ARMSTRONG LABORATORY

PERSONALITY THEORY FOR AIRCREW SELECTION AND CLASSIFICATION

Larry A. Pedersen
Karla E. Allan
Frances J. Laue
James R. Johnson

Universal Energy Systems
4401 Dayton-Xenia Road
Dayton, OH 45432

Frederick M. Siem

HUMAN RESOURCES DIRECTORATE
MANPOWER AND PERSONNEL RESEARCH DIVISION
Brooks Air Force Base, TX 78235-5000

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Frederick M Siem

FREDERICK M. SIEM
Contract Monitor

William E Alley

WILLIAM E. ALLEY
Technical Director
Manpower & Personnel Research Division

ROGER W. ALFORD, Lt Colonel, USAF
Chief, Manpower & Personnel Research Division

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Larry A. Pedersen
Karla E. Allan
Francis J. Laue
James R. Johnson
Frederick M. Siem

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

Universal Energy Systems, Incorporated
4401 Dayton-Xenia Road
Dayton, OH 45432

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Growing acceptance of a taxonomy of personality traits developed by the Air Force in the late 1950s (Tupes & Christal, 1961) has prompted a reexamination of the utility of personality measures for aircrew selection and classification research. Candidate theories are identified and then evaluated according both to general scientific criteria and to specific operational criteria (e.g., Hall & Lindzey, 1978; Imhoff & Levine, 1981). The Five Factor Model (Goldberg, 1990; McCrae & Costa, 1985; Tupes & Christal, 1961) is selected as the most suitable framework for guiding future Air Force research in the personality domain. Example items to measure relevant characteristics are proposed, as are directions for future research.

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PREFACE

This project was completed under Work Unit 77191845, "Development of Aircrew Selection Methodologies." The work was done in response to Request for Personnel Research (RPR) 78-11, "Selection for Pilot Training."

The authors would like to acknowledge the invaluable comments made by Lew Goldberg on an earlier draft of this effort. The authors also want to express their appreciation to Bob Helmreich, Leatta Hough and Larry Stricker for their suggestions and advice during a two-day review of this project. That review would not have taken place without the encouragement and sponsorship of Bill Howell. The authors also to thank Bill Alley, Dave Perry, and Joe Weeks for their guidance during the course of this project. Finally, the authors would be remiss in not acknowledging all the work done by Jim Turner in getting the project off the ground and seeing it through to completion during less than ideal circumstances.

PERSONALITY THEORY FOR AIRCREW SELECTION AND CLASSIFICATION

SUMMARY

This report documents a review of the current and traditional literature in the field of personality psychology. The review was conducted to identify the optimal formal theory or synthesis of current thought to guide future research on the selection and classification of United States Air Force (USAF) rated crewmembers. Dramatic changes in the Air Force organization are affecting the ways crewmembers are selected, trained, and utilized. This research is meant to guide future efforts to provide a personality component to supplement the physical, academic, and aptitude requirements currently employed in aircrew selection and classification.

INTRODUCTION

The purpose of this report is to describe the results of an examination of personality theories for their utility in guiding research on aircrew selection and classification. Since 1955, Air Force pilot trainees have been selected on the basis of their medical fitness, academic performance, personal preference, aptitude tests such as the Air Force Officer Qualifying Test (AFOQT), and previous flying experience. High training costs associated with attrition rates at Undergraduate Pilot Training (UPT), and the impending transition from a single-track UPT system to a multi-track Specialized Undergraduate Pilot Training (SUPT), have underscored the need for improving methods of selecting and classifying pilot trainees

(Kantor & Carretta, 1988).

One response to the concerns with pilot selection and classification has been the development of the Basic Attributes Test (BAT) battery (Kantor & Carretta, 1988: Carretta, 1989). The BAT is a microcomputer-based testing device that measures three types of characteristics identified as essential for the highly effective pilot. Kantor and Carretta (1988) called these types "hands" (psychomotor ability), "head" (information processing), and "heart" (attitudes and personality characteristics). The "heart" component of the BAT has been shown as the weakest aspect of the test battery (Siem, 1990; Carretta & Siem, 1988). None of the original five personality measures used in the BAT were found to be related to training performance criteria in a study of 1,992 pilot candidates (Carretta & Siem, 1988).

Numerous explanations may be profferred for the failure to find significant relationships between personality measures and performance criteria, either in this study or in numerous others (Dolgin & Gibb, 1988). Helmreich, Sawin, and Carsrud (1986), for example, provided evidence that job performance measures are more strongly associated with personality traits than are training outcomes. Also, recent meta-analytic reviews highlight the potential predictive utility of personality scales when they are classified and organized by particular traits (Hough, Eaton, Dunnette, Kamp, & McCloy, 1990).

Interestingly, the meta-analyses were organized around a trait framework based on research in the mid-1950s sponsored by the Air Force (e.g., Tupes, 1957; Tupes & Christal, 1961). Although such research eventually fell into disfavor with the Air Force due to suspicion of its relevance and a concern for associated invasion-of-privacy issues (Alley, 1991), "a small explosion of interest" (McCrae, 1991, p. 399) in the research framework

developed by the Air Force has produced a convergence of views regarding the structure of personality concepts (e.g., Digman, 1990; John, 1990). This revolution in research gives hope that a scientifically compelling personality framework might now be found. The goal of this project, therefore, was to examine the characteristics of selected personality theories to identify the one(s) most suited for establishing a framework for applied research in aircrew selection and classification.

This examination involved a review of a broad spectrum of the relevant theoretical and empirical literature. A set of candidate theories was evaluated against a set of general and operational criteria to determine their potential utility. Subsequently, a theoretical framework for guiding future research was selected. This framework can serve as a tool for generating and guiding research on personality in selection and classification decisions.

Section II of this report describes theory identification, evaluation, and selection. Section III describes the process by which the selected theory was molded into a framework to guide research in the domain of interest (aircrew selection and classification). Examples of assessment items and scales are contained in Section IV. Section V concludes the report with a description of future research activities suggested by the theoretical framework. The Appendix includes a description of each of the theories considered and not selected, with a brief summary of the evaluation process and results as they applied to the particular theory.

IDENTIFICATION, EVALUATION, AND SELECTION OF THEORIES

Identification of Candidate Theories

The first requirement of this project was the identification of a pool of personality theories to evaluate for their potential to guide research in aircrew selection and classification. The primary set of candidate theories were those that focused on the structure of human temperament. These theories focused on "trait" or "type" concepts to describe the basic characteristics of personality. The Statement of Work (SOW) for this project required evaluation of the 3-factor theory (Eysenck & Eysenck, 1985), the 5-factor theory (McCrae & Costa, 1985), the 16-factor theory (Cattell, 1972), the circumplex theory (Wiggins & Broughton, 1985), and the socioanalytic theory (Hogan, 1983). As the evaluation progressed, others were included to provide balance and comprehensiveness. The psychological types theory (Jung, 1971; Myers, 1980; Myers & McCaulley, 1985), temperament theory (Buss, 1988; Buss & Plomin, 1975) and instrumentality-expressivity theory (Bakan, 1966; Spence, 1983) were thus added to the candidate pool. Finally, the needs theory (Murray, 1938) was included in the list of candidates at the suggestion of members of the Laboratory Advisory Group (LAG)[1], who felt that its historical significance demanded its recognition. Eventually, nine structural theories were evaluated.

Although not traditionally associated with selection and classification research, several non-structural theories were sampled and reviewed for their potential contributions.

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[1]The LAG on Personality Theory for Aircrew Selection and Classification met 3-4 June 1991 at the Armstrong Laboratory, Brooks AFB, TX. Members included R. L. Helmreich of the University of Texas (Austin), L. M. Hough of Personnel Decision Research Institutes, and L. J. Stricker of the Education Testing Service. L. R. Goldberg of the University of Oregon was a participant as a consultant for UES, Inc.

Of these theories, the SOW required evaluation of Bandura's (1986) self-efficacy theory, Mischel's (1968) person-situation theory, and Markus' (1977) self-schema theory. For comprehensiveness, Cantor and Kihlstrom's (1985; 1987) cognitive/social theory was added. The final pool of candidate theories is presented in Table 1.

Table 1. Theories Evaluated.

Theory	Author/Proponent	Description
Three-factor	Eysenck & Eysenck (1985)	Structural - trait
Five-factor	Tupes & Christal (1961)	Structural - trait
Sixteen-factor	Cattell (1957)	Structural - trait
Interpersonal Circumplex	Wiggins (1980)	Structural - trait
Socioanalytic	Hogan (1983)	Structural - trait
Temperament	Buss & Plomin (1975)	Structural - trait
Needs	Murray (1938)	Structural - trait/needs
Psychological Type	Jung (1971)	Structural - type
Instrumentality/Expressivity	Bakan (1966) Spence & Helmreich (1978)	Structural - type
Self-efficacy	Bandura (1986)	Non-structural - Social-learning
Person by Situation	Mischel (1968)	Non-structural - Social-learning
Self-schema	Markus (1977)	Non-structural - Cognitive/Information processing
Cognitive Social Approach	Cantor & Kihlstrom (1987)	Non-structural - Cognitive/Social Processing

The pool of structural and non-structural theories just identified constitutes a representative sample of modern personality theories. This assertion was confirmed by the LAG assessment that the candidate pool of theories was an adequate set from which to select or develop a framework.

Identification of Evaluation Criteria

The second requirement of the project was the identification of evaluation criteria. The SOW suggested consideration of two types of criteria: (1) "general" criteria that address customary scientific issues, and (2) "operational" criteria that address practical application issues. This dual-set requirement for evaluation criteria is consistent with the literature and this dichotomy is often referred to as formal criteria and substantive criteria (Hall & Lindzey, 1978; Maddi, 1989).

General Criteria.

Evaluation criteria referred to as "general" apply to theories of any scientific discipline, not just personality psychology. These criteria are sometimes called formal or formative criteria. Rychlak (1968) proposed four general or formal evaluation criteria for personality theories, which he called descriptive, delimiting, generative, and integrative. Hall and Lindzey (1978) suggested six criteria: assumption explicitness, prediction utility, prediction verifiability, comprehensiveness, incorporation of known findings, and simplicity. Maddi (1989) suggested the criteria of importance, operationism, parsimony, empirical validity, and stimulation. A comparative review indicated a significant commonality among these sets of criteria. A subsequent integration produced the following set of six general criteria.

Prediction Utility. A major function of a theory is to provide a systematic mechanism to generate the discovery of new empirical relations between events or variables. The

usefulness of a theory in generating relations (i e., statements, hypotheses, predictions) is determined by the comprehensiveness[2] (breadth and depth) of the relations generated.

Hall and Lindzey (1978) distinguished between systematic and heuristic generation of research relations. Ideally, a theory suggests specific propositions that lead to specific empirical studies (systematic generation). However, the notions of theorists such as Freud and Darwin have been great catalysts to investigative paths by suggesting general, but profound, ideas that serve to stimulate the work of both confirmed advocates and disbelieving opponents (heuristic generation). Both types of influence are valued at the present stage of development in the field of psychology.

Maddi (1989) cautions that, although a theory can have utility in stimulating the search for possible relations, it will not make a lasting contribution unless it also achieves rational explicitness and empirical verifiability (the next two formal criteria). According to Hall and Lindzey (1978), personality theories in general are especially strong on generating research but relatively weak on explicitness and empirical definition.

Explicit Assumptions. A major component of a theory is a set of assumptions that are systematically related. These assumptions should explicitly indicate the empirical events with which the theory is concerned and should provide rules that are logically consistent, permit derivations, and enable prediction of empirical consequences (Hall & Lindzey, 1978). In defining concepts and their relations to one another, the theory's assumptions should avoid using figurative, metaphorical, or analogical language such as "The superego does battle with

[2]Comprehensiveness was listed in the SOW as a required criterion for this evaluation. The employment of comprehensiveness as the measure of the utility criterion is consistent with Hall and Lindzey (1978).

the id" (Maddi, 1989, p. 620). Clarity and precision in assumptions ensure that individuals employing the theory will independently arrive at similar derivations and consequences.

Predictions Verifiable. A major component of a theory is the set of definitions of the theory's terms and constructs. These definitions must be sufficiently explicit and practical to enable translation of the theory's concepts into measurable predictions that permit the generation of verifiable data. Theorists vary considerably in their explicitness. At one extreme, some theorists assume that simply assigning a name is sufficient. At the other extreme, others prescribe relatively exact operations for empirically assessing and measuring each aspect of the theory (Hall & Lindzey, 1978). Such attention to definition provides a precision that precludes someone measuring a construct in a manner at variance with the intended meaning. Maddi (1989) cautions that measurement operations should follow from the theoretical definitions, rather than the reverse.

Incorporation of Known Findings. Besides prediction utility (the capability to generate new empirical relations), another major function of a theory is the capability to provide a logically consistent framework for incorporating known empirical findings (Hall & Lindzey, 1978). Through its framework, a theory offers organization and integration of all that is known about a particular area of study. A satisfactory theory of personality should embrace, in a consistent fashion, the confirmed findings of personality research. Maddi (1989) characterizes this criterion as one of two components of empirical validity. The other, more important component is the degree to which theory predictions are empirically validated.

Predictions Validated. Another confirming measure of the utility of a theory is whether or not its predictions have been empirically confirmed. Although the development of explicit assumptions and the formulation of verifiable predictions are necessary initial steps, the empirical validity of a theory becomes a crucial assessment (Maddi, 1989).

A lack of actual empirical confirmation of a theory's predictions clearly detracts from its credibility. If a theory's predictions are disconfirmed often enough, the theory will be thrown into serious doubt, regardless of its rational adequacy and the apparent adequacy of *post hoc* explanations that incorporate known findings (Maddi, 1989).

Assessment of empirical validity is premature until a theory is sufficiently well developed. Before that, empirical data are best used for theory construction or refinement, rather than evaluation (Maddi, 1989).

Parsimony. This criterion refers to a theory's simplicity in conceptualization (Hall & Lindzey, 1978; Maddi, 1989). Usually, parsimony is judged only after the satisfaction of the other formal criteria. In the rare circumstance when two or more theories generate the same validated consequences, the more simple theory would be preferred. In practice, parsimony has been a matter of personal preference but for current purposes, a theory should be comprehensible by non-psychologist Air Force leaders and managers.

Operational Criteria.

These operational criteria help distinguish the applicability of theories to the particular operational setting of concern. In this project the setting of concern is the selection, via the

BAT testing mechanism, of Air Force aircrew candidates. Although Imhoff and Levine (1981) investigated primarily the use of perceptual-motor and cognitive performance tasks for use in the BAT, they provided some operational criteria that are relevant to choosing personality theories. These criteria include feasibility, sensitivity, and construct validity. The SOW recommended the additional criteria of response bias and legal risk. Several additional criteria that merited consideration were included. These operational criteria were reviewed, and the following set of seven criterion constructs was selected for the evaluation.

Adult Normal-functioning Focus. In this study, the application of personality theory is targeted for adult humans drawn from a normal population. Theories focused only at earlier stages of human development would not be appropriate. Additionally, applicable theories should be those that explain normal human functioning as opposed to those that focus on aberrant or abnormal functioning.

BAT Operational Compatibility. Because the intended implementation of the theories will be as part of the BAT battery to screen large numbers of incoming aircrew applicants, the following characteristics are desirable: (a) computer-hostable, (b) self-rating (as compared to observer reliant), (c) group administered, (d) short administration time, and (e) interviewer or trained administrator independent.

Environment-Personality Match. The application of this study will require theories to distinguish between different job environments (e.g., single- versus multi-crewmember

aircraft). Consequently, an acceptable theory should include hypotheses about the environment and personality to include a distinction between interpersonally oriented versus task-oriented personal characteristics.

Inclusion of Achievement Motivation. Based on past research, achievement motivation is considered a crucial predictor for aviation performance (Chidester, Helmreich, Gregorich & Geis, 1991). Therefore, an applicable theory should feature constructs labelled as achievement motivation or something similar.

Sensitivity. Selection applications will require discriminations among relatively homogeneous groups of aircrew applicants. An acceptable theory, therefore, should have a sufficient level of detail to be capable of revealing small individual differences (Imhoff & Levine, 1981).

Response Bias. Respondents have been found to be able to fake socially or occupationally desirable choices on self-report personality scales (Schwab, 1971). An acceptable personality theory should have constructs that minimize faking, or have mechanisms in the test application that detect faking.

Legal Risk. Fairness in selection is an issue for gender and ethnic groups (Gynther, 1979; Linn, 1978). The assessment use of an acceptable personality theory should allow for

unbiased applications or for separate norms for particular groups that show statistically significant differences. In all cases, the selection constructs must be tied to actual job-performance criteria.

Evaluation of Theories

The evaluation of the theories, according to the SOW, was to be made against both scientific (general) and operational criteria. The SOW, in its background section, recommended sources for selecting the criteria to be used, namely Hall and Lindzey (1978) for the scientific and Imhoff and Levine (1981) for the operational ones. In the technical requirements section of the SOW, some specific criteria were outlined. This charge was interpreted in light of the purpose of the study which was to select one theory or an integration of theories with the greatest potential for utility in the specific domain of aircrew selection and classification. This goal, properly and wisely, established definite parameters for the evaluation. The focus of the effort made it clear that neither a didactic treatise on the field of personality psychology nor a complex meta-analysis of personality measurement techniques was required. Rather, that focus allowed a theory selection process that was fairly expeditious and parsimonious.

Strict application of each general and operational criterion against each theory was attempted in the early stages of evaluation and global judgments of the potential utility of the various theories were also made.

General Criteria.

This set of criteria did not prove to have the discriminating power that was suggested in the SOW. These criteria were formulated by methodologists and logicians of *science*, not personality or even psychology (Hall and Lindzey, 1978). Using such criteria to appraise the utility of a personality theory in a narrow application such as aircrew selection and classification presented procedural as well as substantive problems. The nature of a theory, as opposed to a fact, made subjective and inconsistent the sorting of candidate theories into categories labeled "explicit assumption" or "predictions validated." During the early evaluation phase, hit (+) or miss (-) judgments of each theory against each criterion proved to be time-consuming and counterproductive. What did emerge from that exercise, however, were patterns of concurrent thought and generalizations among researchers about the potential utility of individual theories which was, after all, the objective of the evaluation.

The primary factors that emerged from the evaluation process were a blend of the stated criteria. They could be termed comprehensiveness, robustness, parsimony of operationalization, and verifiability. This process was consistent with the views of the LAG, whose members preferred to discuss and deliberate a similar subset of theories and criteria rather than justifying the rejection of clearly deficient theories.

One theory emerged from this evaluation process as clearly superior. The Five-Factor taxonomy of personality traits excelled in each of the informal criteria. The Five-Factor dimensions, formulated by Tupes and Christal (1961) and Norman (1963), and refined and redesignated Big-Five by Goldberg (1981), form a descriptive model or taxonomy, as opposed to a theory of personality. The Big-Five has become the central focus of a flurry of research

during the last decade. Scores of studies, reviews, and meta-analyses have verified the robustness of the Big-Five (e.g., Goldberg 1990; John 1990; McCrea & Costa 1985, 1988, 1989; Digman 1990). The results of this unprecedented surge of activity have done little to disprove Goldberg's (1981) statement that any model for structuring individual differences will have to encompass - at some level of abstraction - the Big-Five dimensions. This robustness allows the Big-Five to encompass the salient features of all eight of the other structural theories evaluated in this project. Additionally, the richness of trait descriptors and scales developed as markers of the Big-Five (Goldberg, in press) as well as the reinterpretation of other scales into the Big-Five structure (McCrea & Costa 1985, 1989; Digman 1990) exquisitely meet the operationalization criteria of this study. The unique combination of strengths found in the Big-Five taxonomy make it the logical choice for the model with the greatest potential to guide research in aircrew selection and classification.

Operational Criteria.

The Big-Five has unique strengths against the operational criteria as well. The lexical roots of the Big-Five, tapping the common language, makes it flexible when used to construct measurement instruments. Furthermore, the literature on use of self-report measurement with the Big-Five provides no evidence to date of any problems with the operational criteria of sensitivity, interest, independence, response bias, and legal risk (John, 1990). One limitation of the available literature is that none of the studies were explicitly conducted in a personnel selection context in which such problems might become more salient.

Figure 1 depicts the elimination process that resulted in the selection of the Big-Five

taxonomy as the framework for future research. It simplifies the process to show the three major criteria or blends of criteria that emerged in the evaluation process. Comprehensiveness was a blend of general criteria such as predictive utility, explicit assumptions, and incorporation of known findings that addressed the general scope of the theory as it applied to the current study. Scientific acceptance was a reflection of the general criteria of verifiability, parsimony, and validation, as well as general acceptance in current research. BAT compatibility refers to a blend of the operational criteria identified in the report.

THEORY	CRITERIA		
	COMPREHENSIVE-NESS	SCIENTIFIC ACCEPTANCE	BAT COMPATIBILITY
THREE-FACTOR	FAIL		
INTERPERSONAL CIRCUMPLEX	FAIL		
INSTRUMENTALITY	FAIL		
TEMPERAMENT	FAIL		
NEEDS	FAIL		
SOCIO-ANALYTIC	PASS	FAIL	
SIXTEEN-FACTOR	PASS	FAIL	
TYPE	PASS	FAIL	
PERSON-SITUATION	PASS	PASS	FAIL
SELF-SCHEMA	PASS	PASS	FAIL
SELF-EFFICACY	PASS	PASS	FAIL
COGNITIVE-SOCIAL	PASS	PASS	FAIL
FIVE-FACTOR	PASS	PASS	PASS

Figure 1. Theory Elimination Process.

THE FIVE-FACTOR THEORY AS A FRAMEWORK FOR MEASUREMENT

As a result of the preceding evaluation, the Five-Factor theory was selected as the most viable option to guide research on the selection and classification of aircrew members. The Five-Factor theory provides a structural description of the basic dimensions of personality. As such, this theory serves as a scientific framework for the development of predictor constructs for selection and classification. To adapt the framework to selection and classification applications, however, refinement is required.

We know, intuitively, that to provide sufficient predictive ability, measurement of the five factors that comprise the Big-Five model will have to vary in level of specificity. The flexibility inherent in the Big-Five model allows such refinement (Fig. 2).

I Extraversion	II Agreeableness	III Conscien- tiousness	IV Emotional Stability	V Intellect
Assertion Activity-level Gregariousness Impulsiveness	Warmth Trust	Achievement Dependability Efficiency Organization Precision Decisiveness Persistence Cautiousness Punctuality Consistency	Stability	Creativity Intelligence Analyticalness

Figure 2. Examples of Required Second-Level Constructs.

We see that Factor IV (Emotional Stability) may possibly be measured at the global, or first order, level for the purposes of future research because the subjects for such research have been preselected and, as a result of various physical and mental tests, have been reduced to a rather homogeneous population of healthy, normally functioning adults. The other factors will most likely have to be measured via second order constructs to provide the discrimination required to make selection and classification decisions. Despite the educational level prerequisite for aircrew candidates, for example, the intellect factor (Factor V) will require more selective measurement of the second-order constructs, or facets, of intellect that are most appropriate for USAF purposes. These facets might include such aspects of intellect as creativity, curiosity and analyticalness. Finally, facets might be further decomposed to delineate more precisely the level of trait measurement most useful for prediction.

There is ample justification in the literature for the more extensive measurement of Factor III (Conscientiousness) at the second and third orders of specificity. This factor has been shown to be the most reliable in predicting job performance in studies by Barrick and Mount (1991) and Hough, et al. (1990). It is also the Big-Five factor that subsumes the achievement motivation factor that appears prominently in previous aircrew-related studies. Spence and Helmreich, (1983) developed a multi-dimensional conception of achievement motivation that has three relatively independent components: (1) *work mastery* or the desire for meeting internal standards of excellence while performing challenging tasks, (2) *work* or the desire to work hard, and (3) *competitiveness* or the enjoyment of interpersonal competition. Measured by their Work and Family Orientation questionnaire, these factors have been used extensively in their work as well as by Chidester, Helmreich, Gregorich and

Geis (1990) and Davis (1989) to address the issue of aircrew selection and to predict aircrew performance. The Conscientiousness factor (Factor III) contains achievement or will-to-achieve in the factor definitions of several researchers (e.g., Goldberg, 1990; Digman & Takemoto-Chock, 1981; Norman, 1963). The *work* facet also appears in Factor III descriptors such as *industry* (Norman, 1963) or *hardworking* (Goldberg, in press).

SAMPLE MEASUREMENT ITEMS

One advantage of selecting the Big-Five as the framework for future research in the area of aircrew selection and classification is the relative ease of developing an instrument for measuring personality constructs. The sheer volume of existing scales and items developed or adapted to measure the Big-Five domains allows a potential synthesis of measurement items for any personaltiy trait that may be identified as potentially useful. Davis (1989), for example, in his study on aircrew selection used selected items and scales from five different inventories: the Work and Family Orientation questionnaire, the Extended Personality Attributes Questionnaire, the Myers-Briggs Type Indicator, the Crown-Marlowe Social Desirability Scale, and the Reid-Ware Locus of Control. In addition to eliminating the need for costly and time-consuming scale and item development, this sort of synthesis affords the advantage of utilizing existing peer reviews, analyses, and data for the interpretation of results.

The following examples give an indication of the number of potential measurement devices that are currently available "off-the-shelf" for measurement of selected constructs appearing in Figure 2. The samples are provided for illustration and are not meant to be exhaustive.

Legend of personality tests/inventories:

ABLE	Assessment of Background and Life Experience
ACL	Adjective Checklist (Gough)
CPI	California Psychological Inventory
CPS	Comrey Personality Scales
EPAQ	Extended Personal Attributes Questionnaire
EPPS	Edwards Personal Preference Schedule
EPQ	Eysenck Personality Questionnaire
GPP-I	Gordon Personal Profile - Inventory
STDCR	Guilford Inventory of Factors
GAMIN	Guilford-Martin Inventory
HPI	Hogan Personality Inventory
MBTI	Myers-Briggs Type Indicator
MMPI	Minnesota Multiphasic Personality Inventory
MPQ	Multidimensional Personality Questionnaire (Tellegen)
PRF	Personality Research Form (Jackson)
16PF	Sixteen Personality Factor Questionnaire (Cattell)

All item/scale abbreviations are from the original instruments.

CONSTRUCT	TEST/INVENTORY	SCALE/ITEM
Assertion	ACL	S-Cfd; Dom
	CPI	SP; DO
	EPQ	E
	GPP-I	A
	GAMIN	A
	HPI	ASC
	MPQ	SP
	16PF	E

Sample: "Which describes you more?"

1. Not at all competitive - Very competitive
2. Give up very easily - Never give up easily
3. Go to pieces under pressure - Stand up well under pressure

CONSTRUCT	TEST/INVENTORY	ITEM/SCALE
Trust	CPS 16PF	T; P L

Sample: "Which word in the pair appeals to you more?"

a. wary b. trustful
a. accept b. change

CONSTRUCT	TEST/INVENTORY	ITEM/SCALE
Impulsiveness	STDCR HPI MPQ PRF	R Prud IM IM

Sample: When you go somewhere for the day, would you rather:

a. plan what you will do and when?
b. just go?

CONSTRUCT	TEST/INVENTORY	ITEM/SCALE
Achievement	ACL CPI EPPS HPI SDI	Ach Ai Ach Amb Ach

Sample: "How much does your job stir you into action"
"Compared to others, how much effort do you put forth"

CONSTRUCT	TEST/INVENTORY	ITEM/SCALE
Dependability	ACL	Ord; S-Cn; Lab
	CPS	O; C
	EPPS	Ord; Chg
	CPI	So
	GPP-I	R; C
	HPI	Scn; Rel; Str-Tol
	PRF	Ch; Ha; Cs
	ABLE	Trad; Nond; Consc
	16PF	Q3; G

Sample: Which word in the pair appeals to you more?

a. Punctual b. Leisurely

CONSTRUCT	TEST/INVENTORY	ITEM/SCALE
Emotional Stability	ACL	Per Adj
	CPI	Sc; Py; Wb
	CPS	S
	EPQ	N
	ABLE	Emo
	16PF	C; O
	HPI	Adj; Str Tol; SCn

Sample: "I worry quite a bit over possible misfortunes."

FUTURE RESEARCH

The results of this project suggest two separate lines of future research. First, the selection of the Big-Five as a framework for research in aircrew selection and classification leads logically to the development, testing, and implementation of personality trait measurement instruments. Secondly, the success of the Big-Five framework would promote further investigation of the role of personality in job performance domains outside the aircrew career field.

Development of an Aircrew Instrument.

The preliminary findings of this project indicate that the comprehensiveness of the Big-Five framework is sufficient to warrant the development of an operational instrument to measure personality variables for use in aircrew selection and classification. The development of an operational measure of personality traits should follow a four-step procedure: 1) identification of aircrew performance criteria, 2) identification of the most useful traits appropriate to the job performance criteria, 3) development and refinement of scales to measure those traits, and 4) assessment of scale reliability and validity.

However comprehensive the descriptive power of the Big-Five dimensions appears to be, there is still doubt as to the predictive ability of any personality measure for predicting aircrew performance (Dolgin & Gibb, 1988). Although conventional wisdom puts personality measures at the bottom of the list of tools for predicting job performance, recent evidence suggests that the predictive power of personality measures increases significantly when

applied within valid job constructs instead of across them (Hough et al., 1990; Hough, 1991). This suggests that for the Big-Five to function as the framework for measurement development, careful selection of job-related criterion constructs must be developed. Guidance in this vital operation is available from several sources (e.g., Barrick & Mount, 1991; Hough, 1991; Chidester et al., 1991).

Once the job-related criterion constructs have been selected and endorsed by military aviation Subject Matter Experts (SME), appropriate trait descriptors must be found that address the constructs at the proper level of specificity. As outlined in Section III of this report, second, third or lower levels of measurement specificity may be necessary to achieve the degree of discrimination desired. This process will be vital in meeting the operational criteria of independence and sensitivity in measuring personality traits in a population that is relatively homogeneous, due to military entry requirements. Developers will also need to heed the caveat of Chidester, Helmreich, Gregorich, and Geis (1991) and avoid over-measurement of performance-in-training criteria at the expense of subsequent actual job performance.

A promising area of research not included in the conventional measurements of the Big-Five factors needs also to be considered in instrument development. Recent research (Siem, 1990; 1991) has indicated that the measurement of response latency during administration of personality instruments may have potential predictive ability, particularly in prediction of training performance. As response latency is measurable with the current configuration of the BAT, this opportunity to enhance interpretation of scale scores should be fully investigated and exploited. The potential for integrating into the research process some

of the principles of non-structured theories (e.g., self-concept, self efficacy) presents exciting possibilities for the enhancement of overall utility of personality measures in pilot selection and classification.

Expanded Application of Personality Measures.

The selection of the limited domain of aircrew selection and classification was a wise choice for an initial foray into the utility of using personality constructs to aid decision-making in the Air Force manpower, personnel, and training (MPT) community. The aircrew candidate pool probably shares a number of characteristics not found or assured in the general USAF population. As officers and aircrew candidates, successful pilot applicants meet entry criteria based on academic achievement (college graduates), physical superiority, aptitude for flying, and motivation. We hypothesize that these shared characteristics may facilitate the selection of personality traits associated with performance criteria. The use of personality measures need not be confined, however, to this limited population.

Dramatic changes in the mission and organizational structure of the Air Force currently underway are producing unprecedented disruption of the USAF working environment. The Wing/Base structure of Air Force installations is being completely reorganized to overturn an infrastructure in place since 1948. All Air Force functions, including recruitment and classification, will have to respond to these changes. The sheer turmoil involved in the workplace, coupled with the changing demographic makeup of the recruit pool (Johnson, Green, Soldwisch, Turner, & Wall, 1988), creates the opportunity, if not the mandate, to expand the line of research begun with this project to larger and

potentially more productive arenas. Current accession and classification policies and procedures are likely to prove insufficient to fill the new job requirements. The current accession program for line (non-flying) officers and enlisted members relies on a system of academic and aptitude testing (Air Force Officer Qualifying Test or Armed Services Vocational Aptitude Battery) for selection and classification. Supplemental information dealing with personality factors, based on the work put forth in this project, would potentially provide great assistance to future MPT policy makers.

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APPENDIX

THEORY DESCRIPTIONS

This appendix contains a short summary of each theory or concept advanced as a candidate for adoption as a general framework for this research and not ultimately selected. The candidates were advanced either by The Statement of Work (SOW), by Universal Energy Systems (UES), or by the Laboratory Advisory Group (LAG). The summary presented is intended to highlight the major points considered by UES in evaluating the theory or concept and not to specifically justify or document the application of each criterion judgment made by UES in selecting the Five-Factor Theory as the best candidate. Those individual judgments were presented, discussed, and accepted at the 25 Feb 91 and 10 May 91 interim progress briefings and at the 3-4 Jun 91 LAG Conference.

Name of theory: Three-Factor Theory of Personality (Eysenck & Eysenck, 1985)

General description of theory: Structural (Trait theory that emphasizes *types* that are described in terms of traits.)

Synopsis of major characteristics: Eysenck's theory, although called a Two-Factor Theory in the SOW, has been modified to include three superordinate factors of personality. The three factors are the original Extraversion-Introversion and Neuroticism factors plus the added factor of Psychoticism. Strong in the elements of factorial and multivariate analysis, the theory has produced a number of instruments, including the Maudsley Personality Inventory (MPI) and Eysenck Personality Inventory (EPI). Eysenck's extraversion factor has been shown to correspond to Big-Five Factor I (Extraversion). His neuroticism factor has been shown to correspond to Factor IV (Emotional Stability). The Psychoticism Scale has been shown to be a blend of Big-Five factors II (Agreeableness) and III (Conscientiousness).

Strengths (in terms of UES criteria): The theory is explicit, parsimonious, and operationalized. It has generated a high volume of research and is widely recognized. It incorporates a large area of personality research, intellect being the notable exception.

Weaknesses (in terms of UES criteria): The theory may be excessively parsimonious and lack comprehensiveness. Eysenck regards intelligence as something different from temperament and does not explore this factor. His P Scale has poor face validity against an adult/normal population. This theory has been operationalized only at the superordinate level.

Primary reason for rejection: The lack of comprehensiveness disqualified this theory from selection.

Name of theory: Sixteen-Factor Theory (Cattell, 1943; 1957)

General description of theory: Structural (Trait theory)

Synopsis of major characteristics: Cattell was a pioneer in two areas that are basic to current personality research, the lexical approach to trait description and the use of factor analysis to develop a personality taxonomy. The sixteen personality factors that give his theory its name were developed from his attempt to reduce the 18,000 items in the Allport and Odbert (1936) list of personality-relevant terms to major personality dimensions. His work presented a rich theoretical structure that became the stimulus for many subsequent studies. His 16 factors were operationalized in a popular measurement instrument (16PF) which includes five different forms written for different reading levels.

Strengths (in terms of UES criteria): The theory has generated a great deal of study that could provide insight to the present task. Cattell was important in establishing the quantitative approach to personality. His emphasis on measurement provides a number of scales and a rich data base that may be tapped in a composite measurement instrument.

Weaknesses (in terms of UES criteria): Cattell's work, in the view of most contemporary theorists, has not been sufficiently replicated and therefore not widely accepted as a definitive theory. His factors have proven to be difficult to replicate, and his work contains many subjective decisions that were not documented (John, Angleitner, & Ostendorf, 1988). His reluctance to accept and incorporate criticism and conflicting research results based on his work have lowered the general acceptance of his theory. His operationalized measurement device is less parsimonious than that of the other trait theorists.

Primary reasons for rejection: Questionable validity and difficulty in replication removed this theory from serious consideration.

Name of theory: Interpersonal Circumplex (Wiggins, 1980)

General description of theory: Structural (Trait theory)

Synopsis of major characteristics: The theory is deeply rooted in clinical psychology and psychotherapy. Its key feature is the circumplex model of displaying bipolar factors and facets on a two-dimensional orthogonal diagram using only two factors as the axes. These two dimensions are ***power*** and ***love***, displayed on bipolar scales of dominance and submissiveness on one axis and love and hate on the other. This circumplex was borrowed from Foa and Foa (1974) and has been used in various forms by other theorists (Hogan, 1983; Hofstee, et al., in press). As indicated by the title, the theory deals with the interpersonal aspects of personality (what people do to each other).

Strengths (in terms of UES criteria): It is unusually parsimonious due to the limited number of factors addressed. Like all the scale-based, self-report theories, it is operationally compatible with the BAT.

Weaknesses (in terms of UES criteria): This theory is not comprehensive enough to be considered as a sole methodology. The original work considered only interpersonal trait adjectives or 817 of the 1,710 trait adjectives studied by Goldberg (1982). It operates exclusively in the domains of Big-Five Factors I (Extraversion) and II (Agreeableness).

Primary reason for rejection: The theory lacks comprehensiveness.

Name of theory: Socioanalytic Theory of Personality (Hogan)

General description of theory: Structural (Trait theory)

Synopsis of major characteristics: This trait theory is firmly rooted in Hogan's view of the nature of human evolution. It has heavy emphasis on anthropological concepts and social constructs. It states, briefly, that people live in groups and groups are organized by status. The emphasis on group interaction and status has caused Hogan to develop a taxonomy roughly equivalent to the Big Five but with Factor I (extraversion or surgency) split into the factors of Sociability and Activity or Ambition. He also redefines Big-Five Factor III (conscientiousness) as Conformity--thereby showing his emphasis on the social aspects of personality. The result is a six-factor taxonomy that he has operationalized in the Hogan Personality Inventory (HPI). He states that his sociability and conformity factors (Big-Five factors I [Extraversion] & III [Conscientiousness]) are associated with an individual's occupational choice and the other factors are associated with popularity and status.

Strengths (in terms of UES criteria): Hogan's factors are operationalized in an inventory that features Homogeneous Item Composites (HIC) developed for each of his six factors. These composites provide a good second-order breakout of facets that may be useful in measuring traits under any umbrella theory selected for this study.

Weaknesses (in terms of UES criteria): Hogan's theory and its attendant instrument are, as yet, unreplicated by other investigators. The factor structure of the HPI is problematical. The coverage of subordinate traits is not as comprehensive as the Big Five.

Primary reason for rejection: A general lack of acceptance by the scientific community makes it a poor choice.

Name of theory: Temperament Theory (Buss & Plomin, 1975)

General description of theory: Structural (Trait theory)

Synopsis of major characteristics: The theory is based on the existence of four temperamental dimensions that are inherited and observable early in life. The temperaments are ***Emotionality (E), Activity (A), Sociability (S), and Impulsivity (I).*** These temperaments are, by definition, innate personality dispositions. Consequently, they are viewed as building blocks for personality rather than constructs of personality. Buss (1988) expanded the four temperaments to seven traits characteristic of primates: activity, fearfulness, impulsivity, sociability, nurturance, aggressiveness, and dominance. Buss and Finn (1987) constructed a trait taxonomy that is explicit and generative.

Strengths (in terms of UES criteria): The theory is explicit and parsimonious. Buss & Plomin have operationalized the theory in a series of self-and third person report instruments called the EASI I through EASI III surveys.

Weaknesses (in terms of UES criteria): The theory has not generated any significant replication/validation studies. Emphasis on the development of personality from very early age lacks face validity for target population. There is no clear development of second or lower order factors/facets. The theory does not consider intellect as a factor.

Primary reason for rejection: This theory lacks comprehensiveness.

Name of theory: Needs Theory (Murray, 1938)

General description of theory: Structural (Trait theory based on needs)

Synopsis of major characteristics: The basis of Murray's theory is a list of manifest needs that form the basis of man's behavior through the creation and reduction of tension. He defines a need as "a construct which stands for a force in the brain region which organizes action so as to transform in a certain direction, an existing, unsatisfactory situation." These needs, acting upon the individual ("press"), cause its behavior--making this primarily a **motivational** theory. Indeed, Murray feels that you cannot describe personality because it is not static. Nevertheless, Murray's needs has provided a rich tradition of research in personality theory. They are the basis for several personality inventories (EPPS, PRF, and ACL) that present a large, rich data base. The EPPS and ACL have been used to predict success in pilot training.

Strengths (in terms of UES criteria): Murray's needs theory has generated a wide range of research that can be related to other theories such as the Big-Five. Needs, which are dynamic, are related to the more stable traits common to the majority of structural theories. This taxonomy has given the field of personality psychology a number of useful constructs.

Weaknesses (in terms of UES criteria): This taxonomy is, at best, a general framework of descriptors rather than an empirical classification.

Primary reasons for rejection: The theory does not have the robustness of the Big Five, which incorporates its major constructs.

Name of theory: Psychological Type Theory (Jung)

General description of theory: Structural (Type theory)

Synopsis of major characteristics: Jung's theory, as might be expected, is deeply rooted in his basic assumption of analytic psychology that states that personality consists of competing forces and structures, often subconscious, that must be balanced. Originally, he thought that two major orientations to life, extraversion and introversion, were sufficient to explain variance in personality. Later he added two more pairs of dimensions--thinking/feeling and sensing/intuiting. Although he did not operationalize his theory into measurement instruments, others have done so. Foremost of the Jungian based personality inventories is the Myers-Briggs Type Indicator (MBTI), which has been widely used.

Strengths (in terms of UES criteria): Through the popularity of the MBTI with industrial users and some academicians, there is both a rich data base and wide knowledge of the theory. It is historically significant in that it represents one of the earliest attempts to define personality in terms of relatively non-evaluative dimensions.

Weaknesses (in terms of UES criteria): Many recent personality psychologists have found both the theory and its operationalization inadequate to fully explain the variance in human personality. Difficulty in the operationalization of the theory is well documented and includes the lack of support for the view that truly dichotomous variables are measured.

Primary reasons for rejection: Difficulty in operationalization and diminishing scientific acceptance removed it from serious consideration.

Name of theory: Instrumentality/Expressivity (Baken, 1966; Spence & Helmreich, 1978)

General description of theory: Structural (Type theory)

Synopsis of major characteristics: The work of Baken focussed on two primary drives. They were labeled ***Agency*** and ***Communion.*** These fundamental drives, he feels, are interacting in the individual to produce stress, resulting in an ongoing process aimed at achieving balance. Spence and Helmreich renamed the two superordinate factors Instrumentality and Expressivity and later added a third dimension that they called ***Achievement Motivation.*** Agency (Instrumentality) emphasizes separation from others and manipulative behavior, while Communion (Expressivity) emphasizes merging and unity. Spence and Helmreich frequently relate the Agency/ Instrumentality characteristics to masculinity and the Communion/Expressivity characteristics to feminism. Spence and Helmreich have operationalized the theory in an inventory called the Extended Personal Attributes Questionnaire (EPAQ) that measures, by self-report, positive and negative expressivity and instrumentality as well as verbal aggressiveness. They have developed instruments that measure Mastery, Work and Competitiveness, Achievement, and Impatience. The three instruments have been used quite extensively in personality research on military and civilian pilots and aircrews, as well as crewmembers in the space program.

Strengths (in terms of UES criteria): The theory is parsimonious, operationalized, and well established in previous research regarding the target population.

Weaknesses (in terms of UES criteria): The theory lacks the comprehensiveness to make it the primary or sole selection for this research. It has considerable strength, however, and should have utility as an adjunct to the final framework.

Primary reason for rejection: This theory was rejected due to its lack of comprehensiveness.

Name of theory: Self-efficacy (Bandura, 1986)

General description of theory: Non-structural (Social-learning theory)

Synopsis of major characteristics: Bandura's work deals primarily with his concept of human agency in behavior. He feels that self-agency, particularly self-efficacy, allows an individual to exert influence on the environment, and thereby influence behavior, through an interaction process he terms "triadic reciprocality" where behavior, cognitive factors and the external environment combine and interact to become the causative factors of behavior. He feels that self-efficacy determines one's level of motivation and influences the selection of activities and situations one seeks. Self-efficacy also is instrumental in determining coping behavior, goal setting, and anticipated outcomes--all of potential value in aircrew selection and classification.

Strengths (in terms of UES criteria): Bandura's theory is really a theory of behavior rather than personality. It introduces several topics, such as those mentioned above, that have some face validity in aircrew selection research.

Weaknesses (in terms of UES criteria): As a behavior theory versus a personality theory, the behaviors central to this research would be difficult to operationalize in a self-reporting, BAT-hosted, format. The triadic reciprocality model presents a moving target for measurement and would not meet the measurement criteria established for this project.

Primary reason for rejection: It is not really a personality theory and not operationalized.

Name of theory: Person by Situation (Mischel, 1968)

General description of theory: Non-structural (Social Learning theory)

Synopsis of major characteristics: Mischel is an anti-trait theorist who believes that the most important person variables are cognitive processes such as competencies, encoding strategies, expectancies, values and goals, and self-regulating strategies. He is interested in the functional relations between what one does and the psychological condition of one's life.

Strengths (in terms of UES criteria): The theory has a strong focus on situational factors and on cross-situational inconsistency.

Weaknesses (in terms of UES criteria): Like the other cognitive/social learning theories, this would be difficult to operationalize. To analyze behavior Mischel feels that you must know the properties or meaning that the stimulus has acquired for the subject. This presents a moving target for measurement and the need for trained observers; it requires objective measurement of ongoing behavior, recorded as it occurs.

Primary reason for rejection: Difficulty in operationalization and the fact that it is not really a personality theory removed this theory from consideration.

Name of theory: Self-schema (Markus, 1977)

General description of theory: Non-structural (Cognitive/information processing theory)

Synopsis of major characteristics: Markus' theory assumes that attempts to organize, summarize or explain one's own behavior in a particular domain result in the formation of cognitive structures about the self (self-schemata). Self-schemata are cognitive generalizations derived from past experience that organize and guide the processing of the self-related information contained in the individual's social experience. As individuals accumulate repeated experiences of a certain type, their self-schemata become increasingly resistent to inconsistent or contradictory information, thereby providing cross-situational consistency. The theory assumes that only when self-description results from a well articulated generalization about the self can it be expected to converge and form a consistent pattern with the individual's other judgments, decisions, and actions.

Strengths (in terms of UES criteria): The theory includes a few features that are particularly desirable for the current project, such as its focus on normal functioning adults and the emphasis on consistency across situations. It suggests the potential value of recording response latency for analysis of personality traits.

Weaknesses (in terms of UES criteria): The theory has not been operationalized in a format compatible with the BAT criteria.

Primary reason for rejection: The theory has not been operationalized.

Name of theory: Cognitive Social Approach (Cantor & Kihlstrom, 1985)

General description of theory: Non-structural (Cognitive/Social Processing theory)

Synopsis of major characteristics: Like the other social learning/cognitive approaches, the authors' concept of personality centers around the assumption that people's actions are predictable from the knowledge of the **meaning** they ascribe to the situation in which they are located and the **solutions** they have favored in the past. Their cognitive base for personality is "Social Intelligence" which they define as "interpretations and solutions of current and past situations." They introduce three categories of constructs: Declarative-Semantic, Declarative-Episodic, and Procedural. The interaction of these constructs leads to behavior in social situations. Goals, tasks, self-schema, and strategies are the variables in the complex social learning processes that determines behavior (personality).

Strengths (in terms of UES criteria): Like the other cognitive approaches, there is a heavy emphasis on situational variables and a focus on the healthy, functioning adult population.

Weaknesses (in terms of UES criteria): Like the other cognitive approaches, there is a serious problem of operationalization of the theory, particularly in the areas of BAT compatibility and untrained administration and analysis.

Primary reason for rejection: Difficulties in operationalization prevented serious consideration of this theory for this project.

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