeployed time under way influence sailors' desire to attrite. In our survey of focus group participants, sailors planning to separate ranked time away from home as one of the three largest dissatisfiers influencing their decision. Over 70 percent of sailors responded that time away had a negative or strongly negative effect on their desire to stay in the Navy.

Nondeployed time under way

Sailors felt more negative about nondeployed time away than about deployments. Sailors said that they had not expected the nondeployed time under way when they enlisted and found the work arduous without the same sense of mission that is associated with deployments. In addition, long work hours, irregular scheduling, and unanticipated changes to the schedule created difficulties participating in voluntary education or community activities, as well as scheduling problems for family activities or day care.

Statistical tests confirmed that nondeployed time under way has a large, adverse effect on attrition.[25] We estimated the effect of increasing the fraction of time under way in the past 3 months on attrition in a given month. We then converted the impact on monthly cohort attrition into an annual rate. Every 10-percentage-point increase in nondeployed time under way increases annual cohort attrition by about 0.9 percentage points, or 7 percent of the sample mean attrition rate of 11.5 percent. With nondeployed underway time averaging about 30 percent of the nondeployed time, underway time adds almost 3 percentage points to 12-month attrition.[26]

Deployments and ports of call

Deployments involve long work hours, difficulties in scheduling, and extended periods of time away from home. Focus groups revealed mixed perceptions concerning deployments. Although sailors knew and accepted that they would deploy when they joined the service, deployments adversely affected their desire to stay in the Navy. Deployments appear to fall short of their expectations. Berthing and crowding may have been issues. One reason most sailors enlisted was for adventure and travel. Ports of call were very important to junior sailors and highly anticipated. They claimed, however, that there were fewer ports than expected and fewer exciting ports—with some ports, particularly in the Middle East, being actively disliked. In addition, many ports are working ports in which they may have had little or no liberty. Even when liberty was given, there were often restrictions (e.g., no overnight leave or the buddy system).

---

25. We performed separate regressions for the effects of PERSTEMPO on attrition by sailors' initial-year-obligations and occupational groupings. We also estimated separate regressions for sailors serving on aircraft carriers and surface combatants. The measured effects on attrition were largely similar across sample. Appendix B contains a description of the variables we used and the full statistical models.

26. Because nondeployed time under way is often highest before deployments and there is a purging of sailors the month before deployment, we investigated whether our estimate of the effect of time under way may reflect this spike in attrition. Additional modeling, however, showed that little of the effect dissipates when accounting for the predeployment surge in attrition.

When asked on the focus group survey what policies would likely keep them in the Navy, more than 60 percent of the sailors planning to separate answered that improvements in the ports of call would keep them in the Navy. This was higher than any of the other options offered, including a 20-percent increase in basic pay.

Our statistical analyses confirmed that sailors who have experienced a deployment are more likely to attrite; deployments increase 12-month cohort attrition by about 2 percentage points.[27] Unlike previous CNA research linking length of deployment to reenlistment [10], however, we did not see any relationship between the length of the deployment and attrition. Most long deployments recorded in our data were associated with Desert Storm. The sense of mission associated with the crisis may well have been a morale-boosting situation for the crews. However, long deployments as a standard operating procedure may worsen attrition.

We also examined the importance of foreign ports of call in our modeling. The *total* percent of deployed time spent in foreign ports of call did not influence attrition; however, the aggregate data masked some important correlations.

Because sailors in our focus groups rated locations so differently, we grouped foreign ports into three categories: least desirable, desirable, and most desirable. Table 5 lists the least desirable and most desirable ports. We combined all other ports into the middle category.[28]

We found that higher amounts of time spent in "good ports" decreases attrition, while more time spent in the "bad ports" increases attrition. For deployments of 180 days, increasing time in good ports by 2 weeks, or 8 percent, decreases 12-month cohort attrition by about 0.4 percentage points, or 4 percent. The equivalent decrease in

27. In the months a sailor is deployed, we estimate that the probability of attriting is about 40 percent lower—due, no doubt, to the difficulties involved in attriting someone when the ship is away from home port.

28. Of course, not all sailors would agree with our rating of ports. To the extent the ordering is not consistent with sailors' perceptions, our estimates will be lower than the true effects.

bad ports lowers attrition by 0.2 percentage points.[29] These are not large effects, but we believe our estimates to be conservative because we were only able to capture one aspect of foreign ports.[30] We had no data on port restrictions or amount of liberty while in port.

Table 5. Most and least desirable foreign ports of call

Least desirable	Most desirable
Saudi Arabia	Australia
Kuwait	New Zealand
Oman	Thailand
Bahrain	Philippines
Cuba	Singapore
British Indian Ocean	Korea
	N. Europe
	Spain
	Israel
	Egypt

Summary of effect of time away

How much have changes in time away affected attrition over the past decade? Here, we used the statistical estimates to predict what late 1990s attrition would have been under more attractive conditions. Specifically, we assumed that:[31]

- The percent of time under way while nondeployed declines 25 percent.

29. We chose two weeks because, in the late 1990s, this is approximately the difference between the 25th percentile and the 75th percentile.

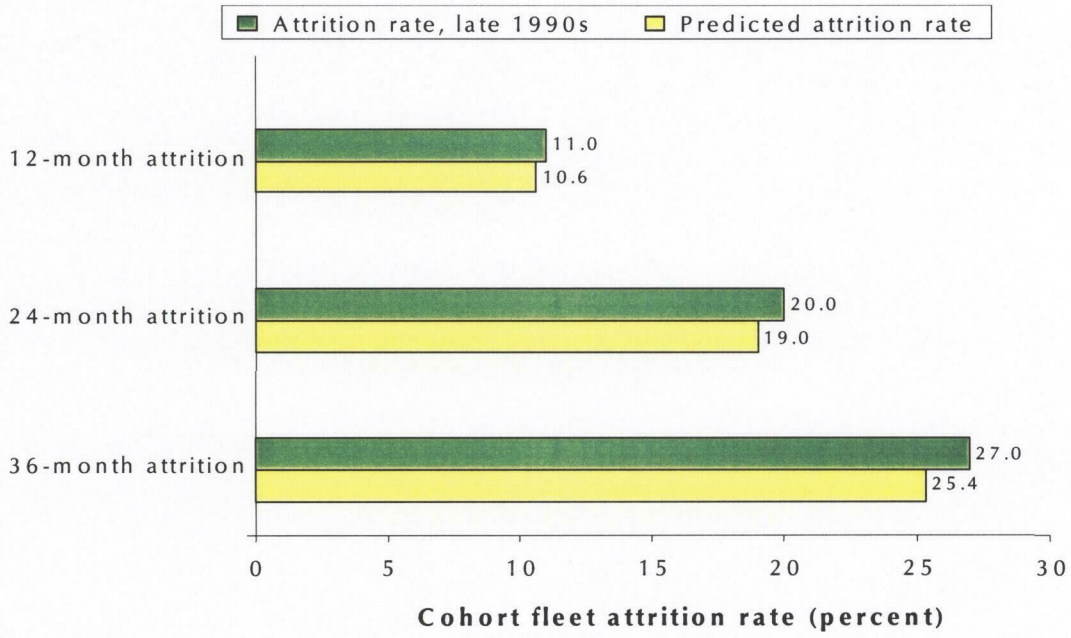
30. Extrapolating from our estimates on time in foreign ports, we can calculate a rough estimate of the effects of liberty on attrition. The logic is as follows: a 7-day port call with sailors having liberty for the entire stay (instead of one-half of the time as liberty) is roughly the same as an additional 3-1/2 days in a good port. The effect of the additional time in a good port is about a 1-percent decrease in attrition, and, consequently, the effect of the additional liberty should also be approximately 1 percent.

31. We also assumed the sailors' first deployment begins, on average, in the ninth month in the fleet and lasts 6 months.

- Time spent in "good" ports during a deployment increases 14 days, from 3 percent of the deployed time to 10 percent.
- Time spent in "bad" ports decreases by 4 days, or 2 percentage points.

These changes are large but are of the same (and opposite) magnitude experienced in the fleet from the late 1980s through FY96. Finally, we assume the sailors' first deployment begins, on average, in the ninth month in the fleet. Our simulation, presented in figure 16, shows that attrition would decline 5 percent. The effect is modest but is likely to be a lower bound estimate because the regressions do not capture expectations nor some aspects of ports of call.

Figure 16. Simulated attrition response for changes in time away



Periods of high workload while in port

Sailors in our focus groups also cited increases in workload over the deployment cycle, periods of heavy workload, and unnecessary work as reasons for attrition. There is no direct evidence of the link between hours and attrition, although the survey of focus group participants suggests such a correlation. We asked sailors how many

hours they worked on average (nondeployed). Table 6 shows the differences in plans to attrite among the focus group participants serving on surface combatants.

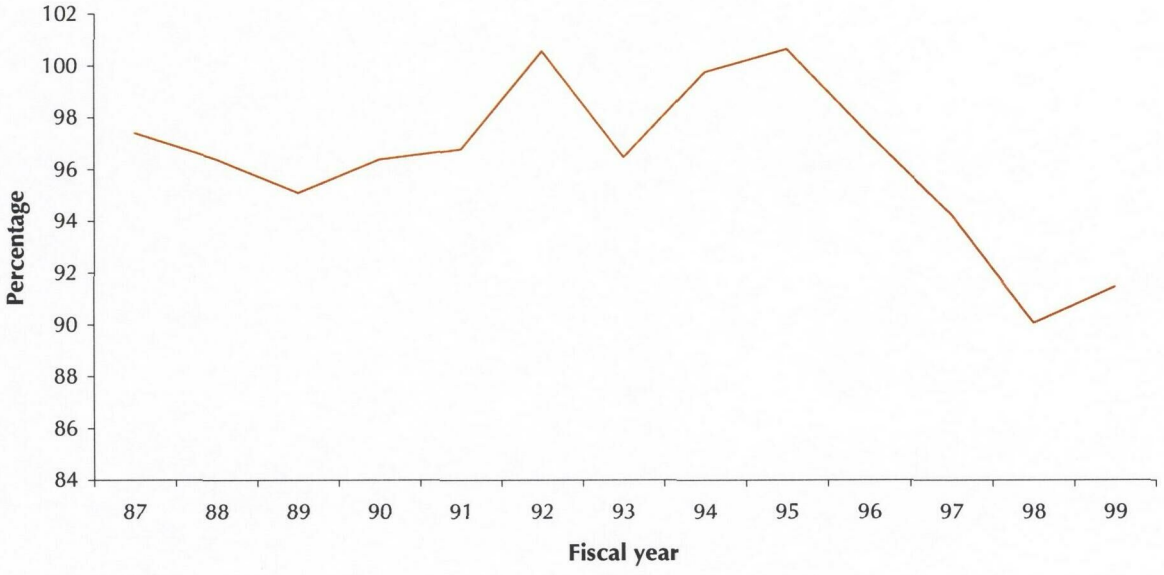
Table 6. Hours of work and attrition plans

Average weekly hours	Percentage of sailors planning to attrite
Under 70	19
70 or above	29

Undermanning

Sailors cited worsening undermanning (both among higher and lower skilled ratings) as a primary reason for the increase in overall workload. Figure 17 shows this drop in total manning, as defined by the E1–E9 sailors on sea duty compared to the E1–E9 billets authorized.[32]

Figure 17. Historical manning on ships[a]



a. Manning calculated as E1 to E9 inventory divided by E1 to E9 billets authorized, CNA Billet File and Enlisted Master File.

32. The data are drawn from our sample of surface ships.

Undermanning places an added burden on individuals because a ship's workload is divided among fewer sailors. Within undermanned ratings, sailors either work extra hours or risk equipment breakage. Gendet undermanning poses further problems. Gendets in our focus groups perceived that they had less opportunity to "strike" for a rating and that the lack of opportunity translated into the desire to attrite. In turn, rated sailors complained of working outside their training in repeated temporary assignments to food service, laundry, and compartment cleaning.

To test this hypothesis, we added data on individual ship manning to our statistical models. We found that lower manning is associated with higher attrition during the sailor's first 3 months in the fleet—a 10-percentage-point increase in manning (the difference between the drawdown and post-drawdown periods) lowers attrition by about 3 percent.[33, 34]

Maintenance activities and inspections

Focus group participants also claimed that certain in-port periods involve unusually long work hours. Major preplanned maintenance and inspections are the two categories usually mentioned. Surveys show, however, that although the net effect of these activities is negative, they appear less important to attrition than time away or pay.

Our statistical analyses confirm this. We found that periods sailors associated with long work hours or tedious work increased attrition. All else being equal, sailors who experienced a preplanned maintenance attrite over a 12-month period at a rate 1 percentage point higher than other sailors (or about 10 percent higher evaluated at the sample mean). Overhauls increase 12-month cohort attrition an additional 0.5 percentage points, or about 5 percent. An inspection raises attrition in the month that it occurs by 0.5 percentage points (annualized).

33. As we discuss in the following section, we also found that higher manning throughout a sailor's tour actually increases attrition.

34. We also tested whether Gendet manning influenced attrition. We found similar, although somewhat smaller, effects than those we report here.

Leadership

In this section, we focus on the role ships' leadership might have in influencing attrition. We look at the incentives ships' commanding officers (COs) are given and how those incentives may affect a CO's actions. We provide evidence showing that attrition is sensitive to leadership's incentives. Then we examine whether all ship captains act similarly in the face of those incentives.

Incentives facing ship leadership

Keeping attrition low

Navy leaderships' concern about attrition is increasingly shared by ship COs. We believe that fleet leaderships' scrutiny of ship attrition rates, and even intercession in individual attrition cases, have been powerful incentives for the COs.

Historically, however, ship captains have not faced such an accounting nor have they had many other incentives to control attrition. Except indirectly, ship captains do not receive the full benefits of low attrition nor do they have to pay the full costs.

Indeed, the Navy has only recently adopted standardized reporting of unit attrition. There is no Navy-wide system in place for identifying and tracking problem ships and no mechanism to alleviate attrition problems at individual commands. Attrition statistics have played a limited role in evaluating a ship, its CO, or any other officers onboard as has the general work environment. The inspections geared toward evaluating retention and attrition efforts were eliminated in the late 1990s, as was the Golden Anchor Award for retention.

In the past, a CO's only incentive to reduce attrition was during times of undermanning. A gapped billet is a cost to a ship's captain—making it more difficult to accomplish the ship's mission—and that

cost varies depending on how long the billet is gapped. The longer the billet remains unfilled, the more costly the attrition.

During the downsizing, the Navy was flush with sailors as ships were decommissioned. Ship captains could expect ready replacements for gapped billets. The cost of attriting a sailor was low. As a result, the standards for sailors' behavior and performance were raised; some people argue that a "zero defect mentality" emerged. Sailors who made one mistake or an error in judgement were attrited. In contrast, when sea manning plummeted after the drawdown, ship captains could no longer rely on a quick replacement. The costs of attrition increased. The need to reduce attrition rose in priority, and individual ship captains and senior leadership made concerted efforts to address the problem.

Other incentives and their implications

It may be that low ship manning, when it occurs, is effective at keeping COs focused on attrition; however, COs are also consistently presented with other incentives and situations.

Historically, the Navy measures and rewards a ship's captain for the physical condition of the ship through regular SORTS and FITREP reports. Inspections verify the condition and readiness of the ship. Awards, such as Battle E's, only reinforce this emphasis. As a result, some COs may favor a strategy of increasing immediate readiness while risking a deterioration of working conditions. For example, a CO may demand longer working hours and tedious painting and chipping to improve the physical condition of the ship and may not consider how these demands will affect attrition.

Because COs are held responsible for any unexpected problems, such as fire or damage to a ship, they try to prevent such problems by ordering extensive watchstanding. Some practices that reduce workload, such as watchstanding extended over several pierside ships, have not gained acceptance, in part, because they may increase the risk to the ships.

The ship captain's concern for all aspects of the ship extends to the behavior of the crew while in foreign ports. Ship COs expect that any

problems in ports of call will be their problems. As a result, they may weigh the quality of the port call less than the possibility of a disturbance. Restrictions on crew in ports of call are a consequence of the incentives given to ship COs.

We are not saying that ship captains shouldn't have incentives to keep the ship in good working order—it's clear they should. It is simply that the crew's well-being and professional development are also part of their responsibilities; evaluation of these aspects is also essential.

Do ships' leaders respond to incentives?

Historically, the primary incentive COs had for cutting attrition was low manning. Thus, we explored the relationship of manning to attrition throughout the first term in our statistical modeling. As a measure of manning, we used total inventory to total billets authorized in the past 3 months at a sailor's assigned command. We also attempted to measure the independent influence of the drawdown mentality, or the rise of the "zero defect mentality," on attrition. We attribute any differences in attrition during the drawdown, holding all other factors constant, to this change in attitude.[35]

We found that COs do respond to incentives in ways that affect attrition. Low manning decreases attrition—a 10-percentage-point reduction in manning lowers 12-month attrition by at least 0.6 percentage points, or about 6 percent. This is a lower bound on the effect of the manning incentive. Low manning also increases the remaining sailors' workload, which may intensify a sailor's desire to attrite. Because the two influences work in opposite directions, the effect we measure is the net effect of both.

Also consistent with the incentives captains face, we found that attrition was higher during the drawdown; holding all else fixed, attrition was about 0.6 percentage points, or 6 percent, higher.

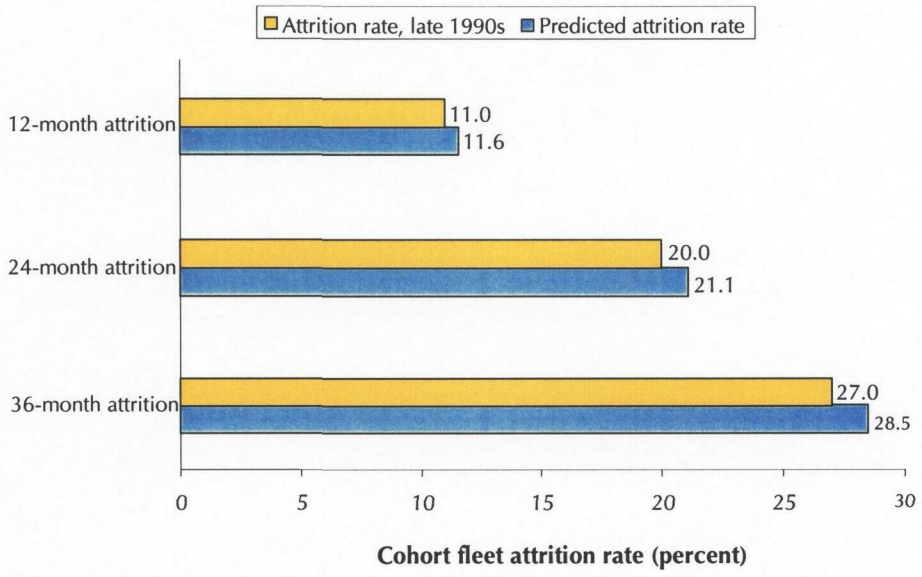
What would attrition look like if leaders were facing the same conditions as in the early 1990s? In figure 18, we show average cohort

35. We defined the drawdown as FY91 through FY95.

attrition rates from the late 1990s for sailors assigned to a ship upon arrival in the fleet. Then we use our statistical estimates (see appendix B) to calculate what attrition would be if leaders faced the same environment today as they experienced in the drawdown. We assumed:

- Manning levels were 10 percentage points higher
- The continuation of the "zero-defect mentality," as measured by the higher attrition experienced during the drawdown.

Figure 18. Simulated first-term attrition rates with incentives to cut attrition reduced



Our simulation shows that attrition would have been been almost 6 percent higher. COs do respond to incentives.

Do commands differ?

The previous section suggested that when COs have incentives to consider the crew's well-being they do so. However, without undermanning, the crew's well-being, and attrition, will receive a relatively lower priority. This has important implications for the crew because COs

influence most aspects of a sailor's well-being. The ship's CO has discretion over a range of conditions, from liberty in the ports of call to workload and work hours to the maintenance and repair of living quarters.

Quality of ship leadership pervaded all other issues raised by sailors in our focus groups. Sailors cited poor unit leadership as a top dissatisfier influencing their plans to separate. Some sailors perceived their captains as interested only in the ship's ability to complete its mission, not in the sailor's well-being or professional development. Others also maintained that, despite the end to the drawdown, not all ships had moved away from the zero-defect mentality.

But, if the incentives toward maintaining a good quality of service are so weak, shouldn't all commands have similar attrition? Certainly, not all sailors were dissatisfied with their leaders; many had extremely positive things to say. Some cited examples of COs interceding in and alleviating sailors' problems that were outside the CO's direct control—such as helping with the detailing process. Others simply talked about how their COs showed interest in them and had praised their work.[36]

We can't observe a CO's philosophy toward sailors in the data; consequently, we cannot quantify how these differences in ships' COs affect attrition rates. We did, however, find systematic variation among attrition based on the characteristics of the CO. For example, the tenure of the CO in his tour matters—a CO in his second year will have lower attrition than a new CO by about 0.5 percentage points, or 5 percent.[37]

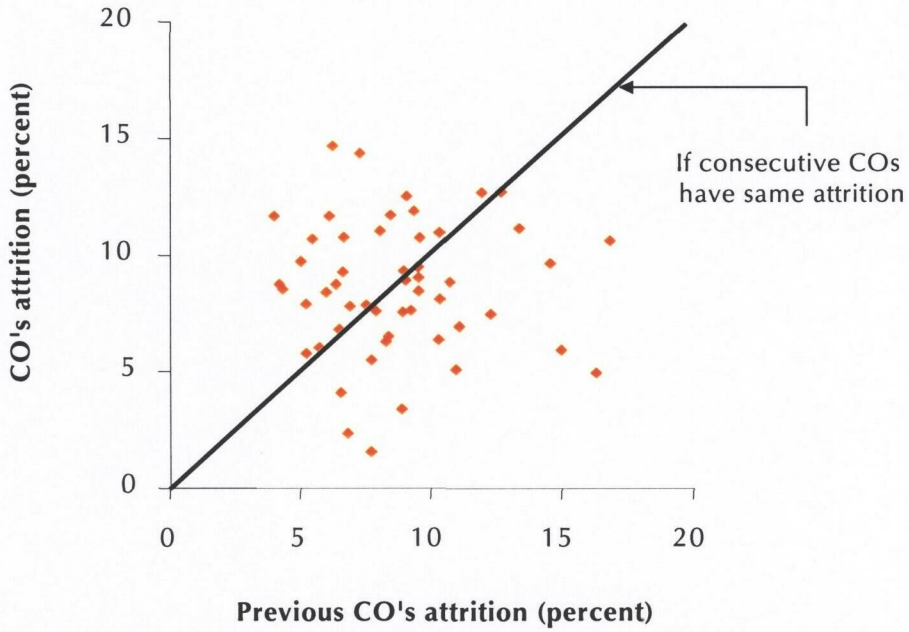
Although some of the variation in COs' attrition rates can be explained by tenure or external conditions, much of it can't be. In other words, some COs will have had lower attrition than others by the end of their tours, even though they faced similar conditions. We illustrate the significance of "individual CO effects" in figure 19. We used a sample of

36. We also asked the question whether the emphasis on a ship's CO was appropriate or whether the ship's executive officer or command master chief was the most influential. Sailors felt that the ship's captain set the tone for the entire ship and that his interest or disinterest in the crew was eventually reflected throughout the ship.

37. We did not see similar patterns for the ship's executive officer or command master chief.

surface combatants to compare the attrition rates of consecutive COs. Each data point indicates average annual attrition of a ship's current and previous CO.[38] This comparison nets out differences in deployment cycle, crew composition, and ship characteristics. If COs have no individual impact on the attrition of their crews, all the data points would lie on the 45-degree line in figure 19. Instead, we see that attrition varies substantially from one CO to the next; 60 percent of the pairs have differences of 2.5 percentage points or more. In addition, the shifts in attrition from one CO to the next don't appear to follow a time-trend. Changes occured in both directions—from low to high attrition and high to low.

Figure 19. Similarity of CO's attrition rates, by ship



We conclude that distinctions between ship COs translate into different attrition patterns from a ship.

38. This analysis only includes current COs who started in FY98 and who had served in their assignments at least 18 months by the end of FY99.

Long-term strategies to reduce attrition

Senior leadership and commands have been focusing on the need to reduce attrition, partly because it is costly to the Navy. Using the methods described in [3], we estimated how much it costs to replace a sailor who leaves early. An increase in annual fleet attrition of 1 percentage point raises accession requirements by roughly 1,000 recruits and net costs by roughly $20 million per year. For this reason, the Navy must ensure that keeping attrition low remains a priority even if the emphasis of senior leadership shifts to other matters.

In this section, we evaluate three strategies the Navy could pursue, or is already pursuing, to lower attrition and keep it low. Increasing commands' accountability for attrition while at the same time encouraging them to experiment with attrition-reduction policies is the most promising approach. Contract completion bonuses and changes to the separation system are other, less promising, approaches.

Increase accountability and incentives to commands

We begin by considering the role local commands might play in reducing attrition and how to keep them focused on attrition over the long run. The goal is to align the COs' incentives to ensure that attrition is appropriately considered in the unit's planning and operations.

Monitor attrition statistics and require accountability

To keep attrition in the forefront, local commands and their superiors must have information on a regular basis. The Navy can now monitor attrition at the local level; however, the reports need to be viewed carefully because not all commands face an equal challenge in combating attrition. For example, attrition rates vary during the deployment cycle and by crew composition.

To avoid some of the difficulties in interpreting attrition rates, we recommend an expansion to the new reporting system (PERSMART). In addition to tracking annual and quarterly ship attrition rates, each ship's attrition should be tracked relative to all other ships within the same type. Tracking relative performance would enable the system to identify ships that are consistently the worst (and best) performers.

We illustrate a notation system in figure 20. In this reporting, each ship receives a letter, each quarter, that corresponds to its attrition ranking. For example, ships with the best attrition (the top 20 percent of ships perhaps) would receive an "A"; those in the bottom would receive an "E."

Figure 20. Set of ships under proposed reporting system

	Q1	Q2	Q3	Q4
Ship 1	A	A*	B	A**
Ship 2	A	C	B	C
Ship 3	C	E*	E	E

* New CO
** Beginning of deployment

We've seen that a ship's relative attrition performance changes significantly with the deployment cycle. Very few ships, however, remain the lowest performers quarter after quarter. During FY99, only seven ships ranked in the bottom 20 percent of surface combatants for three quarters out of the year. In the system we've just described, we believe that three "E's" signal a potential problem, as may particularly high spikes in monthly attrition.[39]

39. Ships could also be compared in a ranking by deployment status or ship type.

Once implemented, this system would provide context to the fleet on how individual ships are doing and could signal when ships exceed the acceptable level. The Navy could then investigate the circumstances of the individual ship.[40]

Such attrition statistics should still be used *in conjunction with* other information to evaluate the ship and its command on a regular basis. Inclusion of attrition statistics on fitness reports would also highlight the importance of maintaining low attrition.

We believe that the visibility of valid, understandable attrition statistics throughout the fleet would provide powerful incentives for COs to factor attrition into their decisions.

Encourage experimentation

Although it is important to make attrition part of the commanders' records, it is also essential to give them the latitude to experiment with different quality-of-life and workload inititatives. A plethora of actions have been taken at the command level—such as tropical hours, changes in watchstanding, substituting simulators for under way time, and expansions of voluntary education programs. In evaluating these actions, the Navy should keep in mind that worthy experiments sometimes don't work out. The Navy can foster innovation by recognizing commanders' efforts even when they fail.

Reward commands

Finally, the Navy can use attrition reporting not only to find problems but also to identify and reward the best performers. A quarterly list of low-attrition commands will give leaders an incentive to improve retention. Reinstating the Golden Anchor Award for best retention would be another way to highlight the importance of retention. Or, given the prestige of the Battle E award, adding a retention requirement should keep commands focused on the sailor and the work environment.

---

40. Other statistics to consider include, for example, a 24-month moving average or a CO's rate over the entire tour. Both would largely eliminate the problem of comparing ships across different portions of the deployment cycle. However, these measures do not reflect a changing attrition climate quickly.

Realign incentives to sailors

Here, we discuss how the Navy might realign incentives for sailors to stay in the Navy.

Financial incentives

One way to lower attrition is by paying a completion bonus to sailors at the end of their obligation. However, even though such a bonus might induce sailors to stay in the Navy, it is unlikely to be cost-effective. We simulated the cost-effectiveness of a $4,500 end-of-first-term lump-sum bonus based on several measures of responsiveness—the attrition response to future SRBs, our pay elasticities, and civilian annual bonus elasticities [20]. Using the methodology in [3], we found that the costs of the across-the-board financial incentive outweigh the savings from reduced attrition (recruiting, training, and permanent change-of-station (PCS) savings). This bonus is not cost-effective because the Navy would have to pay the bonus to *all* 20,000 sailors who continue to the end of their obligation. Even under the most optimistic scenario, only 1,000 *additional* sailors would finish their contracts. Table 7 shows the costs and benefits of three options we studied.

Table 7. Costs and benefits of a lump-sum bonus under alternative attrition reduction assumptions

Scenario	Savings	Bonus costs
Military/civilian wage estimate: decreasing yearly attrition up to 2.2 percentage points	$23 million	$94 million
Lower-bound civilian estimate: decreasing yearly attrition up to 2.0 percentage points	$41 million	$95 million
Upper-bound civilian estimate: decreasing yearly attrition up to 3.5 percentage points	$70 million	$97 million

Improvements to quality of service

We have seen that working conditions on ship and experiences at sea have an impact on attrition. One way the Navy can reduce attrition is by continuing efforts to enhance worklife and shipboard life. The Interdeployment Training Cycle (IDTC) and Smart Work initiatives are two examples of Navy-wide efforts. Some commands have taken additional steps in improving quality of service for their sailors, and we encourage their efforts. However, continued high-level support is essential.

One step the Navy might consider is an assessment of existing quality-of-work programs to evaluate Navy-wide investments. Systematic integration of work issues into the budgetary and planning process—the Baseline Assessment Memorandum, IWARs, or the like—would also help ensure that the proper investment levels are made. Raising awareness of quality-of-work issues throughout the Surface Warfare community is also important; perhaps the Navy could institute a quality-of-work group within the Surface Warfare Direcorate (N76).

Finally, tracking and measuring improvements in quality of service at the local and Navy-wide levels would assist and foster command efforts, and might support Navy-wide initiatives as well. For instance, the Navy might want to track measures of crew development, such as participation in voluntary education and percent of crew taking and passing advancement boards.

Limit attrition authority and eligibility

The last strategy centers on the Navy separation system as a means to control attrition.

Some have argued that the list of loss criteria is too long—containing questionable items—and that there is too much flexibility in interpretation. As a result, some of the Navy's current attrition reduction initiatives have relied on making it more difficult to attrite. The fleets have worked with the medical establishment to decide when sailors should be attrited and when medical treatment within the Navy is appropriate. In addition, commands have increased reliance on

nonjudicial punishments of sailors who they might have otherwise preferred to attrite.

The strategy here goes a step further. The idea is twofold: (1) to review the official Navy loss reasons and tighten the eligibility criteria for early separations, and (2) to eliminate final discharge authority from the fleet. These actions would make it harder for commands to attrite sailors and for sailors to separate.

Restrict early separation criteria

The Navy can restrict early separation criteria by eliminating a reason code or by narrowing the eligibility within any one code. There are two reasons to consider these steps. First, some argue that current criteria/separation reasons are so broad that they lead to the separation of sailors who could still serve honorably in the Navy. For instance, the Navy determined that pregnancy is compatible with service; yet, it is potentially a means of early separation. Another example had to do with losses due to pattern of misconduct. Some thought attriting sailors with two violations gets rid of too many who could be productive crew members.

Second, for sailors who are using the administrative separation system as a means to leave could no longer find an easy way out. Both officers and sailors maintained that many sailors who wanted to attrite would claim vague medical problems or mental illness. Some suggested the criteria be revised so that only sailors with obvious and long-term medical conditions or impaired ability to work would be eligible to separate early.

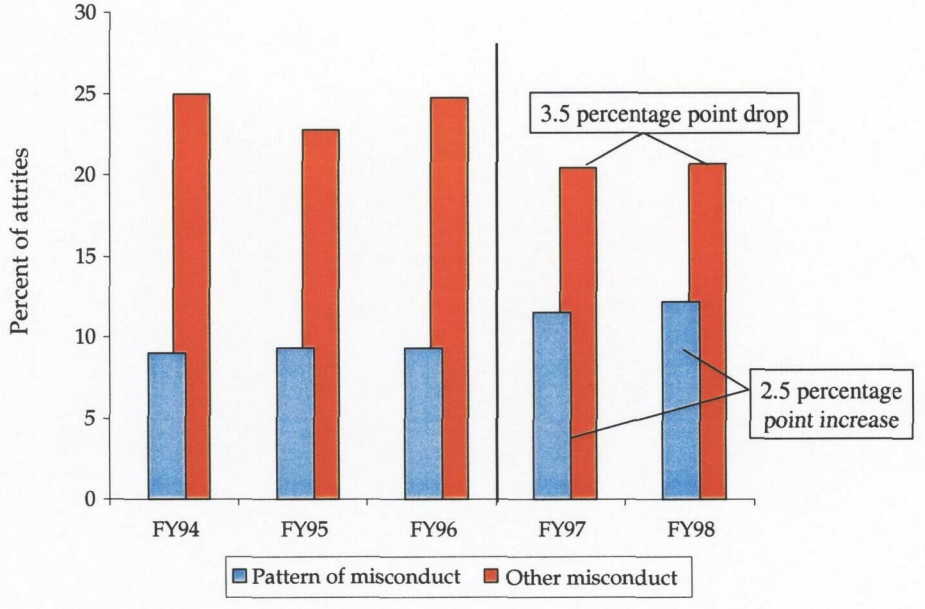
Can restricting the criteria lower attrition?

Eliminating a reason category or narrowing the eligibility cuts off an avenue for attrition. Consequently, it may prevent attrition from taking place at all. On the other hand, attrition may just be funneled through different "reasons" while attrition rates remain unaffected.

The Navy has changed eligibility criteria in the past; these experiences hint that the effect on attrition is small at most. We come to this conclusion based on both focus groups and personnel data.

For example, in FY96, the Navy revised eligibility to discharge a sailor for a "pattern of misconduct" from three or more infractions incurred to two or more.[41] At the same time, "other misconduct" criteria were not changed. Figure 20 shows the percent of sailors who were attrited for a pattern of misconduct before and after the policy change. The Navy expansion of "pattern of misconduct" did, in fact, correspond to higher attrition recorded in that category following the policy change. There was a simultaneous drop in attrition from "other misconduct." Commands could now attrite sailors relatively more easily under the "pattern of misconduct" route.

Figure 21. Percent of sailors attrited for misconduct, FY94 through FY98



Restricting eligibility will only cut attrition if the Navy tightens all separation rules. Ideally, however, the Navy not only wants these sailors to remain until the end of their contract but also to reenlist. That provides a far larger impact on manning and accession goals than simply

41. This change was described in [21].

remaining until the contract ends. With this strategy, however, the sailors affected are likely to still leave the Navy when their enlistment obligation is over. The main problem with restricting loss criteria is that it doesn't address the underlying causes for attrition that we've discussed, such as pay or quality of service at sea.

Decentralize authority

It's been suggested that moving final administrative discharge authority to BUPERS would: (1) provide uniformity across commands in interpreting eligibility and (2) allow eligibility criteria to be interpreted more narrowly in times of high attrition.

Before FY96, final administrative discharge authority did reside in BUPERS. In FY96, authority was decentralized to the fleet for enlisted personnel [21]. The reason for the change was to process out substandard personnel more quickly. However, the effect was also to decrease the cost of separating sailors—it reduced the time and paperwork required to process out a sailor. As the cost of attrition decreases, attrition generally increases. Attrition did increase in the following fiscal year, although there is no evidence it was because of this policy. Interviews with the fleet indicate that the administrative burden of the policy was not enough to substantially affect attrition.

We do not believe this is a particularly effective way to lower attrition. The effect is dependent on the vigilance of BUPERS in investigating individual cases and the administrative burden placed on the commands. If cases are carefully reviewed, there may be an effect, but there are other reprecussions. For example, does the command keep the sailor it wanted to attrite? It seems likely that the command or sailor would be able to find another to separate the sailor.

Conclusions and recommendations

We've shown that first-term fleet attrition is sensitive to the opportunities and conditions facing sailors and ship leadership.

The increase in fleet attrition over the past decade was the consequence of a substantial and simultaneous change in several forces. Civilian opportunities expanded—particularly for some of the most highly skilled sailors. At the same time, sea-duty conditions, such as time away from home port and the quality of ports of call, deteriorated. The continuation of the drawdown mentality exacerbated the situation. It was only after manning declined that stemming the flow of early separations became critical. As the incentives to commands to cut attrition increased and conditions at sea improved, fleet attrition rates started to drop and have continued to fall ever since.

Because fleet attrition losses are costly, keeping attrition low must remain an important goal for the Navy. Given our evidence that commands respond to incentives, the most promising approach is to increase the visibility of attrition within the fleet and acknowledge the responsibility of unit commands in controlling attrition. The goal is to balance the emphasis placed on the physical condition of the ship with consideration for the sailors' well-being.

Finally, while a completion bonus does not appear to be cost-effective, other incentives for sailors to remain in the Navy may be worth investigating. We feel it is important to encourage the fleet to experiment with alternatives.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A: Estimation of Navy-wide attrition

To analyze the causes of first-term attrition, we conducted a regression analysis of sailors' stay or leave behavior. This technique allows us to separate the influence of individual factors while holding other influences fixed. Because the factors that may affect attrition may change over the sailor's time in the fleet, we estimated individual regressions (logistic specifications) for the probability that a sailor attrites within the first year in the fleet, within the second year, and within the third year.

Data sample

We included in our sample all sailors who entered the fleet in FY86 through FY99. Years of accession for this group range from FY84 to FY98. We have data on more than 600,000 sailors.

We estimated the effects of the following potential influences of attrition into our regressions:

- Civilian opportunities and compensation
- Navy job
- Individual characteristics.

For attrition by 12 months into the fleet, we included all variables at the time of entry into the fleet. For attrition in the second year and the third year in the fleet, we used each variable measured at 12 months and 24 months, respectively.

Measures of civilian opportunities and compensation

- Military-civilian wage gap = basic pay for each sailor calculated based on LOS and paygrade divided by predicted civilian earnings. To calculate civilian earnings, we estimated the effect of race, gender, age, technical occupation, and year on civilian earnings for all full-time workers aged 18 to 30 years in the

Current Population Survey. We then used the measured relationships between individual characteristics and earnings to obtain estimates of sailors' civilian earnings.

- Expectation of Selective Reenlistment Bonus: The SRB multiplier for sailors who are making a first-term reenlistment decision in that sailor's same skill or rating.
- Unemployment rate: The annualized monthly rate of unemployment in the sailor's home state.

Measures of Navy job

- Occupational group: Gendet, other nontechnical, technical, and highly skilled technical occupations. For definitions of nontechnical and technical groupings, see [2]. The highly skilled technical grouping includes ratings that have the longest training pipelines and clear civilian counterparts. They include aviation electronics technicians, electronics technicians, data systems technicians, fire control technicians, and gas turbine systems technician (electrical and mechanical).
- Manning = the proportion of billets filled. The fill rate is the number of E1 to E9 personnel divided by the number of E1 to E9 billets authorized at the sailor's local command.
- In fleet during drawdown = 1 if the sailor was in the fleet between FY91 and FY95.
- Type of duty: ship, air squadron, submarine, or shore, as based on activity code.

Measures of the individual sailor

- Quality cell, marital status, obligation length. We did not include gender or race because differences should be reflected in differences in their civilian-to-military wage ratio.

Descriptive statistics

Tables 8 through 11 summarize the sailors' characteristics for our samples. We present the means, or proportions, of the sample with various characteristics.

Table 8. Sample means: full sample

Variable	Entry to 12 months	12 to 24 months	24 to 36 months
Job opportunities and compensation			
Military-to-civilian wage ratio	0.68	0.70	0.73
Unemployment rate	6.18	5.93	6.27
SRB level offered in rating or skill	0.71	0.76	0.81
Navy work experience			
Manning level (inventory to BA)	0.97	0.97	0.97
In fleet during drawdown[a]	0.37	0.37	0.45
Gendet[a]	0.40	0.32	0.18
Nontechnical occupation[a]	0.23	0.26	0.36
Technical occupation[a]	0.29	0.33	0.36
Most technical occupations[a]	0.08	0.09	0.10
Serving on ship[a]	0.58	0.55	0.54
Serving on submarine[a]	0.05	0.05	0.06
Serving in squadron[a]	0.13	0.13	0.11
Serving on shore[a]	0.23	0.26	0.29
Sailor characteristics			
A cell[a]	0.56	0.56	0.59
B cell[a]	0.06	0.06	0.05
C+ cell[a]	0.32	0.32	0.30
C- cell[a]	0.05	0.06	0.05
D cell[a]	0.01	0.01	0.00
Married, with children[a]	0.05	0.08	0.13
Married, no children[a]	0.08	0.13	0.18
Single, with children[a]	0.02	0.03	0.04
Single, no children[a]	0.75	0.74	0.65
Unknown family status[a]	0.09	0.02	0.00
2-year obligor[a]	0.06	0.00	0.00
3-year obligor[a]	0.13	0.12	0.00
4-year obligor[a]	0.61	0.65	0.68
5-year obligor[a]	0.07	0.07	0.09
6-year obligor[a]	0.14	0.16	0.22

a. Statistic represents proportion of sample with this characteristic.

Table 9. Sample means: Gendets

Variable	Entry to 12 months	12 to 24 months[a]	24 to 36 months[a]
Military-to-civilian wage ratio	0.69	0.73	0.76
Unemployment rate	6.22	5.59	5.89
Manning level (inventory to BA)	0.96	0.97	0.97
In fleet during drawdown[a]	0.40	0.34	0.44

a. Statistic represents proportion of sample with this characteristic.

Table 10. Sample means: nontechnically rated sailors

Variable	Entry to 12 months	12 to 24 months[a]	24 to 36 months[a]
Military-to-civilian wage ratio	0.70	0.74	0.78
Unemployment rate	6.15	5.92	5.87
SRB level offered in rating or skill	0.86	0.90	0.67
Manning level (inventory to BA)	0.97	0.97	0.97
In fleet during drawdown[a]	0.33	0.37	0.45

a. Statistic represents proportion of sample with this characteristic.

Table 11. Sample means: technically rated sailors

Variable	Entry to 12 months	12 to 24 months[a]	24 to 36 months[a]
Military-to-civilian wage ratio	0.62	0.64	0.67
Unemployment rate	6.17	5.96	5.87
SRB level offered in rating or skill	1.32	1.22	1.22
Manning level (inventory to BA)	0.98	0.98	0.97
In fleet during drawdown[a]	0.36	0.40	0.44

a. Statistic represents proportion of sample with this characteristic.

Results

Tables 12–15 present the regression results. The marginal effects reflect the percentage-point change in the attrition rate associated with a unit change in the variable (e.g., for sailors entering the fleet, a 10-percentage-point increase in the military-to-civilian wage rate would decrease attrition in the first year by 0.003 percentage points).

Table 12. Regression results for the likelihood of attriting: full sample

Variable	Marginal effects[a] Entry to 12 months[b]	12 to 24 months[b]	24 to 36 months[b]
Job opportunities and compensation			
Military-to-civilian wage ratio[c]	-0.026**	-0.133**	-0.111**
Unemployment rate	-0.003**	-0.001	0.001**
Expected SRB	-0.004**	-0.005**	-0.005**
Navy work experience			
Manning level	-0.014**	0.050	0.075**
In fleet during drawdown	0.005**	0.010**	0.007
Gendet	0.028**	0.027**	0.033**
Technical occupation	-0.021**	-0.025**	-0.019**
Most technical occupations	-0.049**	-0.047**	-0.028**
Serving on submarine	0.006**	-0.010**	-0.019**
Serving in squadron	-0.032**	-0.025**	-0.017**
Serving on shore	-0.041**	-0.021**	-0.002
Sailor characteristics			
A cell	0.003**	-0.001	-0.001
B cell	0.063**	0.067**	0.041**
C- cell	-0.022**	-0.016**	-0.014**
D cell	0.050**	0.055**	0.031**
Single, with children	0.006**	0.020**	0.026**
Single, no children	-0.017**	-0.008**	-0.005**
Married, with children	-0.004**	-0.003*	0.002
Unknown family status	-0.017**	0.002	0.068
2-year obligor	-0.036**		
3-year obligor	-0.015**	-0.016**	
5-year obligor	0.009**	0.009**	0.008**
6-year obligor	-0.003**	-0.004**	-0.003**
Constant	-0.110**	-0.127**	-0.160**
Observations	602,466	513,631	313,271
Log likelihood	-164,198	-153,704	-81,803
Attrition in year	0.081	0.092	0.075

a. Reference category is nontechnically rated, married, no children, serving on ships, C+ cell, 4-year obligors.

b. ** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.

c. The percent change in attrition for a 1-percent change in pay, or the pay elasticity, is calculated as $b * (1 - p) *$ (military-to-civilian wage ratio), where b is the estimated coefficient on the pay ratio and p is the probability of attrition. We calculate that it equals -0.22, -1.02, and -1.11, respectively, for the first, second, and third years in the fleet.

Table 13. Regression results for the likelihood of attriting: gendet sample

Variable	Marginal effects		
	Entry to 12 months[a]	12 to 24 months[a]	24 to 36 months[a]
Unemployment rate	-0.004**	-0.002**	0.001
Military-to-civilian wage ratio[b]	-0.055**	-0.209**	-0.201**
Manning level (inventory to BA)	-0.019*	0.072**	0.133**
In fleet during drawdown	0.005**	0.006**	0.009**
Observations	243,915	164,561	57,143
Log likelihood	-82,243	-60,021	-20,392
Attrition in year	0.109	0.123	0.119

a. ** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.
b. The pay elasticity equals -0.34, -1.16, and -1.49, respectively, for the first, second, and third years in the fleet.

Table 14. Regression results for the likelihood of attriting: nontechnically rated sailors

Variable	Marginal effects		
	Entry to 12 months[a]	12 to 24 months[a]	24 to 36 months[a]
Unemployment rate	-0.003**	-0.001*	0.001*
Expected SRB of 1 level	-0.005**	-0.006**	-0.007**
Military-to-civilian wage ratio[b]	-0.009	-0.106**	-0.078**
Manning level (inventory to BA)	-0.013	0.054**	0.060**
In fleet during drawdown	0.002	0.012**	0.008**
Observations	135,338	134,780	111,556
Log likelihood	-36,179	-39,816	-28,647
Attrition in year	0.078	0.089	0.072

a. ** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.
b. The pay elasticity equals -0.06, -0.88, and -0.85, respectively, for the first, second, and third years in the fleet.

Table 15. Regression results for the likelihood of attriting: technically rated sailors

Variable	Marginal effects		
	Entry to 12 months[a]	12 to 24 months[a]	24 to 36 months[a]
Unemployment rate	-0.001**	0.000	0.000
Expected SRB of 1 level	-0.001**	-0.004**	-0.004**
Military-to-civilian wage ratio[b]	-0.008*	-0.118**	-0.106**
Manning level (inventory to BA)	-0.007	0.035**	0.057**
In fleet during drawdown	0.005**	0.012**	0.006**
Observations	223,213	214,290	144,568
Log likelihood	-44,942	-53,380	-32,667
Attrition in year	0.052	0.070	0.061

a. ** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.
b. The pay elasticity equals -0.10, -1.13, and -1.23, respectively, for the first, second, and third years in the fleet.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix B: Estimation of attrition from ships

To analyze the causes of first-term attrition, we conducted a regression analysis of sailors' stay or leave behavior. This technique allows us to separate the influence of individual factors while holding other influences fixed. Here, we used duration modeling to look at the probability that a sailor will attrite in a *month*. This modeling technique allowed us to capture the effects for factors that may change often over the first term.

Data sample

In our sample, we included sailors who arrived at their first ship-based full-duty billet between FY86 and FY99. Years of accession for this group range from FY84 to FY98. We excluded sailors serving on submarines because we did not have reliable deployment data. We also excluded from the analysis any sailor who was home-ported overseas, who was part of a precommissioning crew, or who was serving back-to-back sea tours. We eliminated observations where the ship was within the first 6 months of commissioning or within 12 months of decommissioning.

Our data consisted of monthly observations for each sailor. Sailors drop out of our sample when they: (1) reach the end of their first-term obligation (minus 3 months), (2) attrite from the Navy, or (3) leave their sea-duty assignment. We did not follow sailors through processing out of the Navy. We dropped them from our sample when they left their sea-duty billets.

We estimated the effects of the following potential influences of attrition into our regressions:

- Deployment cycle
- Ship characteristics

- Navy job
- Individual characteristics.

Measures of time away

- Currently deployed = 1 if the sailor was on deployment in that month. We defined a deployment as more than 56 days away from home port, excluding major preplanned maintenance away from home port.
- Previously deployed = 1 in that month if the sailor was assigned to the ship for all or part of the ship's last deployment.
- Length of previous deployment = the number of days the sailor was deployed for the last deployment. For sailors not previously deployed, it equals zero.
- Percent of time spent in "bad," "good," or "mediocre" ports = the proportion of the entire previous deployment spent in the various port categories, as described within the primary text. For sailors who had not yet been deployed, previous time in ports for the month equals zero.
- Percent of time under way = the proportion of time away from home nondeployed in the past 3 months. For months in which the sailor is currently deployed, time under way (nondeployed) in that month equals zero.

Measures of maintenance

- Experienced major pre-planned maintenance = 1 in a month if the sailor had been assigned to the ship during its last pre-planned maintenance.
- Experienced previous overhaul = 1 in a month if the sailor had been assigned to the ship during its last overhaul.
- Overhaul in month = 1 if the ship the sailor was assigned to was in overhaul for that month. The measured effect on attrition is only for the month in overhaul; it does not imply a permanent effect on attrition.

- Inspection in month = 1 if the sailor is assigned to the ship in a month in which an inspection occurred. The measured effect on attrition is only for the month that the inspection occurs; it does not imply a permanent effect on attrition.

Ship characteristics

- Type of ship: aircraft carrier, surface combatant, mine warfare, auxiliary, and amphibious ship.
- Home-ported in PACFLT = 1 if the ship the sailor was assigned to was home-ported in PACFLT; = 0 if LANTFLT.
- Age of ship in months.

Characteristics of the Navy job

- Occupational group: Gendet, other nontechnical, technical, and highly skilled technical occupations. For definitions of nontechnical and technical groupings, see [2]. The highly skilled technical grouping includes ratings with the longest training pipelines with clear civilian counterparts. They include aviation electronics technicians, electronics technicians, data systems technicians, fire control technicians, and gas turbine systems technician (electrical and mechanical).
- Manning = the proportion of billets filled over the previous 3 months. The fill rate is the number of E1 to E9 personnel divided by the number of E1 to E9 billets authorized at the sailor's local command.
- Manning at fleet arrival = the manning variable for sailors in their first 3 months in the fleet; = 0 for sailors at all other times.
- In fleet during drawdown = 1 if the sailor month is between FY91 and FY95.

Sailor characteristics

- AFQT and educational attainment, race or ethnicity, gender, marital and dependency status, time in the fleet.

- Unemployment rate = the annualized monthly rate of unemployment in the sailor's home state.

Summary of variables

Table 16 shows the means of the variables used in the statistical analysis.

Table 16. Sample means

Variable	Full sample	Gendets	Non-technical	Technical
Time away				
Currently deployed[a]	0.280	0.283	0.289	0.281
On previous deployment[a]	0.713	0.690	0.712	0.692
Length of previous deployment (for sailors on last deployment)	180.218	180.900	181.158	179.371
Percent of time in "bad" ports (last deployment)	2.260	2.360	2.158	2.273
Percent of time in "mediocre" ports (last deployment)	10.750	10.860	10.413	10.723
Percent of time in "good" ports (last deployment)	7.010	7.130	7.019	7.168
Percent of time spent under way, nondeployed (past 3 months)	17.328	17.068	17.700	17.419
In-port activities				
Experienced major preplanned maintenance[a]	0.467	0.447	0.462	0.436
Experienced a previous overhaul[a]	0.492	0.509	0.473	0.493
Overhaul in current month[a]	0.075	0.077	0.078	0.083
Inspection in current month[a]	0.248	0.250	0.243	0.259
Ship characteristics				
Carrier[a]	0.3431	0.350	0.365	0.290
Surface combatant[a]	0.3101	0.253	0.347	0.367
Auxiliary[a]	0.1493	0.194	0.101	0.144
Amphibious[a]	0.1906	0.195	0.181	0.194
Mine warfare[a]	0.0068	0.007	0.007	0.005
Home-ported in PACFLT[a]	0.4492	0.464	0.448	0.449
Age of ship (in months)[a]	231.747	243.831	231.364	236.912

Table 16. Sample means (continued)

Variable	Full sample	Gendets	Non-technical	Technical
Navy work experience				
Manning level (last 3 months)	0.960	0.958	0.960	0.962
Manning level at fleet arrival	0.958	0.956	0.960	0.961
In fleet during drawdown[a]	0.428	0.412	0.425	0.464
Sailor characteristics				
A cell[a]	0.442	0.335	0.515	0.530
B cell[a]	0.061	0.058	0.067	0.059
C+ cell[a]	0.412	0.475	0.368	0.354
C- cell[a]	0.080	0.124	0.046	0.052
D cell[a]	0.006	0.007	0.005	0.005
Female[a]	0.043	0.049	0.041	0.031
Black[a]	0.238	0.265	0.258	0.153
Hispanic[a]	0.101	0.104	0.096	0.105
Other race[a]	0.049	0.055	0.039	0.055
Married[a]	0.222	0.206	0.225	0.242
Number of children	0.173	0.168	0.171	0.182
Age	21.536	21.438	21.483	21.682
Unemployment rate	5.910	5.872	5.932	5.987
Months in the fleet	16.405	16.068	16.426	15.561
Monthly attrition[a]	0.010	0.012	0.009	0.007

a. Statistic represents proportion of sailor months with this characteristic.

Results

Tables 17 through 19 show the factors that influence first-term attrition on surface ships.

The marginal effects reflect the percentage-point change in the *monthly* cohort attrition rate associated with a unit change in the variable. For example, from table 16, the marginal effect of nondeployed time under way is 0.008. This means that each 10-percentage-point increase in underway time raises *monthly* attrition by 0.0008 percentage points, or about 8 percent when evaluated at the mean.

To calculate the effect of a variable on the 12-month cohort attrition rate, we applied the marginal effect each month to a cohort of sailors that shrinks every month by the attrition rate. The new 12-month rate = $(1 - p - x)^{12}$ where p = monthly attrition and x = the marginal effect. Subtracting the new cohort rate from the previous rate, we got the change in attrition. Using cohort attrition rates from the late 1990s, increasing underway time by 10 percentage points results in an increase in the 12-month cohort attrition rate of 0.008 percentage points. A rough approximation would be to multiply the marginal effect by 12. Using this methodology, the increase in time under way raises the 12-month cohort attrition rate by 0.009 percentage points.

Table 17. Regression results for ship-based attrition: 4-year obligors

Variable	Marginal effects[a] (percentage points full sample[b]
Time away	
Currently deployed	-0.0037**
On previous deployment	-0.0017**
Length of previous deployment	-0.0000
Percent of time in "bad" ports (last deployment)	0.0018
Percent of time in "mediocre" ports (last deployment)	0.0002
Percent of time in "good" ports (last deployment)	-0.0049**
Percent of time under way, nondeployed (past 3 months)	0.0077**
In-port activities	
Experienced major preplanned maintenance	0.0010**
Experienced a previous overhaul	0.0003*
Overhaul in current month	0.0014**
Inspection in current month	0.0006**
Ship characteristics	
Carrier	-0.0008**
Surface combatant	0.0000
Auxiliary	-0.0001
Mine warfare	-0.0005
Home-ported in PACFLT	0.0004**

Table 17. Regression results for ship-based attrition: 4-year obligors (continued)

Variable	Marginal effects[a] (percentage points full sample[b]
Age of ship (in months)	0.0000**
Navy work experience	
Manning level (last 3 months)	0.0052**
Manning level at fleet arrival	-0.0024**
In fleet during drawdown	0.0006**
Technical occupation	-0.0017**
Most highly technical occupations	-0.0054**
Gendets	0.0054**
Sailor characteristics	
A cell	0.0001
B cell	0.0072**
C- cell	-0.0016**
D cell	0.0044**
Sailor characteristics and other factors (continued	
Female	0.0035**
Black	-0.0005**
Hispanic	-0.0021**
Other race	-0.0047**
Married	-0.0003
Number of children	0.0008**
Age	-0.0001
Unemployment rate	-0.0002**
Months in the fleet	-0.0001**
Constant term	-0.0503**
Observations	1,599,714
F-statistic	131.4
Monthly attrition in sample	0.0096

a. Reference group is nontechnically rated sailors serving on amphibious ships, C+ cell.
b. ** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.

Table 18. Regression results for likelihood of attriting: 4-year obligors by occupational group

Variable	Marginal effects[a]		
	Gendets[b]	Non-technical[b]	Technical[b]
Time away			
Currently deployed	-0.0046**	-0.0038**	-0.0028**
On previous deployment	0.0036**	0.0014**	0.0018*
Length of previous deployment	0.0000**	0.0000	0.0000
Percent of time in "bad" ports (last deployment)	-0.0005	0.0025	0.0051**
Percent of time in "mediocre" ports (last deployment)	0.0000	-0.0001	0.0003
Percent of time in "good" ports (last deployment)	-0.0080**	-0.0034*	-0.0028
Percent of time under way, nondeployed (past 3 months)	0.0090**	0.0081**	0.0055**
In-port activities			
Experienced major preplanned maintenance	0.0013**	0.0015**	0.0005
Experienced a previous overhaul	0.0005	0.0001	0.0007**
Overhaul in current month	0.0020**	0.0020**	0.0001
Inspection in current month	0.0004	0.0007**	0.0006**
Ship characteristics			
Carrier	-0.0014**	-0.0003	-0.0001
Surface combatant	0.0006	-0.0006	-0.0003
Auxiliary	-0.0002	0.0005	0.0009
Mine warfare	-0.0005	-0.0016	-0.0005
Home-ported in PACFLT	0.0005	0.0004	0.0003
Age of ship (in months)	0.0000**	0.0000**	0.0000**
Navy work experience			
Manning level (last 3 months)	0.0059**	0.0042	0.0062**
Manning level at fleet arrival	-0.0020**	-0.0022**	-0.0041**
In fleet during drawdown	0.0003	0.0010**	0.0006
Sailor characteristics			
A cell	0.0003	-0.0006*	0.0000
B cell	0.0081**	0.0070**	0.0059**
C- cell	-0.0014**	-0.0009**	-0.0009

Table 18. Regression results for likelihood of attriting: 4-year obligors by occupational group (continued)

	Marginal effects[a]		
Variable	Gendets[b]	Non-technical[b]	Technical[b]
D cell	0.0038**	0.0056**	0.0054**
Female	0.0038**	0.0043**	0.0030**
Black	-0.0012**	0.0001	0.0001
Hispanic	-0.0034**	-0.0013**	-0.0010**
Other race	-0.0079**	-0.0037**	-0.0025**
Married	-0.0007*	0.0000	-0.0007
Number of children	0.0012**	0.0003	0.0008**
Age	0.0000	-0.0001**	0.0000
Unemployment rate	-0.0003**	-0.0002**	0.0000
Months in the fleet	-0.0003**	-0.0002**	-0.0001**
Constant term	-0.0563**	-0.0429**	-0.0406**
Observations	634,376	520,432	346,955
F-statistic	43.87	32.26	15.39
Monthly attrition in sample	0.0118	0.0087	0.0068

a. Reference group is nontechnically rated sailors serving on amphibious ships, C+ cell.
b. ** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.

Table 19. Regression results for ship-based attrition by obligation length

Variable	Marginal effects (percentage points)[a] 2- and 3-year obligors[b]	5- and 6-year obligors[b]
Time away		
Currently deployed	-0.0035**	-0.0030**
On previous deployment	0.0014	0.0009
Length of previous deployment	0.0000	0.0000
Percent of time in "bad" ports (last deployment)	-0.0023	0.0017
Percent of time in "mediocre" ports (last deployment)	-0.0034	-0.0014
Percent of time in "good" ports (last deployment)	-0.0012	-0.0064**
Percent of time under way non-deployed (past 3 months)	0.0066**	0.0058**
In-port activities		
Experienced major preplanned maintenance	0.0005	0.0005*
Experienced a previous overhaul	-0.0002	0.0002
Overhaul in current month	0.0014**	0.0003
Inspection in current month	0.0011**	0.0009**
Ship characteristics		
Carrier	-0.0005	-0.0013**
Surface combatant	-0.0004	0.0001
Auxiliary	0.0005	0.0005
Mine warfare	-0.0017	0.0032**
Home-ported in PACFLT	-0.0002	0.0004
Age of ship (in months)	0.0000**	0.0000**
Navy work experience		
Manning level (last 3 months)	0.0033	0.0012
Manning level at fleet arrival	-0.0016**	-0.0023**
In fleet during drawdown	0.0008**	0.0009**
Technical occupation	-0.0017**	-0.0011**
Most highly technical occupations	-0.0023	-0.0040**
Gendets	0.0059**	0.0056**

Table 19. Regression results for ship-based attrition by obligation length (continued)

Variable	Marginal effects (percentage points)[a] 2- and 3-year obligors[b]	5- and 6-year obligors[b]
Sailor characteristics		
A cell	-0.0001	0.0005
B cell	0.0077**	0.0052**
C- cell	-0.0014**	-0.0007
D cell	0.0061**	0.0054**
Female	0.0020**	0.0021**
Black	0.0000	0.0012**
Hispanic	-0.0017**	0.0003
Other race	-0.0038**	-0.0017**
Married	0.0002	-0.0002
Number of children	0.0003	0.0013*
Age	0.0002**	-0.0001**
Unemployment rate	-0.0002**	0.0000
Months in the fleet	0.0000**	-0.0001**
2-year obligor	-0.0034**	0.0026**
Constant term	-0.0516	-0.0370
Observations	511,145	562,938
F-statistic	29.87	57.46
Monthly attrition in sample	0.0089	0.0075

a. Reference group is nontechnically rated sailors serving on amphibious ships, C+ cell.

b. ** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.

THIS PAGE INTENTIONALLY LEFT BLANK

References

[1] Laura J. Junor and Jessica S. Oi. *A New Approach to Modeling Ship Readiness,* Apr 1996 (CNA Research Memorandum 95-239)

[2] Linda C. Cavalluzzo and Jeremy A. Arkes. *Comparisons of Enlisted and Civilian Pay,* Aug 1998 (CNA Annotated Briefing 98-88)

[3] Carol S. Moore et al. *Manpower and Personnel IWAR 2000: Aging the Force,* Jan 2001 (CNA Annotated Briefing 3079)

[4] Donald J. Cymrot. *The CNO Briefings,* Mar 2001 (CNA Annotated Briefing D0003425.A1)

[5] Michael L. Hansen. *Compensation and Enlisted Manning Shortfalls,* Sep 2000 (CNA Research Memorandum 1998)

[6] Carol S. Moore and Henry S. Griffis. *Youth Demographic Trends and the Future Recruiting Environment: IWAR Report,* Dec 1999 (CNA Annotated Briefing 99-136)

[7] Anita Hattiangadi. *Private-Sector Benefit Offerings in the Competition for High-Skill Recruits,* Mar 2001 (CNA Research Memorandum 3563)

[8] *Uniformed Services Almanac,* Uniformed Services Almanac, Inc., VA, 1987–2000

[9] Martha E. Shiells and Joyce S. McMahon. *Effects of Sea Duty and Advancement on First-Term Retention,* Jun 1993 (CNA Research Memorandum 92-205)

[10] Timothy W. Cooke et al. *Personnel Tempo of Operations and Navy Enlisted Retention,* Feb 1992 (CNA Research Memorandum 91-150)

[11] Henry S. Griffis and Ravi Sharma. *Implications of Changes in Time Spent at Sea,* Mar 1994 (CNA Research Memorandum 94-19)

[12] Daniel S. Hamermesh. *Workdays, Workhours and Work Schedules: Evidence for the United States and Germany.* W. E. Upjohn Institute for Employment Research, 1996

[13] W. M. Bokesch and H. L. Williams. *Workweek of Shipboard Enlisted Personnel During In-Port Periods,* Dec 1975 (NPRDC SR 76-5)

[14] Department of the Navy, OPNAVISNT 1000.16J

[15] Carol S. Moore et al. *The Navy Standard Workweek: A Preliminary Assessment,* Jan 2001 (CNA Annotated Briefing 3113)

[16] Department of the Navy, OPNAVISNT 5330.8, Oct 1970

[17] Michael J. Paley and Donald I. Tepas. "Fatigue and the Shiftworker: Firefighters Working on a Rotating Shift Schedule," *Human Factors,* Jun 1994 (36:2), 269-84

[18] June J. Pilcher et al. "Differential Effects of Permanent and Rotating Shifts on Self-Reported Sleep Length: A Meta-Analytic Review." *Sleep,* Mar 2000 (23:2), 155-63

[19] Michael Bennett et al. *Fleet OPTEMPO: Trends and Implications for Carriers and Surface Combatants* (CNA Annotated Briefing, forthcoming)

[20] Arthur E. Blakemore et al. "Employment Bonuses and Labor Turnover." *Journal of Labor Economics,* Oct 1987 (5:4) S124-35

[21] Department of the Navy, NAVADMIN 140/96, Jul 1996

List of figures

List of tables

Distribution list

Research Memorandum D0004216.A2

CINCLANTFLT NORFOLK VA	**OPNAV**
Attn: N1	
CINCPACFLT PEARL HARBOR HI	N00D
Attn: N1	N1
COMNAVAIRLANT NORFOLK VA	N1B
Attn: N1	N10
COMNAVAIRPAC SAN DIEGO CA	N12
Attn: N1	N12B
COMNAVSURFLANT NORFOLK VA	N120
Attn: N1	N125
COMNAVSURFPAC SAN DIEGO CA	N13
Attn: N1	N13B
COMNAVSUBLANT NORFOLK VA	N13T
Attn: N1	N130
COMNAVSUBPAC SAN DIEGO CA	N131
Attn: N1	N132
NPRST MILLINGTON TN	N132C
Attn: Director	N132D
ASSTSECNAV M&RA WASHINGTON DC	N79
Attn: ASN (M&RA)	N769
PDASN (M&RA)	N779
DASN (MPWR)	N789
DASN (PP)	N8
ODASN (M&RA)	N80
Attn: Commander Cahill	N801D
Commander Gruendl	N81
BUPERS MILLINGTON TN	N813
Attn: Commander	
NPC-4	
NPC-40	
NPC-45	
NPC-6	
USNA ANNAPOLIS MD	
NAVPGSCOL MONTEREY CA	
NAVWARCOL NEWPORT RI	
COMNAVCRUITCOM MILLINGTON TN	
Attn: 00	
00B	
CNET PENSACOLA FL	
Attn: Terry Halvorsen (TR1)	