NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
51 HOVEY ROAD, PENSACOLA, FL 32508-1046

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AN EVALUATION OF PERSONALITY TESTING AND THE FIVE-FACTOR MODEL IN THE SELECTION OF LANDING CRAFT AIR CUSHION VEHICLE CREW MEMBERS

D. R. Street, Jr., K. T. Helton, and T. Nontasak

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A. J. MATECZUN, CAPT, MC USN
Commanding Officer

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ABSTRACT

The purpose of our investigation was to determine if personality testing and a five-factor model could improve the selection of Landing Craft Air Cushion (LCAC) vehicle crew members. Vehicle crew members for the LCAC are currently selected by their performance on a computer-based psychomotor selection system. The various psychomotor tests in the selection system have demonstrated predictive validity in LCAC crew training. Certain personality characteristics may also be involved in the LCAC vehicle crew training success. In fact, various researchers have found that personality testing may improve the selection of Navy/Marine Corps aviators. Increasing evidence indicates that a five-factor model may be useful in describing the personality characteristics involved in training success. We believe that a five-factor model may improve the selection system used for LCAC vehicle crew members. A principal component analysis with varimax rotation was conducted to determine the underlying structure of the Adult Personality Inventory with 168 LCAC crew candidates. The resulting factor scores were then statistically analyzed to determine the relation of the personality factor scores and the performance-based test to an underway grade in training criterion. The results indicated that one personality factor, openness, significantly improved predictions of the criterion ($p < 0.05$). Based on these results, we believe that personality testing would improve the selection of LCAC vehicle crew members.

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INTRODUCTION

The Landing Craft Air Cushion (LCAC) vehicle is an amphibious warfare vessel. It is designed to transport weapons, armored vehicles, equipment, and personnel from assault ships off shore to and from inland dispersal points. This capability reduces the risk to larger assault transports while improving the reach of amphibious operations. The LCAC's high-speed capability and maneuverability are unlike any other surface combatant vessel in the U.S. Navy. In fact, the handling and cockpit control features of the LCAC closely resemble those of an aircraft (Dolgin, Street, Nontasak, Blower, & Travis, 1992). Responding to the needs of the Navy to reduce a high attrition rate among LCAC trainees, researchers at the Naval Aerospace Medical Research Laboratory (NAMRL) developed and validated an LCAC personnel selection system. The system was based on computerized aviator testing procedures, a rigorous physical examination, and a variety of personality tests. The resulting system, the LCAC crew selection system (LCSS), was operationally implemented in 1990. Implementation of the LCSS resulted in a substantial reduction in training attrition (Dolgin et al., 1992). Currently, selection of physically qualified LCAC crew candidates is based on the results of several tests of psychomotor coordination, decision making, and complex time-sharing ability. The various skills assessed by these tests have demonstrated validity in the prediction of success or failure in primary LCAC crew training (Dolgin et al., 1992).

The LCSS was initially developed to cover a broad spectrum of potentially important dimensions besides individual skill and ability (Dolgin et al., 1992). Specifically, the LCSS battery includes a personality test and a biographical inventory to assess personal traits and individual experience. The contribution of these measures has not been previously investigated, although other investigations have supported their value. For example, certain personality and motivational tests have been shown to improve pilot selection and training predictions (Helmreich, 1982). Street, Helton, and Dolgin (1992) found that a measure of competitiveness explained a significant amount of unique variance in predictions of success in advanced Navy/Marine Corps flight training. Davis (1989) and Picano (1991) also found personality variables useful in military aircrew selection. These results are not surprising; several authors have acknowledged the importance of personality and motivation in training success in a variety of applications (e.g., John, 1990). Other researchers have demonstrated the value of personality testing in civilian employee selection. For example, Hunter and Hunter (1984) found that personality tests could increase the overall validity of selection decisions. They also indicated that relevant personality tests may reduce adverse impact in the selection of women and minorities when compared to selection decisions based on ability measures alone (Day & Silverman, 1989; Hunter & Hunter, 1984). These results are encouraging because previous efforts to validate personality traits as predictors of job performance have often been unsuccessful (Davis, 1989; Hollenbeck & Whitener, 1988).

A large body of research indicates that personality traits can be organized into five personality dimensions that are empirically derived through grouping items, labels, subtests, or tests according to common statistical variance. In fact, Digman (1990) summarized a number of studies that found a five-factor structure across a variety of instruments. This five-factor model of personality is not a recent discovery. Over four decades ago, Fiske (1949) proposed that personality could be adequately described using five statistically derived factors. McCrae and Costa (1985) used the five factors identified by Fiske (1949) and others (e.g., Norman, 1963) as the basis of a personality model. Their five-factor model organizes traits into five broad dimensions, each representing domains of more distinct traits or behaviors (McCrae & Costa, 1989). This model describes an individual's emotional, experiential, interpersonal, and motivational styles across five broad dimensions.

The most widely recognized labels for the five factors are those proposed by McCrae and Costa (1985), which we use here: extraversion, neuroticism/emotional maturity, openness/practicality, agreeableness, and conscientiousness. An exhaustive description of these labels is beyond the scope of this paper. More detailed descriptions and discussions of the five domains are provided in McCrae and Costa (1985; 1989) and in Helton and Street (1992). Generally, individuals high in extraversion are sociable and assertive, while

individuals who score low are often distant and reserved (Barrick & Mount, 1991). Those who score high in neuroticism are described as anxious and prone to hostility. Those who score low are generally cool-headed and secure and described as emotionally mature and stable. The agreeableness dimension includes trust, cooperation, and flexibility. Opposite traits include skepticism, stubbornness, hostility, and antagonism. Conscientiousness describes individuals who are thorough, achievement-oriented, and industrious. Low scores on this dimension are often associated with carelessness and impulsivity. The final dimension, openness, is represented by originality, imagination, and open-mindedness. Opposite behaviors reflect resistance to change, conformity, and practicality (Barrick & Mount, 1991; Digman, 1990; Digman & Takemoto-Chock, 1981; Goldberg, 1990; McCrae & Costa, 1985, 1989).

Dimensional personality models such as the five-factor model have been proposed for improving the diagnosis of personality disorders (Widiger, 1991). For example, Soldz, Budman, Demby, and Merry (1993) examined the relationship between personality disorders as described by the *Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R;* American Psychiatric Association, 1987) and the five-factor personality model. They evaluated 102 referrals to group therapy with the Personality Disorders Examination (PDE), Millon Clinical Multiaxial Inventory II (MCMI-II), Inventory of Interpersonal Problems Circumplex Scales, and 50-Bipolar Self-Rating Scales. Their results support the value of the five-factor personality model in distinguishing among various personality disorders. In an earlier study, Wiggins and Pincus (1989) demonstrated similar support for the five-factor model in clinical diagnosis. As with the majority of investigations of the five-factor model, both Soldz et al. (1993) and Wiggins and Pincus (1989) employed a combination of principal-component and principal-factor analysis to extract and interpret groups of personality traits. Models such as the five-factor model appear to provide a more empirically sound description of an individual's personality traits than the circumplex, psychosocial, or psychosexual models of psychopathology.

A growing body of evidence supports a five-factor model for the construction and interpretation of personality testing instruments (Helton & Street, 1992). Specifically, McCrae and Costa (1985) designed the Neuroticism-Extraversion-Openness Personality Inventory (NEO-PI) and the NEO-PI rating form to measure individual differences on the five dimensions. The NEO-PI has proven particularly useful in early screening for psychopathology in the armed services. In fact, the NEO-PI has been adopted by both the U.S. Air Force and Navy/Marine Corps for initial screening of enlisted recruits. Although the five-factor model was designed to describe normal personality, the primary purpose and application of the NEO-PI has been in identifying individual mental health intervention needs (McCrae & Costa, 1989). Other researchers have applied the five-factor model to a variety of nonclinical measures to assess the robustness of the model (e.g., Costa & McCrae, 1988; Gerbing & Tuley, 1991; McCrae & Costa, 1985, 1989; McCrae, Costa & Busch, 1986).

Recent applications of the five-factor model to employee selection and performance prediction have also been promising. For example, Barrick and Mount (1991) conducted a meta-analysis of the available body of five-factor research and found that the conscientiousness factor was effective in predicting civilian job performance for police, managers, sales people, and skilled/semiskilled workers across three types of criteria. These criteria included job and training proficiency. They obtained the highest correlations with job proficiency for police and managers. Their results for the training proficiency criterion were limited due to small observation size. Cortina, Doherty, Schmitt, Kaufman, and Smith (1992) investigated the prediction of training success for 314 state police recruits using the five-factor model with the Minnesota Multiphasic Personality Inventory (MMPI) and Inwald Personality Inventory (IPI). They employed hierarchical regression techniques and found that after partialling out the variance of the Civil Service exam, only the neuroticism and agreeableness scales added to the predictability of the various training criteria. The conscientiousness dimension did not add to the prediction of any of the criteria after the Civil Service exam. The incremental validities of the personality tests over the Civil Service exam were small (Cortina et al., 1992). They considered this finding somewhat disappointing, although it is generally consistent with related research (Street et al., 1992).

Using the five-factor model to predict academic performance appears more promising. For example, Dollinger and Orf (1991) used the NEO-PI to study the performance of 118 students enrolled in an undergraduate personality course. They found that conscientiousness significantly predicted final course grades, objective test performance, and measures of effort (e.g., early completion of projects). Openness, described by intellectual openness, also contributed to the prediction of final outcome and test performance. Their conclusions were that the five-factor model, as measured by the NEO-PI, could improve predictions of academic performance.

Studies in military selection have found five-factor solutions similar to that expected in the five-factor personality model. Digman and Takemoto-Chock (1981) and Siem (1990) identified robust five-factor solutions in a series of personality measures used experimentally in the selection of U.S. Air Force officer candidates. A study of U.S. Navy recruits used 24 indexes from various personality measures and found that three superordinate dimensions of the five-factor model, neuroticism, extraversion, and agreeableness, accounted for most of the test variance (Marshall, Wortman, Vickers, Kusulas, & Hervig, 1991). More recently, Helton and Street (1992) found a robust five-factor solution in a sample of Navy/Marine Corps student aviators. They applied the five-factor model to the Pilot Personality Questionnaire (PPQ), which is a combination of the Work and Family Orientation (Helmreich and Spence, 1978), Personality Attributes Questionnaire (Spence, Helmreich, & Holahan, 1979), Locus of Control (Rotter, 1966), Social Desirability Scale (Crowne & Marlowe, 1960), and the Edwards Personal Preference Schedule (Edwards, 1959). In addition, Pedersen, Allan, Laue, and Siem (1992) evaluated this and other models and concluded that the five-factor model had the greatest potential in Air Force aircrew selection and classification research.

Beyond the instruments already mentioned, there are a number of nonclinical personality measures that have been considered in personnel selection research. One recent example of particular interest to our investigation is the Adult Personality Inventory (Krug, 1985). The Adult Personality Inventory (API) is based on the 16PF Questionnaire. It is a self-report instrument designed to measure individual differences in personality, interpersonal style, and career/life-style preferences. It is not based on clinical differences and is designed primarily to describe normal personality traits (Krug, 1985). The API has not previously been factor-analyzed or investigated with respect to the five-factor model. The API includes 25 individual scales divided into 7 personal characteristics scales, 8 interpersonal scales, 6 career scales, and 4 validity scales. The seven primary personal characteristics scales were designed to describe the most often factor-analytically defined traits. Investigations of the API have found very small proportions of the variance in scale scores accounted for by sex (i.e., less than 3%; Krug, 1984) and race (i.e., less 2%; Krug, 1986). The API has acceptable reliability and is considered appropriate for the intended applications (Bolton, 1985).

Previous published studies on personality testing in employee selection have often focused on clinical personality scales such as the MMPI (e.g., Cortina et al., 1992). Nonclinical personality measures such as the API may be better suited to personnel selection (Hollenbeck & Whitener, 1988). This is due in part to the intent of the instrument. Clinical measures are designed to assess undesirable traits and divergence from normality, while nonclinical measures are designed to describe normal personality attributes. Identifying abnormality is considered inappropriate in personnel selection, however in some applications such as the selection of police, certain undesirable traits could be dangerous (Cortina et al., 1992). On the other hand, selection based on desirable characteristics (i.e., nonclinical personality measures) has received increasing support in the selection of military and civilian pilots (e.g., Street et al., 1992).

The five-factor model often provides a robust and empirically sound description of personality dimensions, and has been validated in various applications. However, the value of this dimensional model of personality to personnel selection remains uncertain. We sought to determine the relationship between the five-factor model, the LCSS, and LCAC crew training performance. We believe that an enhanced, broad spectrum battery that includes nonclinical personality testing might improve the prediction of LCAC crew training grades. The first intent of our investigation was to determine the amount of variance in the underway training grade explained by the existing LCSS. In addition, we were interested in LCSS

experimental variables collected during selection testing but not used in the selection equation. The second intent was to determine if a factor analysis of the API scales (Krug, 1984), taken by U.S. Navy LCAC crew candidates, would be comparable to the five-factor solutions obtained by others (e.g., Helton & Street, 1992). Our overall goal was to investigate whether an alternate grouping of the API personality scales into a five-factor model would add to the prediction of underway training grades. We expected that certain factors derived from the API, especially conscientiousness, would enhance the prediction training performance.

METHOD

SUBJECTS

The subjects participating in this study were 168 senior enlisted (E-6 to E-9) Navy personnel serving on active duty, ranging in age from 27 to 46 years (M = 32.95, SD = 3.54). Of these subjects, we had primary training underway grades for 74 candidates: 61 passed and 13 failed in training. The subjects took the API as part of an ongoing validation study of the LCSS between 1990 and mid-1993 (see Dolgin et al., 1992). The API scores did not affect candidate selection decisions. All subjects were high school or GED graduates and had extensive shipboard experience.

DATA ANALYSIS

Initially, we used principal component analysis (PCA) to extract factors from the 4 validity and 21 personality scales of the API taken by the candidates (N = 168). We then entered the 25 scales into a principal factor analysis (PFA) to arrive at a solution where unique and error variance were removed from the factors. Following extraction, we rotated the factors using orthogonal (varimax) techniques to obtain a simple structure for interpretation. Next, we grouped the subtests and labeled the factors according to the attributes measured by each subtest. The factors obtained were compared to the five-factor model based on item and scale content. This was done through a comparison of the subtest descriptors published in the API manual (Krug, 1984) to the various factor descriptors found in our investigation.

For cases with an underway training grade criterion (N = 74), hierarchical and stepwise multiple regression analyses were conducted to characterize the relationship between the underway grade criterion and the various LCSS and API predictors. In the hierarchical regression, the predictor variables were entered into the regression equation in a specified order. This allowed the variability of the criterion to be partitioned into components that could be accounted for by the various predictor variables. Because the candidates were selected for training on the basis of the LCSS performance measures, those variables were entered first. In this equation, the five LCSS selection variables would account for as much variance as possible in the underway grade criterion. The derived API factor composites were then entered in a separate regression equation to estimate the amount of unique variance accounted for by the five API factor composites after the LCSS variables. Finally, we conducted a series of stepwise multiple regressions of the entire field of LCSS and API variables to determine the smallest predictor set with maximum prediction of the criterion. To determine the contribution of the API, any significant LCSS variables were then entered into a regression, followed by any significant API factors.

MATERIALS

The Landing Craft Air Cushion Vehicle Crew Selection System. The LCSS is a computerized, menu-driven test battery that includes two performance-based tests (Helton, Nontasak, & Dolgin, 1992), a biographical inventory, and the Social Desirability Scale (Crowne & Marlowe, 1960). The first performance test, the psychomotor and dichotic listening test (PMT/DLT), measures eye-hand-foot coordination and individual differences in selective attention. The second test, the compensatory tracking and digit

cancellation test (CT/DC), is a measure of psychomotor ability and time-sharing skill. Throughout the validation of the LCSS, numerous variables were included in the selection model based on their relative predictive utility against a pass/fail criterion in training. The variables comprising the LCSS at the time of our investigation included three PMT/DLT variables and two CT/DC variables. We were also interested in other experimental variables derived from the PMT/DLT and CT/DC. A brief description of those experimental and LCSS variables discussed in our investigation is presented in Table 1.

The Adult Personality Inventory. According to Krug (1984), the API was developed to assess a set of attributes representing the fundamental traits of personality as conceptualized by Raymond B. Cattell in the late 1940s. The test is intended for a variety of applications such as personnel selection and placement, education, and different counseling aims. Krug (1984) proposed that the item length, readability, scoring techniques, and report format of the API make it extremely useful.

The short form of the inventory used in our investigation is made up of 189 questions partitioned into 21 report scales and 4 validity scales. The validity questions measure attempts at making a good impression, a bad impression, the consistency of answers (infrequency), and the number of uncertain responses (uncertainty). The 21 report scales are divided into three sections: personal characteristics, interpersonal styles, and career/life factors. The personal characteristics section describes broad behavior patterns. Interpersonal styles includes scales associated with how an individual relates to others. The third section involves measures associated with career choices, job satisfaction, and life-style preferences. The API version used was the Test Plus computer program, which automatically organizes subject responses into the various scales. The test takes approximately 30 min, depending on the subject's reading and comprehension ability.

Table 1. Description of Psychomotor Test/Dichotic Listening Test (PMT/DLT) and Compensatory Tracking/Digit Cancellation (CT/DC) Variables

Variable	Source Test	Description
		LCSS Variables
$LOG_{10}STICK$	PMT/DLT	Stick only task: tracking error score
$LOG_{10}STDLT$	PMT/DLT	Stick and DLT task: tracking error score
$LOG_{10}ALL4$	PMT/DLT	Stick, rudder, throttle and DLT task: tracking error score
$LOG_{10}SGTRK$	CT/DC	Compensatory tracking task: tracking error score
COMPDCCT	CT/DC	Compensatory tracking/digit cancellation composite score (Computed score based on z scores of both tasks)
		Experimental Variables
$LOG_{10}STRDLT$	PMT/DLT	Stick, rudder, and DLT: tracking error score
$LOG_{10}STR$	PMT/DLT	Stick and rudder: tracking error score
$LOG_{10}DLTRK3$	CT/DC	CT/DC task: average raw tracking error for all 3 dual task trials

RESULTS

DESCRIPTIVE STATISTICS

Means and standard deviations for the PMT/DLT and the CT/DC selection variables are presented in Table 2. Table 3 includes descriptive statistics for the primary underway training grade criterion, selected LCSS variables not currently in the selection model, and the API five-factor derived scores. The information in Tables 2 and 3 is partitioned by whether the subject passed or failed during primary training. As shown in Tables 2 and 3, the pass and fail group means for the underway grade were significantly different at the $p < .001$ level. The API openness (FAC4) factor group means were significantly different at the $p < .01$ level. No other API or LCSS variable means were significantly different for the two groups.

Table 2. Comparison of LCSS Variable Means and Standard Deviations (*SD*) for Pass and Fail

Variable	Pass (N = 61)		Fail (N = 13)	
	Mean	*SD*	*Mean*	*SD*
LOG_{10}STICK	4.2	.3	4.3	.2
LOG_{10}STDLT	4.5	.3	4.6	.3
LOG_{10}ALL4	4.8	.2	4.8	.2
LOG_{10}SGTRK	5.2	.3	5.2	.2
COMPDCCT	1.3	.3	1.1	.3

Table 3. Comparison of Primary Underway Grade, Experimental LCSS Variables, and API Factor Scores

Variable	Pass (N = 61)		Fail (N = 13)	
	Mean	*SD*	*Mean*	*SD*
Underway Grade **	89.3	5.4	71.2	21.1
LOG_{10}STRDLT	4.8	.2	4.8	.1
LOG_{10}STR	4.5	.2	4.6	.1
LOG_{10}DLTRK3	5.5	.2	5.5	.1
Introversion (FAC1)	-25.0	6.9	-25.8	6.9
Agreeableness (FAC2)	-9.8	6.2	-10.3	3.0
Conscientiousness (FAC3)	15.1	5.8	15.1	3.4
Openness/Practicality (FAC4) *	-.7	3.7	-3.8	4.7
Neuroticism (FAC5)	16.1	4.3	17.0	3.6

*$p < .01$
**$p < .001$

The intercorrelations of the various variables are presented in Table 4. As shown in Table 4, one derived API score (openness, FAC4) significantly correlated with the underway grade criterion. The openness, or practicality, factor also positively correlated with the pass/fail criterion. The direction of the relationship indicates that as openness or practicality increased, the likelihood of a higher underway grade and of passing training increased. There was a significant negative relationship between the PMT tracking error (LOG_{10}STRDLT) experimental variable and the underway grade criterion. That is, as LOG_{10}STRDLT

errors increased, the underway grade decreased. Further analysis of Table 4 reveals that conscientiousness (FAC3) and agreeableness (FAC2) were significantly correlated such that as conscientiousness increased, agreeableness decreased. Similarly, a significant negative correlation between neuroticism (FAC5) and introversion (FAC1), indicated that as introversion increased, emotional stability decreased. Neuroticism (FAC5) was also positively correlated with agreeableness (FAC2), suggesting that agreeableness increases as emotional stability increases. Different interpretations may be possible since each of the factors represents a broad dimension of related traits. For example a high score on the API-derived neuroticism dimension describes an emotionally stable individual, while a low score is indicative of anxiety.

Table 4. Correlations Among the Underway Grade, *API Factor, LCSS Experimental, and LCSS Variables*

	UG	PF	LSTK	LSDT	LALL	LSTR	CDCT	FAC1	FAC2	FAC3	FAC4	FAC5	LSRD	LDTR
Underway Grade (UG)		--												
Pass/fail (PF)	.58**	--												
LOG_{10}STICK (LSTK)	-.19	-.09	--											
LOG_{10}STDLT (LSDT)	-.21	-.11	.65**	--										
LOG_{10}ALL4 (LALL)	-.22	-.07	.53**	.57**	--									
LOG_{10}SGTRK (LSTR)	-.20	.02	.48**	.49**	.41**	--								
COMPDCCT (CDCT)	.11	.14	-.24*	-.24*	-.45**	-.47**	--							
FACTOR 1 (FAC1)	.06	.05	.06	-.06	-.04	-.04	-.15	--						
FACTOR 2 (FAC2)	.08	.03	.07	.07	.16	.09	.00	-.12	--					
FACTOR 3 (FAC3)	-.03	-.00	-.16	-.01	-.06	.08	.02	-.06	-.48**	--				
FACTOR 4 (FAC4)	.26*	.30**	.05	-.14	-.11	-.03	-.04	-.05	-.11	-.09	--			
FACTOR 5 (FAC5)	-.07	-.07	-.13	-.07	-.07	.07	.12	-.55**	-.20	.23*	-.06	--		
LOG_{10}STRDLT (LSRD)	-.34**	-.11	.47**	.69**	.69**	.45**	-.46**	.10	.11	.01	-.13	-.06	--	
LOG_{10}DLTRK3 (LDTR)	-.04	-.03	.29**	.41**	.52**	.62**	-.76**	.06	.10	.01	-.09	-.06	.52**	--

* $p < .05$
** $p < .01$

FACTOR ANALYSIS

Both the exploratory PCA and the confirmatory PFA analyses of the API scales produced similar solutions. Five factors were retained on the basis of eigenvalues over 1.0 (Kaiser, 1960). The normalized, orthogonally rotated solution accounted for about 79% of the variance in the various subtests of the API. The correlations of the 25 scales of the API with the 5 rotated PFA factors are shown in Table 5 where the first (FAC1) and second (FAC2) factors accounted for 35% and 26% of the total test variance, respectively. Factor three (FAC3) accounted for an additional 8%, while the fourth (FAC4) and final (FAC5) factors accounted for 5.75% and 4% of the remaining test variance, respectively. As shown in Table 5, FAC1 reflects characteristics found in the introversion/extraversion dimension. FAC2 resembles the agreeableness factor. Traits commonly attributed to the conscientiousness dimension are found in FAC3. Traits found in FAC4 of our analysis most closely resemble the openness factor. FAC4 also includes traits relating to practicality versus creativity and traditional versus nontraditional behavior patterns. Finally, FAC5 includes characteristics found in the neuroticism or emotional maturity dimension of the five-factor model.

Table 5. Varimax Rotated Principal Factor Analysis

Scale	Factor FAC1	FAC2	FAC3	FAC4	FAC5
		Validity Scales			
Good impression			.36		
Bad impression					
Infrequency					
Uncertainty	.43		-.56		
		Personality Scales			
Extroverted	-.74	-.41	.44		
Adjusted		-.56			.65
Tough-minded				.81	
Independent	-.62	.37			.66
Disciplined			.91		
Creative		.39	-.36	-.66	.36
Enterprising			.55	-.34	.60
Caring		-.81			
Adapting	.71	-.53			
Withdrawn	.63				-.74
Submissive		.39			-.83
Hostile	-.32	.86			
Rebellious	-.49	.40	-.72		
Sociable	-.90		-.33		
Assertive	-.61	-.55	.38		.36
Practical				.69	.38
Scientific	-.68				.46
Aesthetic				-.77	
Social		-.64			
Competitive	-.64				
Structured		-.31	.87		
Eigenvalues	5.91	5.09	2.84	2.40	2.00
% of Variance Explained	34.94	25.91	8.08	5.75	3.99

MULTIPLE REGRESSION ANALYSIS

The multiple regression of the underway grade on the five LCSS selection variables currently used in the selection model was nonsignificant, $F(5, 68) = .992$, $p < .429$, $R = .261$. On the other hand, in the stepwise multiple regression of 13 LCSS and 5 derived API variables, 8 predictors entered the final equation. The contribution of the 8 variables remaining in the stepwise regression is shown in Table 4. The multiple regression of the underway grade criterion on the combination of five LCSS and three API variables was significant, $F(8, 65) = 3.187$, $p < .004$, $R = .531$.

Table 6. Results of Stepwise Multiple Regressions of Various LCSS and API Variables

Variable	Step	Multiple R	Multiple R^2	Δ in R^2	F to enter	p level
LOG_{10}STRDLT	1	.3415	.1166	.1166	9.5084	.0030*
FACTOR 4	2	.4056	.1645	.0478	4.0631	.0479*
LOG_{10}DLTRK3	3	.4396	.1932	.0288	2.4974	.1189
LOG_{10}SGTRK	4	.4691	.2204	.0268	2.3704	.1285
COMPDCCT	5	.4898	.2399	.0198	1.7756	.1873
FACTOR 2	6	.5043	.2543	.0144	1.2968	.2589
LOG_{10}STR	7	.5193	.2697	.0154	1.3896	.2428
FACTOR 1	8	.5308	.2817	.0120	1.0879	.3008

* significant contribution

Of the eight variables that remained in the stepwise multiple regression, only one LCSS variable (LOG_{10}STRDLT) not represented in the selection set, and one API (FAC4) variable made significant contributions to the equation. However, because the candidates were selected based on the five LCSS variables, we retained these variables in subsequent analyses. The hierarchical analyses, computed by entering the LCSS variables first followed by the various API and experimental LCSS variables, revealed potential improvements to the current selection system. Of particular interest, the increase in the R^2 (for LCSS, $R^2 = .068$; for LCSS + FAC4, $R^2 = .127$) achieved by adding FAC4 to the LCSS predictors was significant, $F(6, 67) = 4.568$, $p < .036$, $R = .357$. The prediction model made up of the LCSS and FAC4, although improved, was not significant, $F(6, 67) = 1.631$, $p < .152$, $R = .357$. Finally, we were able to significantly improve the current LCSS with the addition of FAC4 and one experimental variable. The resulting prediction model was significant, $F(7, 66) = 2.209$, $p < .044$, $R = .436$. Based on these results, the API openness or practicality factor (FAC4) did contribute unique predictive validity to a performance prediction model.

DISCRIMINANT FUNCTION ANALYSIS

The discriminant function (DF) calculated for the LCSS scores of the group of those who passed ($N = 61$) and those who failed ($N = 13$) LCAC training was not significant, χ^2 (5) = 3.53, $p < .618$. The Pearson correlation coefficient was $r = .22$. The amount of variance explained by the DF was $r^2 = .048$ or 4.8%. The LCSS classification matrix is presented in Table 7. When we included FAC4 in the analysis, the results were slightly better, although not significant, χ^2 (6) = 11.02, $p < .088$. The addition of FAC4 resulted in a Pearson correlation coefficient of .38. This model explained 14.7% of the variance and correctly classified 85.1% of the grouped cases. The FAC4 and LCSS classification matrix is presented in Table 8. Based on a comparison of the correctly classified cases of the two models, the addition of FAC4 resulted in 2.7% improvement in accuracy, while increasing the amount of variance explained by nearly 10%.

Table 7. LCSS Classification Matrix *

	Predicted Group Membership		Cases
Actual Group	Pass	Fail	
Pass	61 100.0%	0 0.0%	61
Fail	13 100.0%	0 0.0%	13

* Percent of grouped cases correctly classified: 82.4%

Table 8. FAC4 and LCSS Classification Matrix *

	Predicted Group Membership		Cases
Actual Group	Pass	Fail	
Pass	61 100.0%	0 0.0%	61
Fail	11 84.6%	2 15.4%	13

* Percent of grouped cases correctly classified: 85.1%

DISCUSSION

A small-scale validation of an enhanced crew selection system was carried out with LCAC crew. In both exploratory and confirmatory factor analyses of the API, five factors emerged. These factors appeared to be definable in terms of the five-factor model. In particular, the PFA confirmatory solution very closely resembled the five-factor model obtained by others (e.g., McCrae & Costa, 1989). Our results appear to lend empirical support for the robustness of the five-factor model. As in previous studies of the five-factor model, the introversion/extraversion factor accounted for the most variance in the API. It is interesting to note that the openness factor emerged as the next strongest factor in our investigation. The neuroticism or emotional maturity factor has generally emerged as the next strongest factor in other studies (McCrae & Costa, 1989). Our sample included only individuals selected for training by a rigorous recommendation and ability testing program. These individuals often had 10 or more years of active shipboard experience in the Navy. Accordingly, differences in our investigation may be related to qualities found in this highly homogeneous, select group.

Multiple regression analyses revealed significant relations between the primary underway grade training criterion and the potential LCSS and API predictors. We found that an alternative scoring system derived from PFA of the API yielded a personality factor score that significantly improved predictions of LCAC crew training performance. These results are not surprising in that the five-factor model has resulted in improved

differentiation among personality disorders (e.g., Soldz et al., 1993) and personnel selection decisions (Barrick & Mount, 1991). In our investigation, a series of multiple regression analyses indicated that a primary underway grade could be significantly predicted by the derived API openness score and four LCSS variables. The derived API openness variable includes traits of practicality and conventionality. The significance of the practicality trait is such that individuals who are more conventional and practical tend to do better in the overall LCAC training program. Taken as a whole, the results describe a picture of the successful LCAC crew trainee based on psychomotor coordination and decision-making skill (LCSS) and practicality (API).

Our data are consistent with related pilot selection research (e.g., Picano, 1991; Siem, 1990; Street et al., 1992) and appear to confirm that personality testing can enhance the prediction of LCAC crew training outcomes. We found that a personality test to evaluate practicality and conventionality may enhance a selection system currently made up of psychomotor coordination, information processing, and time-sharing tasks. Our results support the work of others who have identified the value of the five-factor model in personnel selection (e.g., Barrick & Mount, 1991) and academic training (e.g., Dollinger & Orf, 1991). However, unlike these studies, the primary traits involved in LCAC training performance are related to practicality and conventionality as compared to conscientiousness. Openness does contribute to academic performance prediction (Dollinger & Orf, 1991). This may suggest that different personality attributes are involved in different activities. For example, the LCAC training program involves rigorous attention to following procedures while the activities of policeman, managers, and workers studied by Barrick and Mount (1991) usually do not. Unfortunately, there are few studies applying the five-factor model to different groups of workers available for comparison.

The practical benefit of implementing a personality test to predict LCAC crew training performance is difficult to assess. The small size of the existing data base limits the estimation of potential utility until a larger group of candidates completes primary underway training. As these data become available, utility analysis will be practical. In the mean time, the results are consistent with similar studies assessing the value of personality testing in aviation selection. The data support the validity of an alternative five-factor scoring system for the API. The results also provide empirical support for the validity of certain personality tests for the prediction of LCAC crew training performance. As military training programs face increased cost restraints, we believe that valid personality tests may improve LCAC selection and training prediction.

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D. R. Street, K.T. Helton, and T. Nontasak

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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51 HOVEY ROAD
PENSACOLA FL 32508-1046

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13. ABSTRACT *(Maximum 200 words)*

The purpose of our investigation was to determine if personality testing and a five-factor model could improve the selection of Landing Craft Air Cushion (LCAC) vehicle crew members. Vehicle crew members for the LCAC are currently selected on the basis of their performance on a computer-based psychomotor selection system. The various psychomotor tests in the selection system have demonstrated predictive validity in LCAC crew training. Certain personality characteristics may also be involved in the LCAC vehicle crew training success. In fact, various researchers have found that personality testing may improve the selection of Navy/Marine Corps aviators. There is increasing evidence that a five-factor model may be useful in describing the personality characteristics involved in training success. We believe that a five-factor model may improve the selection system used for LCAC vehicle crew members. A principal component analysis with varimax rotation was conducted to determine the underlying structure of the Adult Personality Inventory (API) with 168 LCAC crew candidates. The resulting factor scores were then analyzed using advanced statistical techniques to determine the relation of the personality factor scores and the performance-based test to an underway grade in training criterion. The results indicated that one personality factor, openness, significantly improved predictions of the criterion ($p < 0.05$). Based on these results, we believe that personality testing would improve the selection of LCAC vehicle crew members.

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