PREDICTING ATTRITION IN THE ARMY INITIAL ENTRY ROTARY WING COURSE

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Selection testing for Army flight training goes back to the days of the Army Air Force in World War II and the august crew of psychologists who were called upon to serve their country in time of war. A group including J. C. Flanagan, Neal Miller, Paul Fitts, Edwin Fleishman, Arthur Melton and others launched their successful careers developing tests and measures to select and classify aviators. The Flight Aptitude Selection Test (FAST), which is currently in operational use, has its development (and a few of its items) directly traceable to that research effort undertaken during World War II. Parenthetically, we can note that a few of the aforementioned psychologists are also currently in operational use.

Selection procedures, especially those rooted in antiquity, benefit from an occasional reevaluation and/or revalidation since there are periodic changes in the flight training curriculum and also drifts in the qualifications of the applicant pool. Since the initial development of the Army Air Forces Qualifying Examination (AAFQE) in 1942, the Army has developed the helicopter as a tactical vehicle and weapons platform. In addition, the Army has initiated the aviation warrant officer training program recently heralded in TV spots offering "High school to flight school" training' Thus, our research program at ARI continuously evaluates the selection, mission assignment and training of both commissioned and warrant officer aviators. The Aviation Center's 36 week Initial Entry Rotary Wing (IERW) training course graduates combat ready aviators who have been tactically trained in either the Aeroscout or Utility mission. This paper reviews recent research aimed at optimizing selection in order to minimize attrition in IERW training.

Historically, selection of Army aviators began with the efforts of COL Flanagan's group during WWII. Their AAFQE reduced the attrition rate from 75% with unselected trainees to 35% (Davis, 1947). In the current IERW program, attrition is approximately 7.2% for commissioned officers with about 50% of that attrition occurring because of flight deficiencies. Among the Warrant Officer Candidates (WOCs), overall attrition is approximately 20.5% with 14% of that attrition related to flight deficiencies. Part of the discrepancy in flight deficiency attrition rates relates to the fact that commissioned officers have been through officer development training before coming to the IERW training program, whereas the first 6 weeks of the WOC training program is Warrant Officer Candidate Military Development (WOCMD) training. Thus, over half of the WOC eliminees have attrited before flight training begins. However, the WOC attrition rate, looking only at individuals who have successfully completed WOCMD, is still 15.6%, double the rate for commissioned officers. Although these attrition rates are rather low vis a vis other flight training programs, with IERW training costs running approximately $125,000 per student, there is continuing interest at Fort Rucker in minimizing attrition and optimizing selection.

METHOD

In FY 82, the present authors reviewed the causes and correlates of attrition in the IERW course for all trainees in FY 80 and the first half of FY 81

(Dohme, Brown and Sanders, 1982). In all, the training records of 3,293 flight students were reviewed; 1,108 commissioned officers and 2,185 WOCs. Each student's progress through the course was tracked (including medical or administrative leave time and "turnbacks" to an earlier training class) until either graduation or elimination. Eliminations were analyzed in terms of the stated reason for the elimination, the training phase during which elimination occurred, the incidence of single or multiple turnbacks, and the race of the eliminee. These analyses did not shed much light on the attrition process except in showing no clear differences between black and white eliminees.

Training records were searched for variables that might be predictive of IERW training performance. Since the FAST and the General Technical (GT) subtest from the Armed Services Vocational Aptitude Battery (ASVAB) are prerequisites for application to flight training, they were obvious candidates for predicting graduation/elimination. Other potential predictors included in the analysis were the Skills Technical (ST) subtest from the ASVAB, age at the time of IERW course matriculation, and amount of formal education (where 12 years equates to a high school diploma).

The predictor variables were related to the criterion variable individually (using biserial correlation) and in combination (using discriminant analysis). Two methodological limitations should be noted in this approach. First, the GT and FAST scores have been used administratively to screen the individuals who enter flight training. This reduces the range of observed scores on the GT to approximately the top 35% of the population and on the FAST, to approximately the top 50% of the WOC population and the top 92% of the officer population.* In addition, the criterion measure reflects components other than the individual's ability to master the flight training tasks. Overall, 26.5% of officer and WOC eliminations are related to flight deficiencies while the remainder are related to medical problems, administrative problems (such as illness in the family), resignation and lack of military development.

RESULTS AND DISCUSSION

Figure 1 presents biserial correlations of the predictor variables with the criterion (graduation/elimination).

	OFFICERS		WOCs	
PREDICTOR VARIABLE	BISERIAL r	SIGNIFICANCE	BISERIAL r	SIGNIFICANCE
GT	Not Applicable		.07	NS
ST	Not Applicable		.13	$\rho<.05$
EDUCATION	.18	$\rho<.01$	-.08	NS
AGE	-.46	$\rho<.01$	-.36	$\rho<.01$
FAST	.32	$\rho<.01$	.26	$\rho<.01$

Figure 1. Biserial Correlations of Predictor Variables with Graduation/Elimination for Officers and WOCs.

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*Except for a 9-month period during FY 80 when the WOC FAST cut score was lowered from 300 to 270 corresponding to approximately the 34th percentile.

The biserial correlations are presented separately for officers and WOCs because the two groups formerly took different forms of the FAST. Presently, both applicant groups respond to the same form of the Revised FAST (RFAST) which was first fielded in mid FY 80.

Another way to consider the prediction of IERW training performance is to plot the percent of students graduating (also interpretable as the probability of graduation) as a function of scores on each predictor variable. Figures 2-7 present these data for the variables GT, ST, years of education, age at entry and FAST score for WOCs and officers.

To evaluate race as a predictor, we performed a stepwise discriminant analysis on the data to classify students as probable graduates or eliminees. After the other predictor variables were entered into the stepwise discriminant procedure, race was forced in last. The rationale was that if race adds predictive efficacy after inclusion of the traditional predictor variables, then there are performance differences associated with race that are not accounted for by the other predictors. This outcome would signal a problem with unfairness in the predictor variables and/or racial bias in the IERW training program. The F to enter values for the stepwise discriminant function coefficients are presented in Figure 8.

OFFICERS			WOCs		
VARIABLE	F TO ENTER	SIGNIFICANCE	VARIABLE	F TO ENTER	SIGNIFICANCE
AGE	22.83	$\rho<.01$	AGE	23.53	$\rho<.01$
FAST	8.31	$\rho<.01$	FAST	13.53	$\rho<.01$
EDUCATION	.12	NS	EDUCATION	9.83	$\rho<.01$
RACE	.06	NS	RACE	.25	NS
			GT	.01	NS

Figure 8. Significance of Variables Entering into the Stepwise Discriminant Analysis.

As the F values demonstrate, race is not a significant predictor. In fact, race adds virtually no information to the prediction of graduation/elimination once the other predictive relationships have been accounted for. Moreover, the univariate F ratios for race in the discriminant analysis do not reach significance. For officers, the univariate ratio is $F = .46$ ($\rho \approx .50$) and for WOCs, $F = 2.01$ ($\rho \approx .16$). Thus, race is not significantly related to IERW training performance and we may conclude there is no observed racial effect in the prediction of graduation/elimination in the IERW training program.

Figure 2 shows that the GT subtest is not an effective predictor of IERW graduation/elimination in the range plotted. Since the GT is used to screen individuals for acceptance into the flight training program, there are no scores below 110 in the trainee population. This truncation in range probably affects the predictive relationship to lower the apparent effectiveness of the GT. Figure 3 demonstrates that the ST subtest is somewhat more effective as a predictor than the GT. However, the range of scores is not as greatly restricted on the ST subtest (see Figure 3) since it is not currently used for selection. Also, the intercorrelation between the two subtests is $r = .69$. Subsequent research will evaluate the ST subtest as a selection

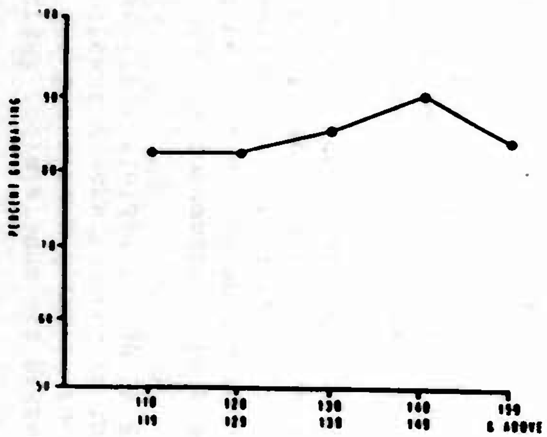

Figure 2. GT for WOCs as a Predictor of IERW Graduation/Elimination.

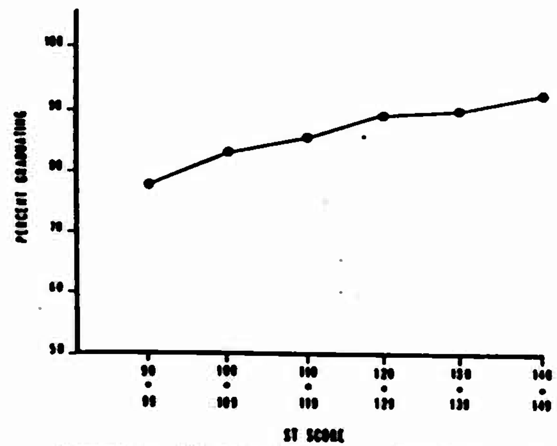

Figure 3. ST for WOCs as a Predictor of IERW Graduation/Elimination.

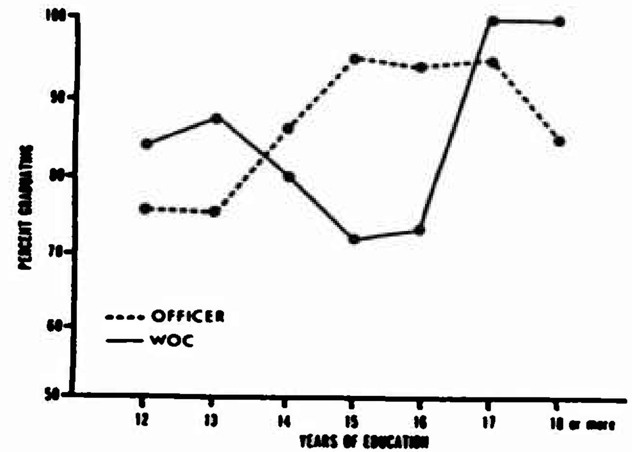

Figure 4. Education for Officers and WOCs as a Predictor of IERW Graduation/Elimination.

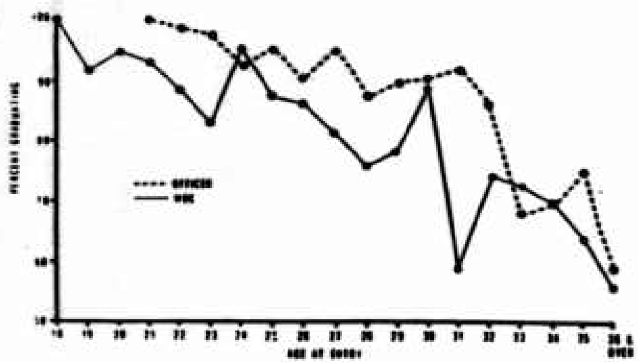

Figure 5. Age for Officers and WOCs as a Predictor of IERW Graduation/Elimination.

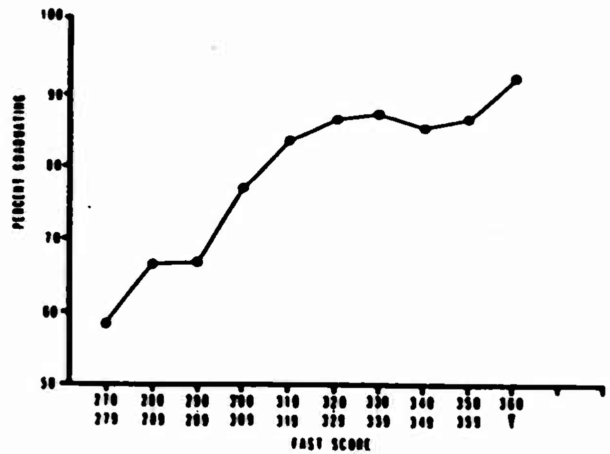

Figure 6. FAST for WOCs as a Predictor of IERW Graduation/Elimination.

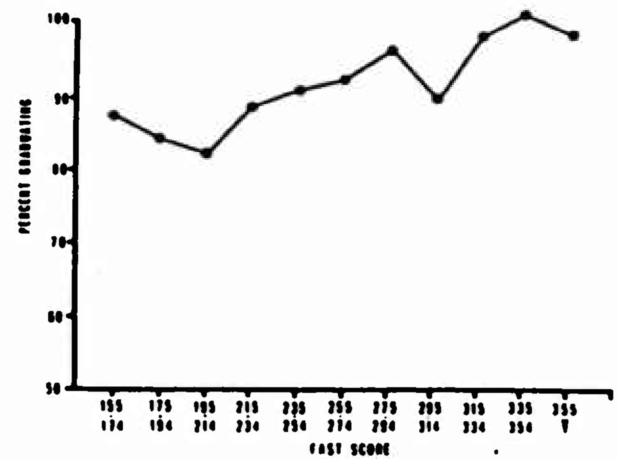

Figure 7. FAST for Officers as a Predictor of IERW Graduation/Elimination.

test to determine whether it adds to the prediction of WOC performance over and above the variance accounted for by the GT subtest.

Figure 4 shows that education has a complex relationship to the probability of graduation for WOCs and officers. Figure 1 reflects that the biserial correlation of education and the criterion is significant for officers (r = .18) but not for WOCs (r = -.08). Figure 7 shows that education adds significantly to the stepwise discriminant analysis but only for WOCs. Drawing conclusions regarding the relationship between education and graduation must be tempered by the fact that some points on the graph in Figure 4 represent very small sample sizes. For example, 7 WOCs have 17 years of education and 4 have 18. Therefore, more research should be performed to evaluate education as a predictor of graduation/elimination.

Figure 5 shows that age is closely related to the probability of graduation/elimination for both WOCs and officers. While both curves show perturbations due to the relatively small sample sizes at each age level, there is a linear trend from age 18 to 30 with an inflection downward past age 30. The biserial correlation and discriminant analysis results show that age bears a strong inverse relationship to graduation from the IERW course.

Figures 6 and 7 show the FAST as a predictor of graduation/elimination for WOC and officer students. A comparison of the 2 figures shows that the FAST is a more effective predictor for WOCs than for officers. Additionally, the WOC FAST battery is most effective as a screening test in that Figure 6 shows a steeper slope for lower scorers than for higher scorers. In other words, the FAST can identify those individuals who are greater risks in IERW flight training.

The best use of this predictor information is to combine the predictors in a stepwise fashion to optimize selection. In fact, we're currently developing a selection procedure for Warrant Officer Branch of MILPERCEN using discriminant analysis to combine the predictor scores discussed above with judgmental scores from the selection board members. The judgmental scores include fresh information in the selection algorithm such as the applicant's aviation background, military experience, and letters of recommendation. Optimal selection of applicants can be achieved by developing and cross-validating an algorithm that uses the variables discussed above as well as RFAST <u>subtest</u> scores, each with its appropriate β weight.

Recent research with the Revised FAST (RFAST) by Lockwood (1982) demonstrated greater predictive validity using the 7 subtest scores in place of the composite score. Eastman and McMullen (1978) estimated that the predictive validity for the FAST was r = .38 for WOCs and r = .44 for officers. The use of RFAST subtest scores in Lockwood's multiple regression equation raised the validity estimates to R = .42 for WOCs and R = .56 for officers for a sample of 108 student pilots. While this finding is subject to cross-validation, it suggests the utility of combining subtest scores in the optimal WOC selection algorithm. In fact, when Lockwood included the ST score along with RFAST subtest scores, the predictive validity for WOCs was raised to R = .68.

Research is currently addressing a number of related selection and assignment issues. An alternate form of the RFAST is being tested for equivalency at the current time. The RFAST has been evaluated for bias and replacement items have been developed to substitute for those found to be biased for and against minority groups. A front-end analysis has been completed identifying the abilities required to fly each of the Army helicopter missions, Aeroscout, Attack, Cargo and Utility. Work is underway to develop tests and measures that will permit differential assignment of student pilots to specific mission training as part of the IERW curriculum. At the same time, an ability analysis has been performed on the phases of IERW training where most flight deficiency attrition occurs, primary and instruments. New FAST subtests will be developed to measure these critical abilities and, hopefully, reduce attrition. Since over half the WOC attrition occurs in WOCMD, a study is being conducted to develop predictors that will identify applicants who are likely to be eliminated in that training phase. In short, we're working the problem and we think COL Flanagan would enjoy being a part of our research effort.

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