

The Efficacy of the Myers-Briggs Type Indicator (MBTI) and the Mach-V in Formulating Determinates for Pilot Candidate Selection

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ABSTRACT

Researchers in crew resource management have sought to examine the association between personality and effective team leadership in the cockpit environment. In addition, most airlines make at least a subjective effort to assess personality style and decision-making skills by placing pilot candidates through a two or three stage interview process. In an ongoing effort at Auburn University to develop a comprehensive Pilot Candidate Selection Model, the authors' purpose was to assess the MBTI and the Mach V as psychological instruments in facilitating the screening of pilot applicants through the development of a discriminate function or variant that would be both reliable and consistent. Neither of these instruments has been employed in the past to screen pilot candidates; yet they measure temperament and leadership skill and could prove useful as supporting instruments in the screening process. The Myers-Briggs Type Indicator as a construct of personality type and the Mach V scale as a construct of skill in small group manipulation were employed in the survey of ninety-eight United States Air Force officers conducted over a three-year period. Research indicates a significant relationship in success in leadership of small groups and the Mach V scores. The authors were able to derive a discriminate function that proved 93 percent accurate in identifying professional pilots from a randomly selected sample of Air Force officers. The results of this study suggest the potential of the MBTI and the Mach V as supporting instruments in the screening of commercial pilot candidates for hire. The authors recommend extending this study to the commercial air carriers by selecting a test group of flight officers with strong CRM performance in order to validate the potential of the MBTI and the Mach V as instruments potentially useful in the larger effort to identify quality pilot candidates.

THE QUEST FOR THE BEST

Commercial aviation, in particular the major air carriers, are well aware of the criticality in selecting those pilot candidates with the highest overall return on the training investment. It is expensive, and to fail means not only increased training costs and lost revenue, but the consequences of increased risk of accidents and the subsequent fallout of public perception are unacceptable.

It is not enough to "select out" those who fail to meet some arbitrary set of technical skills; the industry could benefit significantly from a low-cost screening of candidates based on a model reflecting the attitudes and temperament of those pilots reflecting the temperament and participative leadership sought.

The critical point of screening those who are not amenable to a team-oriented

environment occurs before-not after the applicant becomes an employee (Hackman, 1993). When considering the implicit costs of bringing on board pilots who lack or are resistant to development of team qualifications and operational experience. The industry has indicated the need to incorporate into selection protocol assessment of personality factors, to include attitudes related to crew coordination and effective teamwork under stressful safety of flight conditions (Chidester et al., 1991). Research suggests that pilot selection protocols may have low predictive validity and their content has remained relatively unchanged over the decades (Damos, 1995). These protocols may reflect higher predictive validity in the training regimen than in line operations (Damos, 1996).

LITIGATION INVOLVING PERSONALITY TESTING

There have been very few court challenges of airline physical and psychological hiring criteria by unsuccessful pilot applicants. The cases that do exist are instructive in that they give us, insight into the issues involved and the courts resolution of those issues.

Robinson v. American Airlines, Inc. provides an example of one hiring procedure for airline pilots. In *Robinson*, the court reviewed the American Airlines (American) pilot hiring procedures. American employed a three-phase process to consider new pilots. Phase I included an interview and physical examination. Applicants were required to satisfy all of American's Phase I requirements in order to advance to Phase II.

Phase II consisted of a comprehensive medical examination, including a personality test, additional interviews, and flight simulator testing. American rated all Phase II applicants on a scale of one to five based on the medical criterion. Only those applicants who received a rating of four or five were selected for participation in Phase III. Phase III included additional interviews and skill testing. American offered permanent positions only to those candidates who successfully completed all three phases of the process.

Little doubt exists that physical and psychological fitness are necessary requirements for all airline pilots. Courts have traditionally granted airlines and other travel industries great discretion in determining policies intended to assure passenger safety. In *Robinson v. American Airlines, Inc.*, for example, the court held that an airline "is free to impose more stringent requirements" than the minimum requirements promulgated by the FAA. The court noted that American implemented the more stringent physical requirements to reduce the risk of pilot incapacitation during flight. The court found that American had therefore acted consistently with the statutory obligation to operate with its " 'highest possible degree' of care." In *Murnane v. American Airlines, Inc.* the

court stated, "The airline industry must be accorded great leeway and discretion in determining the manner in which it may be operated most safely." The court refused to substitute its judgment for that of the airline " in a cause presenting safety as the critical element." The court noted that safe is not sufficient for the passenger who expects the safest possible airline service.

It is beyond the scope of this article to delve deeply into the legal aspects of personality testing and pre-employment screening of airline pilot applicants. As long as the airlines employ their screening tools across the board in an unbiased manner, it appears the courts will generally uphold the right of the airlines to set the hiring criteria they feel is most appropriate and in the best interest of passenger safety. In order to provide the highest degree of safety airlines frequently set more stringent physical and psychological standards for their pilots than the FAA requires. Use of the MBTI and Mach V should not present a legal problem; use of psychological testing has been tested successfully in the courts.

RESEARCH QUESTIONS

Given the criticism of current pilot selection protocols, little research has been undertaken to improve them prior to the decision to interview and administer the typical phased selection process. This research aims at providing the first step to screening candidates based on a model reflecting the personality and leadership temperament of those pilots the carrier identifies as optimum. To explore improvements in the initial screening of applicants for interview, the following research questions were raised:

1. Is there an identifiable personality and leadership temperament associated with those pilots a carrier deems most successful in crew coordination and performance under stress?
2. Given such a temperament, do there exist instruments with the discriminatory power to "select out" those applicants who do not meet the

personality and leadership temperament profile of the select pilot group?

METHODOLOGY

Because of its extensive use and well-established population norms, we chose the Myers-Briggs Type Indicator (MBTI) as the instrument to evaluate in identifying personality temperament. To augment the MBTI in measuring strength of leadership in informal, small groups, we chose Christie and Geis's Mach V scale. Our purpose in this study was to assess the MBTI as a psychological instrument in facilitating the screening of pilot applicants through the development of a discriminant function or variant that would be both reliable and consistent. The Kiersey version of the MBTI was employed because of its ease in administration in the field (Kiersey, 1998). Included as well was the Mach V instrument because of its strong correlation to effective leadership in informal, small groups—an obvious attribute sought in crew resource management. A two-group discriminant analysis was conducted using data collected on United States Air Force company grade and field grade officers.

Psychological Type

The Myers-Briggs Type Indicator (MBTI) is a self-reporting, psychological instrument designed to categorize individuals based on their preferences in four areas: where people obtain their energy (internally or externally), how people perceive their surroundings (denotative or intuitive), the approach to decision making (rational or value oriented), and the approach employed in assessing their environment (judging or perceiving)

Based on Carl Jung's research, Isabel Briggs Myers and Katherine Briggs developed the MBTI instrument, adding an aspect that deals with an individual's lifestyle choices. The self-reporting and self-validating accomplished with the MBTI sorts people into four categories. The first category is extraversion or introversion. The person who indicates a preference for

extraversion is one whose energy is directed outward and prefers to interact with people and things. A person who indicates a preference for introversion is one whose energy is directed inward and prefers concepts and ideas. For example, an extrovert might "speak before he or she thinks" and an introvert would probably "think before speaking." The second category is that of perceiving or data collection (sensing or intuition). Those who prefer sensing rely on actual data and pay attention to details. Those who prefer intuition rely on inspiration and look at the "big picture." The third category addresses the decision-making process that people use. Those who prefer thinking make their decision emphasizing logic and principles. Conversely, those who prefer feeling rest their decisions on human values and harmonious relationships. The fourth category addresses lifestyle. In this category people indicate their preferred and most often used mental preference (judging or perceiving). (Nelson and Quick, 2002). Those who prefer judging indicate decisiveness and task or project completion are important. Those who prefer perception indicate that curiosity and starting a task or project is of higher value. Among military officers, over 80 percent fall into two of sixteen categories: ESTJ and ENTJ. There is a dominant category for any generic job classification or profession. Our interest is in the dominant category for successful, professional pilots. Their scoring on the MBTI or another suitable temperament measurement might aid in developing a discriminant function that would serve to screen professional pilot applicants for hire.

Machiavellianism

Machiavelli's The Prince and The Discourses, in the view of many researchers who study organizational power in administration in both public and private sectors, see these works as viable guides to success. Jay (1967) considers present-day management as but a continuation of the character of administration exercised by the renaissance Italian city-states reflecting Machiavellian tenets as crucial to modern leadership. Machiavelli used inductive reasoning and empirical evidence based on his own experiences in formulating his precepts for

organizational power (Jay, 1967). Today the public generally associates the terms power and manipulation with the name of Machiavelli.

Moskop (1985) identifies The Prince as a treatise on war and the exercise of power in a public setting. In his assessment, Machiavellian principles are practical since they view things as they are rather than as they should be. According to Calhoon (1969), Machiavelli continuously proclaims that man does not act as he says he acts. In present-day management, the term “Machiavellian” is not the pejorative term that most would assume. Most formal leaders in modern organizations use Machiavelli’s espoused tactics—those proven actions needed to seize power and control others’ behavior. He points out that the “prevailing connotation of ‘Machiavellian’ as a conniving, manipulative, cold-blooded means of arriving at selfish ends has completely overshadowed the need for and validity of his [Machiavelli’s] concepts” (p. 205).

Calhoon (1969) presents a case for the utility of Machiavellian actions:

“ . . . Machiavellian moves may be warranted and even necessary under many circumstances in today’s organizations. Indeed, some maneuvering in the Machiavellian cast may well be partially for the benefit of the “other” person: the long service employee who has been faithful and diligent but whose work is deteriorating may be moved to a better paying sinecure in the hope of not hurting him; the stubborn but valuable employee who blocks changes may be unobtrusively circumvented or left off committees; the sensitive, useful employee who as grievous shortcomings may be beguiled into taking an assistant whose work will be complementing.” (p. 212)

Christie and Geis (1970) presented Machiavellianism as the concept of interpersonal behavior. A Machiavel is defined as one who manipulates others for personal purposes. Christie and Geis termed their ideal model a “Machiavel. Calhoon (1969) employs this model and its characterization and further asserts that a Machiavel uses manipulation and

exploitation to achieve organizational goals via the emotions—the welfare of others become secondarily important.

To measure Machiavellian orientation, Christie and Geis (1970) designed and developed the Mach IV and Mach V inventories. The Mach V differs from version IV in that it employs a forced triadic response format that greatly reduces the tendency for a respondent to answer in a socially desirable way. According to Christie and Geis, the contrast between a high and low Mach is the degree of freedom from emotional attachment. One with a high Machiavellian orientation:

1. would not be concerned with conventional morality;
2. would conduct oneself emotionally detached from others with the view that personal involvement would limit the ability of one to treat people as objects;
3. would be concerned primarily with ends rather than means—manipulating others would be a prerequisite for achieving goals; and,
4. would be in full control of faculties, able to assess rationally one’s relationship to the psychological environment—neither pathologically disturbed nor possessing a psychosis or neurosis. (p. 312)

In their study of 64 college students, Geis and Moon (1981) reported that high Machs who lie are believed more than low Machs who lie. Epstein (1969) observed that opinions from group members change during a role-playing study. He observed high Machs’ opinions changing only after strong arguments were presented, whereas low Machs change opinions with greater frequency than high Machs.

Oksenberg (1968) observed that, in the formation phase of groups, high Machs tend to

emerge as the “key player” or “key man” more so than low Machs; hence, high Machs more frequently guide and direct group planning. This earlier stage of group formation when planning plays a more prominent role, presents a greater opportunity to improvise—a situation tailored to Machiavellian orientation as described by Christie. Desfosses (1971) supports these findings by observing that high Machs exhibit greater detachment from emotions and thus are able to make decisions more effectively and to resist altering opinion after being subjected to counter-argument. Likewise, Koenig (1980) observed that Machiavels were more effective than low Machs in controlling the views of low Machs when conducting group planning activities in initial stages when the environment is less structured.

In attempting to answer the question “how much do high and low Machs exercise manipulation,” Christie and Geis (1970) studied people in a laboratory setting where game simulations were conducted. They found that high Machs consistently manipulated more regardless of whether the circumstances were ambiguous or unambiguous. Christie and Geis assert that high Machs are able to assess the weaknesses of people better than low Machs and, thus, are able to capitalize on their weaknesses. This, coupled with a greater insensitivity to people, enables the high Machs to pursue personal goals more effectively.

How does Machiavellianism relate to cognitive dissonance? Epstein (1969) observed that low Machs had difficulties with dissonance traced to higher personal involvement in beliefs whereas high Machs are able to remain detached from personal beliefs and attitudes. Bogart (1968) observed that high Machs were able to rise above dissonant behavior because of the high Machs’ more practical approach to problem solving.

High Machs appear to bargain more effectively in achieving what they want. Lake (1967) noted that high Machs were much more aggressive in bargaining, anticipated others to be more aggressive, and were more prone than low Machs to counter aggression with aggression.

Rim (1966) observed that high Machs were inclined to be more risk-oriented in their efforts to influence group decision-making.

In studying Machiavellianism among managers, Gemmill and Heisler (1972) observed that high Machs reflected more job strengths, less satisfaction with their job, and less opportunity for control. They conclude that high Machs in bureaucratic environments become frustrated because of the lack of opportunity to influence and manipulate the organization. In addition, Gemmill and Heisler (1972) assert that subordinates are more likely to have a negative view of supervisors who are high Machs. However, high Machs seem to be little affected by negative feedback from subordinates and peers.

In their assessment of studies of Machiavellianism, Christie and Geis (1970) conclude that those who score higher on the Mach IV and Mach V scales

“ . . . manipulate more, win more, and are persuaded less, persuade others more, and otherwise differ significantly from low Machs as predicted in situations in which subjects interact face-to-face with others, when the situation provides latitude for improvisation, and the subject must initiate responses.” (pp. 312-313)

According to Christie and Geis (1970), research indicates that low Machs are more effective in highly structured situations where roles and rewards are well defined as well as the methods to achieve goals. In contrast, the high Mach would be more effective in a more loosely structured environment where he or she is able to improvise and select the means to achieve goals.

Both experimental and correlational studies suggest that a person’s Machiavellian orientation impacts on personal behavior—specifically, in the behavioral patterns in small group settings and the relative success in exercising referent power and leadership.

Procedure

For Group 1 (G1), the population consisted of professional Air Force pilot officers participating in a Department of Defense (DoD) voluntary education graduate program in Europe and Pacific theaters of operation. Group 2 were comprised of non-pilot Air Force officers participating in the DoD graduate program. The sampling consisted exclusively of company and field grade officers over a two-year period from 1999 to 2000.

Permission to conduct the study was obtained from the Director of Advanced Programs, University of Oklahoma. The respondents completed the questionnaires in confidence and were guaranteed anonymity regarding the results. Each respondent participating in the study voluntarily submitted data pertaining to MBTI classification. Similarly, the respondents completed the Mach V questionnaires in confidence with anonymity guaranteed; in addition, the authors were also able to collect MBTI surveys using the 1998 Keirsey version of the scale.

Instrumentation

For Groups 1 and 2, quantitative data were collected using the 1998 Keirsey MBTI inventory. The Keirsey instrument is a seventy-item, dyadic, forced-response survey instrument based on the original Myers-Briggs Type Indicator. Professor David Keirsey has investigated personality differences so as to refine his theory of the four temperaments identified in the Myers-Briggs research, and to define the aspects of character that differentiate one from another. His efforts have resulted in his version of the MBTI, The Keirsey Temperament Sorter II, which provides a perspective of how the temperaments differ in the intelligent roles they are likely to develop (Keirsey, 1998).

Both the Mach IV and Mach V attitude inventories are derived from the Mach II attitude inventory presented in Likert format to 1,196 college undergraduates in three different universities (Christie and Geis, p. 10).

Conducting a factor analysis, Christie and Geis selected 20 of the most effective items of the Mach II inventory for further research and analysis. Half of these 20 items were structured so that agreement with them was scored in a positive direction while the other half were reversed so that disagreement with them was scored in a negative direction. The resulting revised 20-item inventory was designated the Mach IV attitude inventory by addressing the possibility of respondents answering in socially desirable way, Christie and Geis developed the Mach V attitude inventory, a forced response, triadic questionnaire whose scores “reflect the willingness of respondents to agree with Machiavelli when their tendency to agree with socially undesirable statements is removed.” (p.30).

Both the Mach IV and Mach V attitude inventories consist of 20 questions that address the nature of interpersonal tactics, view of human nature, and conventional morality. The Mach IV attitude inventory is a Likert-type questionnaire whose items allow the respondent to answer based upon levels of disagreement or agreement; in contrast, the Mach V contains a force choice pattern that forces the respondent to avoid biasing the selected answer by seeking a socially desirable answer. Contained in each triad of statements is the variable the scale is designed to measure. Included in the triad is another answer similar to the variable statement in social desirability and the third statement included in the triad is designated as a buffer statement that is the antithesis of the other two statements in social desirability (Christie and Geis, 1970). The respondent is directed to pick the statement that is the most accurate in describing personal beliefs and the answer that is the least descriptive of personal beliefs. The Mach V was selected for surveying both Groups 1 and 2 because of the social desirability bias present in the Mach IV instrument.

Data Collection and Statistical Analysis

Data were collected via a demographic survey, the 1998 Keirsey version of the MBTI and the Mach V attitude inventory. Discriminate analysis was employed using a

discriminant procedure to identify a linear combination of quantitative predictor variables that best characterizes the differences among the groups. The quantitative predictor variables consisted of the four MBTI dimensions: (1) Extroversion-introversion, (2) Intuiting-Sensing, (3) Thinking-feeling; and (4) Judging-perceiving, and the three Machiavellian variables: (1) Conventional morality, (2) Interpersonal tactics, and (3) View of people as resources.

To derive the discriminant function (Variate), we first selected the method of estimation for assessing a singular variant given two groups. The number of observations or cases classified into the correct group evaluated the predictive accuracy. A number of criteria were available to determine whether the classification achieved practical or statistical significance. The discriminant function sums the products of the variables multiplied by beta coefficients. The procedure estimates the coefficients and the resulting function can be used to classify new cases (or, as in our proposed employment of the technique, to identify pilot candidates for hire). The classification of pilot candidates using this function would be based on the temperament and leadership styles of successful professional pilots currently serving.

Computational Method

The Variant was computed so that the predictor variables could be considered concurrently; hence, the Variant was computed based on the entire set of predictor variables regardless of the discriminating power of each predictor variable. This approach was deemed appropriate since we wanted to evaluate each dimension of the complete personality and Machiavellian orientation instruments. Our focus on the MBTI and Mach V instruments is based on research that shows successful leaders in informal group settings reflect a specific personality type and Machiavellian orientation different from the general adult population. (Keirsey, 1998; Christie and Geis, 1970) The average profile of the successful informal group leader would reflect either an ENTJ or ESTJ MBTI category, and a Machiavellian orientation

significantly above that of the general adult population norm.

Statistical Significance

After computing the Variant, we assessed the level of significance by calculating Wilks' Lambda in order to evaluate the statistical significance of the discriminatory power of the Variant. We used the conventional criterion of .05 with the view that if the Variant were not significant at or beyond the .05 level, there would be little justification for retaining the variant. Ninety-eight cases were used in this analysis.

Figure 1 - Group Statistics

Group Designation	Mean	Std. Deviation	Valid N (listwise)	
			Un-weighted	Weighted
One (Pilot)				
Var1 [EI]	5.1935	1.8694	31	31
Var2 [NS]	12.4516	3.1606		
Var3 [TF]	13.5484	3.0314		
Var4 [JP]	15.1290	2.8489		
Var5 [VIEWS]	35.6129	3.7388		
Var6	40.7097	3.5795		
[TACTICS]	9.1613	2.7700		
Var7 [MORALITY]				
Two (Non-pilot)				
Var1 [EI]	4.9254	1.6173	67	67
Var2 [NS]	6.5672	2.7819		
Var3 [TF]	9.6269	2.9120		
Var4 [JP]	10.4776	2.1416		
Var5 [VIEWS]	38.8358	2.9418		
Var6	36.3731	2.5216		
[TACTICS]	6.6269	2.7015		
Var7 [MORALITY]				

By examining the sample means in Figure 1, differences between pilots (Group 1) and non-pilot officers (Group 2) are noted.

Figure 2 - Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
E-I	.995	.527	1	96	.359
N-S	.525	86.964	1	96	.000
T-F	.719	37.456	1	96	.000
J-P	.544	80.594	1	96	.000
VIEW	.818	21.336	1	96	.000
TACT	.669	47.586	1	96	.000
CONV	.839	18.359	1	96	.000

The F statistics and significance values in columns three and six are calculated from a one-way ANOVA computed for each variable. The F statistic equates to the square of the *t* statistic for a two-sample pooled variances *t* test. Wilks' Lambda indicates differences among groups. The discriminatory value of the MBTI E/I axis appears nil. Based on Wilks' Lambda, the remaining variables are reasonable candidates for inclusion in the discriminant function.

Figure 3 - Classification Function Coefficients

	CATEGORY	
	Group One	Group Two
Extroversion-Introversion [EI]	1.579	1.162
Intuiting-Sensing [NS]	1.574	.984
Thinking-Feeling [TF]	.661	.473
Judging-Perceiving [JP]	1.277	.657
Machiavellian Views [VIEW]	2.873	3.279
Machiavellian Tactics [TACT]	4.378	3.872
Disregard for Conventional Morality [CONV]	.542	.356
(Constant)	-171.486	-147.762

The classification functions shown above allow the calculation of Fisher's linear discriminant function by taking the difference between the coefficients of the non-pilot and pilot classification functions:

Figure 4 – Eigenvalue

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
	2.469	100.0	100.0	.884

The Eigenvalue is the ratio of the between-groups sum of squares to the within-groups or error sum of squares. The percentage of variance and cumulative percentage of variance are always 100% for a two-group model such as we have presented. The magnitude of the Eigenvalue indicates strong differentiation between the groups based on the cases used in this study. If the pilot cases in this study proved to be representative of the Cockpit Resource management (CRM) standard sought for hire, this specific discriminant function would be useful for current use in pilot selection.

Figure 5 - Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.288	115.045	7	.000

Wilks' lambda is the proportion of the total variance in the discriminant scores not explained by differences between the two groups; in our study, about 29 percent of the variance is not explained by group differences. We used Wilks' Lambda to test the null hypothesis that the means of the variables across the two groups are equal and present little benefit regarding the success of the discriminant function for classifying cases (selecting pilot candidates). In this study, that null hypothesis is rejected. By transforming Lambda to a variable with a chi-square distribution, we are able to assess whether there is a significant difference between the two group centroids. With a chi-square of 115, we confirm a significant difference between the two group centroids (the means of the seven variables calculated simultaneously).

Figure 6 - Standardized Canonical Discriminant Function Coefficients

Predictor Variables	Function
	1
Extroversion-Introversion [EI]	.212
Intuiting-Sensing [NS]	.513
Thinking-Feeling [TF]	.166
Judging-Perceiving [JP]	.442
Machiavellian Views [VIEW]	-.390
Machiavellian Tactics [TACT]	.438
Disregard for Conventional Morality [CONV]	.151

Because the predictor variables have different ranges, we elected to examine the coefficients after they have been standardized. Doing so allows us to determine those variables having the greatest effect on the model. NS, JP, and TACT appear to discriminate the most in sorting pilot candidates.

Figure 7 - Structure Matrix

Predictor Variables	Function
	1
Intuiting-Sensing [NS]	.606
Judging-Perceiving [JP]	.583
Machiavellian Tactics [TACT]	.448
Thinking-Feeling [TF]	.398
Machiavellian Views [VIEW]	-.300
Disregard for Conventional Morality [CONV]	.278

Extroversion-Introversion [EI]	.047
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The structure Matrix shows the pooled within-groups correlations between discriminating variables and the standardized canonical discriminant function. Variables are ordered by absolute size of correlation within the function.

Figure 8 - Functions at Group Centroids

Category	Function
	1
Group One	2.286
Group Two	-1.058

Within-group means are computed for each canonical variable, in our study with two categorical groups, the means for our seven-variable model are -1.259 and 2.270. Figure 8 shows the unstandardized canonical discriminant function evaluated at the group means. Using the function coefficients shown in Figure 3,

$$Z = (1.579-1.162)[EI] + (1.574-.984)[NS] + (0.661-0.473)[TF] + (1.277-.657)[JP] + (2.873-3.279)[VIEW] + (4.378 - 3.872)[TACT] + (0.542-0.356)[CONV].$$

Hence,

$$Z = (0.417)[EI] + (0.590)[NS] + (0.188)[TF] + (0.620)[JP] - (0.406)[VIEW] + (0.506)[TACT] + (0.186)[CONV].$$

Since the two groups are not of equal size and are assumed to be representative of the population of Air Force officers, a weighted average of the group centroids provides a weighted optimal cutting, calculated as follows:

$$Z_{CU} = (N_1Z_1 + N_2Z_2) / (N_1 + N_2)^{-1}$$

Where

Z_{CU} = Critical Cutting score value for unequal group sizes

- N_1 = number in Group 1
- N_2 = number in Group 2
- Z_1 = Centroid for Group 1
- Z_2 = Centroid for Group 2

The resulting critical cutting score for our sample of active duty Air Force officers:

$$Z_{CV} = [(31)(2.286) + (67)(-1.058)] [98]^{-1} = (-20.000)(10)^{-3} = -0.0200$$

Figure 9 below shows the Variant's predictive ability to discriminate between the two groups. The usefulness of the classification matrix procedure is demonstrated by relating it to the concept of an R^2 in regression analysis. With discriminant analysis, the hit ratio (percentage correctly classified) is analogous to regression's R^2 . It reveals how well the discriminant function (Variant) classified the statistical units.

Figure 9 – Classification Results

		Variable 8 (Categorical)	Predicted Group Membership		Total
			Group 1	Group 2	
Original	Count	1	29	2	31
		2	0	67	67
	Hit Ratio	1	93.5	6.5	100
		2	0	100	100
Cross-validated	Count	1	29	2	31
		2	0	67	67
	Hit Ratio	1	93.5	6.5	100
		2	0	100	100

Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case. With discriminant analysis's tendency to overstate the hit ratio if evaluated only on the analysis sample, cross-validation was deemed necessary. The results of cross-validation still show a hit ratio of 98 percent of the grouped cases correctly classified. We can be reasonably confident that we have a Variant with excellent discriminatory power.

CONCLUSIONS AND RECOMMENDATIONS

This study sought to predict the pilot status of Air Force officers through the use of discriminant analysis. The resulting Variant or discriminate function reflects strong discriminate power in identifying those individuals who are Air Force pilots from their non-flying counterparts in the officer corps. The results also suggest that multiple discriminant analysis could prove useful in screening applicants based on a consensus model of pilot personality and leadership temperament. The air carrier would designate a select group of pilots who have established a record of successful group leadership during line-oriented flight training and leadership exercised during actual emergencies in-flight. A second group would be formed by randomly sampling the remaining pilot force. The MBTI and the Mach V would be administered to the respective groups and the resulting predictor variables would establish the discriminant function or variant to calculate the appropriate cut score for applicants.

How this process would fit into the overall selection process is arguable. Clearly, employing discriminant analysis could prove useful in a later phase after applicants have been screened for technical skills, operational experience, and preliminary medical evaluation. The result would increase the likelihood of hiring competent pilots receptive to crew-coordination training and improved performance on the line.

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