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RESEARCH MEMORANDUM

WHO STAYS AND WHO LEAVES? IDENTIFYING SUCCESSFUL NAVY RECRUITS

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This research memorandum examines the relationship between recruit characteristics and recruit success. The analysis uses three related measures of recruit performance and several recruit characteristics obtained from enlistment applications to determine the characteristics of recruits who are more likely to be successful. Indexes of recruit-success propensity for recruits with different characteristics are calculated for each of the three performance measures.

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1. The Center for Naval Analyses (CNA) was asked to examine the relationship between recruit characteristics and recruit success. The results of the analysis are contained in enclosure (1). It is forwarded to you as a matter of possible interest.

2. The study uses three related measures of recruit performance and several recruit characteristics obtained from enlistment applications to determine characteristics of recruits who are more likely to be successful. Indexes of recruit success propensity for recruits with different characteristics are calculated for each of the three performance measures.

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CRM 88-75 / June 1988

WHO STAYS AND WHO LEAVES? IDENTIFYING SUCCESSFUL NAVY RECRUITS

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ABSTRACT

This research memorandum examines the relationship between recruit characteristics and recruit success. The analysis uses three related measures of recruit performance and several recruit characteristics obtained from enlistment applications to determine the characteristics of recruits who are more likely to be successful. Indexes of recruit-success propensity for recruits with different characteristics are calculated for each of the three performance measures.

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SCREENING FOR SUCCESSFUL RECRUITS

Each year the Navy recruits substantial numbers of entry-level personnel. Selecting these personnel assumes more importance for the Navy than for the typical civilian-sector employer for at least two major reasons. First, these new recruits make up about a quarter of the first-term force, and because the military sector has essentially no lateral entry, these new accessions compose virtually the entire universe of potential second-termers four years hence and third-termers eight years hence. The future Master Chief Petty Officer of the Navy will be one of these recruits. Unlike private-sector firms that hire personnel at all levels, the military services hire few non-entry-level personnel. If potential good-hires are missed at the entry-level stage, they are missed forever.

Second, the Navy provides considerable amounts of training for new recruits at the same time that it pays their wages. Should the Navy access recruits that are not successful, that is, recruits that leave before the end of their enlistment contract, the up-front dollars for training are wasted. Although many private-sector employers also provide training for entry-level personnel and face a similar problem—initial productivity considerably smaller than pay—few private-sector employers provide as much up-front, lengthy, and costly training. In the Navy, for example, all recruits have 8 weeks of basic training; most have another 2 to 18 months of classroom training before they even begin a regular duty assignment. The average cost of initial skill training exceeds $8,000 per recruit, with the cost for some skills exceeding $35,000.

Because of the lack of lateral entry, as well as the significance of up-front training investments, enlistment standards have been a source of much debate and research, especially since the implementation of the All-Volunteer Force in 1973. Recruit selection criteria should identify candidates who are unlikely to succeed in the military, but should not unduly restrict entry of individuals with an "acceptable" probability of success. Not recruiting individuals who would have been successful is costly, but may be less so than enlisting individuals who will not succeed. To improve its enlistment criteria, the Navy must acquire better knowledge of the relationships between recruit characteristics and measures of recruit success. This research memorandum contains a statistical examination of these relationships for recent Navy recruits.

RECRUIT CHARACTERISTICS AND EARLY ATTRITION

The analysis described here complements a substantial body of recent research in which researchers tried to improve the understanding of early attrition behavior as an indicator of recruit performance by (1) expanding the amount of information gathered on each recruit, and (2) using more sophisticated analytical techniques. Although the more sophisticated techniques have not yet yielded additional insights, information has been obtained from survey data on employment history; academic performance and extracurricular activities in high school; attitudes about employment and education; and family characteristics such as income, size, and parents' education.

References [1] and [2] use recruit characteristics obtained from surveys in an attempt to distinguish among high school diploma graduates (HSDGs). HSDG recruits who say they expect more formal education are found to have lower attrition if they enlist, although their enlistment propensity is lower. Recruits who are unemployed at the time of enlistment [3], who have a recent history of job changes [1, 3], or who have no job market experience [2] are more likely to leave the service prematurely. In some cases, the estimated combined effects can show differences that are proportionally as large as those between HSDGs and nongraduates or those with General Equivalency Diplomas (GEDs). Reference [2] estimates that the early attrition risk for HSDGs with poor academic performance (grade point average below C- in high school) and low aptitude (lower half of the population) is twice as high as those with a higher grade point average (C- or better) and high aptitude (top half of the population). Reference [3] estimates that young non-graduates with no history of unemployment have an attrition risk similar to the average of all HSDGs. Among HSDGs with no employment instability, those not expecting more education are estimated to be about twice as likely to leave early as those who say they do expect more education [1].

In contrast, the analysis in this memorandum relies exclusively on the information available from military personnel records.[1] A significant amount of information about each recruit is obtained from personnel records compiled by recruiters. Such information is the only source currently available to screen recruits before they enter the Navy.[2]

Past research has shown that early attrition behavior is associated strongly with recruit characteristics observed at the time of enlistment and appearing on personnel records. Evidence of an individual's inability to adapt to school (or work) environments is a potent indicator of inability to cope with military discipline. In this vein, by far the most important indicator of early attrition propensity is whether the recruit has obtained a regular high school diploma. Early attrition rates for those without such diplomas, including those with GEDs, are typically twice as large as those of high school diploma graduates.[3] Even after accounting for other recruit characteristics, this difference remains. (See, for example, references [3] or [4].) Furthermore, [3] found the effects of other characteristics to be similar for each of the educational categories.

Aptitude, as measured by the recruit's Armed Forces Qualification Test (AFQT) score and resulting AFQT category classification, is negatively related to early attrition. Recruits with high aptitude generally qualify for the most valuable technical training the Navy offers, which may

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1. Because this study does not use information derived from background surveys, interpretation of the results will be improved by considering the potential effects of omitted background characteristics.

2. Navy Personnel Research and Development Center (NPRDC) has developed and tested a recruit background questionnaire (Armed Services Applicant Profile) that attempts to identify statistically those applicants more likely to be successful in the military.

3. Reference [5] finds the same result for quit rates among new hires in the manufacturing sector. The similarity of the results is perhaps surprising given the institutional differences between private-sector employment and military service. The similarity suggests that high school diploma graduation is a powerful screen for adaptability.

increase their job satisfaction and reduce attrition propensity. In [3], evidence of the relationship between job match and early attrition suggests that job assignment policies do not have an independent effect on early attrition. Other things being equal, research indicates that younger recruits, Blacks, and Hispanics are less likely to leave the service before the end of their obligation. The Delayed Entry Program (DEP) allows the recruit to postpone accession up to 12 months from the date of enlistment. DEP participants have significantly lower attrition rates than similar recruits not participating in the DEP (except in [1]). Furthermore, research indicates that the length of time spent in the DEP has an independent effect on early attrition; the longer the recruit spends in the DEP, the less likely he is to abrogate the contract (see [6] and [7]). There is, of course, some attrition from the DEP; however, including DEP attrition as early attrition in [3] did not significantly affect the other estimated relationships between recruit characteristics and early attrition. Furthermore, an analysis of DEP attrition for Navy recruits [8] showed that the only significant predictor of DEP attrition was sex; female recruits in the DEP are twice as likely as males to drop out of the program.

Some of the earlier studies [1, 3] provide interpretations of these results in terms of the job-matching theory of labor market dynamics wherein workers and employers learn the value of the job match through experience. The employment relationship is theoretically terminated when the least satisfied party (or perhaps both employer and employee) discovers that the net value of the relationship cannot be made positive through bargaining. If military performance standards are relatively rigid, the primary determinant of early attrition is the relative ability of recruits to adapt to military discipline. Past research as well as that described here seeks to identify recruit characteristics associated with completion of the initial enlistment contract. Such characteristics are thought to be associated with an unobserved individual adaptability trait.

Relative success in the military is indicated by promotion, which goes beyond just coping with the rigors of military life. Promotion is probably a stronger indicator of the quality of the job match than contract completion. The analysis in this paper studies whether the determinants of promotion and survival are qualitatively (as well as quantitatively) different from the determinants of survival alone. Even more successful job matches are indicated by the agreement of both the recruit and the military service to continue the employment relationship beyond the original obligation. In extending the analysis to retention behavior, it must be noted that the choice between continuing in the military and leaving for civilian life is relatively unencumbered when the contract expires and more likely to be affected by civilian employment opportunities.

Unlike previous analyses of extension and reenlistment behavior, no attempt is made to control for the relative attractiveness of military versus civilian employment at the time of contract expiration. This omission is important for interpreting the results if different types of recruits have different sensitivities to or prospects for employment in the civilian sector. The evidence in [9] suggests that higher quality recruits are more sensitive to civilian employment prospects than other recruits. In this case, differences in retention behavior between recruit types may shrink or grow with changing labor market conditions. When the focus is on enlistment standards, however, these concerns are of little practical importance, because economic

forecasters are unable to predict labor market conditions four years into the future (not to mention the difficulty of forecasting military pay and benefits). Although the results are clearly not appropriate for forecasting retention behavior, they may be useful in understanding how changing enlistment standards may affect future retention behavior.

DATA USED IN THE ANALYSIS

Data for the analysis were drawn from two Navy administrative data sets. The first, kept by the Navy Recruiting Command, details the information about the recruit before the recruit enters the Navy; the second, the Enlisted Master Record (EMR) file, records the recruit's history in the Navy. The analysis was restricted to non-prior-service (NPS) male recruits with initial obligations of four years.[1] To observe behavior over the entire length of the contract, the accession years were restricted to FY 1978 through FY 1982. During this period, 171,015 male NPS recruits entered the Navy with four-year obligations.

Table 1 aggregates these accessions by educational status, Armed Forces Qualification Test (AFQT) category, and age at entry and presents survival rates for each recruit category. Educational status is defined as high school diploma graduate (HSDG), certificate graduates of various types (GED), or nongraduates (NON-GRAD). The AFQT categories reflect the following population percentiles: Category I (93rd to 99th percentile), II (65th to 92nd percentile), IIIA (49th to 64th percentile), IIIB (31st to 48th percentile), and IV (10th to 30th percentile).[2] By law, the services cannot access any recruits with AFQT scores below the 10th percentile. During the late 1970s the AFQT was seriously misnormed, which caused the services to believe they were procuring recruits of better quality than they actually were. The AFQT scores used for table 1, however, as well as the AFQT category group aggregations appearing in later stages of the analysis, reflect AFQT scores that have been correctly renormed.

The overall 45-month survival rate for male recruits was 64 percent.[3] Survival rates varied widely, however. HSDG CAT I recruits who entered the Navy when they were 19 or 20 years old had 80-percent survival rates, whereas recruits without a regular high school diploma had survival rates under 50 percent. Survival differences by AFQT category (the last column in the table) did not vary in such a consistent pattern. Although CAT I recruits had the highest survival, the survival rate of CAT IV recruits was better than that of CAT II or CAT III recruits. Within educational categories, however, higher aptitude recruits generally had higher survival rates. Table 1 does not reveal any consistent relationship between enlistment completion and the

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1. During this period, initial Navy obligations were for three, four, five, or six years. Three-year obligations carried an additional obligation in the Navy Reserve, whereas five- and six-year obligations were generally for those jobs with longer training periods. Although the modal obligation length was four years, more than half of the new recruits had obligations that were either shorter or longer than four years.
2. Current Navy policy defines CAT IIIA as the 50th to the 64th percentile. During the 1978 to 1982 time period, however, CAT IIIA was defined as indicated in the text.
3. Because recruits may leave the Navy (at the Navy's convenience) up to 3 months before their enlistment contracts expire, the analysis used 45 months to indicate first-term attrition.

Table 1. Non-prior-service male accessions for four-year enlistment programs (FY 1978–FY 1982)

Category	Age	HSDG		GED		NON-GRAD		Total	
		Total recruits and fraction remaining at 45 months							
AFQT	17–18	472	0.76	85	0.55	116	0.49	673	0.69
CAT I	19–20	525	0.80	54	0.52	37	0.43	616	0.75
	21–22	397	0.77	36	0.72	15	0.47	448	0.75
	23+	604	0.75	43	0.51	14	0.57	661	0.73
	Total	1,998	0.77	218	0.56	182	0.48	2,398	0.73
AFQT	17–18	11,949	0.76	1,895	0.45	4,776	0.44	18,620	0.65
CAT II	19–20	8,997	0.75	1,216	0.51	1,450	0.50	11,663	0.70
	21–22	3,597	0.73	549	0.57	401	0.52	4,547	0.69
	23+	3,695	0.69	466	0.50	323	0.49	4,484	0.65
	Total	28,238	0.74	4,126	0.49	6,950	0.46	39,314	0.67
AFQT	17–18	13,522	0.75	2,436	0.42	9,295	0.41	25,253	0.59
CAT IIIA	19–20	9,407	0.72	1,575	0.52	2,190	0.46	13,172	0.65
	21–22	2,921	0.71	811	0.49	398	0.48	4,130	0.65
	23+	2,697	0.65	530	0.49	222	0.43	3,449	0.61
	Total	28,547	0.73	5,352	0.47	12,105	0.42	46,004	0.62
AFQT	17–18	14,058	0.73	2,671	0.41	5,813	0.41	22,542	0.61
CAT IIIB	19–20	9,812	0.71	1,611	0.47	1,548	0.48	12,971	0.65
	21–22	2,769	0.68	568	0.48	180	0.47	3,517	0.64
	23+	2,264	0.65	409	0.47	124	0.46	2,797	0.62
	Total	28,903	0.71	5,259	0.44	7,665	0.42	41,827	0.62
AFQT	17–18	15,676	0.71	637	0.42	1,726	0.46	18,039	0.67
CAT IV	19–20	14,512	0.67	337	0.53	614	0.48	15,463	0.66
	21–22	3,492	0.60	46	0.66	51	0.49	3,589	0.60
	23+	2,283	0.61	43	0.68	18	0.34	2,344	0.61
	Total	35,963	0.68	1,063	0.48	2,409	0.47	39,435	0.66
Total[a]	17–18	56,280	0.73	7,771	0.43	22,039	0.42	86,090	0.63
	19–20	43,820	0.71	4,828	0.50	5,922	0.48	54,570	0.66
	21–22	13,336	0.68	2,016	0.52	1,072	0.49	16,424	0.65
	23+	11,712	0.66	1,498	0.49	721	0.46	13,931	0.63
	Total	125,148	0.71	16,113	0.47	29,754	0.43	171,015	0.64

a. Overall totals by age and educational category include 2,037 recruits of unknown AFQT category.

age of the recruit. However, it appears that older HSDG recruits have lower survival rates than younger HSDG recruits. The opposite pattern may hold for the non-HSDG recruits; older non-HSDG recruits may have slightly better survival than their younger counterparts.

To investigate further the relationships between recruit characteristics and success in the Navy, three random samples of about 6,000 observations each were drawn from the main data set. Table 2 describes the variables as well as the sample means. As suggested earlier, it is in the Navy's interest to select recruits who will not leave during their enlistment contract. Thus, the first concern is to examine first-term survival (i.e., the variable MOS45). The Navy is also interested in recruits who are successful during their first term of service. To be eligible to reenlist in the Navy, a recruit must achieve petty officer status (the pay grade of E-4) by the time of the reenlistment decision. Therefore, the second measure of recruit success is whether a recruit survives 45 months and achieves a pay grade of at least E-4 (MOS45E4). The final measure of the successful fit between the recruit and the Navy is whether a recruit with an initial enlistment contract of 48 months will still be in the Navy at 51 months of service. Retention of a recruit (either by an extension or a reenlistment) beyond his initial contract period indicates that both the Navy and the recruit are satisfied by the job match.

Table 2. Variable means

	Sample		
Variable	1	2	3
Dependent variables			
MOS45	.644	.652	.648
MOS45E4	.556	.556	.562
MOS51	.353	.354	.364
Independent variables			
HSDG, Age 19+	.398	.396	.417
HSDG, I-IIIA	.348	.340	.351
NON-GRAD, I-IIIA	.171	.170	.167
NON-GRAD, IIIB-IV	.058	.064	.063
GED	.098	.093	.090
DEP	.668	.657	.680
DEPMONTHS	3.000	2.945	2.990
BLACK	.160	.176	.175
HISPANIC	.038	.040	.040
GENDET	.465	.476	.466
Sample size	6,112	5,902	5,705

The Navy's main concern is to identify predictors of recruit behavior from information readily accessible to Navy recruiters. The explanatory variables in the recruit-success equations all fit this criterion, and in fact, all equations use the same set of explanatory variables. The first five independent variables are different AFQT category and educational background combinations. The reference group is high school diploma graduates (HSDGs) who are 17 or 18 years old and whose AFQT scores place them in the lower half of the ability distribution (IIIB-IV). The variable HSDG, Age 19+ identifies recruits who were at least 19 years old when they entered the Navy; the variable HSDG I-IIIA identifies diploma graduate recruits who test in the top half. The next two variables identify recruits who did not complete high school (either with a diploma or a certificate) by whether they test in the upper or lower half of the ability distribution. GED identifies recruits with some alternative type of high school certificate.

The most common way for a recruit to enter the Navy is through the Delayed Entry Program (DEP). The variable DEP identifies the recruits who entered through the DEP rather than entering the Navy in the month that they signed their enlistment contract; DEPMONTHS identifies the length of the DEP stay. During this period, slightly over two-thirds of recruits entered the Navy through the DEP.[1] The variables BLACK and HISPANIC identify recruits with those characteristics. The final explanatory variable, GENDET, identifies recruits who enter the Navy with no definite promise of schooling for a Navy occupation (Navy occupations are called ratings). If a recruit does not become occupationally qualified (rated) within the first enlistment term, he is not eligible to reenlist. Many recruits who enter the Navy as GENDETS become rated, either by later going to school or by taking training on the job. Recruits who are not GENDETs go to school immediately after boot camp to obtain training for a Navy rating.

As is clear from table 2, the variable means for the three random samples are very similar. Still, the models will be estimated separately for each of the three samples.

INDICATORS OF RECRUIT SUCCESS

Because all the dependent variables are dichotomous, probit or logit models of the binary outcome are appropriate. Because there does not seem to be any clear criterion for choosing one of these specifications over the other, the probit specification was chosen arbitrarily. The appendix details the probit equations estimated for the completion of the enlistment contract (MOS45, table A-1), the completion of the enlistment contract at pay grade E-4 (MOS 45E-4, table A-2), and retention beyond the first term (MOS51, table A-3). As indicated by the standard errors for the individual coefficients, the recruit characteristics are significantly related to recruit success in the Navy. Moreover, both the coefficient estimates and their statistical significance are very similar for the three samples (although there are small differences across the samples in the estimated effects for Black and Hispanic recruits).

1. About 90 percent of current Navy recruits come from the DEP.

Table 3 translates the probit results for the first sample into indicators of recruit success. These are simply the estimated probabilities that recruits who possess the specified characteristics will complete the first enlistment term, will complete the first enlistment term with a pay grade or at least E-4, or will be retained beyond the period of the first enlistment contract. The first two panels of table 3 look at recruits who are HSDGs, separating the HSDG recruits who test in the top half of the ability distribution (categories I through IIIA) from those who test in the lower half (IIIB and below). Under each of these broad categories, four recruit types are distinguished. Those who go directly to school after boot camp (A-school) are separated from GENDET recruits, who had no promise of formal training after boot camp. Additionally, recruits who were in the DEP for four months (average (ave) DEP stay) are distinguished from recruits who entered the Navy in the same month that they signed their enlistment contract (in-month). Similar categories are also provided for non-high school graduates in the upper AFQT categories with the values for certificate graduates (GEDs) in parentheses. Because non-high school graduates in the lower aptitude categories almost always enter the Navy as in-month Gendets, only the probability for in-month Gendets is provided.

Table 3. Recruit Success Indexes

Recruit characteristics	Completion of enlistment	Completion of enlistment at pay grade E-4	Service beyond initial obligation
HSDG CAT I-IIIA			
A-school, ave DEP	77	72	41
A-school, in-month	69	64	37
GENDET, ave-DEP	73	64	37
GENDET, in-month	64	55	33
HSDG CAT IIIB-IV			
A-school, ave DEP	72	64	37
A-school, in-month	63	55	32
GENDET, ave DEP	69	56	33
GENDET, in-month	58	46	29
NON-GRAD CAT I-IIIA (GED)			
A-school, ave DEP	56 (63)	49 (54)	27 (28)
A-school, in-month	46 (53)	40 (44)	24 (25)
GENDET, ave-DEP	51 (58)	40 (45)	24 (25)
GENDET, in-month	41 (48)	32 (36)	21 (22)
NON-GRAD CAT IIIB-IV			
GENDET, in-month	39	25	21

NOTE: The index is the probability, estimated from the sample 1 probit equations (tables A-1 through A-3 in the appendix), that the recruit will complete the first enlistment, will complete the first enlistment with a pay grade of at least E-4, or will be retained beyond the initial obligation.

Categories I through IIIA HSDG recruits have the highest values for all three success indicators. Consistent with the results of other researchers, this analysis finds that graduation with a high school diploma is a more important indicator of recruit success than aptitude test scores. HSDG recruits in the lower categories consistently perform better than high school dropouts in the upper AFQT categories. Although GED recruits have better success rates than non-graduates, their predicted success rates are still substantially below those for HSDGs. For service beyond the initial obligation, the success rate of GEDs and nongraduates is virtually identical and significantly below that of HSDGs.

Within educational and AFQT categories, the pattern of recruit success—from most successful to least successful—varies from (1) A-school/ave DEP, to (2) GENDET/ave DEP, to (3) A-school/ in-month, to (4) GENDET/in-month. These results are quite robust, holding for all recruit success indexes and all educational and aptitude group categories (with some ties).

Differences for Black or Hispanic recruits are not detailed in table 3. These results vary somewhat across the three samples, which suggests that, even for a sample of 6,000 observations, detailed inferences for cells with small sample proportions should be interpreted cautiously. Differences in the point estimates for the coefficients in the three samples aside, the overall finding is that Black and Hispanic recruits are more likely to successfully complete their first enlistment term. Additionally, they are more likely than other recruits to complete the first enlistment term with a pay grade high enough to make reenlistment possible. Finally, Black recruits are much more likely than other recruits to stay in the Navy after their initial contract has expired. (The results for Hispanic recruits vary widely across the three samples for this final indicator.)

The probit equations allowed for a separate effect for older (age 19+) HSDGs. Reference [1] found significant differences in attrition behavior for HSDGs who enlisted when they were "seniors" versus those who enlisted when they were "graduates."[1] The sample used in [1] comprises the 4,718 enlistees in the 1979 DOD Survey of Personnel Entering the Military Service. The variable used in this analysis (i.e., HSDGs who enter the Navy at 19 or older) captures some of the distinction between recruits who enlist as graduates and those who enlist as high school seniors. Nevertheless, none of the random samples of Navy recruits used in this paper supports the conclusion in [1] that there is more attrition among graduates than among senior recruits. Although the sign on the older HSDG recruit variable is negative, the coefficient is not statistically significant in any of the contract completion equations (tables A-1 and A-2). Interestingly, the older HSDG recruit variable is a significant indicator of retention beyond the initial contract. Nevertheless, the impact for retention is exactly the opposite of that estimated for attrition in [1, 3]. Other things equal, older HSDG graduate recruits are more likely to be in the Navy after their initial contract has expired.

1. The analysis does not try to replicate this categorization.

Reference [1] concludes that only DEP length and not DEP participation affects probabilities of recruit attrition. The results detailed in this analysis, however, show strong positive effects for contract completion for both the length of DEP stay and for DEP participation. These findings hold for all three samples (see tables A-1 and A-2). Because these findings are contradictory to those in [1], an interpretation of the difference is in order. An important difference between the 1979 DOD recruit survey data used in [1] and the 1978 to 1982 Navy data used in this study is in the proportion of recruits who enter from the DEP. About two-thirds of Navy recruits (in these samples and for all Navy accessions in this time period) came from the DEP, whereas 94 percent of the senior accessions and 82 percent of the graduate accessions in the 1979 DOD survey came from the DEP.[1] The difference in these percentages suggests that individuals in the DEP were over-represented in the 1979 DOD survey.

The range of predicted first-term attrition rates across HSDGs (23 percent to 42 percent) is similar to the proportional differences predicted in [1 through 3]. It may be that the recruiting and assignment processes produce a stratification of HSDG recruits that is closely related to the survey variables "expect more education" and "high school academic performance." AFQT category IIIB and below HSDG recruits who are not assigned to A-school and not screened through the DEP may consist predominantly of those who did not do well in high school and have little desire for classroom training in the future. Even if the recruit categories produced by the surveys are similar to those of this study, there remains an alternative hypothesis for the relatively high attrition among GENDET recruits—that GENDET duty is inherently less satisfying than the relatively skilled positions filled by those attending A-school. This hypothesis contradicts the results in [1], where job-satisfaction indicators from a survey were found to be unrelated to early attrition. The alternative hypotheses may be reconciled by the different lengths of time over which attrition is measured (6 months in [1] versus 45 months in this report).

Interestingly, the results show that higher aptitude HSDG recruits—the recruits that the Navy finds most desirable—are also the recruits most likely to remain in the Navy after the expiration of their initial enlistment contracts. These results, which cover the enlistment point to retention beyond the first term, contrast with results for retention alone. Most retention studies (e.g., [9]) restrict the analysis to those recruits who have completed the first term and are eligible to reenlist. When the population is defined to be those eligible to reenlist, the high aptitude HSDGs have lower reenlistment propensities than other groups. The difference in the results is explained by the fact that high aptitude HSDGs are much more likely than other recruits to complete their initial enlistments at paygrade E-4 or higher. Although an understanding of who reenlists at the reenlistment decision point is important for retention planning, it is probably more important for Navy manpower planners to understand what accessions are most likely to be retained beyond the initial contract period.

1. The Rand Corporation determined that the 6 percent of seniors who entered the Navy without entering the DEP entered the Navy during the month they graduated from high school.

CONCLUSION

Recruits who are high school diploma graduates and who enter the Navy through the Delayed Entry Program have substantially better success adapting to Navy life than do other recruits. Because the Navy has recognized this differential success, current accessions are more likely to enter the Navy from the DEP and as HSDGs than were recruits who entered during the 1978 to 1982 time period.

Analyses of both the completion of enlistment at a pay grade of at least E-4 and the completion of 51 months of service yield estimates of the effects of recruit characteristics on a joint event—that the recruit remains in the Navy and that the recruit is promoted. Such an approach is appropriate for evaluating potentially successful enlistees, because second-term eligiblity requires both continuation to the enlistment point and promotion to petty officer ranks. The analysis cannot, however, identify the separate effects of recruit characteristics either on promotion or on continuation. However, it is important to know that the group of recruits who are most likely to remain past their initial contract period are the recruits that the Navy is most interested in retaining.

Future analysis should investigate further the structure of the relationships among first-term survival, the promotion necessary for enlistment eligiblity, and retention beyond the first-term. Traditional studies of reenlistment behavior that restrict the population of interest to those eligible to reenlist provide some information. An alternative approach would be explicit joint estimation of the relationships. Such an analysis would statistically link the errors between the separate analyses of survival, promotion, and retention. Such a procedure could also provide insight into how unobserved variables affect survival, promotion, and retention. These unobserved variables are usually considered to represent taste for military service and relative productivity in the service, variables that are not captured by observed recruit characteristics.

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APPENDIX

PROBIT REGRESSION RESULTS

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PROBIT REGRESSION RESULTS

Tables A-1 through A-3 detail the coefficient estimates for the three success indicators for each of the three samples. As the Chi-square values suggest, recruit characteristics significantly affect the success different recruits have with the Navy. The coefficients, as evidenced by their standard errors, are estimated and the results are consistent across the three samples.

To calculate the probabilities estimated from probit regressions, one first multiplies the probit coefficient vector by the vector of desired characteristics to obtain the z score:

$$z = \sum_i B_i X_i \ ,$$

where the X is a vector of the variable values (including the constant) and B is the probit coefficient vector.

To obtain the predicted "probability" of the event, a normal distribution table is required. The estimated probability is the area under the normal curve to the left of the z score.

To obtain slope values (changes in estimated probabilities) for recruits of a specified type, the probit coefficients need to be multiplied by the value of the ordinate of the normal density at the calculated z score. For example, the slope of the conditional mean function is derived by multiplying the probit coefficient vector by the sample mean characteristic vector to obtain the z score for the mean of the sample. The slope values at the mean are obtained by multiplying the ordinate of the normal density at that z score by the estimated probit coefficients.

THE PREDICTIVE POWER OF PROBIT EQUATIONS

A somewhat different question, one not addressed directly by the Chi-square statistic, is how well the probit equation can classify recruits as successful or not. One approach is to compare the predictive power of these equations with a "naive prediction method." A "naive prediction" that used only the aggregate sample characteristics would predict the dominant choice for all observations. Thus, if 80 percent of the sample completes the first enlistment term, a naive prediction would be that each individual would complete the term. Such a prediction would have an 80-percent classification success rate. In brief, the naive prediction will always have the success rate of the proportion for the dominant choice.

The statistical program used to estimate these models, LIMDEP, calculates the prediction success of the probit equation. A success probability, based on the estimated equation, is calculated for each individual in the sample. If the calculated probability is greater than or equal to .5, the equation is (arbitrarily) assumed to have predicted a "1" for this individual. (Calculated

probabilities less than .5 are given predictions of "0".) An example of the outcome of this procedure for the MOS45E4 equation for the first sample is given below.

Actual value	Predicted value	
	0	1
0	1,245	1,470
1	775	2,622

Note that the equation correctly predicts 63 percent of the observations (1,245 + 2,622/6,112), whereas the naive prediction method would predict 56 percent (56 percent is the sample proportion of the dominant choice).

Tables A-1 through A-3 report each equation's prediction rate. All of the models estimated for completion of the first-term enlistment (tables A-1 and A-2) provide better predictions than the naive method. This finding is not guaranteed even with probit models that have significant Chi-square values, as table A-3 suggests. The dominant retention choice is to leave the Navy, and thus the naive classification method that would classify all recruits as potential nonretained personnel would successfully classify 65 percent of the observations for the first two samples and 64 percent for the last sample. These classification success rates are the same as those obtained from the equation.

Table A-1. Probit regression results: completion of enlistment (45 months)

Variable	Sample 1	Sample 2	Sample 3
HSDG age ≥ 19	−.023 (0.040)	−.001 (0.041)	−.017 (0.043)
HSDG I-IIIA	.156 (0.043)	.064 (0.044)	.185 (0.045)
NON-GRAD I-IIIA	−.383 (0.054)	−.407 (0.055)	−.376 (0.057)
NON-GRAD IIIB-IV	−.493 (0.077)	−.606 (0.075)	−.630 (0.077)
GED	−.250 (0.061)	−.251 (0.063)	−.271 (0.066)
DEP	.169 (0.042)	.138 (0.044)	.093 (0.045)
DEP months	.021 (0.005)	.021 (0.006)	.036 (0.007)
Black	.071 (0.048)	.060 (0.047)	.193 (0.049)
Hispanic	.188 (0.090)	.243 (0.091)	.107 (0.090)
GENDET	−.120 (0.038)	−.140 (0.039)	−.136 (0.040)
Constant	.332 (0.054)	.415 (0.056)	.327 (0.058)
χ^2	426.85	375.94	471.11
Sample size	6,112	5,902	5,705
Percent that complete enlistment	64	65	65
Percent that equation predicts in the correct category[a]	67	66	68

NOTE: The numbers in parentheses are standard errors.

a. Refer to text for explanation.

Table A-2. Probit regression results: completion of enlistment at pay grade E-4

Variable	Sample 1	Sample 2	Sample 3
HSDG age ≥ 19	−.023 (0.039)	−.006 (0.040)	−.037 (0.041)
HSDG I-IIIA	.223 (0.041)	.141 (0.042)	.212 (0.043)
NON-GRAD I-IIIA	−.384 (0.054)	−.346 (0.054)	−.383 (0.057)
NON-GRAD IIIB-IV	−.587 (0.079)	−.611 (0.076)	−.650 (0.079)
GED	−.265 (0.061)	−.256 (0.063)	−.243 (0.066)
DEP	.196 (0.042)	.212 (0.042)	.115 (0.045)
DEP months	.011 (0.005)	.013 (0.005)	.031 (0.006)
Black	.052 (0.047)	.076 (0.046)	.148 (0.047)
Hispanic	.121 (0.087)	.243 (0.087)	.125 (0.087)
GENDET	−.217 (0.037)	−.203 (0.038)	−.215 (0.039)
Constant	.126 (0.053)	.119 (0.054)	.132 (0.057)
x^2	507.11	446.02	523.53
Sample size	6,112	5,902	5,705
Percent that complete enlistment at E-4	56	56	56
Percent that equation predicts in the correct category[a]	63	63	64

NOTE: The numbers in parentheses are standard errors.

a. Refer to text for explanation.

Table A-3. Probit regression results: completion of 51 months of service (requires extension of reenlistment

Variable	Sample 1	Sample 2	Sample 3
HSDG age ≥ 19	.042 (0.039)	.088 (0.040)	.108 (0.041)
HSDG I-IIIA	.122 (0.041)	.045 (0.042)	.137 (0.042)
NON-GRAD I-IIIA	−.257 (0.057)	−.145 (0.057)	−.103 (0.060)
NON-GRAD	−.238 (0.082)	−.325 (0.081)	−.272 (0.083)
GED	−.225 (0.067)	−.076 (0.066)	−.089 (0.070)
DEP	.050 (0.043)	.048 (0.044)	.034 (0.045)
DEP months	.016 (0.005)	.021 (0.005)	.020 (0.006)
Black	.273 (0.047)	.344 (0.046)	.406 (0.047)
Hispanic	.025 (0.086)	.252 (0.085)	.003 (0.089)
GENDET	−.100 (0.038)	−.073 (0.039)	−.137 (0.039)
Constant	−.455 (0.054)	−.511 (0.055)	−.501 (0.058)
x^2	223.84	189.33	227.74
Sample size	6,112	5,902	5,705
Percent that complete 51 months of service	35	35	36
Percent that equation predicts in the correct category[a]	65	65	64

NOTE: The numbers in parentheses are standard errors.

a. Refer to text for explanation.